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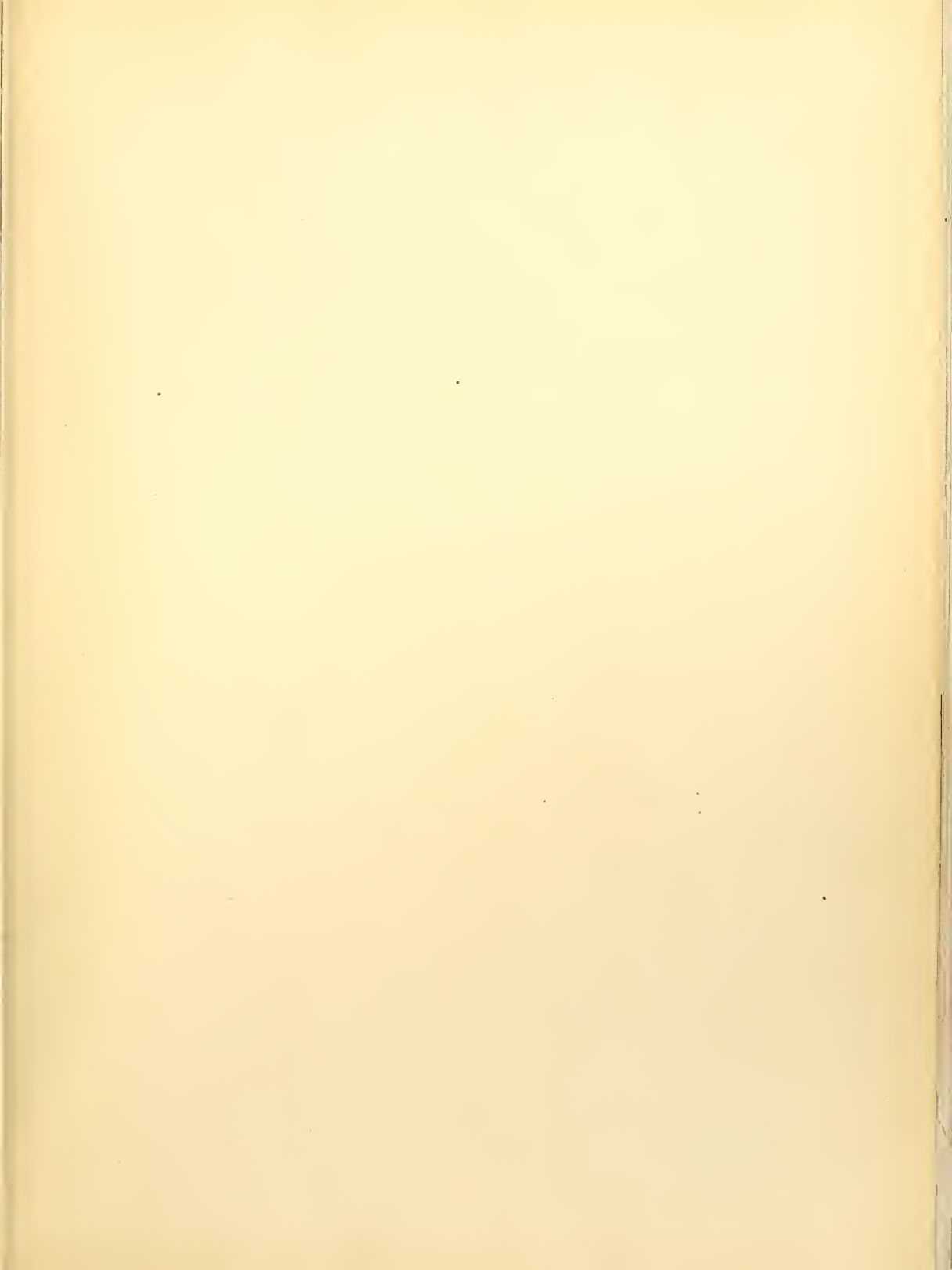
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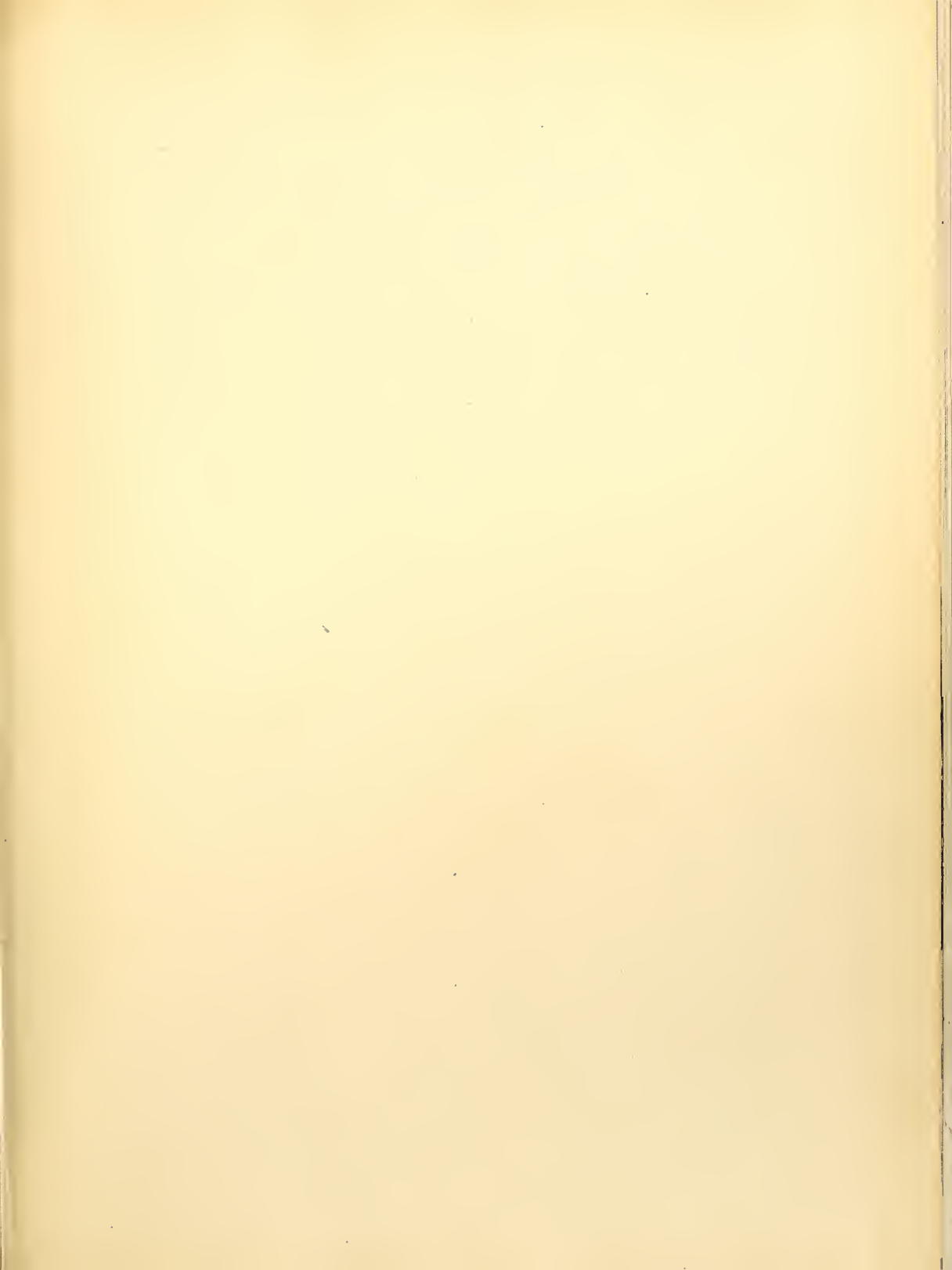




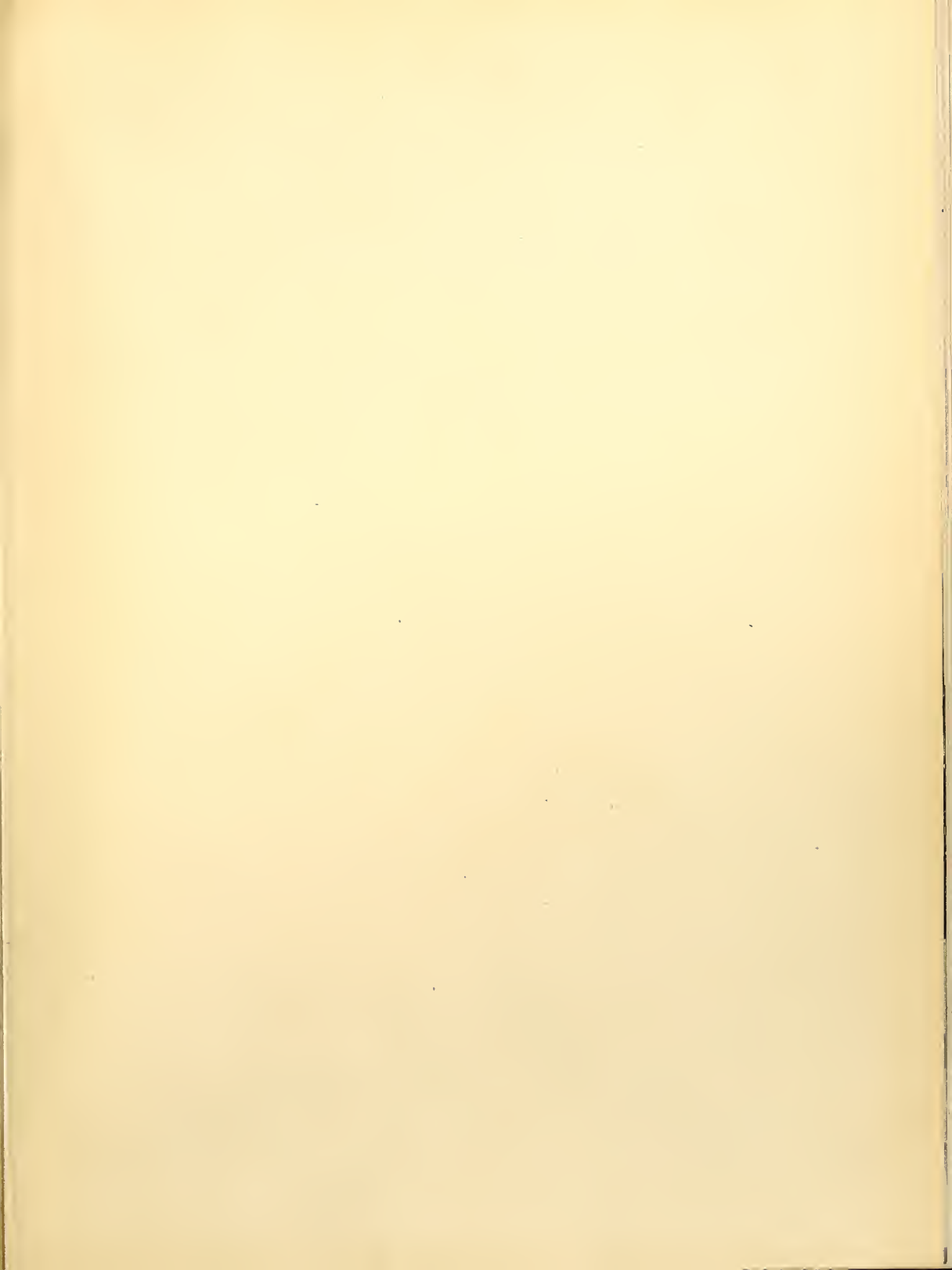












NATURAL HISTORY

THE MAGAZINE OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME LIV

1945

TEN ISSUES A YEAR

Published by

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An Indian carving
excavated in Indiana

January **NATURAL HISTORY** 1945

Island Contrasts • Carr: Gray Foxes • Winter Scenes

Shapiro: Homes of the World • Beau Brummel of the Wild



INDIA

We regret that we were unable to supply all the many people who wrote in for the Padang Buckles advertised in the November issue. This was due to the limited number and the fact that over 100 people wrote in during the first three days.

However, we are able to compensate for the disappointment by offering the beautiful Elephant bells in the photograph. These handsome, reverberant bells from India, with baroque, clawlike design, may be used as service bells or as decorative pieces, and, best of all, THERE IS AN AMPLE SUPPLY. We do not feel we need say more—the photograph tells the story.

3"x3½"	\$ 4.50
4"x4½"	10.00
5"x5 "	12.00
6"x5½"	20.00

for reading

TRAVELS
IN
AFGHANISTAN
By Ernest F. Fox
\$4.00

A fascinating record of Afghanistan—the Khyber Pass, the villages, peoples, and the country through a geologist's eye.

ASIA'S
LANDS AND PEOPLES
By George B. Cressey
\$6.00

A geography of one-third of the earth and two-thirds of its people, by a recognized authority. It includes all of Asia but with special emphasis on China, Japan, the entire Soviet Union, and India.

INDIA
AGAINST THE STORM
By Post Wheeler
\$3.50

An informative book describing the country's cities and villages, races, origins, customs, creeds, and racial and religious hatreds. Well-balanced reading.

The BOOK SHOP

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST, NEW YORK 24, N. Y.

LETTERS

SIRS:

I am stationed in the Pacific area, and on my liberties I try to see and study as many of the birds, animals, and plants as I can here. These interests enhance the enjoyment of reading *NATURAL HISTORY* Magazine.

When reading the very interesting article entitled "The Modern Nature Faker," by William Carr, I noticed that you offer to answer questions on natural history subjects.

My wife recently sent me a newspaper clipping telling how a child in Asbury Park was threatened with having its eyes pecked out by a crow. I have never heard of a crow performing like that and, being interested in birds, would like to know if you can offer any explanation.

CLARENCE R. JOHNSON.

The newspaper item referred to, concerning the crow that attacked the children in Asbury Park, is interesting. The explanation for the occurrence may lie in either of two directions. Possibly the crow was a tame one which was in a mischievous mood and was playing a little roughly. When crows are brought up in familiar association with people, they often show considerable activity directed toward their human associates, pulling their hair, picking at buttons, and generally making a nuisance of themselves. Perhaps it was attracted by the bright eyes of the children. Other birds, of which the crow's near relative, the magpie, is one, have been known to show this predilection.

On the other hand, crows have been reported, how authentically it is difficult to prove, to have attacked lambs by picking at their eyes. This, however, is likely to have been in an open field. The fact that the children were "attacked" near their homes strongly suggests that the crow culprit was quite used to being around people. A wild one would have been wary. If the crow was someone's pet, the owner probably hesitated to announce the fact after damage was reported.

JOHN T. ZIMMER,
*Curator, Department of Birds,
The American Museum
of Natural History*

* * *

SIRS:

... I would like to take this opportunity to express my deep appreciation and the enjoyment derived in receiving your always fascinating magazine. Year by year *NATURAL HISTORY* maintains its high standard. . . .

I think that the editorial staff deserves a great deal of praise for the way they are keeping *NATURAL HISTORY* on its high level during war-time restrictions.

DOROTHY MACNEIL.

Framingham, Mass.

* * *

I wish to express my appreciation for the past year's subscription to *NATURAL HISTORY* Magazine. I received the greatest possible pleasure from it, and in my estimation it is one of the finest magazines of its kind in the world. . . .

WILLIAM M. SOMMERVILLE.

Toronto, Ontario.

* * *

SIRS:

... May I take this opportunity to express my appreciation of long standing for *NATURAL HISTORY* Magazine. It has been the outstanding magazine for use as supplementary reading in our biology classes. Articles are timely and always seem to be in keeping with matters of current biological interest.

It has seemed impossible that you have received so many letters from readers in recent years proclaiming that they had just been introduced to *NATURAL HISTORY*. How have biology teachers missed such valuable reading? . . .

The series of articles on "Strategic Plants" during the past year have been particularly useful to emphasize the importance of plant knowledge in relation to the successful prosecution of the war. A greater knowledge of the value of strategic plants may save us from such colossal blunders as complete dependence upon materials like rubber, quinine, Manila hemp, etc., without careful attention to the economic control over such necessities. The peace-time obligation for guarding these plant interests is surely immense.

A number of publications are used as supplementary reading in our biology classes. In thirteen years of classroom use, *NATURAL HISTORY* stands at the head of the list for interest, stimulation, and admiration.

HOWARD H. MICHAUD.

Fort Wayne, Ind.

* * *

SIRS:

We, too, appreciate hearing from you. Your Magazine, in these war-torn times, is a monthly reminder that somewhere men still hold high those arts and sciences to which we hope to return when peace comes again to this world.

LIEUTENANT S. FINKELSTEIN.

Continued on page 44

PORTRAIT OF A YOUNG DEER: a photograph taken near a camp on Penfield Mountain in western central Pennsylvania, by Thomas E. Rougeux



Gray Fox Adventures



By WILLIAM H. CARR

*Director of the Bear Mountain Trailside
Museums and Associate Curator,
The American Museum of Natural History*

THE Gray Fox of our Eastern woodlands is an intelligent animal with all the grace, speed, and cunning one could wish. His swift, shadowy form is sometimes seen by motorists, particularly in State and National Parks, where he enjoys some measure of protection. Rocky woodlands and forest borders are made to order for this bushy-tailed

▲ Grace, beauty of form, and alertness mark every move of our native Gray Fox

cousin of the larger Red Fox. The ability to climb trees is not the least of his accomplishments. More than one hiker along tree-lined trails has been startled to see the form of a dog-like animal crouching low on a large branch, often as high as 20 feet from the ground. Few realize that the creature is a fox.

We once had a partially tame gray

fox which escaped in midwinter and on being pursued, climbed high up into a huge White Pine. In order to capture him one of us scaled the tree, cornered the creature on a branch, and shook him off into a large snow-drift, where it was possible to grasp him and place him in a box. If the fox had continued to run instead of resorting to tree climbing, we would

Tracy was a gentle pet; Ricky escaped but knew a good thing when he had it; but Louie kicked over the traces.

never have been able to overtake him.

Perhaps the gray fox is best observed when actively hunting in an open field. His actions remind one of a large cat. He stalks along with stomach close to the ground, ears pointed forward, and every muscle seemingly on the alert. When some luckless field mouse is discovered, the hunter will pounce with lightning speed, grasp the mouse in his long, slender mouth—and that is that! If the mouse is hidden in some grass-covered runway and the fox suspects its presence, he will stand motionless, often with one forepaw raised, waiting for the mouse to appear or to make some sort of false move which will instantly spell the rodent's undoing.

On one occasion we observed a gray fox in his watchful-waiting pose, for a space of 20 minutes. He was a perfect statue during all of his patient vigil. At the end, he sprang upward and forward but somehow contrived to miss his prey. He loped away with never a backward look, but gave his tail several spasmodic jerks as though to express his chagrin.

We have had numerous opportunities at Bear Mountain Park to watch the gray fox in his native surroundings, but our greatest intimacy with him has come about through acquaintance with tame ones we have reared in captivity and semi-captivity. Most of our fox pets have been captured when very young and presented to us. Some of our own efforts to secure young ones have not always met with success, even though the animals had been previously caught and confined. We once received a call from a farmer friend to collect four half-grown gray foxes that he had caught in a barrel. The barrel had been placed in the loft of his barn for reasons unknown to us, and he feared the animals would escape before we could come. We made all haste and arrived out of breath with our transportation cages ready. The farmer talked to us awhile before leading us to the barn. He told of his



▲ Jane Hall Cutler plays with Louie and has no fear of his sharp little teeth

All photographs from Palisades Interstate Park Commission by Harold K. Whitford

▼ Tracy squints and flattens his ears to face a cold, biting wind



experiences in capturing the young animals. They were found in his hen yard, and he was able to place the barrel over the only exit and drive them into it.

As we approached the barn, we heard the farmer's young son give a cry, and the next instant four little foxes, one behind the other, leaped from the hay loft to the barn floor and ran at full speed out through the open door to the green fields beyond. They maintained their single file formation until they reached the brush-covered stone wall at the edge of the farm property, then disappeared from view. The boy, in his anxiety to view the foxes to better advantage, had inadvertently tipped over the barrel; the makeshift cover had flown off, and the animals took full advantage of the situation.

An affectionate friend

We were more fortunate with Tracy, a very small gray fox, caught in an open field by another friend. Tracy was so diminutive that we despaired of ever raising him to adult foxhood. He was as shy as could be and seemed to prefer hiding his head under one's arm-pit to accepting warm milk from a frequently proffered bottle. He caught on after a while and not only accepted but demanded to be fed. He proved a gentle, thoroughly satisfactory pet, trotting about after his human friends and running to them with a devotion which was both comical and delightful.

When Tracy reached the age of about eight months, any bird that had the temerity to fly through his cage, usually never lived to fly again. Tracy would leap into the air. There would be a snap of jaw upon jaw, and the bird would disappear permanently. The victims were usually English sparrows that slipped through the wire mesh to pilfer food. Chipmunks also met an untimely end when they wandered into Tracy's range. He had another unfortunate habit with unsuspecting dogs. When the domestic animals became too curious and placed their noses through the mesh, the fox, with the speed of lightning, would dash to the wire and neatly nip the dogs before they could beat a retreat. The sign near their enclosure read, "No Dogs Allowed." One visitor suggested that perhaps Tracy could read and the dogs could not. In any event, we felt sorry for the dogs, even though the responsibility for their well-being

fell squarely upon the shoulders of their owners.

Home life preferred

Ricky was another gray fox which stayed in his roomy enclosure for three years and then, one day, decided to investigate new pastures. Employing his expert, sharp-toed forepaws, he excavated a neat hole where we were certain no hole could be dug, and escaped into the outer world. But Ricky did not go away. Not far off was a lovely fern garden, complete with running brook and shady paths. At one end of the fernery was a tangle of young hemlock trees, viburnums, and other plants. In the center of this green tangle was a large, gray rock, and there in the sunshine on the day after his departure, we found Ricky, curled up and sound asleep.

The fox glanced at us with an air of complete indifference, wrapped his tail more closely about him, yawned, and resumed his slumber. Two red foxes that had been Ricky's companions for a long time and seemed fairly tame, had escaped with the little gray fox. We never saw them again. It was apparent that Ricky had decided to remain near the source of supplies. The fernery was a nice sheltered place, and so he stayed. We could have captured him very easily and brought him back, but we preferred to permit him to return to the wild, in his own leisurely fashion. In truth, we were curious to learn just how long he would remain with us.

Each day, at his regular midafternoon feeding hour, we placed food upon his favorite rock, and we usually found him lying near-by waiting for us. He showed no hesitation in taking food from our fingers. His habits were so predictable that we prevailed upon one of the large news reel companies to visit us and make motion pictures of the fox in its chosen home. The cameramen came, and true to our promises, Ricky performed beautifully. He permitted the cameras to grind away while he lay upon his rock. He wandered off into the underbrush and promptly returned to be fed and, for an extra special treat, climbed into his caretaker's lap and removed a piece of food from the man's lips as he had learned to do in his days of confinement. As a result, his picture was viewed by thousands of people from coast to coast and Ricky became famous as "The Fox Which Would Not Run Away."

Weeks went by and Ricky continued to make his personal appearances. Many persons came to see him, and few were disappointed. As fall came, however, his visits to the fernery rock became less frequent and then, one afternoon, we went to see him and could not discover him anywhere. We had about decided that he had left us forever and were sitting upon the fernery fence to rest when Ricky came slowly into view, head erect, stepping daintily as he always did. A field mouse was grasped firmly in his mouth. Ricky had learned to hunt. After this he often failed to finish the food we placed upon the rock for him. Some two months after his break for freedom, Ricky disappeared from the fernery permanently and, though we roamed the woods looking for him, we were never successful in our quest. No doubt he found an attractive gray fox of the opposite sex and took to the hills where he belonged. We hoped so, in any event.

Habits unpredictable

Our adventures with Louie, another well-liked gray fox which stayed with us for eight years, failed to terminate as peacefully or as happily. Louie, during his last days with us, proved to be a Jekyll and Hyde among foxes. He had been raised as a household pet in a hospitable Connecticut home. The companion of his bottle-fed infancy was a very clever and gentle Dachs-hund. The two slept and played together and enjoyed the best of good times as long as Louie remained in the neighborhood. It would seem that Louie's early introduction to dogs might well have established a friendly regard for them in later life, but such was not the case, as future events proved. His friendship for people, especially women, never slackened. He was ever ready to play and to be fed by hand throughout all but a few hours of the time he lived with us.

Louie also had a pair of red foxes as cage companions. He got on with them famously and, during the winter months the three graceful animals would sleep in a warm group, body to body, snug in their little house. One day the red foxes escaped through a door carelessly left open, but Louie did not follow. In fact, that same door was left open on several occasions and Louie failed to take advantage of his opportunities to gain freedom. Children could play with him by the



^ Louie was far tamer than his Red Fox companions. When they escaped, he remained

hour. He would permit people to place their hands in his mouth and, puppy fashion, would pretend to bite, but his sharp teeth never once pierced flesh. When his previous owners would visit him, years after his departure from their home, Louie never failed to recognize them. He would instantly run to the wire and leap about excitedly until his old friends entered his enclosure and fed him tidbits. Incidentally, he was decidedly

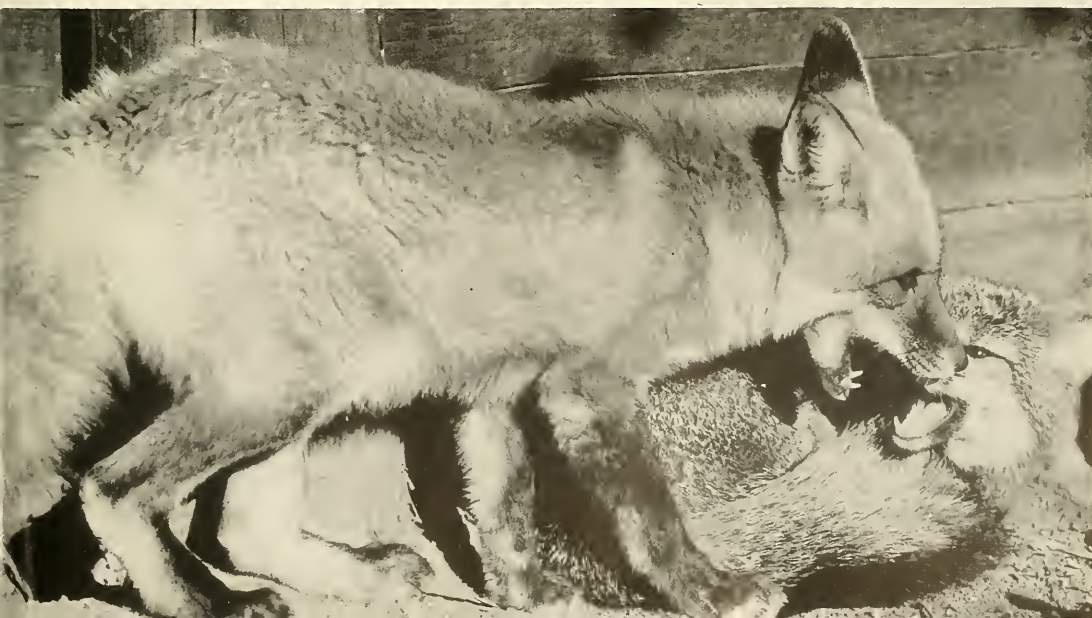
interested in his "foster parents," whether they brought food or not. The women of the house, as usual, were his favorites, and no one could have received a better greeting than they.

For eight years Louie continued to

be one of the star boarders among many tame animals. But he finally kicked over the traces, and his exploits thereafter led to his swift but certain undoing. It all happened while we were resting on the porch one warm July night.

Our two dogs were stretched out on the flagstone floor, enjoying a soft south breeze which came up from the valley to add the final touch to the peace and contentment of the scene.

▼ The two species of fox were good friends. They played together like puppies



Our regular bedtime had come and gone, but we were reluctant to leave the cool, screened verandah. Suddenly the spell was broken. The dogs jumped to their feet and commenced to rush back and forth and up and down along the screen wall. Both animals behaved exactly as though they were in pursuit of rabbits and not far from their quarry, either. The only sound they made was an excited panting. It was very dark, and we could see nothing but the speeding, shadowy white forms of the dogs. Annoyed at the unexpected interruption of our near-slumbers, we scolded the dogs and ordered them to lie down, but to no avail.

The unexpected comes

As we peered at the near-by screen, we saw an indistinct gray form slip rapidly by on the outside of the porch. The dogs were in hot pursuit. We turned on the porch light and quickly discovered that the wraith was none other than Louie. He had left his cage at last. At first we could not discover what governed his strange behavior.

The pacing back and forth on both sides of the screen continued for some time. We simply could not prevail upon the trio to stop it. Finally we managed to drive the dogs inside and close the door upon them. Almost at once the fox disappeared and there were signs of commotion at the back entrance, for Louie had raced around the house and was facing the dogs through the screen door. It was fully evident then that his main ambition in life was to attack the dogs. We closed the inside back door and returned to the porch. There, once more, was Louie, ready for a return engagement. We felt certain that he would remain in the general neighborhood and thus could be recaptured in the morning, so we attempted to drive him away from the dogs through the judicious use of red pepper. We placed some about the edge of the screen and, with much shouting and cries of "Shoo!" we succeeded in persuading the fox to retire. The night was stifling indoors, and it was unthinkable to permit the doors to remain shut. We rested for awhile and then prepared to go to bed. Louie had not put in an appearance for some fifteen minutes, though we heard him bark several times in the distance.

Before retiring, we decided to take the dogs out for their brief evening stroll. Right there is where we made our mistake. We were careful to place the dogs on a leash. We first walked the larger dog, a strong, full-grown Dalmatian, some five feet from the back door. A flash of gray shot out of the night like a speeding arrow, and before we could so much as open our mouths, Louie was upon the dog. We had never seen any animal of the size move so fast; it was like watching a mongoose. Louie simply swarmed all over the far heavier animal, biting it on the forefeet, the hind feet, thighs, and finally on the tongue. The large dog was completely bewildered. When the fox had first approached him, the dog had wagged his tail. Then he became mystified and was totally unable to cope with the gray streak.

In the meantime, we had pulled the Dalmatian to the kitchen door and opened it, dragging the dog into the house and trying unsuccessfully all the while to drive the fox away. The one-sided battle was in full progress upon the kitchen floor. My wife dropped to her knees and attempted to grasp the fox by the scruff of the neck with the intention of pulling it bodily from the dog and throwing it outdoors. Unfortunately, she held Louie too far away from the head and he turned upon her without hesitation. He was no longer the tame little fox we had known and regarded with affection for so long. Before she courageously pushed him from the house, she had received eighteen deep bites upon her hands, arms and wrists. Any fox, or other animal for that matter, would have behaved in like manner under similar provocation.

Louie departs only for a time

By this time it was well after midnight, but we determined to secure the services of a doctor regardless, for considerable blood had been lost. Soon eighteen nitric acid cauterizations were provided for the bites. The police had been called, for the doctor insisted that Louie either be captured or slain to determine whether he had rabies. There was a rabies scare in the community at the moment. Although the errant fox barked several times, the police were unable to locate him in the cloudburst which by then had descended to add confusion to the scene. At five o'clock in the morning, however, we heard Louie's husky bark

directly beneath our bedroom window. Scrambling sleepily from bed, we peered out, and there sat the pugnacious fox upon the lawn as though to issue a challenge to the dogs and to us to come out and do battle.

It was not until the following afternoon that the police located the unhappy Louie, sleeping beneath a pile of boards not far from his cage. He was quickly killed, and it was later shown that he had no rabies whatever. Before the examination was completed, however, Louie's victim was forced to undergo the injection treatment for rabies, rather than chance the risk of contracting the disease.

Actions a mystery

It was a very sad affair. We shall never be able to explain the mysterious forces that drove the doughty fox to attack the dog. Both animals were males. As far as we knew there had been no incident to provoke a feud between them. Certainly the dog showed no inclination at any time to annoy or otherwise disturb the fox. The incident was prompted by a strange quirk that will forever remain a secret to us. The attending physician's only explanation was that the fox must have gone berserk, and this official reasoning provided us with no choice but to follow his instructions to the letter. On the other hand, we knew Louie very well indeed and were certain that he was a perfectly sound fox, despite his impulse to commit mayhem upon our dog.

Numerous and varied were the thoughts offered by many persons in a futile attempt to explain the motives that prompted Louie's unaccountable behavior. An experienced fox hunter suggested that a red fox would never have acted in this fashion, thanks to its superior intelligence. We have insufficient knowledge to accept or deny this conclusion. We have raised a number of each species and we would hesitate to say which one possessed the higher I.Q. They are intelligent in different as well as in similar ways. Our own powers of comprehension are tremendously limited when it comes to interpreting or determining the relative intelligence of animals. Of one thing we are certain. If we had stirred ourselves and captured Louie when he first appeared beside our porch screen, he would be alive today and his empty cage would not confront us whenever we walk by.



▲ Ricky gained freedom but stayed in the neighborhood. John Kenny feeds him in the open



▲ Louis liked the ladies and was quite a lap fox, as Valentine Van Weelden discovers

▼ A study in profiles. Though the Red Foxes were larger, Louie was the "boss"





" . . . the frolic architecture of the snow "

"Beneath the crisp and wintry carpet"



WINTER *through the* CAMERA'S EYE

By JOSEF MUENCH

" . . . Deep drifts smother the paths below . . . "





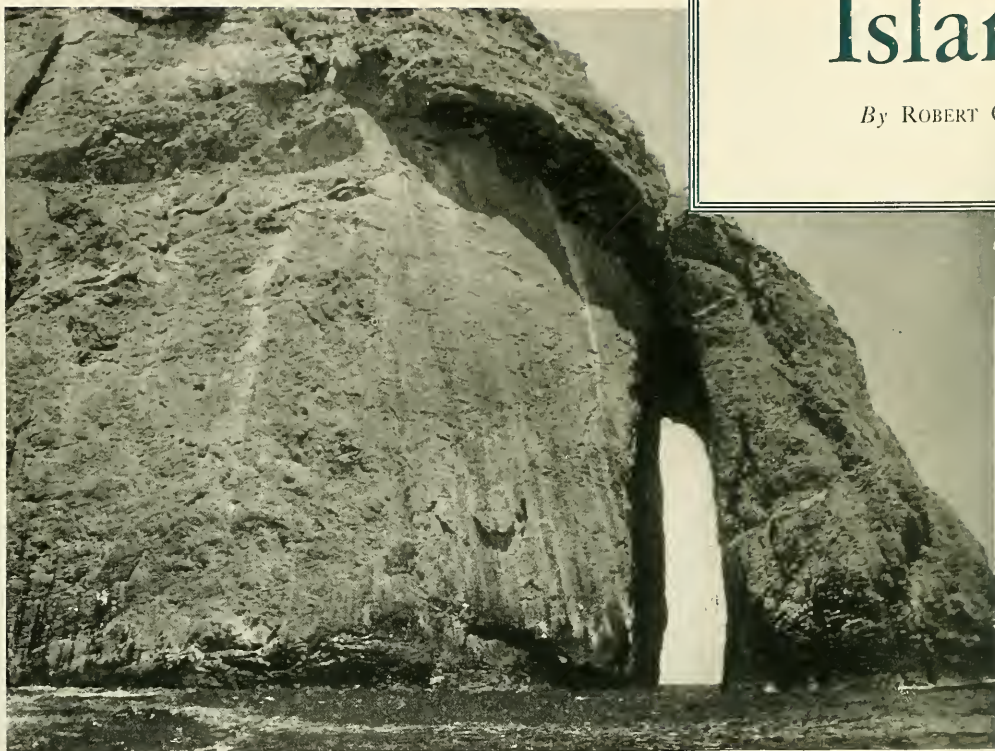
" . . . the cold and barren peaks . . . "

" . . . the branches now are bare . . . "



Island

By ROBERT CUSHMAN



The "Askoy" Expedition explores the fabulous Bight of Panama and its diversified islands. This is the story of three of those islands and the spectacular contrasts in their climate, vegetation, and wildlife

THIS concerns three dissimilar dots of land in the Bight of Panama. Malpelo, 250 miles west of Buenaventura and the first oceanic island in the Pacific ever sighted by Europeans, takes its name from a "bad head of hair," for it is nearly as bald as an egg.

La Plata, 15 miles off the capes of Ecuador, was discovered by Pizarro on his way toward the conquest of the Incas. Its name means "silver" or "money," and perhaps stems from the tradition that in 1578 Sir Francis Drake divided on its only beach the booty of the Spanish galleon "Caca-fuego." La Plata has a stunted, xerophilous or "drought-loving" plant cover, dependent upon scanty rains.

Gorgona, 16 miles off the Colombian coast and midway between Buenaventura and Tumaco, was likewise discovered by Pizarro. Its name may have no fanciful significance whatsoever, but I like to imagine an asso-

ciation with the gorgons because the island, lying under the everlasting watering-pot of Chocó skies and smothered beneath equatorial rain forest, is as full of serpents as the tresses of Medusa.

Malpelo has never been inhabited, but the soil of La Plata and Gorgona harbor stone and metal relics that tell of occupation throughout centuries or millennia by long-vanished Indian populations. The names of all three islands have appeared in the record of our voyage in "Askoy," but now let us go ashore and take possession.

Malpelo

On March 25, five days out of Buenaventura, we made Malpelo, dead ahead, at eleven o'clock in the forenoon. The latitude, 4°N., was a thoroughly wet one at the continental coast, but within 24 hours we had entered "dry seas." For four days following our landfall we remained in

► THE EFFECT OF AN OCEAN CURRENT, as shown by the discrepancy between *course* and *track* while "Askoy" was running under motor power in calm weather on March 28.

At 5:45 A.M., a navigational fix was obtained by intersection of position lines from the stars Antares and Fomalhaut. The course toward Malpelo was then 45° or northeast. At 10:30 A.M., a running fix was obtained by intersection of a position line from the sun and an advance of the earlier line from Antares. (This fix assumes a current flowing due south, though this was not necessarily the case.)

Frequent correction of the course was necessary, and Malpelo was regained along a curved track before sunset. As the course was changed, the effect of the current became more pronounced and the speed of the schooner was progressively slowed

MURPHY

◀ LOOKING THROUGH AN ARCH carved by the sea from a cove on the southeasterly side of Malpelo Island

A black and white photograph showing a massive, craggy rock formation rising from the sea. The rock face is steep and textured with various fissures and ledges. The foreground is filled with the dark, choppy water of the ocean, with small waves visible. The sky is a uniform, light grey, suggesting an overcast day. The overall composition is a wide shot, capturing the scale of the geological feature.

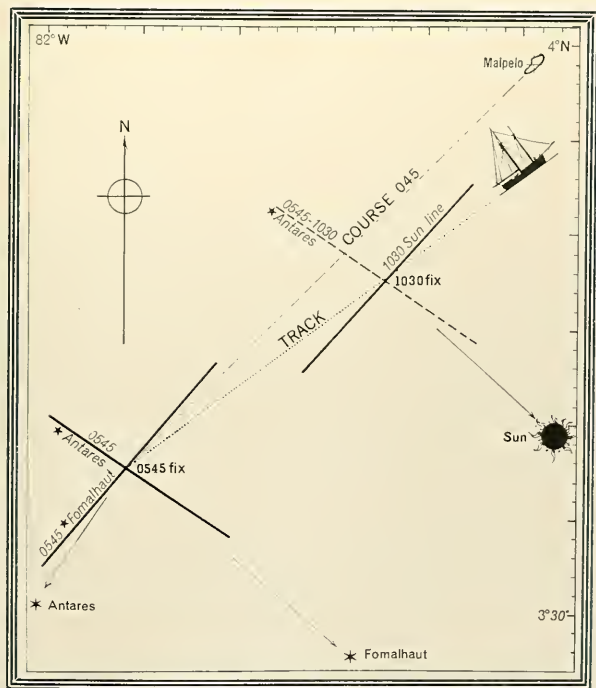
Motor speeds offer a good example of relativity. A four-knot craft, such as "Askov" actually proved to be, may

properly be called half as fast as an eight-knot craft, but the ratio changes as soon as both vessels begin to buck a current. Around Malpelo we encountered a surface current from between north and northwest which attained the extraordinarily high rates of from 1.7 to more than two nautical

miles per hour, or half our engine speed. I say surface current because our instruments showed that the movement was a warm overflow, not more than ten fathoms thick, and that two underlying layers had different relative directions. We ascertained the speed of the surface flow by checking our steered course against our observed track.

Malpeo proved to be the barest monolith of its size that I had ever seen. The skyline, the arches, battlements, and the caves at sea level were spectacular and fantastic. As we circled around the rock, a mile long and nearly 900 feet high, it looked from different aspects like a castle, a battleship, or a smoking volcano, the last illusion being due to misty streamers that clung to its summit. From various points of view in relation to the direction and angle of sunlight the island took on every hue between a black silhouette and the pale pink of a Maxfield Parish painting.

From shipboard, the only vegetation to be seen on the main island was made up of algae on the walls and vaults of sea caves. But one or more of the small stacks off the northern end had tufts of withered grass on the vertical flanks and a few small brown shrubs or bushes near the summit. Unfortunately, these rocks were unscalable, and we were not able to shoot off plant specimens with a Mauser rifle, so nobody yet knows the identity of the almost negligible flora.





▲ A MASKED BOOBY of Malpelo has made a mosaic pavement to serve as its nest on the plantless island

When we approached close to the island, the deeply weathered slopes and saddles were seen to be peppered with white spots, which resolved themselves into masked boobies. The birds were scattered nearly everywhere from a few yards above the foam. Never having seen more than a score of these boobies in any one locality, I had not previously realized that there were so many in the world. A rough estimate made during our stay indicated a population of about 25,000 at Malpelo, more than half of which were usually standing in pairs at the nest, while others were flying singly off to sea or returning in small wedges of nine or ten together.

Armstrong and I succeeded in landing twice on Malpelo on different days. The feat is not easy, even in calm weather, because there are only two none-too-comfortable ledges from which a man may gain the heights. We chose the bank of a swirling cove on the eastern side, where the intertidal rock was overgrown with slippery seaweed and where lacerating barnacles offered the only grip. Rubber-soled sneakers were of no avail, but bare feet proved better, even under the certainty of cuts and bruises. The first move was to lie a few yards offshore and to watch the tons of seething brine lick and bubble over the ledge, converting the cove into a boiling cauldron. Experience showed that two or three successive engulfments would be followed by a spell of quieter water during which Time might be seized by the forelock. Once up beyond the gluey mat of seaweed,

you had little to worry about except the hazards of getting off again, a trial that it was best to defer until the latter part of the ebb.

On an island practically devoid of vegetation, it was somewhat surprising to find clear pools of potable water, with only a slight taste of soda. This had seeped out of the rock and collected in some of the caves and elsewhere above highwater mark. Malpelo may thus be said to have springs, even though it has almost nothing that can be called soil. It obviously suffers during most of the year from extreme drought, yet at certain seasons it receives enough rainfall to support its apology for plant life and to supply a source for the small basins of fresh water that never fail. It is reported that the altitude of Malpelo is sufficient to precipitate occasional heavy showers that fall on the ocean a mile or so to leeward, so that a vessel cutting across down wind may enter rain while the rock itself remains unsprinkled.¹

In 1921, General Paolo Emilio Escobar published a book relating to the Pacific coast which contains certain astonishing information about Malpelo. Fortunately, the author states that he had not personally visited the island but had obtained his data second hand. At any rate, he endows it with groves of coconuts and other palms, thickets of shrubbery, and the simple but thriving gardens of resi-

¹A report on the rock structure of Malpelo, previously unknown, and of the phosphatization of the original volcanic material through the action of bird guano, has been published in the "Askov" Expedition series: Duncan McConnell, Bull. Geol. Soc. of Amer., vol. 54, pp. 707-716, 2 plates.

dent Colombians! Turning to Comandante Fallon for an explanation of this yarn, we were assured that Malpelo had long served a legendary purpose for certain politicians in his country, which, as he rightly observed, are not very different from politicians elsewhere. What could be more appealing and dramatic in Bogotá, he continued, than an impassioned burst of oratory directed toward the succor and cultural advancement of the loyal but neglected Colombian citizens dwelling on Malpelo!

As to actual inhabitants, the first that we met ashore were crabs and lizards, of which two species of each were abundant. Red amphibious crabs (*Grapsus*) swarmed all over the rocks at sea level, and I found a large one in a crevice engaged in the cheerful occupation of eating a smaller example of its own kind. Even more ghoul-ish in appearance were the land crabs, fat and bloated-looking creatures with shells of a ghostly white. They may be quite harmless toward human beings, yet they seem to eye a visitor with an intent that grows uncomfortable. If you sit still long enough, the crabs will move up closer and closer, as if with whetted appetites, and I have a feeling that they would make the night miserable for anyone who had to sleep ashore.

Of the two reptiles, one is an alligator lizard, a moist-looking, fleshy brute of more or less the form and size of a Gila monster, but having a shiny dark skin covered with fine spots. The lesser species is a wall lizard, related to the so-called American chameleons. Curiously, the small species, which is not at all closely akin to the alligator lizard, is likewise covered with fine white spots. Both reptiles differ in this odd character from all their respective relatives. Both are found nowhere in the world except on this tiny rock lying in the midst of ever-restless swells.

Of the less conspicuous forms of life, we saw little during our hurried call. The reptiles, however, contained evidence which should serve as a lure to the next visiting naturalist. In the stomachs of the wall lizard we found remains of small crabs, spiders, pseudoscorpions, beetles, flies and fly larvae, ants and other insects, most of which are probably yet unknown to science.

The recorded bird population of Malpelo numbered only ten species, to which our collections added the red-billed tropic-bird. A sea fowl that

we unfortunately failed to obtain was the resident man-o'-war bird. All man-o'-war birds are now known to be relatively sedentary, rarely ranging as far as 150 miles from their nesting or roosting places ashore. Therefore, nobody yet knows what kind nests at Malpelo, nor can the problem be solved until a visitor collects at least one adult of each sex.

An extraordinarily beautiful resident sea bird is the swallow-tailed gull, a species peculiar to Malpelo and the Galápagos Archipelago. The Malpelo colony is small, and I wished to collect only one or two in order to note the brilliant skin colors and to learn the nature of the birds' food. Going down alone in the skiff on March 26, I found the gulls occupying ledges and niches low over water surging against the perpendicular wall near a great green sea cave. The puzzle was how to get near them, because the wind was onshore and the wild backwash made it prudent to remain at a reasonable distance from the foot of the cliff. I finally fired my gun at the sheer rock, scaring off the whole cloud of gulls, and then it was a simple matter to drop one in a safe spot. The gorgeous bird was as large as a herring gull, but with longer wings, forked tail, and a slender bill. Its brown eyes were surprisingly large, and a hood of dark gray plumage covered the head and neck. The remainder of its feathering was a symphony of white, gray, and black. But the skin colors were the startling feature: eyelids, crimson; bill, black at base, pale blue at tip, with the angles of the mouth crimson; bare skin below

the bill, salmon pink; legs and toes, peach-blossom pink, the webs geranium pink with black borders. Its stomach was crammed with rare red-and-blue swimming crabs (*Euphyllax dovi*) which, to the delight of Doctor Armstrong, we had already found swarming at the surface for many miles around Malpelo.

On March 29, when a great swell from the south had made further landings impossible, we laid our course for Ecuador, unbending the trisail from the mainmast and boom-in-gallows, and rigging the mainsail for the long reach toward Manta. I said nothing to my shipmates, but I suspected that we might find that Mrs. Murphy had flown down from New York for a visit. And that was just as it turned out, when we anchored on April 4.¹

La Plata

La Plata is associated in my mind with venomous sea snakes ringed with black and yellow bands, which infest the waters around it. In remote days, before the buccaneer William Dampier introduced the first goats, the island may have had a far more hospitable aspect than today. It is probable that the original vegetation protected the soil from the erosion that has been gullyng it in recent centuries. At present it would seem that only the infrequency and briefness of the rains have prevented it from being all washed into the sea. The island lies to the west of a curious climatic line, on the eastern side of which there is

¹Grace E. B. Murphy: "Flight to Ecuador," NATURAL HISTORY, vol. 32, 1943, pp. 62-69, 19 illustrations.



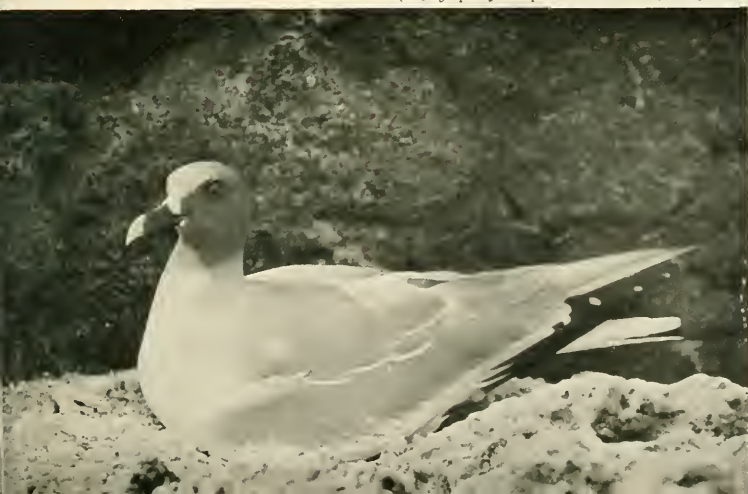
▲ THE "RAIN LINE," to the east of which there is a copious annual rainy season during the northern-hemisphere winter months. To the west, rain is scanty and is most pronounced at intervals of about seven years

a rainy season of five months' duration each year. On the offshore side of the line very slight annual rainfall comes only occasionally between January and April, if at all. About every seven years, however, the same months are marked by heavy precipitation. The time to see La Plata at its best is after the rains. This experience I have had twice, first in 1925, before the end of the deluges of that never-to-be-forgotten year, and again when "Askoy" dropped her hook on April 12, shortly after the lesser showers of 1941.

Nobody lives at La Plata except a lighthouse keeper and his family, although fishermen from Manta and elsewhere sometimes make use of the small landing beach. In 1925, José Garcés was the lightkeeper who dwelt on the little plantation behind the strand. By 1941, Garcés and his numerous brood had ceased to be even a memory to his successor, Manuel Hauptmann. The latter had been in residence six years. Four of his chil-

▼ SWALLOW-TAILED GULL, one of the most beautiful of sea birds. The species nests only at Malpelo and at two or three islands of the Galápagos group

(Photograph by Templeton Crocker Pacific Expedition)





▲ A TYPICAL DUGOUT MINIATURE SCHOONER of the Chocó coast. The craft is less than 30 feet in length. Noteworthy are the logs of balsa wood lashed on each beam. These serve as outriggers and are sufficiently buoyant to prevent the craft from capsizing



▲ A PEACEFUL ANCHORAGE off Gorgona, with the fruitful island of Gorgonilla in the background. The sloop is a native Colombian merchantman from the River Charco. Over her port bow hangs a wicker chicken coop which contains a cock and six hens so that the master of the craft need never go without fresh eggs



▲ GORGONILLA, or "little Gorgona," lies a half-mile off the southern end of the main island. It is extremely picturesque, and parts of its coast are thinly forested so that it offers nesting sites to vast numbers of boobies and other sea fowl

dren had been born on La Plata, and the younger members of the family, including two small boys old enough to serve as our guides, had never been off. Theirs was a Crusoe existence, La Plata serving as the hub of a universe bounded on one side by an ocean horizon and on the other by the barely visible blue sierras of Ecuador.

La Plata, which is about two and a half miles long by one and a half at its greatest breadth, attains an altitude of 700 feet. The perennial vegetation comprises arborescent cacti, algarrobo, lantana, capers, and other drought-resisting woody plants. Many of the trees and shrubs have fleshy leaves or other special equipment for preventing loss of water. Many also bear long beards of Spanish moss, which the Ecuadorians call *lana salvaje*, or wild wool. One conspicuous plant among the generally stunted arboreal species is the *palo santo*, or holy tree, so-called because its twigs, when broken, weep copious aromatic drops that give off the odor of tear gas.

Such is the thickety vegetation which at all seasons combines with a rough terrain to make travel difficult away from the trails. But after the rains, be they ever so feeble, new greenery springs into life, and the ground sends forth vines, herbs, and blossoms in a profusion that soon carpets the bare, cracked surface. Gigantic white *amancaes*, or spider lilies, with golden centers, are among the first to bestar the long slopes between the central hills and the edge of the westerly cliffs. These are followed by

➤ GORGONA is an isle of perennial brooks, fed by rains that fall on practically every day of the year. Their beds offer the only feasible routes to the heights



morning glories, gourds, various grasses, tiny sunflowers, mallows, wild cotton, and a host of others, which combine with the caroling of mockingbirds and the aerial dance of the vermilion flycatchers to create the brief and uncertain season of spring.

Just as I remember sea snakes in the ocean around the island, so I cannot forget the goats ashore. Many of the animals are white, and from far away you see them filing nimbly along almost nonexistent ledges on the face of the cliffs or posing statuesquely against the clouds on some knife-edged ridge. It is the goats, beyond a doubt, that began the destruction of La Plata in the seventeenth century. After they had removed much of the permanent plant cover, the rains were able to go on with the job. Oscar Paar, our engineer, following a hunt on which he shot the half-grown kid that served as the *pièce de résistance* of our Sunday dinner, remarked that there was a strong similarity between the vegetation of La Plata and that of St. Helena in the South Atlantic. At the time, he knew nothing of the fact that St. Helena was heavily forested at the date of its discovery but that it later underwent a long goatish history.

Even life under the surrounding water has probably deteriorated because of the ultimate influence of goats. We discovered, for example, extensive growths of reef corals. During diving operations with our Dunn helmet, we found that many of the masses were in a moribund and rotting state. It surprised John Armstrong, indeed, that reef corals could live at all in water containing as much suspended silt as had recently been washed off La Plata. For the same reason the pearl oysters, which were



▲ A COCAL on the eastern coast of Gorgona. The palms, the coral beach, and the thatched hut combine to make a scene suggestive of Polynesia



▲ IN MANY PLACES the riser behind the shingly shores of Gorgona is curtained with dense masses of feathery ferns

▼ BLUE-FOOTED BOOBIES, the legs and feet of which are actually the color of robins' eggs. They roost in great numbers on rocks around the shores of Gorgonilla





▲ **LA PLATA FROM THE AIR:** a photograph used by courtesy of the Hydrographic Office of the U. S. Navy Department. The landing beach and buildings are in the cove on the quiet shore (upper). The foot-trails show distinctly, one of them leading through the main gorge of La Plata to the low tableland and surf-beaten cliffs of the southwesterly coast. The extraordinary erosion of recent years is evident in this picture



▲ **WHEN "ASKOY" circumnavigated La Plata before dropping anchor off the landing,** Comandante Fallon stood in the rigging and kept a sharp lookout for submerged rocks



▲ **KNIFE-EDGE EROSION** of the bluff at the northwestern point of La Plata. Such destruction of soil has been brought about by the browsing of an overpopulation of goats throughout perhaps three centuries



▲ **OSCAR PAAR, engineer of "Askoy," "brings home the bacon" in the form of a La Plata goat for the Easter dinner of a hungry crew**



◀ **EARLY VISITORS** to La Plata freed burros so that there is today a small wild herd, including at least two stallions of a beautiful mahogany-brown color. When these mammals dashed away in a cloud of dust, the sight resembled a flight of wild asses in Asia

➤ **MASKED BOOBIES** on the overhang of La Plata cliffs, 90 feet above the water. The hard but friable indurated soil of the island shows well in this photograph



formerly harvested, may have disappeared.

Our final day at La Plata was Easter. We carried on as usual, but I found it hard to concentrate because my imagination wandered to New York, where I knew that my first granddaughter was being christened, and that her grandmother had arrived home by plane from Salinas, a town lying under the very clouds that I could see piled above the Andes. All day as I looked over the lonely pampa of La Plata, or at the sea caves and spouters, the coral heads four fathoms down, the angelfish and the waterfowl, I was seeing also a blur of top hats and spring clothes along Fifth Avenue! I doubt whether the light-keeper, the seven little Hauptmanns, or the señora to whom Fallon always referred as "the lady," knew that it was Easter, or even Sunday, but I may be wrong.

Gorgona

Dark Gorgona lies on the parallel of 3° N. latitude at about the limit of naked vision from the Chocó coast. Ever since its discovery in 1527, it seems to have aroused mixed sentiments in its visitors. The marooned Spanish conquistadors regarded it as a place of torture, a hell-on-earth. To the British buccaners of the next century, it seemed, on the contrary, like a bit of Paradise. My own experiences during two visits would lead me to subscribe to both opinions because Gorgona lacks neither perils nor charms. It is a hot, reeking island-mountain, teeming with luxuriant life that runs the gamut from streptococcus bacteria and deadly serpents to entrancing birds and orchids.

On September 16, 1937, I first approached Gorgona in the launch "Wilpet" from the offshore side and rounded its northern end after night-fall. The ocean was black and still along the easterly shore, and also deep, because for a long while on our cautious approach we could find no bottom with the lead until we had come close enough to hear the pleasant whisper of running water and to make out dimly the gleam of a sandy beach, backed by a hut among palms. Then we dropped anchor and turned into our berths, exhausted, while frogs and cicadas lulled us to sleep.

Next morning was bright and sunny, regardless of the season, which was close to the annual peak of rains. Our launch lay under the central hill of the island, toward which the forest



▲ THE AUTHOR of the "Askoy" Expedition series in *NATURAL HISTORY* making motion pictures of masked boobies, above the sea cliffs of La Plata, during his visit of 1925

➤ THE LANDING BEACH and only settlement on La Plata also mark the point at which an ancient river canyon enters the sea. The anchor of "Askoy" was accidentally dropped into this gorge so that, to the consternation of all hands, it descended seventeen fathoms only a moment after the sounding lead had found five fathoms

▼ CONSTRUCTION OF TEMPORARY HOMES on the coast of Gorgona is a simple matter for those who inherit the tradition of the native Chocó Indians. Foundations and beams are lashed together with withes; the flooring is of split palm, and the roof is thatched with palm fronds. Familiar tropical culture plants grow around this hut





▼ ONE of the white and distinctly unprepossessing land crabs of Malpelo. This species (*Geocarcinus planatus*) is known also from certain islands off the western coast of Mexico, which indicates that in the remote past it may have reached Malpelo from the north



(Left and below) ONE of the drought-resistant fleshy-leaved plants of La Plata (*Maytenus octogona*), a member of the Staff-tree, or Bittersweet, family. This example, growing just above the sea cliffs, is extraordinarily large and luxuriant. It carries on its crown the foliage of a gourd vine



▼ A HUGE golden-centered, white spider lily, belonging to the genus *Hymenocallis*, is one of the earliest short-lived blossoms to spring from the soil of La Plata after the rare rainy periods



crown sloped up 1200 feet, with wisps of fog hanging among the trees, the infinite shades of green accented by red patches wherever flowering vines had climbed through to daylight. The water was a clear, deep blue, and we could look down "full fathom five" upon beds of small staghorn coral over which brightly colored reef fishes were moving.

The skipper and I were soon ashore among the *cocales* and their palm houses, which we found filled with all the gear of absent inhabitants. This included balsa outriggers, fish lines and nets, stone anchors and mortars, fireplace pottery, kitchen utensils made of gourds and coconut shells, sandals of both hide and wood, and similar personal effects. Beds of coconuts had been laid out here and there to sprout for subsequent planting. There were also small banana hedges and blooms of red hibiscus and other flowers. Each of several such empty settlements was behind a sand and coral beach, separated from the next one by shores covered with blocks of porphyry, across which walking proved exceedingly difficult. The vertical riser behind such rocky stretches was topped and overhung by dense forest, or curtained with enormous feathery masses of delicate ferns. It appeared that the only routes into the interior were along the beds of brooks that entered the sea at intervals of a few hundred yards.

Later in the day, while I was alone on one of the beaches, however, I thought that I discerned a faint trace of a trail leading over a small point into the jungle. Before returning to the launch for heavy boots and briar-proof clothes, I very incautiously determined to scout for a few moments, clad in nothing more than shorts, sneakers, and sun helmet. Accordingly I climbed the bank and proceeded crouchingly under the overhang of the gloomy woods. But I had gone only a few yards when I leaped involuntarily into the air because of a half-seen brown flash toward my knee. The jump was too late. A fer-de-lance had struck me on the inside of the right leg, five inches above the ankle. The snake now lay half coiled on the wet leaves, with part of its body concealed but its arrowpoint head held well above the ground.

My shin was dripping blood. I turned, dashed back through the brush and vines, down the steep bank to the beach, twisted on a tourniquet, fired

my shotgun four times to attract the captain, and began to suck the wound, which, fortunately, bled freely. Apparently, the strike of the snake had been, so to speak, tangential. Only one fang had pierced the skin, and its direction had been just under the surface, instead of deeply into the muscle of the leg. At any rate, I am undeservedly alive to tell the tale, and the only noticeable after-effects were a slight stiffness of the limb and a round patch of skin which for about two weeks showed all the proverbial colors of a "black eye."

My next view of Gorgona was from the deck of "Askoy" on Sunday morning, April 20, 1941. It had been a dirty and squally night on the northward voyage from Tumaco. The flotsam-filled coastal water flashed constantly with luminescence, and every few minutes in the darkness we heard strange reports, like the crack of rifles, which seemed to come from the waves roundabout. The mystery of these was never solved, and to this day I do not know whether they proceeded from the lob-tailing of porpoises, the whack of a leaping fish, or from some quite different source. The water about Gorgona was now green, instead of ultramarine, and pale jellyfish as large as oranges so filled it that we could count at least one under each ten square yards of surface. We dropped anchor in nine fathoms, not far from the south end of the island, after getting most diverse soundings—two fathoms next to 18, for example,—among the corals.

There was a black woman in a shack ashore, and soon a man and two boys came in from sea in a large fishing bongo with balsu logs lashed along each gunwale. We hailed this craft and loaded it up with our soiled clothes for the woman to wash. Judging by the strident conversation that subsequently came from around the short stem of her pipe, she did not relish the task at all, even though she was going to be well paid for it.

The day was dismal, raw, gusty, rainy, and thundery. Columns of fog swept through the tenebrous forest. The fisherfolk, of whom many were in residence, stated that the weather had been very bad for several weeks, but they cheerfully predicted a pleasant morrow, with sunshine, a southwest wind and a calm sea. The *comandante*, Correia and I at once went collecting on the mountainside, well protected against snakes but not

against the dripping foliage that quickly soaked us to the skin. Armstrong and the engineer made a better choice for the day by putting on a diving program where, as Oscar remarked, the rain couldn't wet them.

After a night of uninterrupted downpour, the promised better weather arrived, and the fishermen began to move back toward their mainland homes, carrying with them the dried fish, coconuts, and other products for which they had come to the green isle. From the first peep of dawn, canoes full of men, with an occasional woman and a few children, were passing southward along the six-mile length of Gorgona toward the outlying island of Gorgonilla. From that point they set their sails for the long trip to the continent which, because of the coastal current, would be attained far to the north of their starting point.

Gorgonilla was the site of a light-house, and presently "Askoy" received a visit from five Indian men in a beautiful cayuco that was painted black outside and red inside. This group evidently scorned balsu sponsons. The men stood bolt upright, each wielding a pointed red paddle and each clad only in a breech-clout and a hat. They looked able and self-reliant and they explained that they were employed in cutting a trail over the steep and jungly terrain of Gorgonilla, from the landing to the gas-accumulator beacon. The object of their call was to buy some tobacco from us. We made them a present of three packages of rather dreadful Ecuadorian cigarettes. Never was bread cast upon the water to better profit, because at evening the same five called again on their return toward their quarters and left us a huge bunch of bananas, a supply of sugarcane, and a heap of limes, papayas, mameyes, aguacates, and coconuts.

For four days more we lay at three different anchorages and found an opportunity to become reasonably well acquainted with both Gorgona and Gorgonilla. Once I crossed the southern part of the main island by one of its few forest trails. As I picked my way through the twilight of midday, I was glad to feel the snake-bite suction cup in a bag attached to my belt. Countless roots and lianas simulated snakes, but the truly live and moving ones were conspicuous to my over-worked eyes. Gorgona is the home of at least ten kinds, including the boa

constrictor and a dangerous coral snake, in addition to the fer-de-lance. There are also extremely long and slender tree snakes, as green as emerald, and several more, most of which I seemed to encounter in the course of my travels. Curiously enough, the boa, largest of all the species, was the only one that aroused no feeling of either suspicion or caution. One about eight or nine feet in length lay in kinks in an open path on Gorgonilla, its scales flashing iridescence in the sunbeams. It puffed and threatened with considerable bravado when Fallon and I approached but then gave up the bluff and decided to be unconcerned if not friendly. We made motion pictures of it, before waving it merrily on its way.

The forest floor of Gorgona was always wet and had always the warm smell of a palm house in a botanical garden. The climatic "greenhouse effect" was, indeed, very evident, for the air among the trees was extremely hot even when the open beach felt almost chilly. Dead leaves lay thick in most places, but yellow, sticky, and rather poor-looking soil was exposed along steeper parts of the trails. The condition was a reminder of the fact that much equatorial forest earth is unsuited to anything except the extraordinarily rich plant life that it originally supported. While one group of bacteria is reducing fallen leaves to humus, and humus to its organic elements, another group is busy denitrifying the bottom of the layer and changing the soil back to a mineral composition. It is for such reasons that tropical erosion, after the felling of a rain forest, often leads to unsightly and disastrous ends.

The most eerie event of my woodland rambles came when a great tree suddenly fell not far from where I was standing. At the moment there was no perceptible breath of wind; the dead trunk, long rotten, had merely attained its time. I have been puzzled ever since to comprehend how, in a region of frequent and violent thunderstorms, a tree could remain upright until it literally collapsed of its own weight. That is the only explanation I can offer, however; without warning, it leaned and toppled, then broke into fragments which crashed on the earth with a loud yet muffled sound, followed within the instant by profound silence.

(To be concluded)

THERE'S NO PLACE LIKE I

The second and concluding installment in a discussion of dwellings around the world, illustrated by the American Museum's extensive collection of authentic house models

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HOUSING or shelter of some kind is a universal need. It provides man with necessary storage space for his gear and supplies, it surrounds him and his family with privacy, and especially it creates a climate which contributes to his comfort or enables him to live in areas which otherwise would be impossible for human habitation.

Man has developed an enormous variety of house forms and has utilized an astonishing number of materials. Not always, however, is the construction or the material the most suitable. In certain areas and circumstances the choice of a building material is limited by its accessibility. For example, the pioneers who settled the treeless plains of the Mississippi Valley found themselves without a local supply of the materials traditional for house building in the areas from which they migrated. Logs were unavailable or scarce. Stone or cut lumber meant a long expensive haul from the East. Sod, however, lay everywhere underfoot, available to anyone at the cost only of his own labor. As a result, the "soddy" or sod house became the common dwelling of the pioneer. Its form followed accustomed lines. It was rectangular with doors and windows and resembled, except for its material, the familiar cabin.

It is interesting and significant that these pioneers did not adopt a form of shelter already widely used in the very area where they were building their sod houses. The Indian tepee, built of skins stretched over a frame of poles, might have served as a model for newcomers, since skins were easily obtainable from the vast herds of bison and construction of the tepee presents few engineering difficulties. Despite its convenience, it was rejected, because the tepee is a relatively inefficient shelter against cold. Al-

though its thin skin covering, pegged to the bare ground, sheds rain and snow well enough and provides a welcome shade in the summer sun, its insulating value in below zero weather is negligible. Its redeeming virtues were the ease with which it could be assembled or dismantled and its extreme portability. For the nomadic tribes of the Plains these were prime considerations. They were, however, of no value to settled agriculturists who expected to remain on their quarter sections and who welcomed permanence.

Under the circumstances, therefore, sod or earth were the only choice open to the pioneers, who solved their problem in a fashion not too dissimilar from the semisubterranean earth lodges of the more permanently settled Mandan and Arikara, who were also inhabitants of the Plains.

Where the circumstances are not as stringent as this, tradition may influence the choice of material, as may be seen from another example from our own architectural history. The first English settlers in New England brought with them from East Anglia a familiarity with wooden frame construction. They found in their new homeland an abundance of wood, as well as of stone and clay for bricks. Wood, it happens, was universally adopted in preference to the more permanent stone and brick, partly because the trees had to be felled anyway in clearing the land, but also because the settlers' knowledge of house building was based on wooden models in the old country. Thus, tradition was largely responsible for filling New England with wooden houses.

But farther south, the Dutch and Germans, who found a forest as abundant as in New England, preferred to build in brick and stone because they were already adept in the use of these materials in house construction. When the Western Reserve was made accessible for settlement, the New Englanders who migrated to this newly opened territory carried with

them this already long established habit of home construction. In such early Ohio towns as Marietta, houses still stand that are faithful to the New England styles of the eighteenth century. Although time has changed the architectural detail, it would be interesting to know how much of the persistence of wooden frame construction in the United States today survives from the New England tradition established three hundred years ago.

Where the level of skill or culture declines, the influence of the environment becomes progressively ineffective in suggesting the best material or the most efficient construction. Thus we find the unfortunate inhabitants of the cold, raw land of Tierra del Fuego, who exist on a low level of culture, shivering behind their inadequate windbreaks, miserably protected from cold and wet.

All photos A.M.N.H.

▼ WINTER FINDS many natives confined to small, portable dwellings, prevented from using larger and more permanent shelter by the necessity of conserving heat and of moving in search of food. Here we see a camp of the Kutchin Indians on the upper Yukon in eastern Alaska as they



HOME



were observed about 1850. The Arctic Circle passes through their country, and the winters are long and cold. The usual type of winter house, as shown here, is dome-shaped, with arched poles supporting a skin cover. Sleds drawn by dogs are in use, and hunting and fishing are the chief occupations

▲ A CRUDE WINDBREAK and the simplest of skin clothing constitute the only protection enjoyed by these Tehuelche in their chilly homeland near the southern tip of South America. Their tent, or toldo as it is called, is an interesting illustration of evolution in house design. Four centuries ago, at the time of Magellan's historic voyage, the Tehuelche lived in an even smaller and simpler shelter

resembling that of their neighbors, the Onas (illustrated in the previous chapter). But, like some tribes in our own country, they soon learned to use the European horses, and by 1750 they had become a tribe of horsemen accustomed to treks through thousands of miles of country. This permitted them to carry this larger shelter. Notice that even the baby's cradle has been altered to fit across a pack load





▲ THE NECESSITY OF TRAVELING in search of food requires the Eskimo to move all his worldly belongings in winter on a sled. He has solved his house building problem so effectively that he needs to carry only a snow knife in order to construct a dwelling in which he can live comfortably for weeks or months



▲ A SHORT TUNNEL and protecting wall bar the doorway from bitter winds and provide shelter for the dogs. Illumination within is improved by a window of clear ice, here seen above the door



WHEN the natives are ingenious and skilful, we see remarkable adaptations to material and weather. The Eskimos' invention of the snowhouse illustrates how the ingenuity of skill can overcome the rigors of climate and the paucity of material to produce a satisfactory solution to a difficult problem. In this instance, the specifications are formidable. The Eskimos normally live in semisubterranean sod or stone houses, but certain groups who travel during winter and pass considerable time on the sea ice need another kind of house. Since the winter temperatures are extreme, this dwelling has to provide warmth and protection from the cold. Moreover, the material has to be something easily available, because the only method of transportation, the dog sled, rules out the possibility of carrying suitable building material. Skins or felt are inadequate to the conditions, and stone or wood are too heavy and cumbersome for building when speed is essential. Digging a semisubterranean shelter is impractical in winter even on land, for the earth lies solidly frozen beneath the snow, and of course impossible when traveling over the frozen seas.

Without some kind of an answer to this problem, winter travel would be out of the question, and hunting—a constant necessity for the Eskimo—would be dangerously limited. The genius of the Eskimo surmounted these obstacles in his invention of the snowhouse, which can be erected within an hour out of material everywhere at hand and in which he can live in comfort.

◀ THIS INTERIOR of an Eskimo snowhouse exhibited in the American Museum shows the skins that are sometimes pegged to the snow walls to give greater insulation from the cold. Eskimos frequently remove their upper garments in the snowhouse, because the temperature is brought well above freezing. The seal oil lamp that the woman is tending here is a shallow stone receptacle for blubber. The melted blubber burns through a moss wick

of the traveler



▲ RELIANCE UPON MATERIALS easily available has resulted in the elaborate use of birchbark by the roving Ojibway Indians. Note that two shapes of shelter are constructed with the same material, one dome-shaped, the other conical. In the center a birchbark canoe is being made, and at left an Indian is stripping the bark from a tree



◀ THE CREE INDIANS near Hudson Bay also use a tepee covered with birchbark. Sometimes caribou skin is used instead. These Indians make extensive use of rabbit skins for clothing, in the production of which the women shown here are engaged

➤ AS MANY AS SEVEN or eight persons live in one of these huts used by the Alacaluf Indians in an exceedingly rainy climate near the southern end of South America. Four sticks are put in the ground and bent over to form two parallel hoops. Other poles are then forced into the ground and bent across in the other direction, and lighter poles are added to complete the dome-shaped framework. Ten to twelve sea lion skins form the covering. The two doors at opposite sides are screened against the wind by fern fronds. A fire is built in the center of the hut and the occupants sleep at either end. When they travel to another location, they take only the skins with them

THERE'S NO PLACE LIKE HOME



the permanent



▲ IN CONTRAST to people who follow a nomadic existence, those who pursue settled occupations such as farming are apt to

be found living in permanent dwellings. Even in about 2700 B.C. the Neolithic people of Denmark are known to have erected

substantial houses of wattle and daub, as illustrated in this model. The mound in the background was used for burial purposes





ALTHOUGH the material may influence the design and structure of a house, it is not the only criterion by which houses are differentiated. The manner in which a building is employed may be as important as, or even more important than, the material itself.

The birchbark and the skin tepee, while differing in material, are essentially the same in structure and design. Similarly, stone or brick may be used interchangeably with little or no modification in the type of house itself. On the other hand, the same material may be applied to structures widely divergent in design. The domed shelters of the Winnebago, the tepees of the Ojibway and the Cree and the lodges of the Iroquois, despite their variety of shape, size, and construction, were all covered with bark. In distinguishing these abodes architecture is obviously more important than the nature of the covering spread over the skeleton of the building.

MOST of the house types among the uncivilized folk of the world are one-roomed affairs in which the high degree of room specialization familiar to us is absent. Here a single room

contains most if not all the activities that we disperse among kitchen, bath room, dining room, living room, and bedroom, not to speak of the libraries, music rooms, game rooms, bars, offices, dens, studies, etc., of more elaborate establishments. The departures from the basic one-room plan and they are never very great, can usually be traced to specific circumstances in the life and environment of the inhabitants.

In warm climates, where the heating problem is not acute and the warmth generated by cooking need not be conserved, detached kitchens are often found. Where special structures are not put up, the cooking may even be done out of doors.

Agricultural people, who must store food in large quantities, frequently build for this purpose special storehouses or rooms as in the pueblos of the Southwest. But in general, a single room suffices, and may in cold regions be necessary in order to take advantage of every source of heat, artificial and human. Anyone who remembers an old-fashioned farm house in winter with its annual contraction of domestic life to a single room, usually the kitchen, can readily appreciate the advantage of the one-roomed dwelling.

◀ A GABLED HOUSE of bark is the home of the Sauk and Fox Indians west of Lake Michigan. Their elaborate use of basswood in the making of useful articles is illustrated in this model

▼ The Navajo Indians of Arizona and New Mexico build this characteristic log and mud house known as a hogan. Their life centers around the cultivation of corn and the tending of sheep, whose wool is woven into blankets as shown here



In more beneficent climates, sleeping quarters may be divided from the main room, and even special houses are sometimes erected where the young men of the village retire to sleep.

AMONG most people, the house is designed to accommodate a single family and is therefore small. These small units, however, have a definite relationship to each other. With the few exceptions to be mentioned, these units are detached but arranged in a village pattern, usually either along a street or in a circle. The latter arrangement, adopted by the Plains Indians, provides some protection against attack by hostile neighbors. Walls, too, are often an essential part of the village design either for defense or to enclose domestic animals. The famous kraals of southeast Africa were regularly

surrounded by a stake fence within which the cattle could be confined. Walls to ensure family privacy are also known in rather more complex groups. The compound with its surrounding wall, found in Malay groups, is an example of this, and analogies to it exist in other parts of the world as well.

One of the most interesting village arrangements in aboriginal America is the pueblo of the Southwest. It is a single structure consisting of attached units all forming an apartment-house-like building, in contrast to most villages, where the family units are detached and separate. The pueblo takes several shapes but typically rises several stories, with each one set back from the one below it.

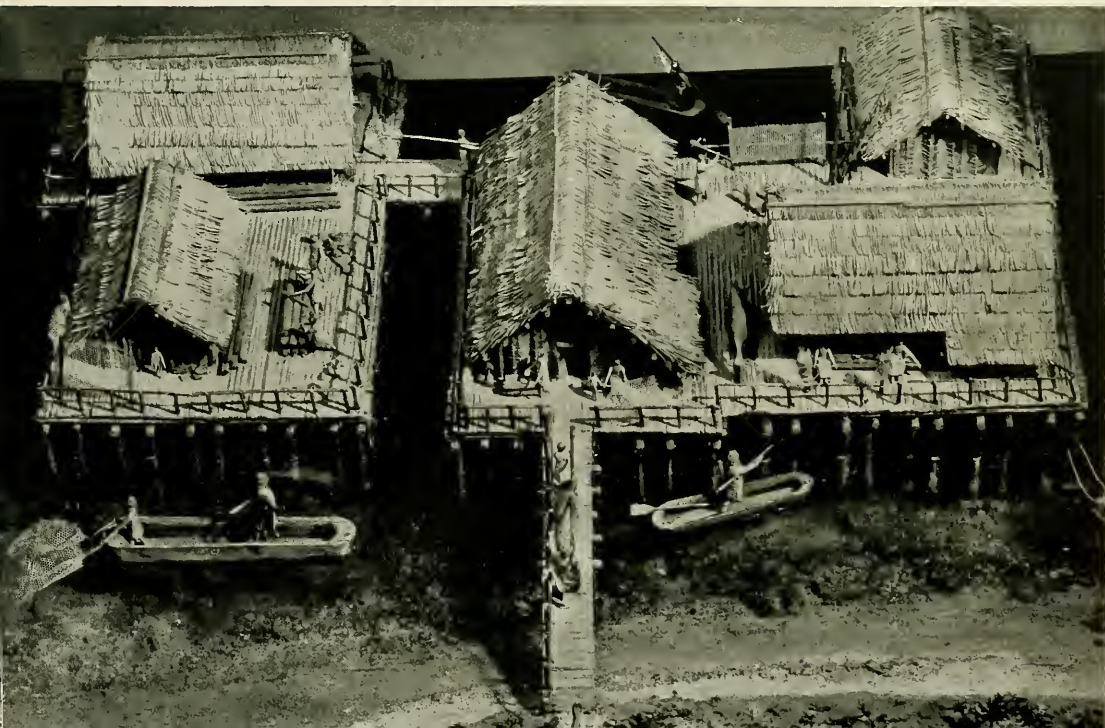
These examples of house plans and village arrangement are all drawn from social and familiar structures

where each family inhabits its own private dwelling. Social custom, however, may decree a more intimate form of living. In such societies we find communal houses occupied by several families (such as the long house of the Iroquois) or even by the entire village where such groupings are small in size. The dwelling then becomes considerably expanded in order to shelter under one roof a relatively large number of people. The Iroquois long house was often from 50 to 100 feet in length, and the Haida built substantial communal structures 40 by 100 feet. Each family usually had its own recognized section of the large hall-like interior, where it might store its goods and possessions and where it could retire to sleep. Thus, social organization, mode of life, and climate tend to modify and control the house plan and the village arrangement.

▼ ARCHITECTURE and village plan usually reflect the community life of the people. Even as long ago as the time of the prehistoric Swiss lake dwellers we find an orderly arrangement of houses forming a well-knit social unit, as shown by this scientific reconstruction based on archaeological evidence. A narrow wooden causeway, easily defended against enemies, connects the village with the shore. The people be-

community

longed as much to the world of water as to that of land, but their social life was circumscribed and conditioned by the narrow boundaries of their pile-supported village platform. A foundation so difficult to build would be expected to do for many generations





life

▲ AN "ISLAND WORLD" of a different sort is embraced within the walls of the Hopi pueblo. Community life there fits into an environment of roof tops. These houses are built and owned

by the community instead of by individuals or families. The woman at left is making a coiled basket; the one in the center is "building up" a pottery vessel by adding successive rounds of clay

▼ ON FIRST VIEW, the compact Hopi pueblo, accommodating many families on different levels, suggests certain resemblances to our city apartments. But its

community life is much more intimate. Everyone knows everyone else, and the various roof levels, accessible only by ladder, interconnect with one another



UNQUESTIONABLY one of the most distinctive features in a house is its method of construction, by which I mean not only the manner of building the house but also its relationship to ground level, and its decorative features. If we include as houses all kinds of shelters, they may be classified into the following basic forms: open shelters (lean-to's and windbreaks), the circular house (either dome-shaped or conical), and the rectangular house with pitched or flat roof. Variations and elaborations of these typical forms are, of course, numerous. I have not included caves in this classification, because they are natural phenomena, exhibiting no evidence of human construction. A claim might of course be made for the artificial caves used by some of the Chinese or masonry-fronted caverns of southwestern Europe.

The open shelter may consist of a series of stakes or branches joined to form an open shell-like structure, covered with leaves, skins, earth, or some other suitable material. It may also be a simple wall to deflect the wind, or it may be a lean-to type where the wall is inclined to form a half roof. These devices, which are of the most primitive character, are nevertheless widely distributed. The Australian aboriginal often uses nothing more. The Apache of the Southwest sought protection behind a similar screen. I have seen natives in the Malay jungle bedded down under such an open-sided shelter that was covered with broad leaves as a kind of thatch. It is at best a makeshift and suitable only as a temporary lodging for nomadic people living in warm climates, where its ability to shed rain may justify it. To find such a poor protection in common use among the Ona of Tierra del Fuego, where cold wet winds are frequent, seems contrary to the rule that man adapts his shelter to fit the environment.

The circular and the rectangular house are fundamentally distinct in their structure. In the former the roof or covering is often a continuation of the walls, which must therefore slope inward. This type of construction simplifies the problem of the roof and renders the circular house a highly desirable form under certain circumstances. Some circular houses do, however, have distinct roofs with overhanging eaves. But this shape, of course, limits the size of the house, since too great a diameter would cre-

ate engineering problems of considerable magnitude.

There are many variations in the basic plan: the beehive house found in Africa, the simple dome covered with skins or felt among the tribes of Northern Asia, and the classic tepee of North America. Fibers, grass, mats, and mud can generally be applied effectively as a covering, but other materials too are used. The skeleton is generally a simple one of poles, interlaced branches, or of horizontal members tied to uprights set into the ground. Among the Eskimos, where wood is often hard to come by, the native builder has sometimes used the curved jawbones of the whale for the frame, covering it with sod.

The rectangular house represents a more adaptable form of dwelling, since it allows greater floor space and more head room. At the same time, this type of house may be enlarged without overtaxing the architectural skill of the primitive builders and becomes, therefore, the preferred form where engineering knowledge has advanced but not yet reached the virtuosity required for large domed edifices. One of the major problems presented by the vertical wall is the break between the roof and the wall itself, which must be protected from leakage. In dry climates a flat roof is generally adequate, but in areas of abundant rain or snow, the roof must be pitched sufficiently to allow water to drain off rapidly. It is necessary, furthermore, to protect the top of the wall from absorbing moisture directly from the rain or from the runoff. The roof, therefore, becomes a cowl resting on the walls by means of a series of rafters, which meet along the ridge and project beyond the walls as eaves. This technical solution to the problem makes it possible for the builder to widen his dwelling, which he does at the expense of heavier wall construction, to support the increased weight of the roof. The simple pitched roof is by far the commonest form among these structures. Intersecting roofs with troublesome valleys at the junctions are never attempted by the primitive. The other two roof constructions in modern dwellings, the lip-roof and the mansard, are unknown. All the most highly evolved houses found among uncivilized natives belong to the rectangular category, and in such forms as the plank house of the Northwest coast or the elaborate houses of the Mernagkabau

of the East Indies the architectural knowledge displayed is very impressive.

ALTHOUGH modern architects have become increasingly concerned with the relationship of house to terrain and have achieved novel and interesting adaptations to land contour, their purpose is largely esthetic. The primitive builder, on the contrary, builds his house in relation to the land on more practical considerations, but he manages in certain instances to achieve notably pleasing results. Not only does he build conventionally, resting his house directly on the ground; he also goes underground and above the ground.

The true underground house has no counterpart in modern domestic architecture, yet it is a most efficient manner of insulating a dwelling from cold by making use of the same principle that keeps our cellars warm in winter. It is a form of construction found only in the most rigorous climates. The classic type is the Koryak house of northeast Asia, but variations where the excavation is shallower are found among the Eskimo and among the prehistoric people of the Plains. In fact, the semisubterranean house has been traced over a large part of Eurasia and North America. It is possible that the subterranean ceremonial kiva, in which the Pueblo Indians perform their sacred religious rites, may be a survival of an underground house type once employed by their ancestors when they ranged farther north, just as our own religious architecture tends to preserve antique styles long abandoned for secular construction.

ELEVATING the house off the ground is achieved by primitive builders by means of stone platforms, by piles, or by building in the trees. The Marquesans, for example, set their dwellings on stone platforms which formed a terrace surrounding the house. The use of wooden piles for supporting a house is fairly common, the earliest known being the prehistoric pile dwellings in the Swiss lakes. Modern examples may be seen in tropical America and various Pacific Islands.

There are several reasons for adopting this method of construction. The most dramatic is the protection that a pile-dwelling, set in a lake, lagoon,

or along the shore, affords its inhabitants. Since a dwelling enclosed in such a natural moat cannot be approached on foot, a measure of safety is thus automatically assured. Some of the villages in the lagoons and along the shore of Melanesian Islands are said to have been built by people who formerly sought refuge there from their land-based enemies. Such a strategic retreat could prove a

blessing for fisherfolk, who would find their source of food conveniently at hand.

Tree dwellers such as the Gaddang and Kalinga in Luzon and the Manobo and Mandaya in Mindanao set their dwellings as high as 40 to 60 feet in the branches of trees. These lofty ceeries provide an excellent protection from human enemies.

Pile dwellings, more prosaically,

by raising the floor of the house above the ground also offer another kind of protection—relief from vermin, animal incursions, and the humid exhalations of damp village sites. Native housekeepers find their superior elevation a convenience in their domestic tasks, since garbage may be easily disposed of below the house where the scavenging pigs of the village have free access.

protection from enemies

▼ TREE DWELLERS in the Philippines build their houses as high as 40 to 60 feet above the ground and thus secure excellent protection from human enemies. This is a full-size model on exhibit in the American Museum of Natural History



protection from enemies

▼ PROTECTION AGAINST ENEMIES was attained to an extraordinary degree by the builders of the cliff dwellings in Southwestern United States. Extremely long ladders were sometimes the only avenue of approach. Protection from the rain was usually

given by the overhanging cliff above. The stone and adobe buildings were plastered in a color closely resembling that of the surrounding cliffs. This model is a replica of a cliff village in the Canyon de Chelly in northeastern Arizona.



▼ The Zulus of Africa protect their cattle within a double circle of fencing, with the village huts occupying a unique position between the two rings





▲ THIS MODEL OF A VILLAGE of the Manus tribe in the Admiralty Islands is a beautifully executed example of house design showing the community life of a people who dwell over the water. For all the necessities of life,

these people depend upon their skill in fishing and in navigating their large outrigger canoes. They trade fish for vegetable food and for wood for their houses and canoes. Note that the natives have painstakingly

built up in the sea a small island of coral rubble to serve as a "town hall," where important meetings take place. Elaborate feasts connected with marriage, birth, and death enliven their isolated community life

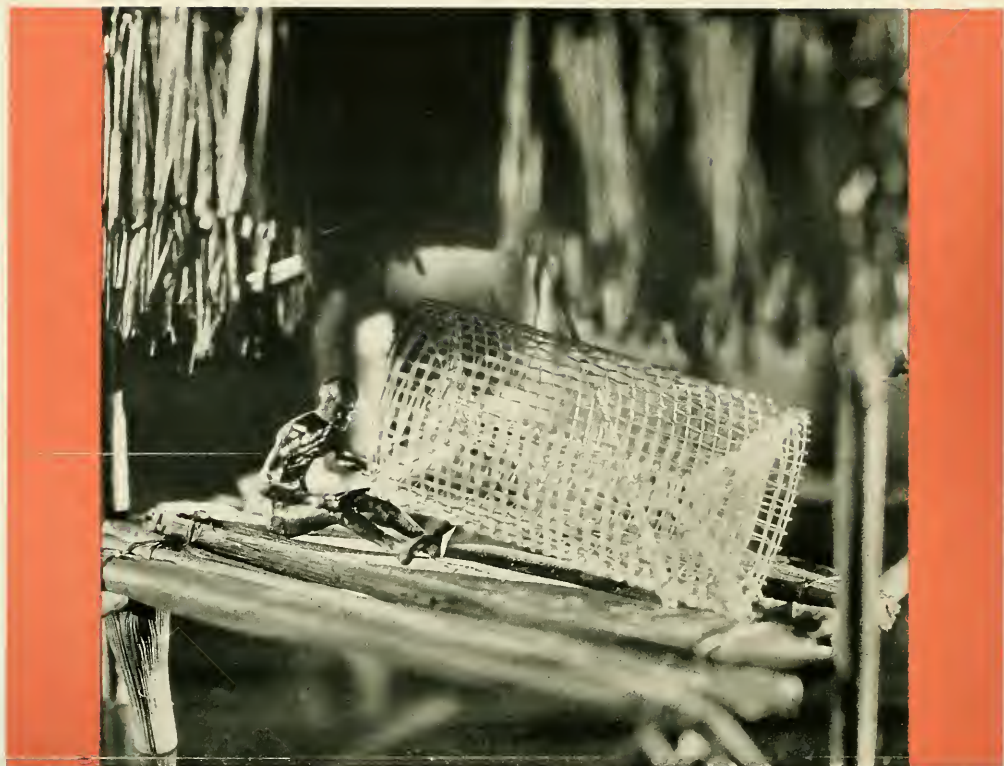
a village over a lagoon

▼ THE PEOPLE OF THE MANUS tribe make voyages to distant islands in sailing canoes like the one repro-

duced here in miniature. A cargo of pots is being brought as a handsome gift to the kindred of a young man who is about to be married. His rela-

tives have already paid many hundreds of dogs' teeth to signalize the marriage





▲ A DETAIL VIEW from the model of the Manus village showing the construction of a cylindrical fish trap. Many important phases of the life of the people are shown within the single model. Such an exhibit is possible only after many months of scientific study among the people. The investigator may have to learn to speak the native language in order to secure all the necessary information. In addition photographs and drawings aid the Museum's technician in reconstructing such a model

▼ EVERY OPERATION in building the full-size house is performed by the model maker, who thus produces in miniature an exact scientific replica of the original

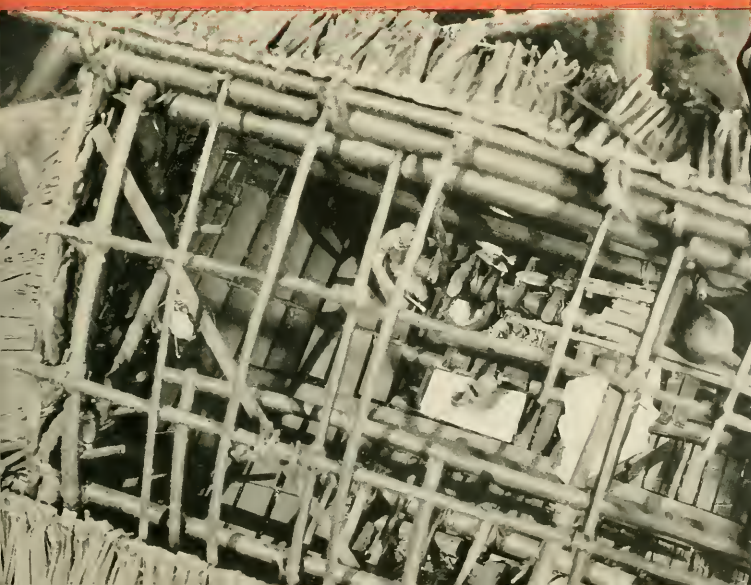
▲ IN THIS INSTANCE, before the model house is completed its inhabitants must be put inside, because one is intended to see them busy at their daily tasks through an opening left in the roof

► THUS, THROUGH the blackened rafters one sees the woman of the house preparing a meal of fish.





▲ SCRUPULOUS attention to detail is observed in every stroke of the knife in fashioning the smaller objects for one of these models, in this case an outrigger canoe, identical except in size with those used by the Manus tribe



WHATEVER beauty most types of native houses possess is functional and accidental. It springs from the quality of material employed and the surface it lends, from the shape and mass of the house itself, and from the structural details of the building. The esthetic distinction not infrequently evident in these simple houses does not represent a conscious striving for an effect; it is the natural result of the construction.

I recall vividly the pleasing effect which the under side of a thatched roof produced in the interior of a Polynesian house in which I once lived. The steep, lofty rafters, completely exposed from below, were covered by overlapping layers of thatch, narrowly spaced. This simple, functional finish was perfect in itself and needed no further adornment.

In a few noticeable instances, how-

ever, the native builder does consciously attempt to enhance the beauty of his work by additional details that have no purpose save to enrich the architecture. The Maori of New Zealand elaborately carved the gables of his house with fine scroll and open-work inlaid with shell, and he frames the doorway with similar decorations. Carved and painted designs of great elaboration are used by the Tlingit and Haida to embellish their houses.

House decoration reaches a very high level in the East Indies, where carved and decorative elements are frequently incorporated into the façade and gracefully curving roof lines, and where telescoped gables and sweeping eaves are exaggerated for their esthetic values.

Some of the most interesting examples of primitive house decoration are the molded walls of African mud houses. The plasticity of this material

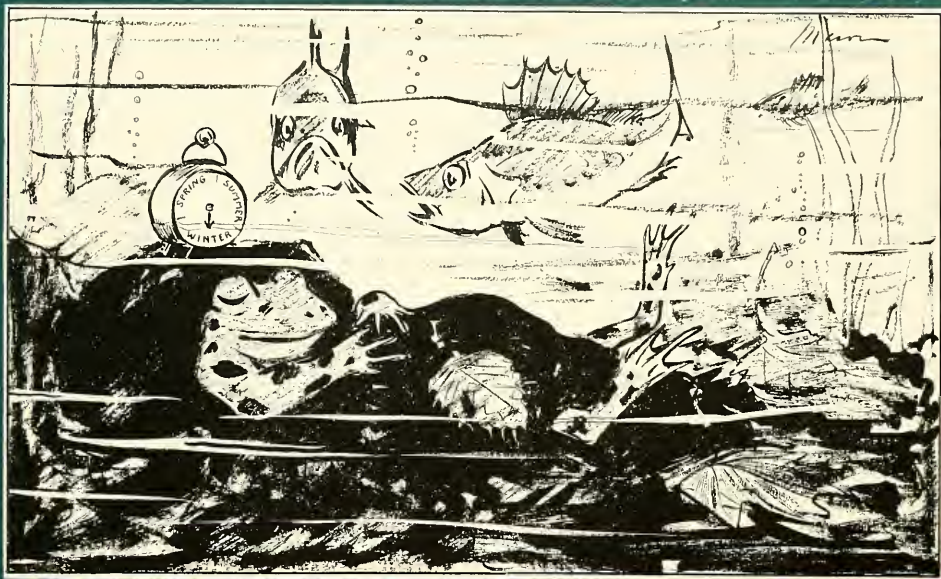
lends itself particularly well to the vivid fancy of the African natives, who often achieve very striking effects by simple means.

The house, however humble, embodies and reflects so much of our history, our traditions, our skill and culture; it speaks so eloquently of our opportunities and our failures that one can't help agreeing that where'er we may roam,—“there's no place like home.”

▼ The natives of New Zealand, the Maoris, spared no pains in applying their high skill as wood carvers in the decoration of their houses. The style of decoration in which they have distinguished themselves is illustrated here by one of their carved food store-houses, on exhibition in the American Museum of Natural History



FROG IN WINTER



By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

NOT long ago people believed that when winter came the swallows dived down into the mud at the bottom of ponds and spent the winter sleeping there. This was pure fancy, of course. Swallows really go south to warmer regions where insects fly all winter. But it is a strange fact that frogs do spend the winter much like the swallows were supposed to do. They go down to the bottom of their ponds and bury themselves in the mud. Sometimes dozens of frogs are found in the same pond-bottom, lying closely packed like sun-bathers on a city beach in the summertime.

Frogs spend part of their time on land. They can jump along the shore or into the water and they breathe air, but they have not become fully suited to a life away from the water. The skin does not give much protection from drying; its outer horny layer is very thin. A frog will dry up and die in a little while if kept away from

moisture. This is a drawback, keeping frogs close to ponds and streams, but it does allow them to spend the winter under water.

On land a frog breathes much as we do. It has no ribs or diaphragm so it must "swallow" the air, but the same exchange of gasses goes on. Carbon dioxide gas, produced by the

chemistry of living, is given up, and the life-giving oxygen is taken in by the blood to be carried to the various parts of the body. In addition to the lungs, the skin of frogs permits this exchange of gasses, thus serving like an accessory lung. Just below the skin there is a network of blood vessels, and the thin, moist outer layer of the skin allows oxygen and carbon dioxide to pass readily. We cannot breathe through our skin this way, for it is relatively thick and waterproof—even the most delicate human skin has a good horny layer.

A frog can stay a long time under water, even in the summer. When the animal is hibernating, cold almost to freezing and with all its life processes slowed down, skin-breathing is sufficient.

One frog, the so-called hairy frog of the Congo region, is covered on the sides and thighs with slender threads of skin, densely set and almost an inch long! Each "hair" contains blood vessels that run near the surface. This frog "breathes" all the time by means of the strange skin-growths; it has only vestiges of lungs.

ON YOUR RADIO

Program of the American Museum
of Natural History for January, 1945

WEDNESDAYS

over WNYC & WNYC-FM
from 3:30 to 3:45 P.M.

Science for the Seven Million

Conducted jointly by Lucy Clausen and
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- Jan. 3—*Science in the News*
- Jan. 10—*Contract with Nature*
- Jan. 17—*Food for Warmth*
- Jan. 24—*Captive Heat*
- Jan. 31—*Winter Camera Trip*

By WILLIAM M. RUSH

Beau Brummel of the Wild



Although long despised because of his name, this little fellow with impeccable manners and an immaculate home has proved himself the true aristocrat of desert creatures

IT is unfortunate that many of our North American animals were given wrong names by the first settlers. The American moose is an elk; our elk should have some such name as gray deer, red deer, or the Indian name wapiti, which is sometimes used; and buffalo are really bison. But perhaps the most unfortunate mistake is to apply the name "rat" to the most beautiful and gentlemanly mammal on the continent, our native kangaroo rat.

Its scientific name is *Dipodomys*, which translates into English as "mouse with two feet." This is appropriate, as the animal travels on two legs at a gait known as "saltation," a series of leaps somewhat like the kangaroo.

The despicable brown rat which causes this country millions of dollars damage every year and transmits to us the dread diseases of plague and typhus, is an importation from Europe and Asia and deserves nothing better than complete annihilation. *Dipodomys* is as far removed from this slinking, hard-tailed, beady-eyed,

destructive creature as white is from black. *Dipodomys* lives far from civilization in all the western states except Washington, thriving in the hottest, driest desert regions and causing mankind little trouble.

There are a dozen or more species, varying mostly in size and coloration. Sometimes two or more species are found in the same region.

I came upon a "kangaroo's" house in the Painted Desert of Arizona one fine spring day. He had made no attempt to conceal his home. It was built around a creosote bush of sand, gravel, and twigs. Its gray, white, and brown colors blended prettily with the bright green leaves, brown stems, and yellow flowers of the creosote bush. I hesitated to desecrate the home, but how else could I learn anything of its occupant? I was careful not to wreck it any more than I must, but even then I plucked away the sticks and scooped away sand and gravel with the feeling I was house-breaking.

There were tunnels running in several directions, mostly lateral and

downward. There was more than one outside entrance, all plugged with sand to keep out intruders. I used a shovel to get down to living quarters. And there was another very good reason why the house of a desert rat should not be explored by the bare hands. Oftentimes rattlesnakes, particularly the sidewinder, take up their abode in some of the tunnels. *Dipodomys* is suspected of sealing them off from the outside world so that the snakes must die of slow starvation, but this needs confirmation.

I found several chambers partially filled with seeds and other food supplies. All of the rooms and runways were scrupulously neat and clean. All droppings had been carried outside, mixed with sand, and deposited on top of the house. Urination was done outside. From a hygienic standpoint the house was a model.

Curled in a remote corner was the only occupant. The beautiful little desert creature blinked his owl-like eyes at the unaccustomed brightness of daytime, for he is strictly a nocturnal animal. I picked him up. He

did not attempt to bite or scratch as I stroked his fur but huddled in my hand. I set him down again. He reared on his haunches and fondled his tail. He stood about six inches high. Hind legs, more than twice as long as the front ones, set him three or four inches taller. His feet were furred, permitting him to travel silently on desert sand. His head was large, gnomelike, out of all proportion to his body but shapely, with big wistful eyes and rounded ears.

It is the color and pattern of his coat that earns for *Dipodomys* the title of Beau Brummel. Upper parts were reddish buff, the belly white. Black patches ornamented the base of his whiskers, a black bar struck across his nose. Black eyelids and blackish ears were set off by white around the eyes, white spots and bands around the ears, and a white band across the thighs. His long whiskers were black, the short ones white.

Dipodomys keeps himself well groomed. He is especially fond of his long tail, which is a beauty, eight inches long, black and white striped, with a white ring at its base and a tuft of richly colored brown hair at its tip. As I watched he held the tail in his forepaws and drew it across his mouth several times to groom it fastidiously. Then he dashed to an open tunnel and disappeared. This luxurious tail has a very practical value, as it acts as a balancer and rudder while *Dipodomys* is traveling fast. Without it he would be almost as lost as a boat without a rudder.

Hearing

Dipodomys' ears are well adapted for life under as well as above the ground. Above ground they appear relatively small but shaped to catch every sound. Inside the skull are large auditory chambers of very thin bone occupying about half of the total skull space. These are supposed by some to act as ear trumpets to magnify the slightest sound or vibration that comes through the ground.

Such a seismograph is also a feature of other ground-living animals, of which pocket gophers and pocket mice are examples. This is the reason for the owl-like heads, out of proportion to their bodies.

Although *Dipodomys* looks like the jerboa of Egypt and Asia, it is not related. In the hind legs of both jerboa and *Dipo* there is a single bone below the knee instead of two as in

ours. But jerboas have only three toes, whereas our kangaroo rat, which has progressed less far in the scale of evolution, has five on each foot. (Some species have only four toes on the hind feet.) Jerboas were a favorite article of diet with the Tartars when they overran Russia in the thirteenth century. There is no reason why *Dipodomys* would not be excellent food, were he not called "rat."

The food of *Dipodomys* is chiefly seeds, although he eats green forage on occasion. Underneath his black and white whiskers are capacious pouches, which he uses to carry food.

One evening in late August, from the top of a large flat rock in northwestern Nevada, I watched a kangaroo rat gathering food. He came out of his house shortly after sundown, peered all around from the top of a mound for a minute or two for possible enemies before venturing away from his underground fortress, then jumped on hind legs, several feet at a jump, to a clump of bunch grass, never touching front feet to the ground.

Standing erect, the little fellow again looked around to satisfy himself that all was safe, then began to gather seeds and stuff them into his food pockets. He worked quickly, moved on to another clump of grass, and from there went out of sight.

It was almost dark when he came flying back, in leaps two feet high and six feet long, tail streaming out behind like a banner. A prowling coyote had disturbed his evening labor. At the house he dived inside without a moment's pause. He had no more than disappeared when the gray dog of the prairies came along, nose to the ground. He tracked his quarry to the underground house but did not try to dig it out. Perhaps the coyote was afraid of digging down on a sidewinder.

Dipodomys has for enemies every nocturnal meat-eating animal of the desert country. He does not venture abroad in daytime so is safe from hawks, but owls keep a close watch and swoop down on him with beak and talon whenever they get a chance. His only defense from owls is quick escape under some spiny bush. Coyotes, foxes, weasels, and bobcats slink through the cacti, sagebrush, and mesquite to kill and eat as many of the little seed-gatherers as they can catch away from thorny retreats or underground refuges.

Snakes, however, are possibly the worst enemies. The desert sidewinder has two methods of hunting kangaroo rats. One is to lie in wait where the little dandy is sure to come for food and strike him down. No other animal can do this with success. And any creature that attempted to sneak up on *Dipodomys* might as well be a locomotive as far as sounding a warning is concerned. The sidewinder's other method is to crawl inside the dandy's house and wait until its occupant comes home.

Dipodomys' defense is quick retreat. His super senses of sight, hearing, and smell give him warning. If he acts quickly enough he lives. Otherwise he is a dead dandy.

Lively fighters

A friend of mine has some pet kangaroo rats. They love to be fondled and never attempt to bite or scratch unless roughly handled. But sometimes they fight one another, clinching with forefeet, kicking and scratching with hind feet, slashing with teeth. Their fights often result in the death of one and sometimes both antagonists. A wheel inside their cage gives them amusement and exercise. They love to play. Unfortunately they are nocturnal and do most of their playing at night. Daytime is sleep-time for them.

In the wild state the young are born from early spring to late summer. In confinement there is no set time as food is always abundant, but very few kangaroo rats have been born in captivity. There are two, rarely three or four, in the litter. The young are born naked and blind and are carefully cleaned and attended by the mother. She is devoted to them and will fight to the death in their defense.

Father *Dipodomys* gives his family little attention after mating.

When the young are a week old, whiskers begin to show; in about eleven days teeth appear. In sixteen days, when the eyes open, the color pattern is distinct. When 20 days old they play with one another; at 25 days they collect food in their seed pouches. At two and a half months they are almost grown, and at four months they are about as large as they ever will be. The period of gestation is 21 days. With care they live three years or more as pets.

A check on the capacity of the kangaroo rat's cheek pouches shows that they can hold more than a teaspoonful each. Six hundred trips with

Continued on page 44



THE COLOBUS *Family Album*

A DIFFICULT JOURNEY and much patient observation would be necessary to see anything like these scenes of Colobus family life, exhibited in Akeley African Hall in the American Museum of Natural History. These beautifully patterned monkeys live almost entirely in the trees. Since they remain far from human habitations, they are rarely seen; and they do not survive long in captivity. Their range includes most of the forested regions of Africa.

Colobus monkeys feed chiefly on leaves of trees, also probably on fruit; and they have developed specialized teeth and a specialized stomach, adapted to this diet. The young are almost pure white. The long, silky black and white pelage is used in the fur trade and by natives for ceremonial adornment. Measures for the protection of the Colobus monkey have been taken by international agreement.

A.M.N.H. photographs







SIRS:

Can you give an explanation for the heap of pine scales shown in the accompanying photograph?

The pile was nearly symmetrical and cone-shaped. It was about four feet in diameter at the base, two and one-half to three feet tall, and contained about four bushels of scales . . .

This heap of scales was built around an old decayed stump, dimly seen in the photograph. The top of this stump was covered with seeds from the scales . . .

Near the base of the pile was a hole about two inches in diameter, which seemed to connect by a short tunnel to a cavity under one of the decayed stump roots . . .

Several Fremont Chickaree were observed in the area, and I suppose they were the constructors of the heap; but why the size, compactness, and symmetry of the formation? This was absolutely the only accumulation of any kind of scales within several hundred yards, as far as we looked.

BILL R. EASTMAN, JR.

Douglas, Wyoming

The heap of pine cone scales and cores is without doubt the midden heap of a chickaree, or Fremont red squirrel, although of exceptionally large dimensions. Occasionally even larger heaps are formed, the accumulations of many years.

The squirrels sit on the stump to work over the cones, and the refuse drops in different directions by chance. This leads to symmetry in the pile. Probably several squirrels use the stump, and it is evident that the pine cone crop was a good one.

The holes are burrows made by the chickarees in their refuse heap, probably as shelter holes to escape possible hawks.

JOHN ERIC HILL,

Assistant Curator, Recent Mammals,
The American Museum
of Natural History

BEAU BRUMMEL OF THE WILD

Continued from page 41

loaded packs would equal a bushel. It may take all night for him to cram them full of seeds but he can empty them in a fraction of a second by a forward movement of the front paws. This ability to dump his load quickly is of great value in making a quick getaway from his enemies.

Dipodomys breeds prodigiously. He lives an independent life away from civilization. His natural enemies are legion yet he manages to outwit them and survive in plentiful numbers. In some localities he becomes a nuisance on cattle ranges.

An old bow-legged cowboy in Nevada came in one night with a face full of spines and a skinned nose.

"My hoss stepped into a gold-danged rat's nest when I wuz runnin' some dogies and spilled me in a prickly pear!" he raged. "What danged good are them rats, anyway?"

I didn't tell him that they might be delicious food if they were called by another name, or even that such beautiful and interesting little animals were worth saving as an object of natural history. Every naturalist knows that there are times when it isn't wise to defend a wild creature, no matter what its virtues. And this was one of those times.

SIRS:

What a privilege it would be to hear your remarkable duet—the singing mice and the musical alligator! But, laying aside all tempting facetiousness, let me say that there is no magazine that I recommend so wholeheartedly to my classes in Biology and Nature Study in Boston University as *NATURAL HISTORY*. So often I use the pictures in projecting machines and speak specially of the valuable information which you gather for us and send to us each month. Thank you!.

EARLE A. BROOKS.

Newton Highlands, Mass.

SIRS:

. . . I am 95 years old . . . and do not write letters very often. I want to have the Magazine as long as I live. If I forget to renew, please remind me.

ELEANOR FROST.

Hanover, N. H.

OTHER COMMENTS:

"... the Magazine of Magazines. . ."
"Every copy of the Magazine is a pleasure to me, and as long as I can half-way spare the money I would not like to miss it. . ."

Correction

The George Fuhrman Well did give both fresh and salt water as described in the December issue of *NATURAL HISTORY*. But it did not issue in separate States. The well is at Rapid River, Michigan, as indicated on the diagram, not at Rapid River, Wisconsin, as inadvertently stated in the text. No reader, strange as it may seem, has called this additional "marvel" to our attention as the current issue goes to press.—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.



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SPARKLING HIGHLIGHTS

By THANE L. BIERWERT

*Acting Chief, Division of Photography,
American Museum of Natural History*

THE children love it. The apartment house superintendent hates it. The sportsman enjoys it. The Department of Sanitation prepares for it. The truck driver dreads it. The photographer can't wait until it comes. What is it? Snow.

When the snow does come, be ready for it: know what to wear, what films and filters to use, and how to photograph subjects to best advantage. First of all, take a tip from the skiers and cold weather explorers: wear outer clothing that is closely woven and wind-proof. In handling the cold metal parts of the camera, protect your hands with thin gloves of cotton or wool, reserving heavier gloves for the longer spells between shots. If you have sun glasses, wear them too, but don't judge the picture possibilities through them. A filter may be needed to achieve the same effect.

Cameras do not enjoy cold weather. Shutters become sluggish, changing the timing because the metal contracts, the oil congeals, and the rubberized cloth of the focal plane shutter hardens. There is a remedy: keep the camera under your jacket when not in use. If it still sticks, limber it up by tripping the shutter a few times with your hand over the lens. If very much cold weather photography is planned, have "your oil changed" to the new high altitude aerial camera oil developed during the last few years. Never try to clean the lens in below freezing weather by blowing on it.

In wintry weather when a camera is brought suddenly into a warm room, moisture rapidly condenses on the lens and metal parts. Photographic equipment should therefore be protected from sudden temperature changes.

Snowscapes are not easy to photograph. Some experts say that we should use long scale, soft-working films, such as Super-XX or Ultra-Speed Pan. Others state that we should overexpose and underdevelop our negatives, using a contrastier film like Panatomic-X or Superpan Supreme. Who is right? Be your own expert, select the film that you like, and master it. With most color films, you can control only the exposure, for the development is out of your hands. More important is what you see to photograph, how you photograph it, and whether or not the finished result is what you wanted it to be.

If you are a beginner in snow photography, try this experiment and judge for yourself which picture produces the best result. Go out on a sunny day after a snowfall. Look for some animal tracks running near evergreen shrubs or tree trunks. Photograph that area "around the clock," with and against the sun, cross-

lighted, with and without filters, and over, under, and normally exposed. Keep a record of each exposure. When you view your prints or slides, compare them for detail in the high-light areas of the snow in each picture. Compare likewise the detail in the shadows and note what effect the filters had. See which angles brought out the crystalline texture of the snow to best advantage, and which gave the best composition and perspective. This experiment carried out to completion and carefully analyzed, will prove more educational than six articles and eight lectures on how to make excellent snow scene exposures.

A book could be written about winter subjects and how to photograph them. Several basic suggestions are all that space permits here. When beginning snowscape photography, work in large tonal areas. Use dark areas to carry out lines of composition. The deeper blue the sky is, the lighter the filter necessary. Make prints with plenty of sparkle in the snow; overaccent the contrast if necessary. When shooting color, look for blue and violet shadows to lend interest and increase color-consciousness.

When photographing people, expose for the faces and let the rest of the scene take care of itself. Snow-covered fields, ice-covered streams, snow-laden bushes, tracks in the snow, sporting scenes, close-ups, and whole mountain sides can all be successfully pictured when once we learn what and when to photograph. Even overcast and stormy days offer possibilities for pictures to show atmosphere.

There will be days when we do not make a single exposure, but we will have had a marvelous time tramping through the snow. It is the change we need after a week of indoor work: invigorating air, mild exercise, mental freedom, and relaxation.

If readers of NATURAL HISTORY have specific questions regarding photography in the realm of natural history or science, we shall be glad to try to answer them.—ED.

AWARD

At the tenth anniversary meeting of the American Polar Society, held at the American Museum of Natural History on December 5, Lincoln Ellsworth received the illuminated scroll emblematic of Honorary Membership in the Society. It was only the fourth time in the history of the American Polar Society that the award had been made. Mr. Ellsworth, who is a Trustee of the American Museum, has made seven expeditions to the



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PHOTOGRAPHIC EXHIBIT

All nature photographers are cordially invited to submit their four best prints to the Seventh International Salon of Nature Photography at the Buffalo Museum of Science. The photographs selected will be exhibited from May 16 through June 12 at the Buffalo Museum of Science.

Six classes of photographs will be considered, as follows: (1) Mammals, (2) Birds, (3) Plant Life, (4) Scenery, (5) Miscellaneous, and (6) Color (not hand colored).

Complete conditions appear on the entry form, which is available on request. A non-returnable entry fee of one dollar must be sent with the entry form. The closing date is May 13.

polar regions and is the only person who has crossed both polar ice caps.

Previous recipients of the award are Brig. Gen. David L. Brainard, U.S.A. (Ret.), Rear Admiral Richard E. Byrd, and Dr. Vilhjalmur Stefansson.

In his address, Mr. Ellsworth emphasized the potentialities of the Antarctic and announced his intention of establishing a permanent weather station on the fog-bound coast of James W. Ellsworth Land.

YOUR NEW BOOKS

MOUNT MCKINLEY WOLVES • THOMAS JEFFERSON
CONSERVATION • CLIMATE • CONDITION OF MAN

THE WOLVES OF MOUNT MCKINLEY

----- by Adolph Murie

Fauna Series No. 5
U. S. Gov. Printing Office, 40¢, 238 pages

THIS is a scholarly study of the wolves in Mount McKinley National Park, Alaska, and is one of the best statements of its kind that this reviewer has seen.

For some time there has been widespread concern over the status of wolves and coyotes in Alaska and the depredations they might be causing upon the wildlife there. The National Park about Mount McKinley was used as a test area for the study of the wolf and for those species upon which it preys. In order to secure all of the data before passing judgment upon the wolf, it was necessary to make first-hand observations of all the ecological associations centered about the wolf.

The author, therefore, gives not only a very full and convincing account of the life history of the wolf but also has chapters on the Dall sheep, the caribou, the moose, the grizzly bear, the red fox, and the golden eagle. In all of these pages he draws upon the recorded observations of others but adds immeasurably from his own exceptional background of intimate acquaintance. He has spent long periods of time with all of his attention directed toward securing these facts. As an example of this application he writes: "Between May 15, when the den was discovered, and July 7, when the wolves moved a mile away, I spent about 195 hours observing them. The longest continuous vigil was 33 hours, and twice I observed them all night."

After providing the reader with a splendid background, the author summarizes his conclusions, which seem well justified by the evidence. He finds the wolf preying largely upon the Dall sheep and the caribou, both of which appear to be able to stand the consequences. The animals killed by the wolves are largely the young and the old or diseased individuals. The sheep and the wolves may now be in equilibrium, but it is apparent that the wolf is the chief check on the increase of the sheep within the Park. The caribou has maintained itself in the presence of the wolf over a long period of time, and if wilderness conditions prevail there is no reason why the wolf-caribou relationship should not continue as in the years before man appeared upon the scene. If man should himself become an extensive check on the caribou, it may be necessary to revise the degree of tolerance given to the wolf.

Regardless of whether the sympathies of

the reader are with the sheep, caribou, and other so-called game species, or the wolf, which is frankly described as a predator, he will find Murie's report indispensable to an understanding of the problems. The reviewer cannot praise to highly this splendid piece of natural history reporting.

H. E. ANTHONY.

THOMAS JEFFERSON AND THE SCIENTIFIC TRENDS OF HIS TIME

----- by Charles A. Browne

Chronica Botanica Company, \$1.25
61 pages, 12 illustrations

THE recent bicentenary of the birth of Thomas Jefferson has been the occasion for extensive review of the qualities and accomplishments of that great man. He was, as has been made abundantly clear, a sort of universal genius whose interests ranged over the whole field of human knowledge and activities. Such breadth is unique among presidents and rare among men.

Most of the recent publications on Jefferson have been mere eulogies. This pamphlet seriously attempts to evaluate Jefferson's scientific activities in the light of contemporary knowledge and of later history. His interests were, indeed, universal, but his personal and original contributions to science, important as they were, have often been exaggerated.

Jefferson was, above all, an organizer and a stimulator of scientific work. His sponsorship of the Lewis and Clark expedition, his founding of the University of Virginia, and his presidency of the American Philosophical Society were outstanding, enduring, but indirect contributions to science. Original work was, however, not lacking. Most notable are his invention of a new plough and his "Notes on Virginia," a geographic study strongly suggestive of the later and much more extensive "Kosmos" by Jefferson's friend Humboldt. Both his public and his private occupations focused much of Jefferson's attention on agriculture, a sub-

ject on which he thought and wrote much, while making practical applications on his own estates of the observations and theories of many other students of the subject.

It is clear in almost all his contacts with science that Jefferson was, above all, utilitarian. He was inclined to deprecate pure or theoretical science as mere speculation. He underrated the most progressive scientific (as opposed to technological) developments of his day and often clung to concepts that were already becoming outmoded. His own relatively few attempts at theorizing had no lasting value and, indeed, serve only to reveal that in the realm of the abstract he lacked insight and judgment.

Jefferson's genius was for the concrete, and his true role in the history of science is more as patron than as actor.

G. G. SIMPSON.

THAT VANISHING EDEN

----- by Thomas Barbour

Little Brown and Co., \$3.00
25 illustrations, 250 pages

IN his new book, Thomas Barbour describes "A Naturalist's Florida;" thus, in a very inclusive sense he writes of mounds, Seminole Indians, forests, drainage, sponges, mammals, the Fairchild Tropical Gardens, and the Everglades National Park.

It is written for popular consumption with such a keenness of observation and freshness of description that the reader as well as the author, becomes eager to further the constructive development of Florida and prevent the destruction of her resources. This well-known naturalist imbues the layman and scholar with his enthusiasm for continuing the "diggings" of Florida's prehistoric and now observable bones, while the chapter entitled "Ditches" gives a true picture of a flower-carpeted heaven of today.

The original material is so good that it is unfortunate that such long passages are quoted verbatim from Bartram, Small and Willson. The Seminole Indian situation is well presented. It is only the secondhand information that is incorrect. Contrary to Doctor Barbour's statement, tribal laws and punishments are rigorously, though secretly enforced, for fear of unjust white interference, and Seminole culture has changed surprisingly little. Mortars and pestles are not things of the past, and sifting baskets are still being made. The author was misinformed in a number of other cases as well, but these are things of minor importance. With the growth of Florida, it is pointed out, the future of

NATURE ENCYCLOPEDIA

Edited by G. Clyde Fisher: five volumes bound in De Luxe Green Keratol lettered in Gilt. pages are 5½ x 8 inches. Lives and habits of Birds, Mammals, Fish, Reptiles, Flowers and Trees; described by renowned Naturalists; 700 illustrations, 200 in Natural color. The Literary Mart, 8 East 33rd St., New York 16, offers this set for \$6.00, remittance with order, returnable for full refund within five days.

the Seminole Indians must be given special consideration.

The book is altogether agreeable and ends on a constructive note. We visualize the conservation of our native flora and fauna in the proposed Everglades National Park and the expansion of our national resources by increased food and plant production in the 'Glades area. But we cannot overestimate the great value to our country of the suggested experimental laboratories in South Florida. Primitive Eden may vanish, but the possibilities of great developments lie ahead.

ETHEL CUTLER FREEMAN.

COMPASS OF THE WORLD

A Symposium on Political Geography

- - Edited by Hans W. Weigert
and Wilhjalmur Stefansson

The Macmillan Co., \$3.50
466 pages, 39 illus.

IF Americans have had to learn the hard way that there are certain inexorable geographic facts that govern the conduct of war, they must also awaken to the significance of geography in maintaining the peace. Perhaps the most dramatic evidence of this necessity is the use of airplanes and airways that have brought near to us places we thought were far. There has been a revolution in our orientation in the world and we must appreciate it to understand the advantages it brings us as well as the dangers that may beset us.

It is the purpose of this symposium of 28 pages by almost as many authors to bring home to the public the meaning of geography in the world of tomorrow. Although the various papers are not as well knit into as co-ordinated a whole as one might expect from a single author, they compensate for this lack of sharply focused continuity by presenting a wide range of topics and a nice assortment of authority. Here are critiques of Haushofer's geopolitics, the significances of the airplane in laying down new directions of world orientation, the role of continental land masses, the influence of climate upon population movements, the emergence of once neglected areas, the northward course of power, Siberia and the Soviet Arctic in the future world, and the importance of population differentials in world affairs.

We have gone beyond the point where it was a genuine discovery to proclaim that we all belong to "one world." We must learn to live in it. *The Compass of the World* offers us some enlightened views on what we face.

H. L. S.

THE AZTEC AND MAYA PAPERMAKERS

- by Victor Wolfgang von Hagen

J. J. Augustin, \$6.00. 120 pages, 39 plates

THE history of the manufacture and use of paper is a fascinating subject of study. In the Old World its history is closely linked with the development of modern civilization, and, although the use



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of paper never achieved comparable importance among the New World cultures, it had a curious development here which anyone interested in the subject will not care to overlook.

The story is brought together for the first time in this attractive and well illustrated book. The American Indian never made a true paper molded from fiber pulp, but a very similar product was obtained by extending the interlaced fibers that exist in the inner bark of various species of American fig trees. Paper of this kind was extensively used by the Mexicans and the Mayas in the making of books or codices and for various ceremonial purposes. The Aztecs collected a tribute of 480,000 sheets of paper annually from their subject tribes. The same material is still used in Mexico and Central America for purposes of witchcraft and for clothing, and a full account and illustration of the present day techniques of manufacture forms a valuable portion of Mr. von Hagen's study.

This book is clearly designed for the general reader, but it is nevertheless a real contribution to American archaeology and history. Besides bringing scattered material together into easily accessible form the author clarifies one misconception that has been current in the literature since the nineteenth century. He shows that Aztec papers were all made from the bark of the fig tree and never from the leaves of the maguey plant. The final chapter is a description of the American fig trees by Paul C. Standley, pre-eminent authority on the trees and shrubs of Mexico.

There are some unfortunate errors in the book, such, for instance, as the caption to plate 4a (the building shown is at Chichen Itza and not at Uxmal) and the ambiguous caption under the map opposite page 12 which partially indicates that American papers were derived from those of the Old World. Nevertheless the book is a valuable addition to the literature on the American Indian and one that will receive wide recognition.

G. F. EKHOLOM.

THE CONSERVATION OF NATURAL RESOURCES

- - - - by H. Basil Wales and
H. O. Lathrop

Laurel Book Co., 554 pages, 204 illus.

MOST parts of this book are of unusual merit. It contains much, more instructive and useful matter about the conservation of our resources than one could expect to find in a volume of such comparatively small size. It is very well written, and good judgment is shown in allotting space to the different subjects and in emphasizing the important matters; and it gives testimony to the knowledge and ability of its authors and their careful work in planning and perfecting it.

The authors confine themselves to the teaching purpose of the book, describing the present conservation work and methods going on in the United States and indicating how it can be increased and made more effective. Matters of past history are briefly passed over or omitted, and few statistics are given, which reduces its value as a reference book but permits more thorough consideration and discussion of conservation methods and practices.

One feels apologetic in finding any fault with so good a work, yet it is open to some serious criticism. Anti-National Park propaganda such as the following should not have been permitted in it:

"When people generally understand that forest management does not mean forest destruction, and that a managed forest can be just as beautiful and inspiring as a natural one, public opinion may decide that the waste of timber in public parks cannot be tolerated."

Such fallacious statements are especially harmful in a work otherwise so excellent and reliable. A moment's reflection will make clear that a managed forest cannot compare in beauty and attractiveness with a natural one, as the chief characteristic of a managed forest is that the large trees which would give beauty

and grandeur to the natural forest have been cut and removed. Neither is it true that the timber in the parks is being wasted. Under the care of the National Park Service the forests in them are improving in quality and not wasting away. And fortunately the public knows that were the park forests to be subjected to management for timber production, all the magnificent trees that now delight the millions of visitors would quickly disappear. There are no indications that the public would tolerate anything of the kind. The park forests contain much less commercially valuable timber than is generally supposed and are of minor importance economically.

Although plywood has become one of the most important and constantly increasing uses of wood, and is one which may impose important modifications on forestry practices and policies, owing to the large and fine logs required for it, the word "plywood" does not even appear in the index of the book and plywood is barely alluded to in the text. It is hard to explain such an omission.

However, only very few reasons for such criticisms are to be found in the book, which can be highly recommended both as a school textbook and to the general reader interested in conservation.

WILLARD G. VAN NAME.

A SHORTER HISTORY OF SCIENCE

- by Sir William Cecil Dampier

The Macmillan Company, \$2.00
189 pp. New York

SIR WILLIAM CECIL DAMPIER, Sc.D., and Fellow of the Royal Society, has done a welcome thing in giving us an abridged and condensed edition of his monumental work, *A History of Science and Its Relations with Philosophy and Religion*, which has already gone through three editions.

This newly written work, a compact little volume, is an achievement. In eleven short chapters, the author has told the story of the development of the physical sciences from the very beginning, as well as that of the biological sciences. It has been written with a feeling "that early specialization is dangerous, an opinion which leads to a desire to give even scholarship candidates a well-balanced education."

Beginning with prehistory, based upon archaeological evidence, the author traces origin and development through the dawn of history in Egypt, Babylonia, China and India, Crete and Mycenae. "Some anthropologists," he says, "regard magic as leading directly to religion on one side and to science on the other, but Frazer [*The Golden Bough*] thinks that magic, religion, and science form a sequence in that order." In discussing the Greek religion, he remarks, "As Xenophanes recognized as long ago as the sixth century before Christ, whether or no God made man in His own image, it is certain that man makes gods in his."

Following is a swift-paced account of Greek and Roman science and philosophy, including the work of Thales of Miletus, Aristotle, Archimedes, Hipparchus, and

others of the ancient world. The reasons for the stagnation during the Middle Ages are set forth. The Renaissance with Leonardo da Vinci and Copernicus forms a fascinating chapter, but none more interesting than the following one on Galileo and Newton. The author then follows the course of the various sciences through the eighteenth and nineteenth centuries, and down to the present day with the new physics and chemistry.

We have here a very readable little volume, written by one who lectured for many years in Trinity College, Cambridge.

CLYDE FISHER.

CLIMATE AND THE ENERGY OF NATIONS

- - - - - by S. F. Markham

Oxford University Press, \$3.50
236 pages, 23 maps and charts

WHY are some nations centers of culture and progress while their contemporaries either stagnate in mediocrity or decline into a condition little better than savagery? Why does civilization move from one center to another, leaving one trail that begins in Egypt and passes successively through Crete, Asia Minor, Greece, Rome, Constantinople, Italy, France, the Low Countries, and England? These questions and countless variations of them have perplexed many minds and have yielded many answers.

Historians like Gibbons offer political and historical explanations. Other interpretations emphasize economics or sociology or invention of martial prowess. Race too has its protagonists. Some rely on a kind of super-organic analogy by which nations are compared to human life cycles with a youth, a middle age, and a senility. Recently we have had cogent arguments based on soil exhaustion and erosion. Even the lowly louse has been evoked as a *causa causans* of the fate of nations. In *Climate and the Energy of Nations*, Mr. Markham lays his money on climate, and makes out an excellent case for it. He points out that as individuals our energy output is strongly influenced by the state of the weather. On hot, humid days most of us are prostrated and have little inclination to exert ourselves. On cool days we feel fine and ready to go.

If this is true for us as individuals why is it not equally applicable to us collectively as a people or a nation? The author points out, in fact, that the high civilizations of today are distributed precisely in the areas where optimal climatic conditions exist. If we consider the problem historically, we find, as Mr. Markham explains, that civilization has moved northward into more bracing climates because we have discovered how to cope with them and still be comfortable. England, for example, was unable to harness her energizing climate until she had developed or borrowed the hypocaust system of heating (the hearth and chimney) which enable Englishmen to think of other things than merely how to keep their fingers from freezing. Air-conditioning the author sees as an extraordinarily significant means of distributing the bene-

fits of good climate in regions now at a disadvantage and of improving the all year round conditions for all.

There is much pregnant thought in this book, and whether or not one accepts the universality of the climatic explanation, one must reckon with it as an important factor in civilization.

H. L. S.

THE NATURAL HISTORY AND BEHAVIOR OF THE WESTERN CHIPMUNK AND THE MANTLED GROUND SQUIRREL

- - - - - by Kenneth Gordon

Oregon State College, 75 cents, 104 pages

THIS hundred-page study contains much interesting and original material as well as a survey of the work of others. Illustrations by the author supplement the text. About half of this consists of observation on the biology and ecology, the other half is an account of the behavior, both observed and experimentally tested in the field. The wild rodents, motivated by food, solved mazes, undid latches, turned discs, and pulled strings.

Many suggestions for studies of similar nature are to be found here.

J. E. H.

THE CONDITION OF MAN

- - - - - by Lewis Mumford

Harcourt Brace and Co., \$5.00

THIS is the third book in a trilogy praising modern man. In his first book, *Technics and Civilization*, Mr. Mumford considered man's material culture and the technology of modern times. In his second, *The Culture of Cities*, he surveyed the way we live, our communities, our sociology if you wish. Now in the present volume, his subject is the spiritual values of man. In all societies and in all times, men live and die, they marry and beget children, but the ideals that they seek, the utopias they crave, the values that give meaning to their existence vary and change. But not without a sequence and a logic. The events of two thousand years ago touch our lives very closely, just as what we do today will affect those who follow us. The historical continuity of the human drama is very vivid and real to Mr. Mumford, and in this as well as in the other volumes of his trilogy he explores deeply into the past to find the clues for the present. There are few Americans writing today with more scholarship and with a greater understanding of the historical process.

I cannot attempt in a brief notice to begin to give the flavor of this fascinating book. It covers a long span in western civilization by means of masterly summations of successive periods. It traces the growth and disorganization of the human personality. It sets man against his spiritual environment and seeks to explain the condition in which he finds himself at the present time.

Even if one does not agree with all of Mr. Mumford's interpretations, it is a book that is rich and rewarding.

H. L. S.



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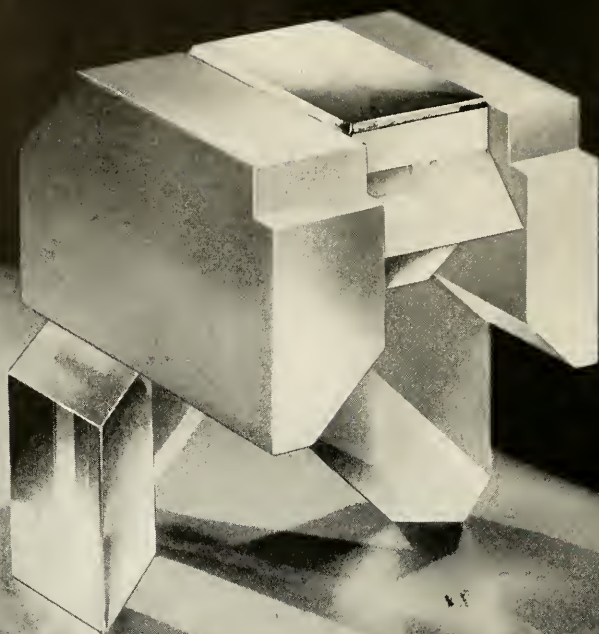
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L E T T E R S

SIRS:

Last summer a crowd from Sigourney, Iowa, went on a picnic to the classic Skunk River. When we arrived at our destination, I walked into a pasture with tall blue grass and buck thorns and came to a circle of buck brush (as we call it). To my surprise, on the other side of the brush were eight little young garter snakes, about 12 or 13 inches long, with their heads about three inches up in the air. They were weaving in and out, passing each other, and making a calling noise. The old snake was lying under the buck brush. The little snakes kept up this dancing or whatever you might call it, until one of the crowd came bolting up and scared them. You would never have known there was a snake in the whole pasture.

I am wondering whether this is where the American Indian gets the idea of the Snake Dance. . . .

(Mrs.) H. I. SCHIFFER.

Sigourney, Iowa.

The following comments on Mrs. Schipfer's observation are given by the Curator of Amphibians and Reptiles at the American Museum of Natural History:

The observations on garter snakes reported by Mrs. Schipfer are interesting, but I cannot interpret them with certainty. When garter snakes mate there is a courtship that often consists in the male's passing over the female and then pausing as she moves on. When one or more competing males is on hand the general appearance of the snakes is of their bodies weaving in and out. But ordinarily the heads are not held high. Usually the male attempts to rub his chin along the back of the female, and presumably he is stimulated by such contact through special sense organs on the chin.

In any event the snakes described by Mrs. Schipfer supposedly were too small to be mating. It is possible that what she saw was a brood of young garter snakes recently brought into the world by the larger snake observed under the buck brush. In garter snakes the eggs are retained in the body of the parent until they are ready to hatch. When first expelled the young snakes are encased in a transparent capsule or membrane from which they emerge immediately. Shortly thereafter they shed their skins, a process that involves some crawling about, since a slight amount of friction is required to break the skin at the tip of the snout. Because a hiss is the only noise that a garter snake can make, beyond that involved in the rustling of the coils when the lungs are inflated, the "calling" must be attributed to some other animal.

On the other hand, it is not impossible that the snakes were actually adult Dekay's snakes carrying out their normal

courtship. This smaller species could easily be mistaken for the garter snake, and the behavior of Dekay's snake while courting has never been described. Perhaps the head is raised,—as it is in some species.

A third possibility is suggested by observations made on a brood of Texan patch-nosed snakes in the laboratory. When this brood was permitted to bask in the light and heat provided by a photoflood lamp, several of them rested on the sand with their heads raised while a progression of waves traveled from the head to the tail. Some small racers in the same cage failed to perform in this remarkable fashion, and I cannot advance any theory that would account for such behavior in the patch-nosed snakes.

Thus the snakes seen by Mrs. Schipfer could have been courting, shedding their skins, or merely undulating their bodies for unknown causes. Personally I would doubt whether observation of the nuptial behavior of snakes contributed any notions utilized by Indians in their ceremonials. The Snake Dance of the Hopi Indians is intricately woven with their mythology and religion, but so far as I know, snakes are involved in the symbolism of the ceremony only in that they are regarded as messengers to the tribal divinities. The ceremony is known as the Snake Dance

because the participants carry the ophidian "messengers" rather than because of any imitative behavior on the part of the dancers. However, students of the American Indian may have additional knowledge never brought to my attention.

CHARLES M. BOGERT.

* * *


SIRS:

Having just read in your last issue the article on the Eagle, I thought an incident which I witnessed some time ago might be of interest.

I was approaching a water hole on my cattle ranch near Chowchilla, California, when I saw a large bunch of Gray Geese in and about the watering place. The geese seemed to be nervous but did not at once take to the air. I then noticed a large Bald Eagle sitting on the fence at the end of the pond. When I had ridden to within about one hundred feet of the geese they arose from the water. Immediately the eagle darted among them and seized a goose behind both shoulders and flew off with him, going about a quarter of a mile. I followed, and the eagle again took off with the goose but for a shorter distance. As I again approached, the eagle rose into

Continued on page 94

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The Magazine of the American Museum of Natural History

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FEBRUARY, 1945

Hawaiian Honey Creeper.....Cover Design

From a Kodachrome taken by Thane L. Bierwert in Whitney Memorial Hall at the American Museum

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THE COVER THIS MONTH

The scarlet, curved-billed bird displayed on the cover of this issue of NATURAL HISTORY is the Iiwi of the Hawaiians, named *Vestiaria coccinea* by Forster, the naturalist in Cook's party who discovered the Hawaiian Islands. It belongs to the Honey Creepers (Drepaniidae), a family which provides a most interesting case of divergent evolution. The family is restricted to the Hawaiian Islands, and all its members have probably descended from a single goldfinch-like ancestor. Yet the specializations in their bills range from a short, stout, almost parrot-like form to an extraordinarily long, curved, sickle-shaped organ. Eight different species of honey creepers are displayed in the exhibit in Whitney Memorial Hall from which this photograph is taken.

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YOUR NEW BOOKS

WOMEN AND MEN • CURRENTS AND EDDIES AMPHIBIANS AND REPTILES • WOODCOCK

WOMEN AND MEN

----- by Amram Scheinfeld

Harcourt Brace & Co., \$3.50
40 line drawings, 453 pages

MR. SCHEINFELD could hardly have chosen a subject of more general interest than this. Men and women have discussed and disputed from time immemorial and on all levels of emotion the basic differences between themselves. Almost every conceivable human failing or virtue has been attributed to one or the other of the sexes. Our entire social system is built upon the fact that certain critical differences do exist and on the belief that many more are significant. Recently, however, there has been a tendency to minimize the secondary differences and to account for them as the result of social and psychological conditioning. Proponents of this view are inclined to endow men and women with equal abilities, qualities, and rights, and to insist that women, except for their reproductive function, do not differ in any essential degree from their men folk.

Mr. Scheinfeld has surveyed with exemplary catholicity the recent scientific literature on the nature and degree of sex differentiation. He brings together the scattered results of hundreds of workers and summarizes their findings in anatomy, growth, behavior, physiology, endocrinology, psychology, vital statistics, crime, sickness, clothing, skills, division of labor, achievement, and various other activities and categories. He finds an overwhelming mass of evidence to support the contention that men and women are fundamentally and basically different—a difference which colors and permeates every aspect of life. It is, he feels, the wiser course, biologically as well as socially, to recognize these distinctions and to use them to advantage rather than to deny them and create unnatural tensions and frustrations.

Throughout, Mr. Scheinfeld emphasizes the differences between men and women but also insists that these differences cannot be assessed against each other. Men are not better or worse than women; they are simply different and complementary.

Since Havelock Ellis treated this classic subject, we have had no compilation of the steadily growing information dealing with it. It is, therefore, a welcome opus that Mr. Scheinfeld has produced, not only because he offers us a more modern compilation than Ellis, but also because he casts a wider net. Indeed, Mr. Scheinfeld's omnivorous appetite for evidence of sex differentiation almost produces an indigestion. It certainly is responsible for

a touch of banality which might have been avoided by a more rigorous selection. However, *Women and Men* should prove a fascinating book to almost any reader.

H. L. S.

AMPHIBIANS AND REPTILES OF THE CHICAGO AREA

----- by Clifford H. Pope

Chicago Natural History Museum, \$1.75
12 plates, 50 text figures, 276 pages

TO many people the frog is "a reptile with edible legs" as defined by the noted cynic, Ambrose Bierce. To thousands of biologists frogs, as well as salamanders, are "laboratory animals," creatures that afford excellent material for studies of the endocrine glands or developmental mechanics. To countless others—the amateur naturalists—amphibians and reptiles are animals to be sought and observed for pleasure, recreation, or sport.

This book is designed for those in all three categories. The uninformed gourmet will learn that a frog is not a reptile and that it and its toad and salamander relatives perform useful services to mankind through their consumption of countless insects. He may also infer that indirectly they contribute to his welfare, since the foundations of many medical discoveries were based upon amphibian material. The biologist and the field naturalist will find in this book summaries of the habits, behavior, and reproduction of each of 52 species, with notes on their requirements under captive conditions, as well as means of identifying specimens.

Ablely written by Clifford H. Pope, the author of two outstanding popular books (*Snakes Alive and How They Live* and *Turtles of the United States and Canada*), this is the most elaborate treatment of the amphibians and reptiles of any limited area that has yet appeared. Five colored plates depict 16 species, and each of 10

salamanders, 11 frogs and toads, 18 snakes, 3 lizards, and 10 turtles are illustrated in the other plates or in 50 well-chosen text figures. "Technical terms and scientific jargon have been avoided," to quote from the introduction, "but numerous details are included because much of the fascination of animal behavior lies in its complexity."

While this book is designed for use in the "Chicago area" including portions of Wisconsin, Illinois, Indiana, and Michigan that border on the southern end of Lake Michigan, most of the species treated are widely distributed throughout north-eastern United States. Consequently it will be of immense value to naturalists and scientists, as well as to laymen, throughout this region—and the chap who believes that a frog is a reptile with edible legs had better read it too.

C. M. BOGERT.

THE GOLDEN ROOMS

----- by Vardis Fisher

The Vanguard Press, \$2.50
324 pages

THIS is a companion volume to *Darkness and the Deep*, by the same author, reviewed in *NATURAL HISTORY* Magazine, May, 1943.

It attempts to show how man created his speech and culture. The text is the type of fiction which does violence to historic accuracy, and the psychological interpretations of the situations created seem overstated. The plot embraces the adventures of two contemporary family groups: (a) a primitive apelike troop, (b) a pioneer *Homo sapiens* family. Group (a) is pictured in grossly exaggerated traits of anatomy and behavior, filthy, detestable creatures, revolting in every detail. Apes and other wild animals, not confined in cages, keep their pelts free from filth, so why not these apelike men? On the other hand the second family group (b) is perhaps too favorably delineated. Each of the two groups is headed by two leaders, a male and a female, individuals of superior intelligence, the inventors of fire-making and clothing in group (a), of bows and arrows, the domestication of animals, and the planting of seeds in group (b).

The more exciting episodes begin when these two contrasting groups discover each other. The male leader of group (b) is shocked by the revolting traits of group (a), resents their intrusion, and leads a party of his fellows to exterminate them. This seems to be the beginning of race prejudice. Then the leader of the victors

NATURE ENCYCLOPEDIA

Edited by C. Clyde Fisher; five volumes bound in De Luxe Green Keratol lettered in Gilt, pages are 5½ x 8 inches. Lives and habits of Birds, Mammals, Fish, Reptiles, Flowers and Trees; described by renowned Naturalists; 700 illustrations, 200 in Natural color. The Literary Mart, 8 East 33rd St., New York 16, offers this set for \$7.50, remittance with order, returnable for full refund within five days.

is stricken with remorse and haunted by the ghosts of the dead, until he becomes a fear-ridden neurotic. His women on the other hand are more realistically minded, accepting a surviving infant of group (a), even defending it against the murderous threats of their men. If the reader of this book disregards the faulty historical sequences suggested, he may find profit in the author's psychological speculations, but they, too, are so exaggerated as to approach the abnormal.

C. W.

WITHIN THE CIRCLE

----- by Evelyn Stefansson

Charles Scribner's Sons, \$2.50
117 illustrations, 160 pages

THE circle is the Arctic Circle and the author, Mrs. Vilhjalmur Stefansson. Her husband, Dr. Stefansson, who years ago took upon himself the task of convincing people that the Arctic was not all ice and snow, but a rich land with many possibilities for the white man, has found in his wife an enthusiastic advocate of his favorite theme, the friendly Arctic. That Doctor Stefansson was right in his prediction of the future of the Arctic goes as a red thread through the present book, which is the writer's second on an Arctic subject. Even those who hesitate to accept the Arctic as a land that flows with milk and honey must admit, after reading it, that she has got some very strong points.

The idea of the book is to give a cross-section of the Arctic. To that effect, Mrs. Stefansson has turned the spotlight on six communities, separated by hundreds of miles and in many respects very different but with one thing in common: they are all located north of the Arctic Circle. The six communities are Disko Island, in West Greenland, Grimsey, tiny island north of Iceland, Kiruna and Gällivare in Swedish Lapland, Igarka in Siberia, Point Hope, Alaska, and Aklavik, Canada. Of these, the chapters on the modern Swedish mining center, the work of the Soviet Union in the Arctic, Doctor Livingstone's farm at the mouth of the Mackenzie River, and the large number of excellent illustrations will probably make the deepest impression upon the general public.

A little grey color mixed in with the rosy would not have done any harm to this otherwise pretty picture of the Arctic.

HELGE LARSEN.

WOODCOCK

----- by John Alden Knight

Alfred A. Knopf, \$4.00
15 plates, 1 map, 171 pages

THIS is a book for the lover of upland game-bird shooting. It is written in an easy vein as from one sportsman to another and contains a great deal of sound information collected from a variety of sources, seasoned with the author's own observations, and sauced with anecdotes. It is hardly, as the publishers state, the "first complete and up-to-date book" on the species, but the author makes no such

claim. It is, in any case, an interesting and readable summary of knowledge and opinion on the subject.

The woodcock is nocturnal, or crepuscular, and secretive, and there are many things about it that have not yet been discovered or proved, concerning which there is, of course, much difference of speculative opinion. Is the twittering sound that is given as the bird leaves the ground of vocal or instrumental origin? Do the males return each year to the same chosen singing ground? Are the sexes distinguishable without dissection? These and similar questions have been the subjects of much argument and discussion. The author does not always agree with the majority opinion, but he is frank to confess that there is disagreement. His summary of fact and opinion gives, therefore, a good picture of the bird's life and behavior.

All this is written with one eye on the woodcock as a game bird, and the last few chapters of the book are devoted wholly to that aspect of the topic. Favorable hunting grounds, equipment, dogs and guns, and hunting methods are discussed in detail from the writer's considerable personal experience. Those who are of similar persuasion will enjoy comparing notes with him, and they, as well as those who may be interested in the bird for its own sake, will profit by his general discussions.

The colored plates by Edgar Burke are pleasingly good, and the photographic illustrations interesting.

J. T. ZIMMER.

CURRENTS & EDDIES

----- by William J. Schaldach

Trade Edition by A. S. Barnes and Co., \$5
Limited Edition by Countryman Press,
\$12.50

IN this day of war-emaciated books, the format of *Currents & Eddies* is as restful and pleasant as its content. The book has a most attractive dust cover reproducing one of the author's color plates, is printed in large clear type, and contains fine reproductions of Mr. Schaldach's beautiful and original paintings and line drawings. It is written in an effortless way, conveying both the thrill and the relaxation of fly rod angling. Anyone, angler or not, interested in the habits of trout, black bass, or even bullheads, and the waters in which they live, will find pleasure in reading it. The angler, or the would-be angler, will get help about how to assemble his tackle and how to use it. Mr. Schaldach has vividly conjured up visions of wading and casting, of flashing trout and arched rods, and of that lovely moment when "the chill of evening creeps down and freshly caught trout are curling and sizzling in a pan over a birchwood fire."

In addition, *Currents & Eddies* has a very special appeal and value, for from its informally written pages emerges the picture of a very integral part of country boyhood in America—a boyhood "whose simple adventures are" as the author says "with variations, your own."

F. LAM.



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CORN

and

Early American Civilization

By CLARK WISSLER

Curator Emeritus, Department of Anthropology,
American Museum of Natural History

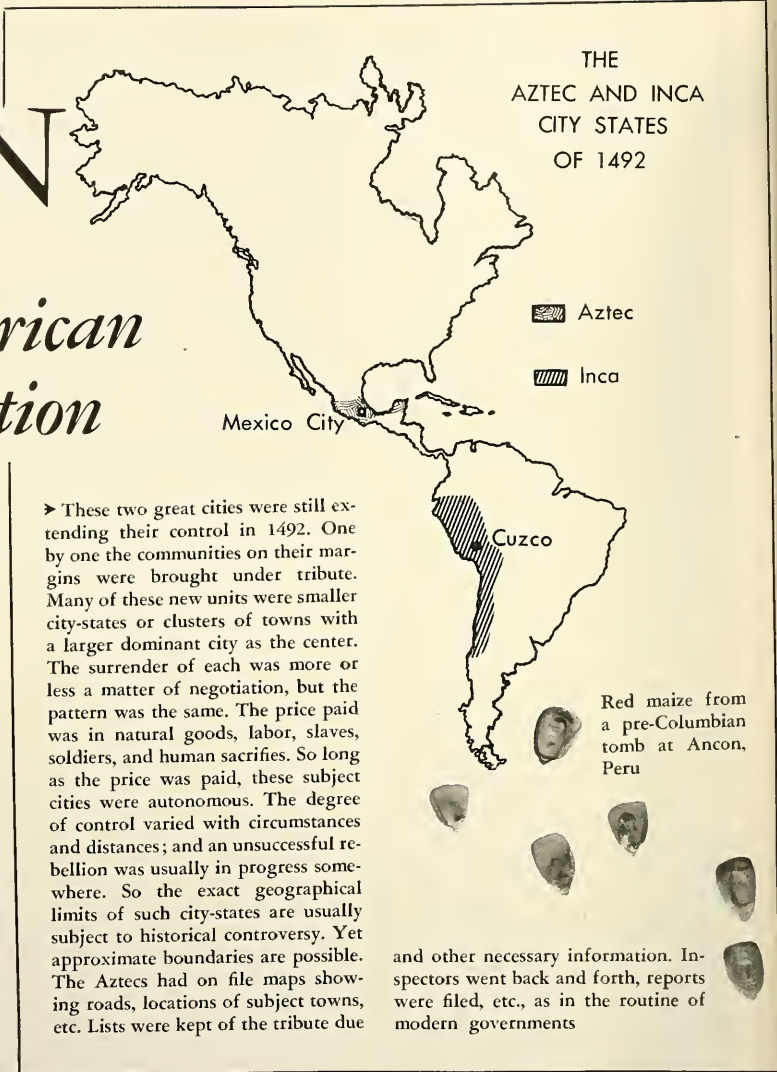
THE Spanish explorers following closely on the heels of Columbus found two large political units in the Americas, the Aztec regime in Mexico and the Inca in Peru. The relative extents of these so-called empires are shown on the map. Many books have been written seeking to prove that these were not empires like those of the Spain, France, and England of 1492, which is true; Aztec and Inca-land were different because they were not modern but reminiscent of Egypt, Ur, and Indus of early days. They were city-states and had evolved along lines generally parallel to the Old World city-states we mentioned in an earlier article on Wheat and Civilization.¹ The two outstanding seats of power were the Aztec City of Mexico and the Inca City of Cuzco. Between and surrounding these two dominant nations were smaller city-states.

The Old World city-state pattern of empire began with Ur and ended with Rome, after which the Dark Ages of the barbarians prevailed, to emerge eventually through feudalism into the Christian type of empire of which the Spain of 1492 was a good example. The Aztecs and Incas, on the other hand, were yet evolving a stone and bronze age type of city-state civilization such as we described in the previous article. This is why the favorite way to characterize these American aboriginals in 1492 is to say that they were engaged in an evolution of civilization, in a way

► These two great cities were still extending their control in 1492. One by one the communities on their margins were brought under tribute. Many of these new units were smaller city-states or clusters of towns with a larger dominant city as the center. The surrender of each was more or less a matter of negotiation, but the pattern was the same. The price paid was in natural goods, labor, slaves, soldiers, and human sacrifices. So long as the price was paid, these subject cities were autonomous. The degree of control varied with circumstances and distances; and an unsuccessful rebellion was usually in progress somewhere. So the exact geographical limits of such city-states are usually subject to historical controversy. Yet approximate boundaries are possible. The Aztecs had on file maps showing roads, locations of subject towns, etc. Lists were kept of the tribute due

and other necessary information. Inspectors went back and forth, reports were filed, etc., as in the routine of modern governments

THE AZTEC AND INCA CITY STATES OF 1492



parallel to what had happened in the Old World, but about 2000 years behind schedule.

We gained an insight into Old World civilization by noting that its distinctive characteristics were cereals and animal husbandry. Everywhere and even now among the heirs of these Old World civilizations wheat is the chief cereal. We shall find it equally important to recognize that the basis of aboriginal New World civilizations was the group of cereals designated as maize (corn), accompanied by a weakly developed animal husbandry. Herein lies the chief contrast. We can

now see the significance of our previous statement that Old World civilization is based upon a well integrated, nicely balanced economy of cereals and animal husbandry.

The Pattern of New World Civilizations

We found it useful to characterize Old World civilizations by enumerating fundamental traits defining a pattern in their then new way of living. It may be doubly illuminating to tabulate in parallel columns the traits most

¹NATURAL HISTORY for November, 1943.

The story of one of our great basic foods—the mystery of its origin and how it came to dominate the industry and economy of prehistoric civilization in the New World

A ➤ In 1920 a quantity of ancient fodder was found in the ruins at Aztec, New Mexico, dated about 1120 A.D. by the tree ring method of chronology. During the lunch hour, one of the mules belonging to the workmen ate a large part of the fodder before discovered in the act. The ear marked A at right is one of the pieces from that cache

OTHER TYPES OF MAIZE IN THE EAR

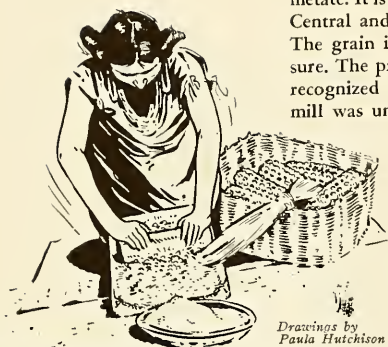
- B** Pre-Columbian maize, fourteen rows of grains to the ear, in spiral. (From Arica, Chile)
- C** Modern maize, eight rows. Pawnee Indians
- D** Modern maize, eight rows. Iroquois
- E** Modern maize, eight rows. Pueblo, New Mexico

White maize grown by Iroquois Indians about 1905



☞ PRE-COLUMBIAN and modern maize, or corn. As a rule the ears and grains of pre-Columbian maize are smaller than modern maize





*Drawings by
Paula Hutchison*

◀ THE NEW-WORLD DEVICE for grinding grain: the metate. It is still in use in the United States, Mexico, Central and South America, and the West Indies. The grain is crushed between two stones by pressure. The principle of the revolving wheel was not recognized in the New World, hence the circular mill was unknown

▶ THE OLD-WORLD WAY of grinding grain is the hand mill. It goes back to Ur, Egypt, and ancient times generally, and is still seen in Oriental and Mediterranean countries. The advantage of the revolving principle is that power can be applied. First, hand power was used, then draft animals, water, wind, steam, etc.



Outstanding Traits in Old and New World Civilizations

Old World

Cereals (wheat, barley, etc.)

Domesticated animals (cattle, horses, asses, sheep, swine, dogs, poultry, bees, etc.)

Plow (drawn by man, later by cattle)

Wheel (cart, hand mill, potter's wheel, etc.)

Cities, aqueducts, and irrigation systems

Temples and state religious systems

Metals (gold, silver, copper, and bronze)

Special hand crafts (as in stone, wood, textiles, etc.)

Writing (wax and clay tablets, paper, inscriptions on stone)

Slavery and regimentation of labor

Tribute, or taxes, imposed upon subjected cities

State ownership of resources and land

State highway systems

Freight by ox cart, rapid transit by horses

New World

Cereals (types of maize)

Domestic animals (turkey, guinea pig, llama, dog, bees, etc.)

Digging stick (foot plow and hoe)

No wheel (human packing, metate, hand shaped pottery)

Cities, aqueducts, and irrigation systems

Temples and state religious systems

Metals (gold, silver, copper, and bronze)

Special hand crafts (as in stone, wood, textiles, etc.)

Writing (paper, the quipu, inscriptions on stone)

Slavery and regimentation of labor

Tribute, or taxes, imposed upon subjected cities

State ownership of resources and land

State highway systems

Freight by human carriers and llamas, relay human runners, suspension bridges

distinctive of the Old World civilizations as compared with those defining the character of New World civilizations, as in the accompanying table.

Close parallelism seems to dominate these two patterns, but certain differences are conspicuous. Thus in the New World there is neither the wheel nor its common applications in the cart, pottery wheel, and rotating hand mill. The metate, a flat slightly concave stone, is the New World device for crushing cereals for meal or flour. Secondly, neither cattle, horses, sheep, nor swine were known. Instead of the time-honored plow, the New World used the simple digging stick, with its more specialized form, the spade, or foot-plow. In other respects the two world patterns are remarkably similar. Yet what a gap these few exceptions leave in the profile of American aboriginal civilizations. To their Spanish conquerors the Aztec and Incas seemed contemptible—no cannon, no steel weapons, no metal armor, no horses, no oxen, no carts, man power only.

Another point of interest to us is that so far as is known the élite of the Aztec and Inca possessed some knowledge of the barbarian tribes on their respective frontiers but were wholly unconscious of an Old World and the achievements of its inhabitants. The possibility of such an entity as another hemisphere had not occurred to them. Small wonder is it that the appearance of Europeans with unheard-of weapons, ships, and horses, with a background of learning and insight incomparably more acute than they had ever experienced, rendered them incapable of any effective resistance.



◀ NATIVES of the Western Hemisphere did not know about the plow when Europeans arrived. Digging sticks and spadelike implements were the universal New World agricultural implements. This illustration is an Aztec drawing showing a farmer planting maize with a digging stick. The traction plow is an Old World device, assumed to have evolved from the digging stick

From the Codex Florentino

▼ A MANDAN INDIAN GIRL of about 1700 A.D. cultivating maize with a hoe, made of the shoulder blade of a bison. The history of the hoe is obscure. In the New World it had a limited distribution in eastern United States but was unknown in our southwest, Mexico, and South America

Statuette by Paul Wright, in the American Museum



Some of the Wild Hunters Begin to Grow Plants

In a former article² we noted that the first human beings to discover America were primitive stone-age hunters from Siberia. The time was late Pleistocene, when the last of the huge elephants were still tramping through the swampy parts of North America; camels, wild horses, and tall long-legged bison could yet be seen in the open grass lands, and the giant sloth was using caves as burrows suitable to his size. Other kinds of game more modern in character were there in plenty. Up until that moment none of these American animals had ever seen human beings, so they were ignorant of man's predatory nature.

Once in America, these invaders found themselves in a hunter's paradise, free from enemies of their own kind and surrounded by game easy to approach. The animals were similar to those of their homeland, but the plants were for the most part strange, inviting experimentation to learn their uses and dangers. All of these new objects and freedoms stimulated the savage mind; food was abundant, so the population increased rapidly. When a band of hunters became too large it divided, and the new band moved into the unoccupied country ahead. Old vocabularies were discarded and new words invented to designate new objects and relations. The tempo of life and health was stepped up. At least, this seems a reasonable expectation.

No wonder anthropologists found about 1500 different languages spoken in the New World, and though linguistic experts have been able to group these languages into about 175 families of speech, they have been unable to be sure of genetic relations between any of these families. Again, those who study the ways of living, customs, and habits of the many hundred surviving tribes of Indians, find them of great variety. The new methods devised by archaeologists are revealing that rapid changes occurred in ways of living even in the same localities, far too rapid to be correlated with changes in climate and other ecological phenomena. In the main, this welter of detail will be found consistent with the expected adjustment of successive generations of hunters to the changing local en-

vironments besetting their migration routes.

As the hunters spread southward, every now and then a favorite plant food would not be found in the next strange locality. Thus new problems would arise, such as: could plants be moved? When the Andes were reached, large game was probably less plentiful than formerly, but plants did not decrease, merely changed in kind. From a survey of the plants domesticated many botanists favor the Andean highlands as the place where good wild plant foods were most abundant and where newcomers would therefore find the greatest incentive to experiment in agriculture.

That maize was the first plant to be cultivated is unlikely but its wide distribution testifies that, once it was on the way, its merit was obvious. Certain caves in Kentucky and Arkansas have yielded evidence that agriculture was practiced long before the earliest appearance of maize in their deposits—for example, seeds of the domesticated sun-flower, the giant ragweed, etc. Nor is it likely that any single plant can be proved to have been the first. Conditions being favorable in many localities, there may well have been spontaneous independent experiments with different local species of plants in different sections.

List of Native American Plants of Economic Importance

CULTIVATED

Maize	potato
tabacco	peanut
manioc	sweet potato
pumpkin	tomato
cotton	sisal
avocado	pineapple
beans	chocolate
calabash	caca
chili	sunflower
ragweed	pigweed
barnyard grass	cashew nut
maté	cinchona

NOT CULTIVATED

rubber	pawpaw
copal	plum
Indian hemp	water lily
nettle	camass
basswood	mesquite
wild rice	acorn

That the Indian eventually selected food plants of extraordinary qualities is evidenced by the world-wide use of maize, the potato, bean, peanut, squash, cassava, pineapple, etc. The Old World can scarcely rival this list. So quickly were many of these carried

to all parts of the world that it has been difficult to prove their New World origin, except by noting that their obvious wild ancestors were not found outside of the New World. Thus in Europe maize was first called "Turkish corn or wheat," for the same reason that the native poultry of the Aztecs is called *turkey*, even in America, because these foods were quickly adopted by the Turks and from thence introduced into Europe. In the same way, the name "Irish" potato concealed for a long time the South American origin of that important food.

Weak Development of Animal Husbandry

That the farmers of the New World made the most of plant exploitation is clear. The intruding white population did not discover a single wild plant of outstanding economic importance not recognized and used by the aborigines. Even rubber was gathered in the Amazon country and produced in Mexico from the dwarf guayule plant.

The aborigines were aware that animals could be tamed, but they failed to grasp the idea that the propagation of animals for their flesh was feasible. And in animals for traction the aboriginal score stands at zero. Was this due to blindness as to the virtues of the wheel or because suitable traction animals were lacking? When we note that in ancient Mexico toy animal figures were made mobile by small wheels, the mystery deepens. The more primitive tribes in the bison area of the United States and the Eskimo of the Arctic used dogs for traction, the former with the travois and the latter with sleds in winter. The Aztecs had no burden-bearing animal; the Inca used the llama, which could carry a load of about 90 pounds. That tells the story. It is a poor showing in contrast to the ancient Old World with oxen, asses, horses, camels, elephants, etc., able to draw heavy loads and carry one or more persons upon their backs. The Aztecs were doomed to carry freight upon their own backs: the roads to Mexico City were lined with carriers, many with huge packs upon their backs for delivery to the Aztec tribute gatherers. Now and then came a trader with a troop of carriers, but most frequently men and women carried goods individually to market in the towns. Within the City of Mexico were numerous canals and

²"The Origin of the American Indian," *NATURAL HISTORY*, September, 1944.



National Park Service photograph

▲ AN ANCIENT CORNFIELD UNCOVERED. Skillful excavating permitted archaeologists to expose the wavy surface several feet underground representing the orderly ridges of earth. This field was tilled by prehistoric Indians on what is now the Ocmulgee National Monument, Macon, Georgia. The early people later buried the field while landscaping for a ceremonial building

➤ RAPID TRANSIT BY MAN-POWER in old Peru: a jar and the drawing that decorates it (*below*). The drawing shows a dignitary surprised by unexpected guests, perhaps officials with captives from "the front." The dogs on the roof are behaving normally



A.M.N.H. photo



A.M.N.H. photo

▲ EARLY PRE-COLUMBIAN MAIZE excavated by Junius Bird near Arica, Chile, showing tassel, root-node, ear, husk, and cob. Corn was cultivated many centuries ago and over a wide area in North, Central, and South America. But it was probably not the first agricultural product in the Western Hemisphere



then the lake, crowded with canoes similarly loaded, but over the country at large, freighting between cities and towns was back-breaking drudgery. Some of the rich were carried in litters, but most people walked, burdened with baggage.

We have praised maize as a cereal fit to implement a civilization, yet as a food, wheat makes a strong claim for being the No. 1 world's cereal. Above all it is still the leading source of bread. Maize was a good substitute, but its modern popularity rests upon its value as a stock-food. The weak point in Old World animal husbandry was the want of a satisfactory stock-food, but the world was quick to discover the superiority of maize for animals. So let us give the aboriginal American his due. He may have a poor record in the integration of agriculture and stock raising, but he compensated for it by contributing to the world the ideal stock-food, thereby bringing about an almost ideal integration of agriculture and animal husbandry, the one basic principle in maintaining modern civilization.

Origin of Maize

The wild ancestor of wheat was not discovered until about 1900; and as for maize, no wild plant has even yet been found which qualifies unquestionably as the original ancestor. The leading contestants for the honor are:

Teosinte (*Euchlaena mexicana* Schrad.)

Tripsacum (*T. dactyloides* L.)

Pod Corn (*Zea mays tunicata*)

Neither cultivated maize (*Zea mays* L.) nor Pod Corn has been observed able to propagate itself in a wild state. Neither do the traditions of Indian tribes nor early colonial documents give much help in recovering the lost history of maize. The first explorers found it grown from Maine and Quebec on the north, to Florida on the south, in the Mississippi valley, in the West Indies, in the lowlands of South America, in the Andes, and as far south as Patagonia. Archaeology has proved its antiquity in our Southwest, Mexico, and the Andean countries (see map p. 65).

Perhaps no other domestic plant has been subjected to as much exhaustive botanical research as maize. Many experimental agricultural stations have made such research a major part of their respective programs, a large fraction of which have been concerned with a search for wild ancestors, because of

the need for a clear understanding of maize genetics. Yet the mystery remains. However, the intricate detailed knowledge of maize chromosome patterns does make some suggestions. The tendency now is to assume a South American Andean highland origin for its first cultivation, and so prevails the still unrealized hope for finding a wild ancestor somewhere in that area.

Maize is regarded as a grass, prone to cross with a wide range of other grasses. Further, domestic maize still reveals flexibility to environment, rendering its specific adaptation to local conditions easy.

On the other hand, the original Indian type of maize possesses a vitality equal to the preservation of its essential qualities, even though cultivated for centuries by the more primitive hunting tribes of the marginal maize areas. The surviving modern types were produced from seed originally taken directly from Indians in eastern United States. The several recognizable modern varieties are:

Pointed popcorns

Dent corns

Flint corns

Flour corns

Sweet corns

The latest theories about the origin of maize are chiefly of two types:

(a) that it originated in Guatemala in the cultivation of a wild grass, teosinte or tripsacum;

(b) that the Andes was its home and that the ancestor was a form of wild pod corn not yet identified.

The modern approach to the solution of the problem is through the study of chromosome patterns in the germ cells. The most recent work by P. C. Mangelsdorf and his students suggests that the earliest form of maize was propagated in South America as a hybrid, which spread throughout the Andes, finally reaching Central America; there it was again crossed with a related wild plant, finally reaching into the valley of Mexico, where once again it crossed with a wild grass. Thence, some of this seed passed into the West Indies and southern United States, to be returned to the Andean highlands, all in pre-Columbian time. The arguments used in debating these theories are too technical to be understood by anybody except a few experts in the genetics of modern maize.

The Geographical Setting

We noted that civilization in the New World began in the central part



A.M.N.H. photo

▲ ACCORDING TO ONE THEORY, MANIOC was the first plant to be domesticated in the New World. That it is a good food for man and beast is clear from its popularity and wide modern use under the names cassava, sago, and tapioca. It is easily cultivated and well suited to people on the level of a hunting economy. Originally grown in eastern South America and the West Indies, it has been introduced to the natives of tropical Africa and other parts of the Old World. Civilized peoples grow it for stock-food where the climate is suitable. The root is pulverized and dried, providing a good cereal substitute



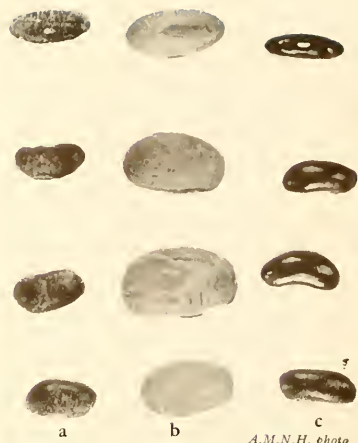
A.M.N.H. photo

THE MODERN cultivated sunflower and the wild sunflower compared: an illustration of the improvement that can be accomplished in a plant by primitive farmers. Cultivated seed heads as large as any now grown have been found in pre-Columbian

rock shelters in Arkansas and Missouri. The Indians of eastern United States were observed growing sunflowers by the first colonists. They ate the seeds parched and ground into flour and extracted an oil from them



Photograph courtesy of C. M. Goethe, in Sierran Cabin . . . from Skyscraper



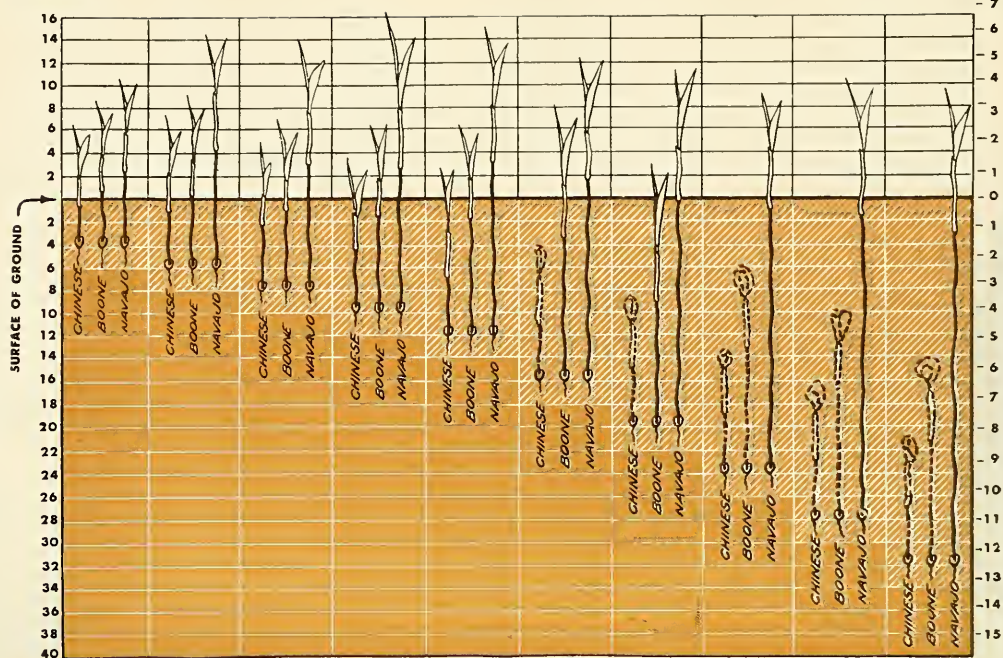
A.M.N.H. photo

THE CULTIVATED BEAN is of New World origin. Two types grown in pre-Columbian times are compared here with a modern type

- (a) Kidney beans from Surco, Peru
- (b) Lima beans from Surco, Peru
- (c) Kidney beans, Iroquois, about 1905

▼ RANGE IN SIZE at one time and place is shown by these ears from the largest and best preserved cache of pre-Columbian maize ever found. The collection was discovered by Earl Morris in 1923 in Canyon del Muerto, Arizona. It was in a stone cavity tightly closed by a slab of sandstone, in the floor of a rock shelter. The several hundred ears are dated at about 500 A.D. and differ from modern pueblo Indian maize in color and size. They resemble old pre-Columbian types in South America. The grains are dark red, 10 to 14 rows to the ear, mostly straight but some spiral





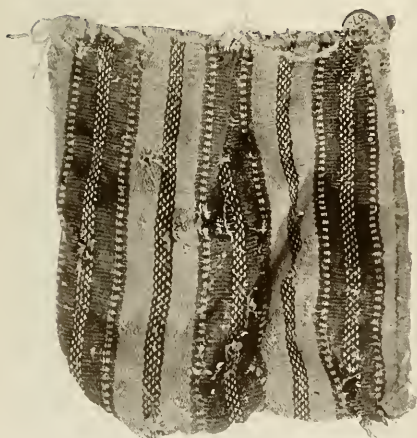
After G. N. Collins, courtesy The Journal of Heredity

SUPERIORITY OF NAVAHO MAIZE FOR DEEP PLANTING

▲ PROOF that Navaho corn is adapted to planting at a depth of more than one foot (32 cm.). The type was

developed by artificial selection for planting deep enough in dry sand for the roots to reach the yet deeper moist ground

THE OLDEST KNOWN POPCORN. The well-popped grains were still fluffy white when found in the adjacent bag attached to the belt of a mummy in Chile. The popcorn was probably left as a mortuary offering. The horny shells remaining show that the kernels were deep red



A.M.N.H. photos

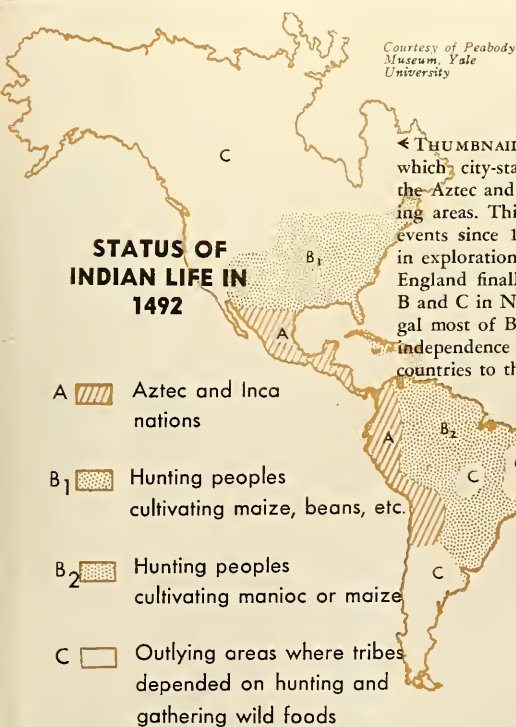




A.M.N.H. photo

▲ REPRESENTATIONS of corn on Peruvian pottery of the early Chimú Period, about 500 A.D.

► **POD CORN**, one of the three contestants for the honor of being the ancestor of maize, here shown in a pre-Columbian ceramic replica from Peru. Each grain has a separate husk as is usual among grains. But pod corn has never been observed to propagate itself in a wild state



of the land mass (*see map*). Mexico, Central America, and the Andes highlands are neighboring regions. However, if we look at separate single complexes of living habits, some of them will show a wider geographical distribution than others. For example, the cultivation of maize in 1492 will show a wider distribution than many other traits of the Aztecs and the Incas.

Further the simple map we present tells the story of the evolution of society in the New World as of 1492. The two great city-states, Mexico City and Cuzco, ruled over the greater part of area A, comprising in all many smaller cities and towns more or less subjected. The boundaries between Inca and Aztec lands did not overlap but were widely separated in Colombia and Central America by intervening towns and cities. Area A on the map defines the region of intensive culture and the sphere of influence of the Incas and the Aztecs in 1492.

Thus this crude little map not only tells what happened here before 1492 but is the key to what happened since. It seems to make the fundamentals of American history so plain that one pauses in astonishment that the teaching of history even in our elementary schools should not have adopted this device from the first. Our grandfathers were fond of the expression "a thumbnail sketch;" this is an illustration of what they had in mind. If the reader has been able to grasp the significance of this map, he need not be a specialist in American history to "know where he is at."

What Might Have Been

Almost everyone who reads a short account of the evolution of these New World civilizations, spontaneously frames the same question: If Columbus had failed and America had remained isolated for another 2,000 years, what would have happened? Attempts have been made to answer this question. It is inconceivable that no advances would have occurred. On the other hand, the discovery of America was inevitable, because Europe had awakened, ships were at hand capable of long voyages, the idea of the rotundity of the earth was not only accepted by many learned contemporaries of Columbus but the proofs of the theory were considered sound. At most two more centuries would have brought the solution to what lay beyond the western sea. So such speculation is futile.



▲ **WESTERN GREAT HORNED OWL:** a bird of mixed reputation. It is equally efficient, at times, in the destruction of injurious rodents as it is in its attacks on game birds and poultry, for which it is widely condemned

➤ **TEXAS NIGHTHAWK.** This little bird of the dusk is the most northern member of a tropical species that ranges widely through Central and South America. It has many points of difference from the common night-hawks of North America, of which there are a number of geographical forms. Among the more obvious differences are the smaller size and browner color, and the position of the white band near the tip of the wing

BIRDS of the DESERT

By GEORGE MCCLELLAN BRADT

As typical of the Southwest as its deserts, canyons, mesas, and wooded mountaintops is its bird-life. Epitomizing the essential character of the region, that of contrast, Southwestern birds range in size from tiny three-inch hummingbirds to eagles with a seven-foot wingspread. In habitat they show wide variation from river-bottom herons to mountain-loving falcons, in nesting dates from incubating owls in March to nestling doves in September. In feeding habits they range from seed-eating finches to carnivorous birds of prey.

Twelve birds common to the numerous yucca and cactus deserts of southeastern Arizona, southwestern New Mexico, and western Texas are shown in the accompanying photographs, all of which were taken in the vicinity of El Paso. These conspicuous members of the region's bird population can all be found at one time or another along the Southwest's desert highways. Hawks perch on telephone poles or, like the eagle and vulture, soar high in the clear blue sky; shrike, thrasher, mocker, wren, and oriole fly to roadside yuccas; woodpeckers cling to weathered fence posts; and headlights pick out the night-loving owl. It is not in the least unlikely that each of these species could be seen by a watchful motorist on a single hundred-mile trip taken late in a desert spring.



▲ WHITE-RUMPED SHRIKE. Like other shrikes, this southwestern bird has the habit of impaling some of its prey on convenient thorns, from which it derives one of its common names—the butcher bird

▼ WESTERN MOCKINGBIRD: a talented mimic but also a gifted songster in its own right. Like the Eastern Mockingbird, it is much given to singing on moonlight nights, when it is not always appreciated by the drowsy listener. The bird's sober plumage belies its colorful voice



▼ MARSH HAWK: a bird of wide distribution, nesting from northern Alaska and Hudson Bay to Virginia and Lower California and migrating to the West Indies and northern South America. Close relatives are found in Europe and Asia. The Marsh Hawks are highly beneficial, feeding largely on field mice, rabbits, and ground squirrels





◀ **SCOTT'S ORIOLE:** one of the duller members of a brilliantly hued group of birds but still handsomely dressed in olive yellow, black, and white. The female is somewhat more soberly clad in still duller yellow and green, with a little brown and white



➤ **CACTUS WOODPECKER:** a common woodpecker of the southwestern country, found in the valleys and lower elevations of the mountains. It is related to the downy and hairy woodpeckers but differs from them in various ways, such as by its speckled breast and sides and its barred back, without a broad white longitudinal stripe



◀ **CURVE-BILLED THRASHER:** an inhabitant of the thorny brush, building its nest of spiny twigs with a thin lining of grasses, in the shelter of such protecting plants as cactus and yucca

▼ The photographer observing from his blind





◀ **WESTERN BURROWING OWL:** an interesting inhabitant of the open country, nesting in deserted prairie dog or ground squirrel burrows and coming out principally at dusk to hunt its prey. In the daytime these owls may often be seen standing at the entrances to their burrows, bobbing their heads or bowing comically and giving a chuckling call before backing down the holes or taking short flights to an adjacent position



► **ASH-THROATED FLYCATCHER.** Like other members of its genus, but unlike most other members of the family, this species nests in holes in trees, posts, stumps, and similar places, using snake skins sometimes for part of the lining as does its relative, the Crested Flycatcher

► **CACTUS WREN.** The conspicuous nests of the Cactus Wrens are large, bottle-shaped structures, with the opening in the side through the narrow "neck." The bird's name tells of its favorite haunts. It is far less musical than most of its near relatives



➤ **GOLDEN EAGLE.** The Golden Eagle is not a true desert bird, but will descend from its mountain home when necessary in the search for food. Tales of this species carrying away children are purely imaginary



◀ **DESERT SPARROW HAWK.** This little falcon, the smallest member of its family in North America, is a familiar bird of open or semiopen country, where it may be seen darting about in search of grasshoppers, mice, and such small prey. There are numerous geographical forms of the species, ranging from Canada to Tierra del Fuego



THE *Friendly* CHOCOANOS

By ROBERT CUSHMAN MURPHY

*Chairman, Department of Birds,
The American Museum of Natural History*

The "Askoy" expedition wins the good will of a charming people who rarely receive visitors from the outside world, and each learns interesting things from the other

THE Chocó was inhabited land before Europeans discovered it, and Negroes inherited it. The Indians along the coast to the south of the Isthmus of Panama were, indeed, one of the earliest impediments to the advance of the conquistadors toward Peru. At first these hostile peoples were mostly by-passed rather than overcome by the Spaniards. Later, they were supposedly subdued, but in 1726 they succeeded, by means of a general uprising, in throwing off the yoke of their overlords. From that date to this they have remained a free folk, unaffected by successive political changes in the Spanish vicerealties that have become American republics.

Although the Chocó Indians have thus escaped a large share of overt warfare, they have not been able to avoid more subtle competition that

falls within the meaning of the term "struggle for existence." The transplanted African has proved a better "native" than the Indian himself. By this I mean merely that the Negro is more resistant to tropical heat, moisture, and diseases, and that he not only produces more offspring but also rears a larger proportion of them, even under the handicap of a sanitary system inferior to the Indian's. For such reasons black men in the Chocó appear to be crowding out the red. The process has already pushed most of the Indian communities inland and "upstream" into relatively inaccessible areas.¹

¹These subjects have been expanded by the author in the following two publications: "Racial Succession in the Colombian Chocó," *Geographical Review*, vol. 29:461-471, 1939; "The Earliest Spanish Advances Southward from Panama Along the West Coast of South America," *Hispanic American Historical Review*, vol. 21:3-28, 1941.



The first Chocó we met was a man making a call in the village of Santa Dorotea at Piñas Bay. When I saluted him, he walked forward and greeted us like a gentleman, smiling but showing no levity. He was wearing a khaki hat of the "Sherlock Holmes" type, with a visor aft as well as forward, and a khaki suit. His chin and cheeks were painted symmetrically with radiating red lines. On his chest and belly were more elaborate designs in blue, the details of which could be only partly seen through his open jacket. His hands were stained a brilliant purple-black, which contrasted startlingly with the ruddy skin of the wrists. We were told later that this stain is prepared from the fruit of a shrub called the *achioté*, mixed with powdered charcoal.

This Indian was a fine-looking man, dignified, well set up, and taller than most of those we met later. He was joined within a few moments by a son of about twelve, who wore a blue shirt above his breech-clout, and by a daughter, somewhat older, clad in a printed cloth wrapped around her



(Above and below) CHOCÓ INDIAN HOUSES among the coco-palms on the barrier beach at Cocalito. These dwellings were not occupied at the date of the visit and had consequently fallen into slight disrepair. They were still filled, however, with many of the household utensils that the Indians use



◀ AN INDIAN YOUTH who was traveling with his uncle along the shore of the Ensenada de Coredó at the time of the arrival of the "Askoy" Expedition. The chin and throat of this boy were painted bright red below the line of the mouth

▼ A GLIMPSE of the charming Chocó settlement near the mouth of the River Cocalito, as seen from the crest of the barrier beach that protects the site from never-ceasing surf



waist and falling to the knees. The legs of the girl, from the ankles up, were dyed the same hue as the hands of her father. All three Indians seemed completely clean.

Next day on the same beach I photographed two small Indian children. They were with their mother, whose permission I obtained to use the camera. The women asked me the cause of the red and peeling blotches on my bare legs. When I explained that the unsightly condition had been caused by the rays of the tropical sun, I felt doubtful whether sunburn was anything that she was capable of understanding.

Another unanticipated meeting occurred at the mouth of the Rio Coredó, Colombia, on the afternoon of May 18. By good luck Comandante Fallon and I landed from "Askoy"

in a bongo just as two Indians were wading across the mouth of the stream. One was a man in early middle age, the other a handsome lad in his late 'teens. The youth looked like a bit of a dandy because his "hair-do" included a lock meticulously dressed down the middle of his forehead. His throat and the lower part of his face were painted a uniform red, and his teeth were stained a shiny black. When I called a greeting, both Indians advanced to meet us and we solemnly grasped hands. Cristobal Colón himself could not have been welcomed more graciously by the aborigines of the New World.

After exchanging a few amenities, I asked the privilege of being photographed with them. Subsequently it was quite agreeable to them to be snapped alone, and the boy also per-

mitted me to make a close-up of the cryptic designs tattooed on his left forearm.

Our next glimpses of the Chocoanos were at the beautiful Ensenado de Guayabo Chiquito. At the time of our first call, in March, I remember particularly the admirable sight of a sharp-bowed, red-and-black canoe shooting through heavy breakers under control of three young women clad only in bead headbands, girdles, and loin cloths. They remained standing in their cranky little craft while it surfboarded ashore on the forward slope of a roller. At the last moment they leaped into the foamy water with perfect synchronization and carried their dugout high and dry.

All of the foregoing gave no more than a tenuous touch with Indians, but on May 3 I had an opportunity to talk at length with two boys belonging to the extensive colony of the Chocó in the delta of the River San Juan. Through the courtesy of the Colombian War College, I was invited to accompany a military mission

on a one-day voyage from Buenaventura to the *pueblo* of Palestina. We left the pier in Comandante Fallon's gunboat "Junín" at three o'clock in the morning, and were blessed by what passes for a fair day in the Chocó. This means that heavy showers were well dispersed and that in the intervals we enjoyed blue or silvery skies, rainbows, brief displays of sunshine, and the frequent sight of flickering golden patches on the ocean even while our vessel was receiving the full force of a squall.

Just before seven o'clock we came to the outer bar of the great river, which we entered through the most southerly of its eleven mouths, known as the Boca San Juan. "*Braza y tres cuartos*" (a fathom and three-quarters), sang the sailor who hoisted the lead. Then "Two," "Upwards of two," "Two and a half"—and "Junín" had safely crossed. Thereafter the water deepened rapidly to four fathoms, and we increased speed. There were, however, further shallows inside the entrance, and the com-

mander on the bridge had a tense expression as he stood at the control and listened once again to the announcement of soundings. This time we went to a "Fathom and one-quarter, scarce," the very draft of the vessel, before passing permanently into the safety of the river bed.

Presently we began to see establishments of the Indians along the banks. Some of them were large and more or less communal houses, without walls. Open dwellings of this type always meant Indians; whenever we saw a hut with planked or plaited walls, binoculars invariably revealed its occupants as Negroes. As we steamed along in midstream through



▼ TWO CHOCÓ INDIANS of the Ensenada de Coredó whose faces are also shown elsewhere. Each man carries a shirt which, however, he prefers not to wear while traveling. A "diplomatic pouch" suffices for baggage. The machete and knife are necessary parts of gentlemen's equipment

► TIBERIO, a young Chocó Indian of the San Juan delta. His neck is encircled with many strands of small beads in four colors



the grayish-yellow current, we could watch large numbers of men, women, and children seated on the high floors under the shade of palm roofs. Most of the people were nearly nude, and their bronze skins had a warm glow, especially when accented by the strands of brightly-colored beads around the necks of many of the men. In front of the houses, from two to a dozen spoon-bowed *cayucos* were usually moored to the shelving shore by poles thrust through a hole in the forward overhang. We soon began to find Chocós on the move in similar canoes—a young woman paddling along the margin of the river with utmost grace and apparent lack of effort; two wholly naked boys disappearing into a reed-lined *estero*; two men with bones stuck through the septum of the nose, standing and paddling at either end of a precarious little dugout and endeavoring to catch



◀ ONE OF THE INDIANS who welcomed the expedition at the mouth of the River Coredó, north of Point Marzo, Colombia. He stated that his home was inland on one of the rivers flowing into the northerly part of the Ensenada

"Junín." They failed by a narrow chance, and I saw in the bottom of their craft three bowls of eggs which they had doubtless wanted to sell to our ship's cook.

For a time the river widened upstream and, we entered a district of low alluvial stretches where the cultivations of the Indians could be made out clearly from deck. These included sugar cane, corn, bananas, pineapples, yuccas, papayas, and other crops. The plantations stretched in narrow bands alongstream, extending only a few yards back from the water's edge. Sugar cane no doubt satisfies a demand for quick energy-producing food. In one laden canoe, manned by half a dozen women, I saw the bow paddler stop to pick up a length of cane from her boat, and with a machete hack off a section which she thereupon proceeded to chew while she worked. Many *cayucos* 35 feet long, or more, appeared to be conveying whole families from one abode to another. We counted as many as ten individuals in one, besides the heaps of baggage.

It was amazing, after our experience elsewhere in the Chocó, to see so many Indians and so few Negroes. Anthropological literature on the region records that the blacks have already appropriated the greater part of the San Juan Valley. I learned

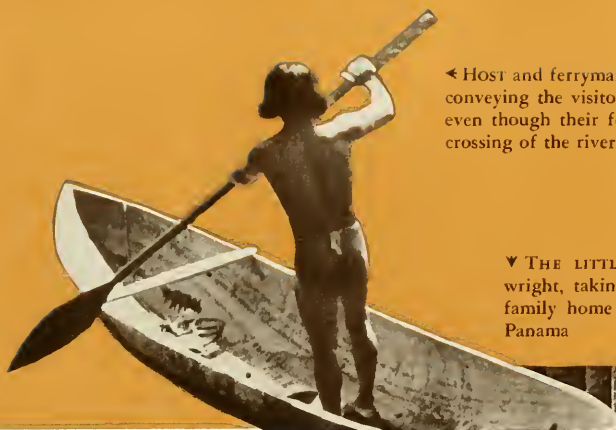
later, however, that this applies chiefly to the middle reaches of the river and its main tributaries. The delta, between Palestina and the mouths, together with the remote headwaters of the river system, are still almost exclusively Indian.

Near the junction of the San Juan with a side channel known as the Brazo Cabeceras, two Indian youths paddled out from shore with desperate energy, intercepted us, caught the handrail of the main deck, and hung on, while "Junín" was making ten knots. The maneuver was as skillful as anything that could be imagined in the way of small boat handling. One boy stood at each end of the narrow canoe, which was about 25 feet long and had to approach our gunboat practically head-on across the bow-wash before it could swing parallel. After using a similar *cayuco* throughout four subsequent summers on Long Island, I can appreciate all the more the amazing boatmanship of the Indians, which can be a product of nothing less than daily practice from babyhood.

The boys made fast their craft with bark ropes and remained standing with one hand on our rail, prepared to complete their upstream journey in their own bottom which was rushing furiously through the white water alongside. When they were invited

aboard by the Army officers, however, they at once clambered through and joined us on deck. It turned out that they were headed for the store at Palestina to buy a new shirt apiece, for which purpose each boy had a peso note in his breast pocket. Shirts, by the way, are more or less semi-formal garments among the Indians. They don them when they are about to enter the company of black folk or white. If they were to visit the streets of such a real metropolis as Buenaventura, they would make further deference to convention by slipping on trousers over the breech-clout.

For more than an hour I conversed with these boys, with the aid of my Colombian military friends. They were brothers, Tiberio and Neldo Mercazar, about 19 and 16 years old. But neither knew his age; neither could read or write; neither knew who was president of Colombia, nor anything whatsoever about the political affairs of the country. Neither knew that there was a boundary between Colombia and Panama. In other words, they were wholly independent human beings in an ancestral land that was still their own. Both were grave and reserved, and when a questioner asked something designed to be amusing to the rest of us, the boy addressed replied so simply that he was not the one to be laughed at.



◀ Host and ferryman at Cocalito. He insisted upon conveying the visitors back to the beach dry-shod, even though their feet were still wet from a first crossing of the river higher upstream

▼ THE LITTLE DAUGHTER of Maestro Chucutí, the shipwright, taking her siesta on the sleeping platform in the family home on the shore of the Ensenada de Guayabo, Panama

They had identical mops of black hair, bobbed off as evenly as if trimmed around a porridge bowl. All the area below had been shaved or clipped close to the skin. Each boy wore around his neck several thick ropes of small beads which were yellow, red, light blue, and dark blue. Neldo said that his beads, which weighed slightly more than a pound, had cost four *pesos* (\$2.00). The Colombian officers stated that the beads were of German manufacture. The boys looked as though they wore nothing but their shirts, but hidden under the tails were a red breech-clout on one and a yellow on the other. Their skin was clear and ruddy, except that the legs and feet were spattered with small scars, the record of countless scratches of the jungle. Tiberio had twelve holes, in rows of three, bored or burned through his right thumb nail, each showing a circle of the quick underneath. He would make no replies to several questions regarding the significance of these. Both boys had large holes in the lobes of their ears, but these bore no ornaments at the moment.

Tiberio and Neldo each smoked a cigarette or two when invited to by the military men. They asked for nothing, however, and behaved as gentle guests, answering questions willingly with the exception of several concerning their native language. For some unknown reason, both boys said that they spoke only Spanish, which could not be true. One of the Colombian officers who had some knowledge of the two Chocó dialects had heard them shouting advice or commands in their native tongue during the hectic moments before they succeeded in grasping our rail. When we asked them what the Indians called themselves, they replied "Cholo," the same



answer that was given us everywhere between Darien and the San Juan. They told us that many Indian children in the delta had recently died of the *tos ferina* (whooping cough). We passed one cemetery in the forest on a stretch of high river bank, and among the jumble of toppling wooden crosses was a cluster of small new ones still standing upright. Most of the Indians are nominally *cristianos*, though relatively few see the inside of a church throughout their lives.

Tiberio and Neldo had no interest in our cameras or field glasses. I am certain that one of the boys took in a well-focused view of the river bank through my own binoculars, but it was quite clear that he saw nothing advantageous in the trick. I suspect that both of them grasped the meaning of a military chart of the San Juan delta when an officer pointed out



the very waterways, junctions, and hamlets that we were then passing.

But it remained for a major of aviation to break down the guard of the boys and to throw them into a state of frank and unmistakable astonishment. This he did by demonstrating a gadget on his riding boots. These were an old pair, for which the calves of his legs had grown too stout. He had therefore had a boot-maker in Bogotá slit them down the back, from top to heel, and sew on zippers. When this officer raised his foot to the ship's rail, called the attention of the Indians to the back of his leg, then ripped his boot open from top to bottom and as quickly mended the rent, the complete bewilderment of Tiberio and Neldo was comical to behold. They took no share in the joke, however, but maintained a countenance of such grave mystification that it was impossible for gentlemen to laugh.

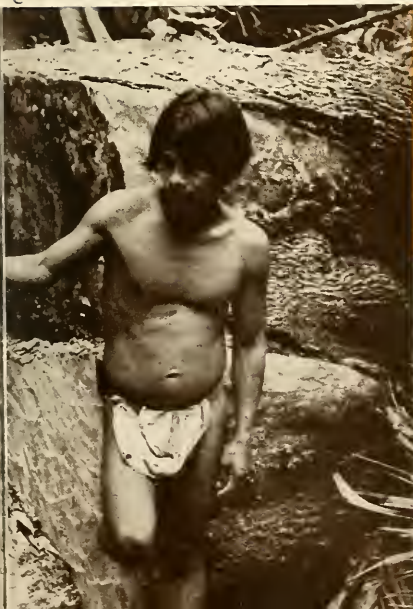
Upon our return to Guayabo Chiquito on May 20, we had an opportunity to establish more intimate relations with a number of Chocó Indians. Shortly after dropping anchor for the second time, we received a call from a small and wiry Indian named Chucutí, and his young son, Brigido. Chucutí was a boat-builder, and the two had come to "Askoy" in the most beautiful small salt-water canoe I had yet seen. With all the air of a squire on his own estate, Chucutí invited us to his home. Since we had no tender suitable for landing through the waves

of an open coast, don Antonio Maya Cardona, who had a trading post at the Ensenada, hospitably supplied us with a beautiful surf bongo, sharp at both stem and stern, and with two expert Negro boatmen from Quibdó to man it. Comandante Fallon and I, with our cameras and light-meter packed in waterproof bags, sat in the bottom of the bongo. The bow boatman rowed with one long oar; the helmsman used a seven-foot leaf-bladed paddle on the other side. It was simple going until we came to the landing *playa*, where the surf was piling in. There our boys waited until a series of big waves had passed. Then they pulled and pushed hell-bent for shore. We rode in superbly, were cast up on a wave that broke without flooding a drop over our gunwales, and none of us was wet above the ankles while attaining dry land.

Our host lived in a house with a beautifully plaited *paja* roof, just behind the crest of the beach. Barrigón ("Pot-belly"), the grandfather, came down to greet us. He was misnamed, for, as they say in either English or Spanish, he was a fine figure of a man. Chucutí had not beached his own canoe until he had seen us safe ashore. Arquimedes, a fifteen-year-old son of Chucutí, showed a regrettable touch of sophistication, because, before taking part in the welcome, he ran up to the house to put on a sweater, a felt hat, and a belt that held up nothing. The other men and boys rested content with their

g-strings. Arquimedes was therefore the only one who looked incongruous, with the jaunty hat from Panama almost resting on wooden plugs in the lobes of his ears, and wearing nothing below the hips except his many-colored breech-clout.

We climbed the seven-foot notched pole to the floor of the dwelling and were invited to be seated. Since there



◀CHUCUTÍ, his elder son, Arquimedes, and the 31-foot seagoing craft which the Maestro had carved from a single tree trunk in the heart of the Darien forest. The boat was still attached at bow and stern to the log from which it was being hewn. Chucutí was only five feet tall, and, although he was strong as well as competent, there were indications on his torso that in childhood he had suffered from rickets or some related nutritional deficiency



were neither chairs nor stools, the floor was the answer, so the *comandante* and I joined the family circle. At my left was Chucutí's wife, bare from the waist up, within a month of producing a sixth child, and sublimely indifferent to the revelation of either fact.

At one end of the house a platform, measuring about eight feet by 20, rose a foot above the rest of the floor. This made the sleeping quarters. Above it hung a string of delicate shells and crayfish claws, which tinkled faintly when the air stirred. This, said Chucutí, was a bat-scarer to frighten off the nightly vampires. Arquimedes, Brigido, and the two younger sons were seated along the edge of the platform, and in the middle lay a charming little girl of about two, sound asleep. I could not help asking whether she was quite well, to which the father replied that the hour was merely that of her *siesta*. The hair of all the Indian children showed curious bleached streaks. Chucutí reported that his own hair, now entirely black, had been similarly pale when he was a child. I do not know whether the sun or some other agency is responsible for this condition, but I have since learned that bleached hair among the youngsters of both the Chocó and Cuna Indians has been widely reported.

After we had chatted for some time, I produced some trinkets which Mrs. Murphy had supplied against such great occasions. To Chucutí's wife I gave a necklace made of three strands of metal, and her eyes gleamed. Some additional Woolworth items went to Chucutí and the children, while Barrión received a glass dog, guaranteed to keep all interlopers away from his residence. He enjoyed the joke, but obviously appreciated the precious crystal because Fallon had a hard time convincing him that it had not been handed him merely to look at. The whole family, with the exception of the sleeping daughter, then came down to the ground to be photographed, after which we took our leave. When the matron extended her left hand in parting, we were amused to hear her husband admonish her with a whispered "Right hand," just as we do to our children at home.

Chucutí and Arquimedes now launched the little surf canoe, and we followed in our bongo to another cove of the Ensenada, where Chucutí had a boat in the making. We landed below a bank on which the forest had

been burned, climbed a hill through blackened tree trunks, the Indians leading, and followed a trail for more than half a mile into the primeval world. The sight that then met our eyes was one never to forget. A giant tree that had been well over a hundred feet in length lay prostrate. I do not know the species, but Chucutí called it a *jenené*, characterized by hard and enduring wood and much better for large craft than the espavé or wild cashew out of which he carved his smaller canoes. We walked along the enormous bole of the fallen tree, seven feet above the forest floor, until we reached the craft in process of being hewn out of the living wood. It was all of a single piece, 31 feet long, slightly more than six in beam, and about five feet high. Stem and stern were still attached to the vast log, but the interior had been carved out with perfect symmetry and the outside finished at least roughly from bilge to gunwales.

Under Chucutí's animated explanations, we learned the reason why the inside of such a boat is first brought to perfection. It seems that when the work is carried thus far, the builder bores series of holes about $2\frac{1}{2}$ inches deep in the hull of his craft, after which the outside is carved away until each hole is exposed. Such is the technique for obtaining uniform thickness. After completion of the work, the holes are plugged with pegs, the positions of which can be seen in any large bongo built by an Indian.

Comandante Fallon, as an accomplished naval officer, knew a good job of shipbuilding when he saw it. He was as awestruck as I, and while he engaged Chucutí in a discussion of sheer, balance, buoyancy, and other nautical details, I aimed my motion picture camera. Three months of Chucutí's labor had already been expended on the bongo. When he finished it, a trail would have to be cut down the hillside, and skids of split logs built to slide the heavy hull to the water. Altogether, the Indian estimated, the task would require at least six months of his time. From this point we ceased to address the man as Chucutí and called him "Maestro" in recognition of the fact that he was a master shipwright.

This bongo was built not to use but to sell, and perhaps to be equipped with an engine. At the home of the Maestro we had seen a new single-barreled Stevens shotgun, listed in the United States at a price of nine

or ten dollars. The gun was an advance payment on the bongo, given by a trader. After completion of his contract, Chucutí said that he was to receive, in addition, two boxes of shotgun shells, 200 percussion caps for a muzzle-loading shotgun, one pound of powder, one pound of lead shot, and a sack of salt. Weighing in my mind the two balances of this bargain, all I had the heart to say to the Maestro was that he was obtaining a very strong and reliable American shotgun for all his toil. He beamed at the remark, as we returned to the cove.

Before our final departure from the Ensenada de Guayabo Chiquito, I asked our friend whether we might not have something else on board "Askoy" that we could leave him as a *recuerdo*. The Maestro thought solemnly for a moment, and then stated that he would be happy to receive two fishhooks, a package of Epsom salts, and some quinine, if we could spare them. We could.

Cocalito or "Little Coconut Grove" lies only eight miles south of Guayabo Chiquito and is one of the few sites at which a Chocó Indian settlement reaches the seashore. Its persistence beside salt water is due to the double protection of trackless forests and beachless coasts for many miles north and south, and to the great rollers that break, even when the ocean is calm, against the sandy barrier across the mouth of the valley. On two occasions we had sailed "Askoy" close to this beach with the hope of making a landing, but each time the terrifying waves had dashed our hopes. With the kind aid of Señor Maya Cardona, however, we finally achieved success on May 21.

Before nine o'clock we were off the dancing spray of Cocalito, but this time our boatmen guided us toward a relatively quiet strand in a cove north of a small hilly peninsula. With Armstrong and Fallon, I crouched again in the bottom, and we oscillated just outside the combers until the right moment arrived. The secret of success was the speed that the long, lean boat developed under power of pole and paddle to outrun the next wave.

We trudged southward along the wild steep beach, which had a flat forefoot of shingle on which the surf was crashing. Along the crest of the dune, the Indians had wisely planted rows of young cocopalms that were flourishing hopefully in front of full-grown trees. The grove as a whole



◀ A CHICKEN HOUSE and roost on the Cocalito beach, built according to the same principles of construction as the homes of the people themselves

➤ A SMALL LASS OF COCALITO, who, a few moments before, had been in an almost complete "state of nature." Pulling on the finery demanded by so festive an occasion as being photographed had ruffled her hair but not her disposition



◀ THE COCALITO SETTLEMENT was full of the symbols of normal and happy childhood. Here is a toy boat of balsa wood, abandoned as cheerfully as though its owner were a small boy or girl at some water front in the United States

➤ CASIMIRO, the fish-spearer of Cocalito, a boy of about twelve years, who had an important part in welcoming the visitors from "Askoy." The aristocratic courtesy and graciousness of Casimiro would be a model for lads of his age in any community



was so exquisite that nothing in Polynesia could surpass it. Shrubs covered with white blossoms, and others with red, stood among the swaying trunks, and on the side away from the sea the shadowed ground sloped down to the Río Cocalito. Behind all was the backdrop of the coastal mountains, where yellow and heliotrope crowns of vast flowering trees stood out against the mass of varying greens. There were two houses in the grove, both unoccupied but well filled with possessions, including toy boats and other belongings of children. Beside each one was a well-finished chicken house, standing on stilts and roofed with thatch. When we reached the edge of the rushing river, we saw that Indians were occupying four or more houses on the opposite bank. Several of the inhabitants had an eye on us while we inspected the property on the spit, so we sent one of our Negro boys as an emissary to request the privilege of calling at the settlement.

Half a dozen dogs of the Indians waded out to a dry bar in the river and barked at us, but at the same time they wagged their tails vigorously. Furthermore, they were clean and well-fed animals, and it was not long before I coaxed two of them into admitting that they had not really meant to bark at all. They felt, indeed, rather apologetic about it. From this I concluded that the people would prove worthy of their dogs.

The Indians were smiling and cordial. There were at least fifteen persons in the first large house that we approached, and everything in it was visible because of the absence of walls. In its accoutrements it probably differed very little from a Chocó residence of the days before Pizzaro. There was, to be sure, a well-oiled rifle on the rafters (for which some poor red man had doubtless been bled white). There were also a porcelain Buddha in one corner of the floor, a Singer sewing machine in another, and a five-gallon gasoline tin hanging above the three fire logs in an earth-filled square hearth, but nearly everything else had a primitive look. Rice threshing-rings of balsa bark, water gourds covered with carved designs, plaited fans for fire-reviving, and large bundles of white bark fiber were among the many objects suspended inside and under this dwelling.

Several men and women were at work around a canoe about 12 feet long which had been brought up to the high floor and filled to the brim

with a brew of palm nuts and water. In answer to Fallon's questions, they explained that from this mixture they skim oil for cooking and then prepare a drink from the residue.

We told them that we had long wanted to land and call upon them. They remembered our maneuvers offshore in March, and had watched us from the dunes on our three approaches. They said that their latest visitor, except for a familiar trader from Panama, had been a submarine that had lain off the settlement about six months before, after making several dives and returns to the surface. Men in blue uniforms had finally come ashore in a boat drawn out of the back of the big craft and, after capsizing two or three times, had taken off several loads of water from the river. These men, they said, spoke a strange tongue that was not English. They were also impolite, and they had entered the homes of the Indians without even asking permission.

I asked the Indians whether any of them remembered a visit from Dr. Erland Nordenskiöld and his wife, Señora Olga, nearly 15 years before. One elderly woman, who seemed to be the matriarch of the community, appeared to have a dim recollection of this event, but I could not be sure. Then we began to talk about making photographs, and for a time Comandante Fallon was convinced that the people had no idea what we meant. I tried another approach by walking down to the river where a very handsome twelve-year-old boy was spearing fish from a canoe. He had already transfixed a snapper and was now darting at a *tamborero* or blowfish. I asked his name, addressing him as a *valeroso pescador* (brave fisherman), which amused him mightily. He was called Casimiro. Then I pointed to my 16-mm. motion-picture camera and told what I wanted. At once he struck heroic poses with his fish-spear, held up samples of his catch, and showed forthwith that he knew something about the cinema.

Comandante Fallon had an Irish great-grandfather from whom the charm of the Blarney Stone has descended. The effect of his running and irresistible harangue, together with that of watching me use the camera on the boy in the boat, produced a magical change. All the Indians suddenly went Hollywood! Chests and bags were opened and finery was yanked out. There were vehement smoothings of hair, snapping on of

bead and coin necklaces, encirclement with garments like Joseph's coat, hooking in of earrings, donning of embroidered vests. The more vociferously we admired, the more delighted were our hosts, and within five minutes they all marched out from several houses into the tropical sunlight and lined up, even to babes in arms. We thereupon photographed the residents of Cocalito, both collectively and individually. Later we all entered the large house again and devoted ourselves wholly to conversation. Under the shadow of the low eaves it was too dark for photography, but we had an opportunity to learn that gaiety and merriment were no less characteristic of these people than their courtesy. The women went no further than to smile, but the men frequently broke into the heartiest of chuckles at the fluent sallies of Fallon. After a little encouragement, two of them were persuaded to bring out a bundle of ceremonial wands or maces, the carved figures on which seemed to me, however, to represent an African, rather than an American Indian, motif. It is possible that during the past three centuries the cult of the Negro has had its effect even upon a group that stands rigidly apart.

I paid all possible attention to the many children, including a baby of about four months, the daughter of a very pretty mother. Before long one little girl of three years was willing to sit beside me most affectionately, to the somewhat surprised amusement of her parents. She wore only a red, blue, and yellow g-string which hung down in front almost to her ankles, and of which she seemed inordinately proud. When I pulled out of my haversack another of the "gold" necklaces, so thoughtfully supplied by my wife, and locked it around this child's neck, she was utterly entranced and thereafter followed us about with winsome smiles.

Some of the names were obviously purely Spanish, while others apparently belonged to the native tongue. One of them, "Comogre," was interesting because a *cacique* or chief of the same name was known to Vasco Núñez de Balboa, in Darien, in the early sixteenth century.

When we left, our Cocolito friends attempted to load us down with baskets of fresh eggs, but we thanked them and explained that we had taken on at the Ensenada de Coredó more eggs than we could well consume on the remainder of our voyage to Pan-

THREE MEN and three women of the Cocalito settlement show faces that range from narrow and aquiline to broad and rather flat. In different costumes one or another of

these persons might pass for other native Americans, such as Algonquin or Eskimo. The bead bands and strings, and the silver earrings are native handicraft



▲ TWO MEN WORE ordinary "store vests," which were, however, elaborately embroidered with ceremonial designs

▲ THIS NECKLACE IS of Ecuadorean silver coins, traded northward through hundreds of miles of tropical forest



▲ DROPS OF PERSPIRATION on this woman's face were probably due to embarrassment rather than the temperature

▼ THIS CHARMING young Indian woman was the mother of two or more children. Note the elaborate silver earrings



ama. We had learned in advance that the Indians regard tinned fruit as a luxury, so we left them a small supply with which the generous Maya Cardona had supplied us for the purpose.

Our black boys were permitted to wade back to the beach across the Río Cocalito, but not Armstrong, Fallon, and I, even though our feet were still wet from the former crossing. One

of our hosts insisted upon transporting us in his shapely canoe to the far side. There we said farewell, climbed the dune which was carpeted with pink morning glories, and waved to the boatman who was paddling back to his home. Another man and Casimiro took a short cut to the little beach where our bongo was hauled out, in order to see us off with proper ceremony and to supply us with green

pipas, for which the man had climbed a tall coconut palm. Casimiro had by this time adorned his left ear with a brilliant red hibiscus blossom. On the way out to "Askoy" our Negro helmsman summed up our own opinion of the Indians, even though there was incongruity in his words. He said, "*Buena gente; muy castellana*" (Fine people; very Castilian). It was the perfect compliment.



▲ VERTICAL TRAVEL presented no difficulty to the gentlemen of Cocalito, who supplied the expedition with an abundant gift of green coconuts to take back through the surf to the schooner. This man went up the tall palm squirrel-fashion, without aid of a loop or any other device

➤ BEFORE accompanying the visitors from "Askoy" to the beach where their surf bongo was launched, young Casimiro dressed up in a white shirt and thrust a gorgeous red hibiscus blossom through the perforated lobe of his left ear





PAPER CASTLE IN THE AIR

By ROY L. ABBOTT

A WORKER wasp of the genus *Vespula*—the kind known as the bald-faced hornet—was making her first hunting trip of the day. Since dusk of the night before she had remained quiet, along with her numerous sisters, in the home nest, a paper castle in the air. It was a gray, half-bushel-size Chinese lantern sort of thing, hanging lightly from the end of a thorn apple branch perhaps 200 paces from where she now was.

Hungry from her long fast, she quested patiently for some insect upon which she might pounce. Her thick black and partly yellow-banded body, three-quarters of an inch long, gleamed in the sun as she flew slowly back and forth low over the tops of the weeds. She hunted, it seemed, chiefly by sight, but although her great eyes made up a large portion of her head, they were apparently best adapted to close-range work, for several times she darted upon what appeared to be a victim only to have it turn out to be a bit of wood or a dark spot upon a leaf. But she made no mistake when she swooped like a hawk upon a big blue-bottle fly whose body showed sharply clear against the freshly cut surface of a stump.

Sweets were the diet usually preferred by "*Vespula*" (if we may give the individual wasp a name to which all members of the colony are entitled). But now, as if hunger for flesh had for the moment overwhelmed her, she seized the fly and winged her

way to a near-by twig. Unlike her cousins the solitary wasps, which anesthetize their victims by stinging before dragging them to their nest, *Vespula* killed her prey by biting. She tore away the fly's head and wings and legs and abdomen, before finally regaling herself upon the remainder—the solid muscles of the thorax.

She did exactly the same thing with her next victim, another blue-bottle, except that this time she did not eat the remains. Instead, she carefully chewed the fly's heavy thoracic muscles into a pulpy mass, and holding this ball of flesh—a sort of insect-burger, so to speak—firmly in her jaws, she sprang into the air and headed for the home nest. Hundreds of her sisters had also been abroad that morning, and soon she found herself merely a unit in a great double stream of wasps traveling to and from their paper castle. It was as if the nest were a great hangar, and each worker wasp a transport plane. Some, laden with supplies, were delivering their burdens, while others, having discharged their cargoes, were now setting forth on a new trip.

But not all of *Vespula*'s sisters had been on the hunt for meat that morning. Adult wasps eat a great deal of sweet foods, particularly fruit juices, sap from trees, and nectar from flowers, and even now some of these home-going foragers were heavily gorged with such provender. On arrival at the nest, they would disgorge

most of this to feed the queen and nourish those workers that had remained behind to do the general housework of the castle and to act as nursemaids for the developing brood.

Still others, who flew along with *Vespula* on the homeward trip, carried neither meat nor plant juices. Instead, each bore in her jaws a dark pellet, a mass of paper pulp; for these workers were the paper makers, the nest builders, and general repair squad. Save for the first tiny comb that the queen herself had contributed, these workers in wood pulp had built the whole great paper castle, and it was their present job to keep it in repair and make whatever additions were required.

Their paper-making process was simple. All that was necessary was to find a bit of weathered wood, say an old fence rail or post, chew up a mouthful of this, all the while mixing it well with saliva, and the ball of gray pulp thus produced was ready to be spread. Once at the nest, the paper gatherer simply placed her wet ball of pulp against an unfinished surface—the edge of a comb or a wall of the nest—bit it sharply to fasten it in place, then walked slowly backward, smearing it out into a long thin strip which required only a further bit of patting and biting to smooth it into permanent form. And then away for another load. Thus had the whole castle been constructed.

When *Vespula* arrived with her

cargo, she entered the castle's one and only gate—a two-inch hole near its base—and climbed rapidly up the inside of the wall to the top floor. For, strangely enough, although appearing from the outside as if it were one great hollow shell, the castle really was a huge tenement house with five floors. Each floor consisted of a circular comb nearly a foot wide, suspended from the one above it by strong paper columns. Stranger still, when *Vespula* reached the top floor of the castle, she had really arrived only at the first floor, for in this topsy-turvey home of the wasps, the top floor or comb had actually been built first. The second floor had been added below it, and so on down to the fifth and last. It was this interesting fact that had led the Laputan philosopher, in *Gulliver's Travels*, to suggest to Gulliver that men should build their dwellings in similar fashion—first build a roof, he said, and then add the rest down to the basement as needed.

And delightfully consistent with all this "upside-downness" was the arrangement of the castle's floors or combs. For unlike the combs of the honeybee, which are double and placed vertically so that the larvae lie in a comfortable horizontal position, those of the wasp castle were single and bottom side up, so that the eggs and young larvae had to be glued to the bottoms of their hexagonal cells in order to remain there. The largest grubs appeared to hang precariously only by means of their wide heads, which apparently wedged them in.

But *Vespula* and the two or three dozen other workers who chanced to be on that floor for the moment, and whose task, like hers, was to feed the larvae, apparently saw nothing queer in the arrangement of things. Upside down and with a meat ball in her jaws, each crawled slowly across the comb doling out her "insectburger" bit by bit into the mouths of the hungry grubs. It was a seemingly endless job, requiring many long trips daily for each huntress, but it was not entirely without compensation. For unbelievable as it may appear, the worker wasps—as is also the custom among their relatives the ants—exact a toll from the larvae in return for the food given them; the toll is a sweet and abundant salivary secretion given off freely by the larvae, usually in response to a mild biting or tapping of their faces by the workers. This strange "you feed me and I'll feed

you" relationship was probably the strongest of the ties that bound the wasp colony together.

The fat helpless grubs which *Vespula* was feeding appeared utterly unlikely ever to become vigorous, 6-legged, strong-winged, pugnacious creatures like herself. Yet barely two weeks before, each had been only a tiny, white, fertile egg, glued there to the bottom of its cell by the queen mother who had produced it. Now, as full-grown larvae, each would spin for itself a silken cocoon, the upper end of which would serve as a cap to the cell. Here, in the privacy of its paper case, each would unwittingly perform all those marvelous chemical and physical changes necessary to transform it from "worm" to fully developed insect. And when it had finished the nearly month-long tenancy of its cell, that cell would be quickly renovated by a worker and prepared for a new occupant. As long as the queen reigned, there were no empty cells in this paper castle of the air.

But all these wonderful transformations from tiny egg to winged adult insect were hardly more remarkable than the changes that had taken place in the castle itself. Now, in the month of July, it was a more or less heart-shaped bag, 16 inches long by perhaps a foot wide, swathed in gray folds of paper like an oriental turban and peopled by many hundreds of industrious, warlike citizens. But in early spring of that year, it had been scarcely the size of a golf ball with a short funnel-like extension at the bottom and with no inhabitants save the queen who had built it. And but a month before that, even this golfball-size structure had not existed except potentially in the body of the queen, who at that time, in the manner of all social-wasp queens, lay dormant and half-frozen in the center of a pile of cordwood, her jaws firmly gripping a hickory splinter as if in pathetic fear of being carried away while she slept.

Warm days had finally come, however, and the queen had at last roused herself and ventured forth from her winter's hiding place to feed in the sunshine upon the early spring flowers. She had been born in the late summer of the year before, and since she had hibernated shortly after mating, she had never had any experience in paper making, nest building, or in raising a family. But, as John Burroughs put it, "Nature had been wise for her," and she soon set to work

gathering wood pulp, with which she built a small circular comb. This contained a dozen or more cells surrounded by a spherical wall of several envelopes of paper. The whole beautiful structure, the so-called queen nest, hung like a tiny paper lantern from the tip of a thorn apple branch. In each cell, she placed a fertilized egg; and when these had hatched into larvae, she made many long hunting trips to capture insects upon which to feed them. And when this first brood of worker wasps came forth from their cocoons to take over affairs, the paper castle in the air may be said to have had its real beginning. The tiny "queen nest" had been its cornerstone, so to speak, but from here on the ceaseless labor of this first brood of workers and many succeeding ones had brought the castle inch by inch and by way of constant remodelings to its final great size.

But from the very inception of this paper castle in the air, tragedy (at least from the human point of view) had been inherent in the lives of its people. For Mother Nature, far more niggardly in her gift of days to the wasp tribe than she had been to their near relatives, the ants, had granted, even to the queen wasp, a life span of only a year, and to *Vespula* and her fellow workers, only two or three months. True, as if in compensation, she had allowed the colony, in late fall, a brood of drones and queens, and these had set forth to mate, the males to die in a few days after mating, and the fertile queens to hibernate over winter.

Yet this brood of young males and queens—the only hope of this colony and of others like it—had hardly matured before the old queen died, completely exhausted from her labor of laying some ten thousand eggs. And following her death, *Vespula* and the rest of the remaining workers died one by one, many never returning from their final trips after paper or food.

Thus it came about that in late October not a wasp sallied forth to challenge the human observer who stood close under the thorn apple and tentatively and somewhat timorously touched the great nest with a stick. For the paper castle in the air was then deserted, and the wasp population of that neighborhood existed only in the bodies of the hibernating queens who, hidden away in a hundred out-of-the-way crannies, waited the coming of another year.



The life cycle of a **Paper-Making Wasp**

By PAUL GRISWOLD HOWES

Curator, The Bruce Museum, Greenwich, Connecticut

Wasps made paper from wood pulp long before man did. The procedure is a routine part of their nest-making and therefore forms a vital feature in their reproductive cycle. The following photographs show the process as conducted by a member of the genus *Polistes*. The first photograph is of a living insect, as are those of the larvae, pupae, and eggs. The others are from dead or torpid insects

▲ IN THE SPRING, fertile queen wasps scrape balls of pulp from old weathered lumber or dead limbs of trees, to make their spring brood nests, small in the beginning as shown in this photograph. Actually the wasp works upside-down, but the photograph has been inverted here so that it may be studied more conveniently

THE BACKGROUND of this page shows how a weathered bit of lumber looks through the enlarging camera after a wasp has scraped it for wood pulp



◀ THE QUEEN, having been fertilized in the fall and hibernating in that condition, lays her glistening eggs in the paper cells she has fashioned, one in each. She raises this first brood herself, feeding these young from day to day on such delicacies as nectar and chewed-up insects. Here again the photograph has been intentionally inverted

➤ AFTER THE FIRST brood of workers is raised by the queen, she ceases work on the nest and confines herself to egg-laying. All other labor is attended to by her first and succeeding broods of workers. Here we see an opened and much magnified nest containing several eggs. Note the coarse but strong texture of the wasp-made paper, which withstands all kinds of weather



◀ YOUNG WASPS are footless grubs (*right-hand individual*). After they are fed for some time by the older wasps, they turn into pupae—delicate and soft, but otherwise perfect wasps (*left-hand individual*). The full-grown larva, before changing into a pupa, caps the cell with silk, as indicated by the arrows

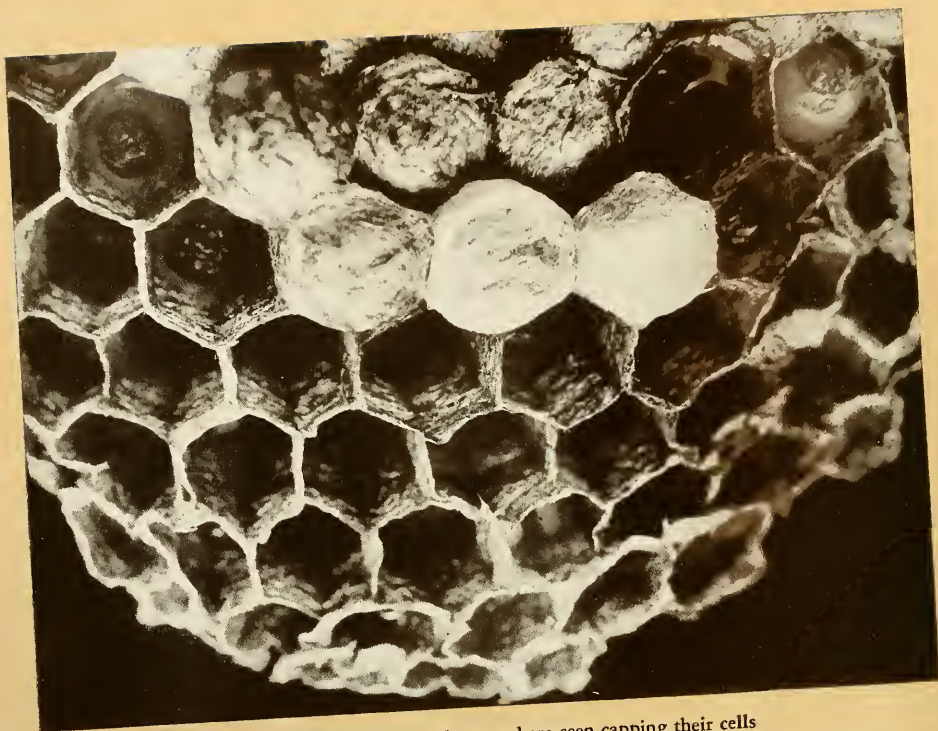


▲ AS THE COLONY grows, the busy workers continue to add paper, cell after cell, to accommodate the queen's many eggs and offspring. Here is a worker that has just arrived with a large ball of wood pulp, which, when mixed with the insect's saliva, becomes tough gray paper. The photograph is inverted



▲ BY MID-SUMMER the paper cells are crammed with larvae, each of which must be fed every day

and many times each day. Still more broods mature and pitch in to help; but now fall is approaching



▲ THE FINAL broods of the year, here seen capping their cells with silk, will emerge before frost kills off the workers. These final wasps of the season will all be queens and males



▲ HERE IS PORTRAYED the completion of the cycle as the queens and males emerge from their cells (photograph inverted). These insects now pair, and the males die soon after-

ward. The fertilized queens crawl into safe hiding places for the winter, to emerge in spring and start new colonies single-handed again, as shown in the first picture

ANTARCTIC NURSERY



By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

THE ice that covers the bays and inlets of Antarctica is the nursery for the baby Weddell seals. Early in the southern spring, the first part of October, the females come up on the ice. For about a week before their babies are born they spend most of the time lying about and sleeping. The young seals are large at birth, half their mother's length or more and about 75 pounds in weight. The mother stays with her baby the first week, then goes into the water to catch fish. The young ones grow rapidly; by the time they are ready to be weaned, after about eight weeks, they weigh about 300 pounds. The mother seal loses just about that much weight during this time.

The baby seals enter the water when they are only a little over a week old. At first they swim with their mother in the shallow pools on the bay ice. Mother and young play and roll about in the water. Sometimes the mother supports the young seal, sometimes she pulls it under and if her

baby does not want to go in, she may catch it by the neck and pull it in.

The young seals are pale gray, lighter below and faintly mottled, while the adults are shiny, dark iron gray above, streaked and spotted with yellowish white below. From nose to tail a large one stretches nine and a half feet and may weigh nearly a thousand pounds. Their heads are rela-

tively small and so are their flippers. All year around the Weddell seals live in the bays where the ice is permanent. They feed on fish of various sorts, chasing them under the ice. They must be successful at this, for during the winter the seals get extremely fat.

Although they have to breathe like we do they stay in the water under the ice all winter; it is decidedly warmer here than on top of the ice, with the storms and bitter wind. Killer whales, the chief enemy of the seal family, can not go far under the ice; although they resemble fish more than seals do, they cannot breathe under ice. The seals get air even though the ice may be eight feet thick. As the cold increases, ice contracts and cracks with noises like cannon shots. The seals come up in these cracks and chew through the ice that forms over them. Their strong, peglike teeth project forward. Weddell seals use these teeth like a drill, twisting and swinging the head, with the mouth wide open, and they rasp through several inches of ice in a short time. The snow forms deep drifts over the blow-holes and hides them, but seals can be heard frequently throughout the winter.

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WEDNESDAYS over WNYC and

WNYC-FM

from 3:30 to 3:45 P.M.

Science for the Seven Million

Conducted jointly by Lucy Clausen and Julius Postal

Feb. 7—*Science in the News*

Feb. 14—*Romantic Animals*

Feb. 21—*Early American Scientists*

Feb. 28—*Thawing Out*

THURSDAYS over WNYC and

WNYC-FM

from 8:15 to 8:30 P.M.

Science for Freedom

Conducted by Julius Postal

This program presents answers to questions covering a wide range of topics in natural science.

NATURE THROUGH THE CAMERA'S EYE

By RICHARD L. CASSELL

▼ A DESERT TORTOISE: *Gopherus agassizii*



► PORTRAIT OF
A BARN OWL



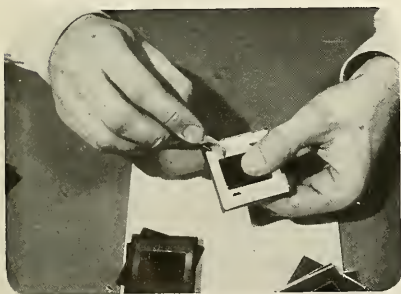
◄ HORNED TOAD:
Ptychocheilus cornutus



▲ **MOUNT** your best Kodachromes between glass for protection and to ensure uniform focus in the projector. To remove the film from its original cardboard, peel the mounting apart along the edge opposite the fold



▲ **AFTER RECORDING** the title, location, date, and number of the photograph on the paper mask, sandwich the film between carefully cleaned cover-glasses. Bind the mounting with an 8½-inch length of tape



BEFORE PRESSING the tape firmly in place, cut the corners with a razor (*above*) or snip them off with scissors (*below*). This is to make them lie flat



THE great pleasure of Kodachrome photography is viewing the results. Nothing is more beautiful than a well-exposed, nicely composed, sparkling color transparency. You see more in the slide than you ever saw in the real subject.

Often you invite friends to enjoy your slides with you. Naturally you are thrilled at seeing the woodland scenes, close-ups of flowers, various vacation shots, and the rest of your collection "blown up" on the screen. After the show, the guests may turn and say, "Great stuff, Old Man. Certainly must make you feel good to have a group of pictures like that. Well, must be running along now—hard day tomorrow."

To show color slides properly entails honest-to-goodness work. There is plenty of drudgery, repetitious at that, but well worth the effort, because your friends will say, "That fellow really knows how to put on good entertainment. If he ever invites you over some evening, by all means go."

The spectator is interested only in the result, but in order to produce a show (and that is exactly what you are doing) everything must be organized. The slides must be arranged, and a script or outline prepared. Projector, screen, and seats must be properly placed, and you must know where the house lights are located. During the first few performances, you may become tangled in the cables or seat Aunt Esther of the high hair-do directly in front of the projector, but that is one way to learn.

The first step is to select the pictures. Before you do any trial projecting, exclude those that are over- or under-exposed and those with poor composition. The ones that are left should be thrown on the screen and further reduced in number.

The good pictures should be mounted between glass. Why not leave them in the cardboard mounts? Good slides deserve protection from finger marks, atmospheric changes, and heat buckling. It is easy to clean glass but very difficult to clean the delicate surface of color film.

*Make a good
showing
for yourself*

By **THANE L. BIERWERT**
*Acting Chief, Division of Photography,
The American Museum of Natural History*

Work out an assembly line method for the work of mounting. Lay out as many masks as you have slides to mount and write on each the title, location, date, and catalogue number, if you have that many slides. Remove the film from the cardboard mounting, peeling it apart along the edge opposite the fold. In cleaning the cover-glasses, use one of the window cleaning preparations; this is easier and quicker than using hot water and soap. Sandwich the films between the cover-glasses, being careful to brush off the inside surfaces to remove lint and dust. Cut several lengths of tape eight and one-half inches long, laying them parallel on the table, and then start binding. Don't forget to paste a star or other adhesive marker at the lower left-hand corner to show where the thumb grasps the slide in putting it into the projector.

This is a pleasant pastime for those long evenings, and winter is an excellent season for it because the air is dry. Slides mounted in humid weather cloud over when heated up in the projector.

An assortment of mountings—plain cardboard, glass with cardboard, glass with standard mask, and metal bindings—require individual focusing. Some fit snugly, others jump around in the carrier. Uniform mounting will make the performance run smoothly from start to finish.

▼ **SEVERAL WAYS** of labeling the slides on the outside are shown here. The star or dot indicates position of thumb in inserting the slide in the projector. The number also establishes sequence. These labels can be changed without taking slides apart



Now comes the important task of arranging the sequence. First group all similar slides in separate piles and plan your show. If the story is about a trip you made, follow a chronological order. Arrange a selection of slides to illustrate a typical day of your adventures photographing wild life. Or, project a series showing changes in autumn foliage that you recorded the past fall. Never, under any circumstances, blindly project box after box of slides regardless of subject. Have an interesting and appropriate explanation for each slide. Experience with the reaction of your audience will help you to build up toward dramatic effects.

In all probability most of your shows will be for the family and for interested friends. Arrange your theater before your guests arrive. When you go to the movies, you don't find the workman still hanging the screen. For small audiences a screen with a smooth, white, matte surface is preferable because at close range a beaded screen throws back a glare. Place the screen slightly above the eye level of your audience and seat them about halfway between the screen and the projector, because this position most nearly duplicates the camera position and angle.

As soon as the first picture is on the screen, check your focus and speak your piece. Never hurry on to the next slide, but don't linger too long either. Allow your audience enough time to take in the contents of the picture, depending upon its importance in your story. When you change to the next slide, take about one second to make the transition; scientific experiments have determined this as the best interval. Do not zip your slides across the screen or you will have a headache-y audience wishing for the end of a jumpy show. And be sure your projector is anchored so that the picture is rock-steady on the screen.

Who knows but that you may have the makings of an Elmendorf, a Stoddard, or a Burton Holmes. After you have organized a few first class family shows you will find that they are in great demand by the local Women's club, Boy Scout troop, or Masonic Lodge.

MINIATURE ANIMALS

A new exhibit of the unique collection of miniature animal sculptures modeled by Louis Paul Jonas, taxidermist and artist, will remain open to the public at the American Museum of Natural History until February 18. Each model is one-tenth life size and scientifically accurate in every anatomical detail.

Mr. Jonas has created his sculptures in characteristic attitudes of the living animals. A zebra guarding her young colt, a pair of bull moose locking horns in battle, white sheep leaping rocky crags, and a baby kangaroo looking out at the world from his mother's pouch are only a few of more than 100 lifelike miniatures.

Mr. Jonas' work as a taxidermist and sculptor of full-size animals is represented in many United States museums, and with this knowledge of animal anatomy he began, some ten years ago, to reproduce in scale miniatures the outstanding wild life of the world. What started as an interesting workshop hobby soon became a full-time job. Children's museums of natural history, schools, colleges, universities, and institutions for the blind use them as "three dimensional pictures" in the study of natural history, in miniature habitat groups, and in more highly specialized exhibits on comparative anatomy.

After study of anatomical records, action photos, and motion pictures of an animal, Mr. Jonas works an average of two weeks on the original sculpture in clay. A plaster mold is then cast from the clay sculpture, and plastic is forced into the mold by compressed air. When the plastic hardens the mold is removed and the miniature is painted in the distinctive coloring and markings of the animal. Horns and tails, being of latex, are unbreakable.

Mr. Jonas' studio is undoubtedly the most unusual in the world—an old, abandoned

railroad station in Mahopac, New York. The former waiting room now serves as the modeling studio, and his office occupies the ticket-agent's compartment.

The exhibit was arranged under the direction of Miss Katharine Beneker.



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If readers of NATURAL HISTORY have specific questions regarding photography in the realm of natural history or science, we shall be glad to try to answer them.—ED.



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LETTERS

Continued from page 49

the air, but after going a little way, the goose fell away from him and dropped to the ground. I then rode over to where the goose lay and found him practically dead. I would judge that the goose weighed at least five or six pounds.

R. O. BLISS.

San Francisco, Calif.

* * *
Correction

The Indian rock shelter depicted in a model on page 462 of the December 1944 issue of *NATURAL HISTORY* was unfortunately described as being located near Armonk, New York. The rock shelter shown was actually found near the northern end of Manhattan Island, in Inwood Park.—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.

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SCIENTIFIC SPECIMENS FROM THE WAR ZONE

Many Americans in service in the South Pacific become interested in the strange or highly colored fishes of those waters. Frequent letters come to the American Museum describing or asking for information about them, and occasionally a few specimens are forwarded to add to our collections. The most interesting such addition so far received is a shipment of freshwater fishes from New Guinea, which reached us some five weeks after being mailed by Lt. Otis Barton, U.S.N.R.

Fresh-water fishes cannot cross the sea, and Australia and New Guinea

MUSEUM FISH PORTRAITS ADORN SUBMARINES

SEVENTY-THREE famous American men and women are honored by inclusion in the Hall of Fame, but more than twice that number of fishes have been given individual underwater art galleries. These are the fishes after which submarines in the United States Navy are named.

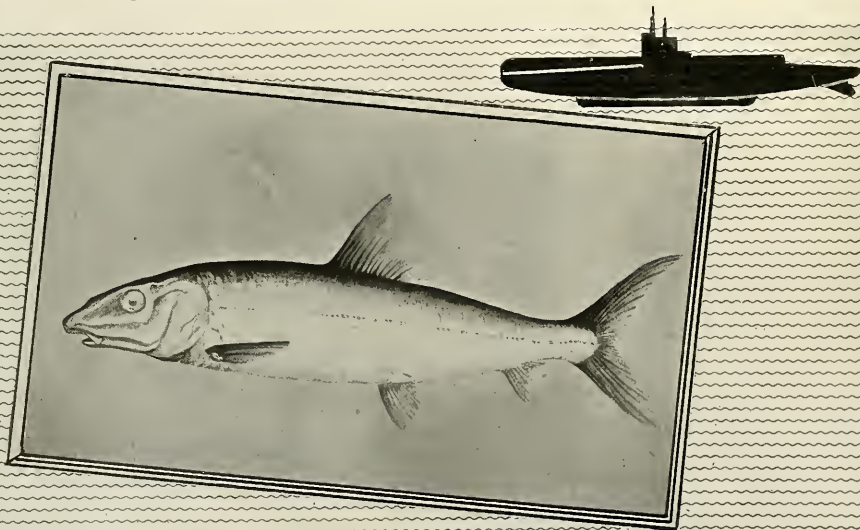
Some months ago the American Museum

of Natural History was asked to assist in providing authentic fish portraits for new submarines. To date, the artists of the Museum's Illustrators' Corps have contributed between 70 and 100 scientifically accurate paintings. As many more have been done by staff artists employed by the ship yards; and the American Museum's Department of Fishes has been

instrumental in providing much of the necessary information.

How many fishes have been honored in this way is the Navy's secret. The one photographed here just before being sent to sea is the Macabi. But many of the "totemic" fishes will have to content themselves for the present with the admiring glances of their own crews.

THE MACABI, namesake of a submarine: one of the many fish portraits provided by the American Museum for undersea craft



have been separated so long from the continent of Asia, that continental fresh-water fishes such as the carp family, abundant enough in the East Indies, do not occur there. There are, however, numerous small fresh-water species, representative of marine families such as the cardinal fishes (Apo-gonidae) and of *Melanotaenia* and related genera, singular little fishes which are probably derived from the marine silversides (Atherinidae).

Lieutenant Barton writes that these fishes were collected in rather shallow water of a deeper lake with dynamite, and describes going to the lake to collect them as follows:

"It was all clear from camp, a valley clad in tropical forest, on the bottom of which a fair-size stream cascaded among crystalline boulders. Farther down the forest thinned out, and the stream meandered into a lake. I figured that I could walk to it in two hours, but it actually was to take four.

"At first I scrambled down a steep forest-clad bank. Footprints and rootings of wild hogs were apparent in the mud. I soon connected with a tributary stream and climbed down a rocky stairway along its bed. A flock of butterflies were sunning themselves on a boulder. Their markings were browns, grays, and whites; none of the giant blues were here.

"The tributary led to the main stream, where I had a refreshing swim, and proceeded. . . .

"Further on my way I saw a pair of strange birds slowly patrolling the edge of the jungle from the air. To me they seemed to have the beaks of hornbills and the trailing legs of herons. Down on the flatter country a massive form hopped away through the cover. Far downstream I met four bronze-black natives. They had been digging for something in the stream bed,—maybe gold. They took a great fancy to my wrist watch. Fingering it, they remarked 'Ticketon, ticketon.' I felt a little apprehensive, but then thought of beckoning upstream and waving to an imaginary escort. Soon I was well past the natives."

Censorship does not permit Lieutenant Barton to mention the specific locality where he secured the fishes he sent us. Among the specimens, a goby and two or three individuals belonging to the *Melanotaeniinae* still retained their bright colors as in life, and a sketch has been made of them for permanent record, as fishes lose color in preservative.

Lieutenant Barton hopes to study the specimens he is sending after the war.

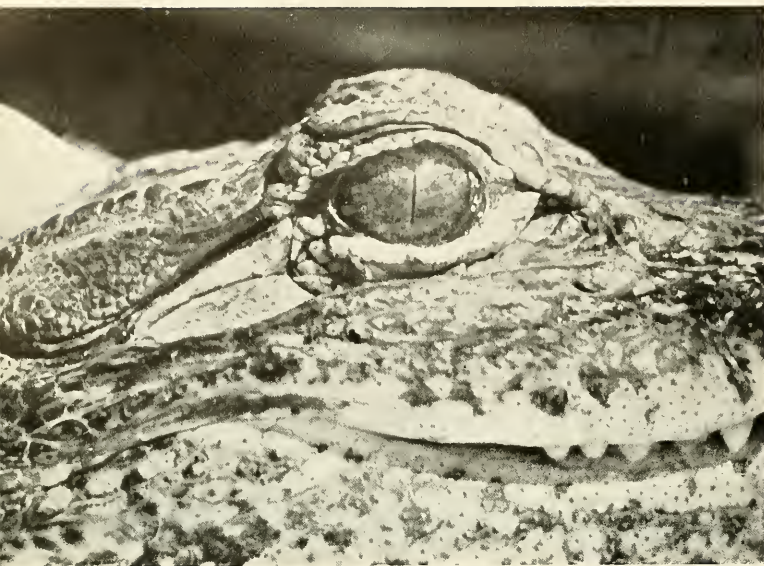
J. T. N.



▲ NATIVES of Netherlands New Guinea in an outrigger canoe: a scene from the region in which Lt. Otis Barton collected the fish described in the accompanying note

▼ NAVY MEN inspecting a Moorish Idol, a peculiar widely distributed tropical Pacific fish. Its arrival at the American Museum is expected in another shipment of scientific specimens collected by Lt. Barton, on duty





▲ THE ALLIGATOR'S EAR is so well hidden by a flap of skin that many persons familiar with the animal do not know where it is located

Where are the 'Gator's ears?

SIRS:

"The Saga of Oscar the Musical 'Gator'" in which Dr. Frank A. Beach described the reactions of a captive alligator to various sounds (NATURAL HISTORY, December, 1944) prompts me to submit the enclosed photographs. During the past summer I spent a month, with Dr. Edwin H. Colbert and C. M. Bogert of your scientific staff, at the Archbold Biological Station in Florida. We were studying the effects of heat on alligators and therefore were not particularly concerned with their hearing. However, during the course of our work we discovered that virtually no one, including experienced hunters, knew where the 'gator's ear was located even though hunters often resort to grunting in order to draw these large crocodilians from cover.

As may be seen in the photograph, the ear is situated behind the eye and rather high on the head so that it is not submerged when the alligator lies on the surface. The relatively enormous tympanic membrane or "ear drum" is securely hidden by a flap of skin that serves as a valve. When the reptile goes beneath the water the muscular flap tightly closes, presumably excluding water. But when the 'gator comes out of the water the muscles relax and a slit is apparent. Doctor Colbert noted that immediately after coming to the surface, 'gators sometimes vibrate these flaps, apparently to shake off any water that remains on them. When the flap is lifted with the thumb, as can be seen in the photograph, the tympanic mem-

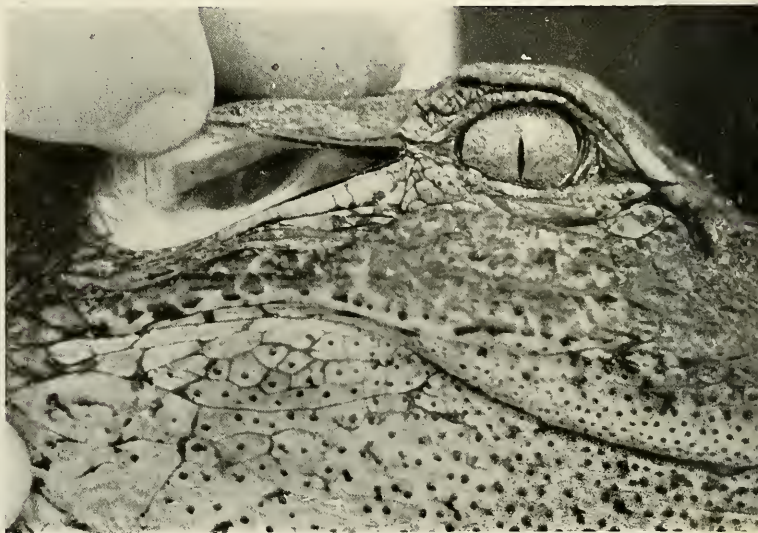
brane is readily apparent, and even the cartilaginous connection leading from it to the stapes is dimly visible through the transparent tissue.

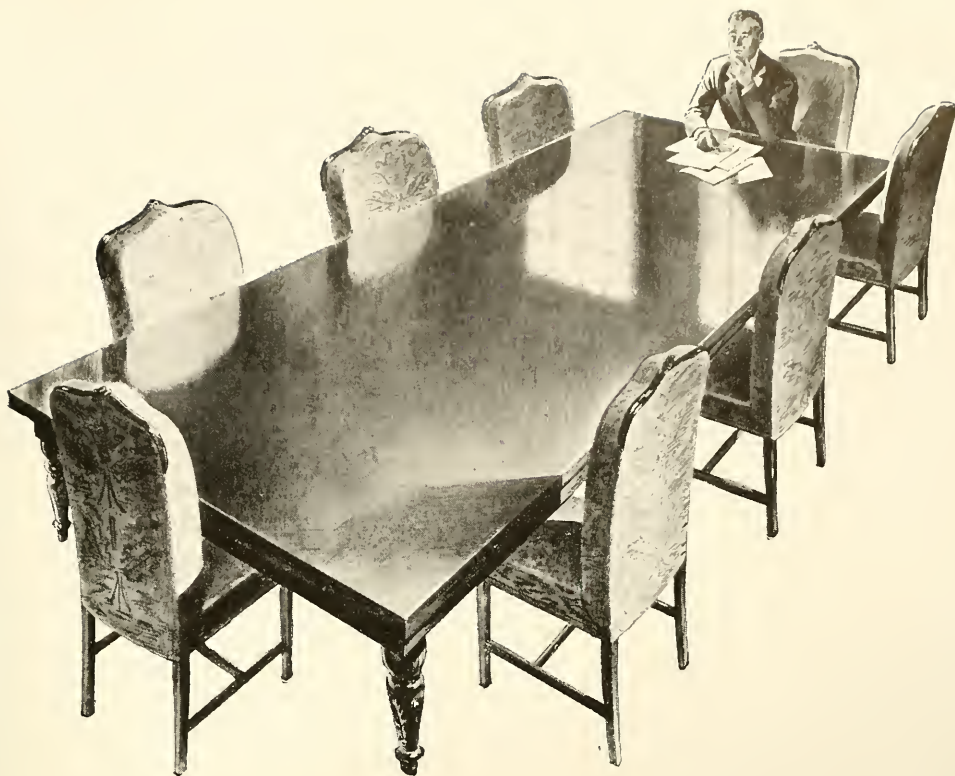
Presumably the sunken position and the flap provide the protection necessary for such a large tympanic membrane. Its size is possibly associated with more acute hearing than that found in most other reptiles. 'Gators evidently hear both under water and on the surface. During our stay in Florida we heard accounts of 'gators that had learned to respond to calls. While visiting the Caloosahatchie Canal the Lockmaster, Mr. Fred Flanders, provided a demonstration. For several months he had been feeding a five-foot 'gator from his boat landing. Although he had already fed it the day we arrived, he went to the edge of the landing and called "Toby!" a few times. Within a few seconds the reptile came up from the depths and rested on the surface until Mr. Flanders threw it a slice of bread, scarcely its normal food. However, it swam forward a foot or so, seized the bread, and then dived. A short time later it came to the surface several feet away, still holding the bread in its mouth.

Alligators are indeed among the more interesting reptiles, and we were pleased to learn that the State of Florida is taking serious measures to protect them. Perhaps Doctor Beach's excellent article will stimulate even more interest in these relics of a bygone era.

RAYMOND B. COWLES,
Department of Zoology,
University of California,
Los Angeles, California.

▼ BUT WHEN THE FLAP is raised, the 'gator is seen to have a large ear drum, which may help to explain the creature's acute hearing





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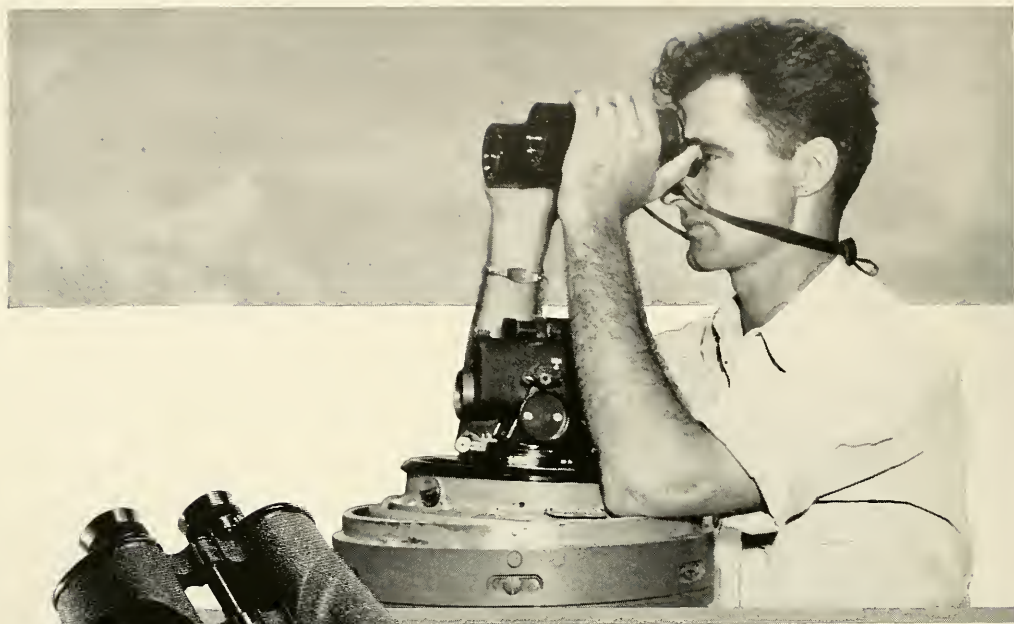
Now is the time to make your plans for peace of mind. It's something you owe yourself . . . owe your family. Buy War Bonds and hold onto them!



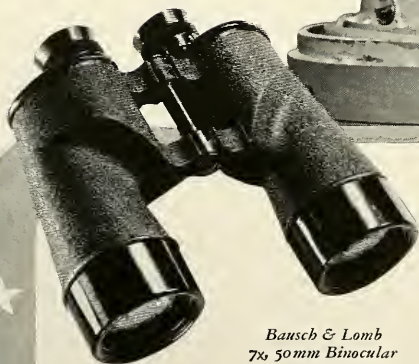
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by Vera Kelsey

LETTERS

SIRS:

... All five of us in my home and many of our friends enjoy the *NATURAL HISTORY*. It is one of the few magazines whose old copies we keep and treasure and refer back to from year to year.

This past year we have especially enjoyed the articles on the voyage of the "Askoy," partly because of the excellent way they are written and partly because some of the phenomena described have counterparts in Hawaii. We, too, have our wet and dry coasts. With us, too, the sea will show different colors where the depth, temperature, or other conditions vary. Off our eastern and southern shores we have seen areas something like Dr. Murphy's "dancing waters" and smooth slicks over which the sea birds hover.

The "dancing waters" as viewed from cliffs on shore appear as small areas of normal water that have been roughened with a giant file, or as if some huge sea monster were playing just below the surface and distorting the normal shoreward set of the waves.

The cause here is purported to be the impounding of large quantities of subterranean fresh water through outlets along the steep submerged cliffs close to shore. Because of the height of our mountains and the heavy rainfall, this fresh water is said to come out with considerable force and, being lighter in weight than the salt, to rise and disturb the normal currents along shore. However, I have never been able to reconcile this explanation with the relative coldness of the fresh water, the heavy undertow that exists all along this coast, and the lack of pressure in the water in wells bored not far inland.

No explanation has ever been given me for the slicks, nor why they should seem to contain more life than surrounding areas of ocean. No explanation has been given either of the long slow swells which sometimes pile in irregular "tides" at times when the seismographs indicate no earthquakes.

If the true explanation for these is known and can pass the censor, may we have it in some not too distant issue of your magazine? If it is not known, then I think it would be fine if the "Askoy" and her staff would study Hawaiian waters more thoroughly after peace comes again.

HELEN S. BALDWIN.

Hilo, Hawaii

* * *

The following answers to the questions in Helen S. Baldwin's letter are offered by Dr. Robert Cushman Murphy, who also expresses his appreciation for her gracious remarks about his articles on the Askoy Expedition:

Two of the correspondent's questions are, fortunately, rather closely related, because they concern the pressure or weight of water and air respectively.

Hawaii has, indeed, extremely strong

contrasts between wet and dry coasts, the rainfall on certain islands being of world's-record proportions on the windward side but almost negligible to leeward. Yet I am confident that the true explanation of the "dancing water" seen offshore has nothing to do with *subterranean* water pouring into the sea. It is certain that the bulk of rapidly running fresh water on the islands is carried in *surface* streams, and that most of the water underground flows downhill only by a process of seepage.

"Dancing water" may be caused by friction of several kinds, one of which results from wind whipping the surface against a tidal or other current. It may also be produced along the borders of two surface currents having different directions and densities. The latter word, which is equivalent to weight, refers to different temperatures or different salt content in the two masses of water. A third cause may be "upwelling" from a layer of deeper ocean water through a surface layer of different density. Such phenomena are possible because the ocean is made up of stable and stratified layers which, owing to their different densities, do not mix readily. Due to rapid evaporation and cooling at the surface, the relative weights of superimposed layers sometimes get out of balance or become inverted. This may result in a more or less violent overturn, of which "dancing water" becomes the visible expression.

Slicks on the ocean are usually to be attributed to living organisms. Sometimes the excreta of fish, porpoises, or whales make a microscopically thin film over a considerable area of surface. Also, the mere presence of a very large school of fish, or even of smaller creatures, has the physical effect of disrupting wave action. The resulting smoothness of the surface, when contrasted with surrounding rough water, sometimes resembles an oily slick.

The long, slow swells are related neither to local winds nor to earthquakes, but represent what are known as "barometric waves." They usually come from a distance and often pile up as enormous breakers on continental or island coasts. It is difficult to think of air as a heavy substance, and yet its weight on the surface of the ocean amounts normally to about 14 pounds per square inch. When the barometer falls, the air weighs less, and when it rises, the air weighs more. Rapid changes in atmospheric pressure therefore cause depressions or rebounds of the surface of the ocean, and these are sufficient to produce swells that travel very rapidly for hundreds or thousands of miles.

Casablanca, where our troops first landed in Africa, is a famous place for barometric swells that have their origin in middle latitudes of the North Atlantic. Before the war a regular meteorological service existed for the purpose of predicting the "surf days" on the African coast.

Continued on page 140



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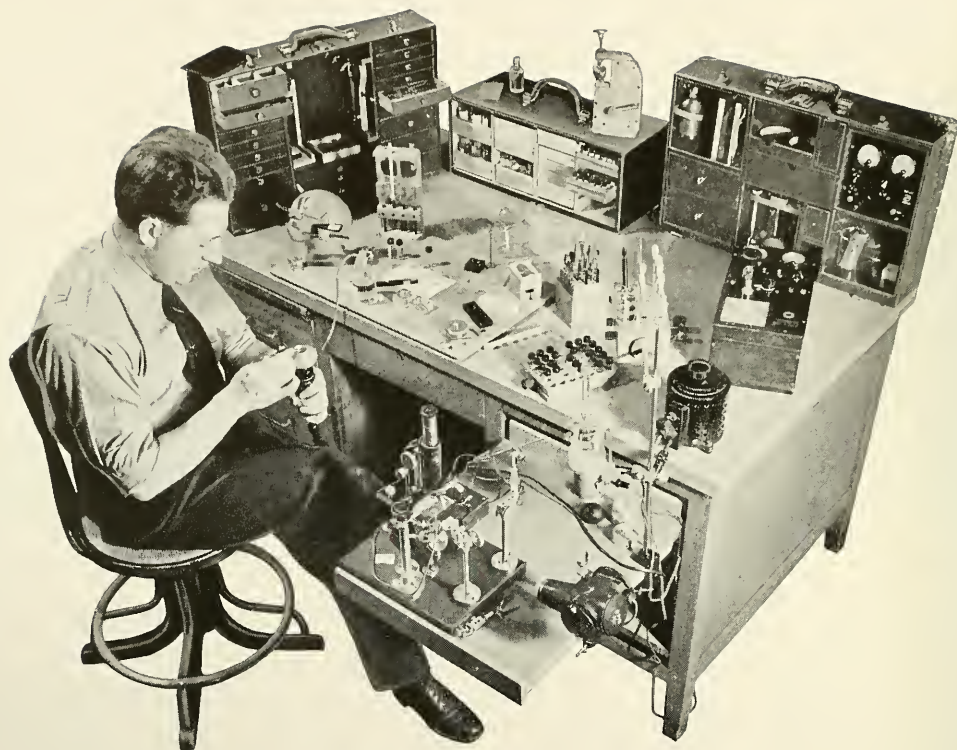
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The Magazine of the American Museum of Natural History

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MARCH, 1945

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THE CANADA GOOSE on this month's cover was photographed by Henry B. Kane, whose outstanding work is familiar to readers of NATURAL HISTORY. This Kodachrome not only shows this fine goose to good advantage but also illustrates some of the hazards of nature photography. To quote Mr. Kane, "The shrub growing up beside the nest looks like a dead alder, at casual glance. So did lots of others sticking out of adjacent hummocks. I pulled the boat through by grasping them firmly, and held the boat still by wrapping an arm about one. Too late, I discovered they were poison sumac!"

The Canada Goose is well known as a harbinger of spring, and nature lovers in North America eagerly await the first sight (or sound) of the V-shaped flocks powerfully winging their way northward. There is no surer sign that winter is on the way out. These geese formerly nested much more widely than at present, for the opening and draining of new lands have driven many water birds to more restricted areas in the north where they may still find conditions to their liking and where they have a chance to survive and rear their young. There are some portions of the northern United States where the Canada Goose may still nest sparingly—a shadow, only, of the former vast flocks that made their summer homes in that region and even farther south.

The nest is built on land or in shallowly watered terrain, sometimes on muskrat houses or on hummocks like those shown in this photograph. It is lined with down and may contain from four to six creamy or greenish white eggs, rarely as many as twelve. Twenty-eight or thirty days are required for incubation.

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YOUR NEW BOOKS

SOUTHWEST PACIFIC BIRDS • HONEY • WOLVES
LATIN AMERICA • ANTHROPOLOGY OF KODIAK ISLAND

BIRDS OF THE SOUTHWEST PACIFIC

----- by Ernst Mayr
Preface by Robert Cushman Murphy
Color Plates by Francis Lee Jaques
and Line Drawings by Alexander Seidel

The Macmillan Company, \$3.75
3 color plates, 16 figures, 316 pages

OPPORTUNITY and the man did a model job when they joined hands to produce this volume. To two and a half years of field exploration the author has added a sufficient period of laboratory research in the American Museum to handle fully the details of relationships and distribution in a manner designed effectively to assist others. For the first time, therefore, we have in a single small authoritative volume a key to the birds of the Southwest Pacific. More definitely, the territory covered includes Samoa and the Phoenix Islands on the east, westward to the Solomons, and northwestward to the Marianas, an area of continental dimensions.

Dr. Mayr's skill and experience in assembling data have assisted him in presenting his facts without needless duplication and with economy of space. Wide-ranging species, like sea birds and the largely migratory shore birds, are treated respectively in Sections I and II. The Land and Fresh-water Birds are grouped systematically in Section III and geographically in Section IV. The book, therefore, serves both as a general, as well as special guide. It tells us of birds as well as of the bird life of the islands or groups whose avifauna is more or less local or insular. This arrangement should be of much assistance to the student. Dr. Mayr emphasizes the comparatively limited amount of material he has had to work with and urges others to help fill the many gaps in our recorded knowledge of the range and habits of Southwest Pacific birds, and he gives an outline to guide us in our studies.

Three well occupied color plates, by F. L. Jaques, and about a dozen line drawings by Alexander Seidel introduce us to 50-odd species of birds that we may not have met before and thereby help in our identifications. The author dedicates this attractive book to his wife.

FRANK M. CHAPMAN.

THE SCIENCE OF MAN IN THE WORLD CRISIS

----- by Ralph Linton

Columbia University Press, \$4.00
532 pages

THIS book was planned to reveal anthropology as a contributor to the solution of world problems. Of its 21 chapters, 10 were written by anthropologists, 5 by sociologists, and 6 by specialists in an equal number of other academic fields. Without exception the anthropological authors are optimistic; the pessimists are to be found chiefly among the sociologists. Obviously the contributors were handpicked, but not all groups of research problems pursued by anthropologists are considered, the topics being somewhat arbitrarily selected. In the main, the foci of discussion are the concepts of race and minorities. Numerous slogans and warnings are sounded, as, pleas for more study of human biology to prevent world collapse; defense of the thesis that all races are born equally intelligent and of equal competence; that studies of personality will save the world; that understanding the processes of culture change and man's capacity to learn will point the way to eternal peace; that the natural resources of the world will maintain man for thousands of years, though there is danger in over-population; that the Indian problems in North and South America are on their way to solution; that the greatest threat to the peace of the world lies in colonial possessions, masses of "color," hotbeds of race prejudice ready to explode, etc.

If there is agreement among these 21 contributors, it is that humanity desires individual freedom, unselfish toleration, and a blind faith in the slogan that "man can make himself after any social pattern he chooses." Not all do more than hope that this is the last war and that national aspirations can be curbed. Though the anthropologists are sure that

their science can save the world, no one of them has ventured to outline a plan of action to achieve the desired ends; their plea is for more and more research in anthropology. We suspect the general reader may find the chapters more or less difficult, since a good grounding in anthropology is presupposed.

If the statements of the anthropological contributors are truly representative, they seem to imply that there is no such reality as human species behavior. Psychologists and biologists, however, usually assume the reality of "original behavior" as an important part of the environment to which culture, or human group life, must adjust itself to realize security and the "fuller life."

C. W.

WILDWOOD WISDOM

----- by Ellsworth Jaeger

The Macmillan Company, \$2.95
469 illus., 474 pages

INDIANS are always most ingenious in making tools from the things they have. Before the advent of the white man they lived off the country, successfully hunted the wild game, fished the waterways, made boats and all the equipment necessary to live a healthy life in reasonable comfort and ease. They read the trackless waste and unraveled its mystery to the early explorers and adventurers. To the friendly Indian of the past we owe our knowledge of American woodlore.

Ellsworth Jaeger is one of the few who gathered his information firsthand and spent many summers with the Indians in the United States and Canada. His activities brought him in contact with such leaders of the great out-of-doors as Ernest Thompson Seton, Dan Beard, John Burroughs, and Kermit Roosevelt. *Wildwood Wisdom* is not just another book to read but a veritable encyclopedia of woodlore, gleaned from years of experience and research. It is a book for the experienced woodsman as well as for the vacationist who plans a trip for the first time to the trackless wilds. Mr. Jaeger describes and illustrates with countless drawings all the essential requirements for the camper.

The first part of the book covers primitive and modern equipment such as clothing, shelters, beds, fire and firewood, the use of the ax and knife, and a very clear description of camp cooking with illustrations of edible, poisonous, and useful plants and trees. The second section

NATURE ENCYCLOPEDIA

Edited by G. Clyde Fisher; five volumes bound in De Luxe Green Keratol lettered in Gilt, pages are 5 3/4 x 8 inches. Lives and habits of Birds, Mammals, Fish, Reptiles, Flowers and Trees; described by renowned Naturalists; 700 illustrations, 200 in Natural color. The Literary Mart, 8 East 33rd St., New York 16, offers this set for \$7.50, remittance with order, returnable for full refund within five days.

is devoted to the crafts and skills acquired as by-products of camp life. There are chapters on barkcraft, canoes, trail blazing, animal calls, primitive tools and weapons, wildwood medicines, camp furniture; also winter life in the woods, including toboggans, dog sleds, and harnesses. Also included are diagrams showing how to make all these intricate things, and patterns showing how to make clothing from skins.

Wildwood Wisdom is written in simple direct language that will afford hours of pleasant reading by the fireside. It contains 474 pages of text, 193 plates of nearly a dozen illustrations each, a complete index, list of contents by chapters, and an alphabetical list of illustrations.

Mr. Jaeger is a skilled craftsman as well as an author and lecturer. His ambition has been to popularize nature study, and he has done this by every means available to him. GEORGE G. GOODWIN.

THE WOLVES OF NORTH AMERICA

----- by Young and Goldman

The American Wildlife Institute, \$6.00
131 plates, 15 text figures, 636 pages

THIS book of 636 pages is an exhaustive report upon the history, life habits, economic status, and control of wolves, as well as the scientific classification of these animals. The authors are senior biologists in the Fish and Wildlife Service and have had wide experience with their topics.

Stanley P. Young, in Part I, presents a well-documented account under many headings. Full descriptions of the habits and characteristics are given and are usually illustrated by field observations. The wolf has been very widely distributed, but the range has been materially reduced in historical times. Certain natural checks, parasites, and diseases control the numbers of wolves, but through conflict with human interests man has become the dominant factor in the reduction of the wolf population.

A reader familiar with the problems of Federal mammal control and the criticism it has evoked from the conservationists will scan the writings of Mr. Young with particular interest. Such a reader will be encouraged by the following statement in the Introduction: "In the more remote parts of North America, especially in Alaska, northern Canada, and on the other extreme, even in Mexico, suitable habitats remain where these large killers can exist in no direct conflict with man. No reason is, therefore, apparent to us why they should not always be tolerated, and even accorded a permanent place in the fauna of the continent; rigid control, however, must be maintained where their presence clashes with human welfare."

Major Goldman's classification of the wolves, in Part II, is a systematic review. A revision of the North American wolves has long been needed, and it would appear that Goldman's work has brought order where formerly there was chaos. He catalogues all but three of our wolves under 23 subspecies or geographical races of a circumpolar species, *Canis lupus*, the

name given by Linnaeus to the Old World animal. For three wolves found in Florida, Louisiana, and Texas, Goldman uses *Canis niger* and its subspecies. Between the wolves of the *lupus* group and those of the *niger* group, there are rather significant differences, such as smaller size and more slender proportions, as well as distinctive cranial features.

Wolves interbreed freely; they seldom encounter a physical barrier to their geographical distribution, and anyone studying the map of the 23 subspecies of *Canis lupus* might be pardoned if he wondered whether there were actually this many identifiable races. Goldman believes all of these do intergrade but states that the distinguishing features are maintained with a fair degree of consistency over areas often of considerable extent. If he is able to correlate his material and pigeonhole specimens from a given region, then he has satisfied the criteria for a subspecies. However, I suspect that a person with one or two specimens from uncertain localities might have difficulty fitting them into the proper pigeonhole.

H. E. ANTHONY.

HONEY AND YOUR HEALTH

----- by Bodog F. Beck and

Dorée Smedley

Robert M. McBride & Co., \$3.00
12 plates, 10 figures, 246 pages

FIRST published in 1938, by the late Dr. Beck, this successful book has now been revised and enlarged by Dorée Smedley. Far from being solely an invaluable eye-opener on the enormous value of honey as a health food, the authors have compiled a far-reaching, extremely noteworthy history of the honeybee and beekeeping as practiced by ancient and modern apiarists.

Among the Anglo-Saxons, honeybees supplied the king and nation with an important food, also the famous honey drink, and wax candles. But the most fertile field in which bees played a paramount part in social, economic, and spiritual life of the ancient, lay in Egypt. German archives tell of Charlemagne's domesticating wild bees in Nuremberg forests out of gratitude because, after being stung, he recovered from obstinate gout. The Nuremberg forests were the beegarden of the Holy Roman Empire, and under Charles IV, the bee-garden of Germany.

India, China, Greece, France, the Island of Corsica, Hungary, Austria, and Slavic countries, all show early records of the part "man's best little friend" played in the production of honey: drink, light, and medicine. History states that honeybees were non-existent in two regions, Australia and the Americas, and were there imported. In the seventeenth century, honeybees were brought to America by English, Spanish, and Dutch settlers. In the nineteenth century honeybees were introduced into California. Today, the best honey producing areas in the United States are New York, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, Minne-

sota, and mountain areas of the West, and territory within 100 miles of Los Angeles, California. Florida is known for its Tupelo and Orange blossom honey.

Today, as of old, beekeepers may be either fixtures or nomadic. Ancient apiarists placed hives on boats and drifted along the Nile; today in United States, apiarists place hives on trucks, following the sun and blossoms to Florida and then North again to greet the summer.

ELIZABETH LINN.

THE ANTHROPOLOGY OF KODIAK ISLAND

----- by Aleš Hrdlička

The Wistar Institute of Anatomy and Biology, \$5.00
228 illustrations, 486 pages

KODIAK ISLAND lies along the southeastern base of the Alaskan Peninsula. Together these two land areas form a connecting link between the mainland and the thin line of Aleutian Islands that reach out toward Asia. Any wave of migrants seeking an American landfall via the Aleutian causeway would, therefore, be likely to reach Kodiak and in all probability leave some evidence of their passage. Moreover, any coastal migration moving down from the Bering Sea region might be expected to touch Kodiak on its southward course. For these reasons, the archaeology of southwestern Alaska, including Kodiak Island, has always held out the promise of harboring the evidence from which a reconstruction of the settlement of the New World might be achieved.

Dr. Hrdlička began his investigation of the Alaskan area in 1926 and for ten seasons thereafter until 1938 he spent his summers, assisted by students, digging for the remains of the folk who had inhabited those regions in the past. Five seasons were put into excavating a settlement at Uyak Bay, Kodiak Island. Acres of soil were peeled off and 2,000 years of occupation were uncovered. Two principal occupations of the site were established. The first one continued for 12 to 15 centuries and is named "Pre-Koniag" by Hrdlička. These pre-Koniag people were physically quite different from their successors, and Hrdlička is inclined to associate them with Indians, in particular with the Algonquin of the eastern United States. Their culture was of relatively high artistic merit.

The Koniags who followed the earlier Indian-like inhabitants possessed a simpler and cruder culture. Physically they seem to represent an intermixture of an Aleut strain with the Indian stock of Southern Alaska. The natives found in residence when Kodiak was discovered were representatives of the Koniag occupation.

The conclusion arrived at by Dr. Hrdlička that the earlier inhabitants of Kodiak were basically Indian fits nicely the hypothesis of an Indian origin for certain strains of Eskimo, which other students have set up to explain insistent similarities.

This opus will be gratefully received by all students of native America, who

Continued on page 142



A.M.N.H. photo

▲ AN UNUSUALLY PERFECT FOUR-
POUND CRYSTAL of tantalite

By FREDERICK H. POUGH*

Curator of Physical Geology and Mineralogy
The American Museum of Natural History

SOME of the minerals that are considered of strategic importance now that we are at war are old ones whose value has long been recognized, such as the ores of mercury, tin, and nickel. Others are Cinderellas, which have been touched by a magic wand only since the war began. The need for these has far outstripped anything imagined a few years ago. Quartz, with its general use in radio communications, is one such substance. Tantalum, a relatively rare and very heavy metal, is another. As with quartz, we have had

*Dr. POUGH's mineralogical activities have been partially traced in previous articles in *NATURAL HISTORY*. In 1933, -35, and -37 he traveled in Europe, visiting mines and mineral localities. He has recently made two trips to Mexico to observe the new volcano, Paricutin, and procured the most spectacular photographs that have been taken of its eruption. During the past year he has twice visited Brazil on mineral surveys, incidentally collecting the most notable mineral specimens that have been added to the American Museum's collection in some years. These include a new mineral of gem quality, which he named brazilianite in honor of the country.

Nature photography, particularly with flowers, is an active hobby with Dr. Pough, and he lectures on native orchids, gems, and volcanoes. He has studied at Washington University (St. Louis), Harvard, and Heidelberg.—Ed.

Tantalite— a Cinderella among Strategic Minerals

When expert mineralogists were hurriedly sent far and wide to search for one of the less conspicuous elements, the secrets of its important role in the war effort were so closely guarded that even they did not know exactly how the mineral was to be used

to turn to other nations for our supplies; and Brazil has turned out to be one of the most important sources of both these minerals.

Tantalum is an inert, heavy, light bluish-gray metal, unaffected by most acids. It melts only at 2900° C. and

is as hard as steel. Its uses are dictated by these properties. Its name is derived from that given the ore tantalite (from the Greek *Tantalus*) because it was "tantalizingly" difficult to make into a solution for analysis.

▼ JOSE MARCELINO DE OLIVEIRA, owner of the Alto do Giz, weighing \$6000-a-ton tantalite, one of the heaviest minerals

Photo from Coordinator of Inter-American Affairs



Before the war, tantalite received scant regard, and production was small. Gradually, as experience with the metal increased, more and more uses have been found for it. Some were extensions of older uses in which tantalum performs a service better than another metal; others are new ones, resulting from the creation of new compounds that demanded a substance with properties possessed by tantalum. Pipe linings and containers made of tantalum are used for corrosive chemicals used in wartime manufacturing. Radio transmitter tubes with grids and anodes of tantalum are of great importance in the small portable radios of the armed forces. Tantalum carbide is a constituent of practically all cemented carbide cutting tools. Perhaps most important of all its uses is in surgery, for tantalum has been found to be the ideal metal to take the place of shattered bone; flesh clings to it as to no other artificial substance. Today, when so much surgery of this type is necessary, tantalum is in great demand, and for many months it was the newest and most important strategic metal of World War II.

Tantalum may be derived from many different minerals, though one alone fills most of the ore sacks shipped to the Fansteel Metallurgical Corporation, sole processor under the government regulations in force today. This is tantalite, a well-known oxide mineral. It has been mined occasionally for years as opportunity afforded but was utilized principally for the other metal that it contains in varying proportions—columbium, also called niobium. As the proportion of columbium rises in this isomorphous mixture, the name of the mineral changes and it becomes columbite.

Columbium oxide is far lighter than tantalum oxide, so that measurement of the specific gravity of a piece gives a reasonably accurate determination of the relative proportions of the two oxides. A specific gravity of 7.2 means that there is 70% of tantalum oxide and 30% columbium oxide. At 6.5, each is present in equal amounts, and only the seller of tantalite knows what to call it. For him tantalite goes down to 35%, the lowest grade used for the extraction of tantalum today. To the mineral collector, anything with over 50% niobium oxide is properly called columbite.

The way in which the rocks containing columbite and tantalite were formed fortunately caused them to be



Frederick H. Pough photo

▲ TANTALITE is found in "dikes," tabular bodies that were injected while molten into fissures in the earth's crust. When weather and running water lower the surrounding land, the dikes are left standing, sometimes like walls. This is the Urubu (or Buzzard) Mine, showing typical workings and dump on the top of the hill. The level Borborema peneplain is seen in the foreground



Frederick H. Pough photo

▲ A TYPICAL WALL-LIKE PEGMATITE DIKE, with dumps around its base from prospecting attempts. Tantalite mining is highly speculative. This locality proved too poor to work. Carnauba, Rio Grande do Norte

▼ THE Boquerão Mine, on a hilltop above Parelhas, a typical *alto*, or hill, and one of the most productive in the area

Frederick H. Pough photo





Photo from Coordinator of Inter-American Affairs

▲ **THE ALTO MAMOES**, one of the longest of the dikes, over half a mile in length, and now proving to be one of the richest

localized in a rather conspicuous type of geological formation. They are found in coarsely crystallized granitic "dikes." These are tabular bodies that were injected while molten into fissures; and here in northern Brazil subsequent erosion of the surrounding terrain frequently leaves them standing like walls. The molten rock of which they are formed was the last of a larger mass to remain fluid. The first portions that crystallized used only the common elements, like iron, aluminum, sodium, calcium, magnesium, silicon, and oxygen. All of the rare elements remained to be deposited in the dikes—beryllium, caesium, lithium, uranium, tantalum, and columbium,—along with volatiles, like water, carbon dioxide, and fluorine. Thus the dikes contain interesting minerals built up from the molecules of these uncommon elements, scattered through a coarse matrix of large crystals of quartz, feldspar, and mica. The rocks of which the dikes are formed are known

technically as pegmatites, and the rare minerals contained in them are said to belong to the pegmatite assemblage.

The northern states of Brazil—Ceará, Rio Grande do Norte, and Paraíba—reveal some of the world's finest pegmatite dikes. Only where ancient parts of the earth's crust contain large masses of granitic rock that have been exposed through ages of erosion do we find pegmatites. And the molten mass must have been insulated and thus prevented from cooling all at once. The ancient crystalline shield that forms eastern Brazil from Ceará to São Paulo provides just such conditions. It is an ancient highland that has been elevated above sea level for many geologic periods and now almost entirely bared of the sediments that covered it for brief intervals. So we find there a wonderful exposure of crystalline igneous rocks marking the top of an ancient batholith.

When too much of the overlying material is worn away, the dikes are worn away along with the upper

layers of granite and the low places in the batholithic roof. But in the northern Brazilian states we have almost ideal conditions. Erosion has progressed just to the top of the batholith, and many roof pendants of the ancient sediments persist in the lower places of the originally undulating ceiling of the upward sloping granitic intrusion. Pegmatites are not the only economic deposits in the region. Tungsten ore, fluorite veins, and rutile deposits are a few of the related phenomena so well revealed here.

Geological conditions and agents of erosion have made the area an especially propitious country for geological work and economic exploitation, while climate has joined to make it a mineralogist's paradise. Even though but a few degrees north of the equator, high country and almost desert conditions make the temperature and humidity bearable at all times, and there is little vegetation to obscure the outcrops of the interesting formations.

The high plateau, with a base elevation around 1800 feet, is marked by many hills caused by variation in the resistance of the rocky foundation to erosion. Through the best of fortune, the pegmatites seem to be the most resistant formations, with the result that they occupy peaks of eminences or stand like walls of ancient masonry cutting across the countryside. Prospecting is easy; mining is simplified. In a country where timber is almost unobtainable and underground mining a difficult task, what could be more ideal than to find deposits that can best be worked as open cuts or simply washed from the gravels flanking the sharply rising dikes? There are difficulties in pegmatite mining, however, which will be discussed later.

There are two types of dikes in this region, and they are not unlike pegmatites the world over. The commonest, by far, are the simple, or, as they are called in Brazil, the homogeneous pegmatites, which are mineralogically monotonous and economically worthless. They are usually smaller than the valuable dikes and are composed of a mixture of the common granite minerals, quartz, feldspar, and mica, with perhaps a little black tourmaline or garnet. They are narrower than the complex, or inhomogeneous, dikes and resemble prehistoric walls in their numerous outcrops.

The complex pegmatites are rarer, though usually larger, and they are

by no means scarce. Unfortunately only a few are rich enough in valuable minerals to repay the work of mining them. Prospecting is simple. The slopes below the outcrops are tested to see if they contain any of the heavy mineral, tantalite, which is the chief object of mining in this area. Should there be found an alluvial concentration where it has been washed down from the decomposing pegmatite, the *garimpeiros* consider it indicative of the possibilities from the still intact dike. A high yield of tantalite gravel will warrant an exploration by quarry methods, but mining of a pegmatite is probably one of the greatest gambles a mining man can undertake. Many pegmatites are sampled, but very few repay the work and cost and time by giving up the heavy mineral in quantities to pay the workers and give the owner a profit, even though high grade ore sells at \$6000 a ton.

The mining of a pegmatite is unlike ordinary vein mining, and the experienced engineers who have been sent there by the American govern-

ment to assist the Brazilians in getting the maximum possible production in a limited time all swear that when they have finished the job they will never again have anything to do with pegmatite mining. The reason for this is that in vein mining there is always a definite lead to follow. The vein may grow thicker or thinner, richer or poorer, but at least every day sees some production.

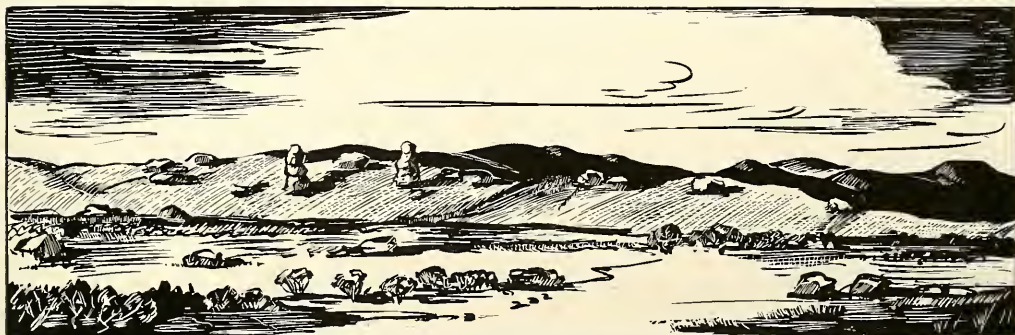
In pegmatite mining there is also a definite vein to follow, but work may proceed for days, weeks, or months without seeing anything worth recovering.

When they do hit ore they may get a rich mass, as in the Alto Taboa, which not long ago produced three tons of \$6000-a-ton ore in a single mass. This particular mine has been a consistent producer and has yielded other pods with two or three tons. But between these rich strikes they go for days without seeing a speck of black in the rock. At the prices, they can afford the barren work, but few mines are so successful. Three thou-

sand tons of rock are removed for each ton of recoverable tantalite, and the operator about to give up never knows but that the next blast will produce enough to keep him going for half a year.

It is not surprising that the visiting geologist rarely sees any of the mineral. Tantalite's value is so great that no trace is left standing in the mine after a discovery. All ore is immediately cleaned out and shipped, usually the same day. There are few places in the world where one can visit mines day after day and never see any ore, though the mines are operating all the while and many of them paying well.

Other pegmatite minerals are associated with tantalite, some of which, like microcline feldspar, spodumene, and lepidolite, would also bring a good return in another country. But here, where there is no near-by consumer and transportation is so difficult, the minerals must accumulate in the dump. Only the beryl, for which about \$150 a ton was being paid when



Drawings by Museum Illustrators' Corps

▲ PEGMATITE DIKES standing up like walls and bastions on the eroded peneplain of Borborema in Rio Grande do Norte

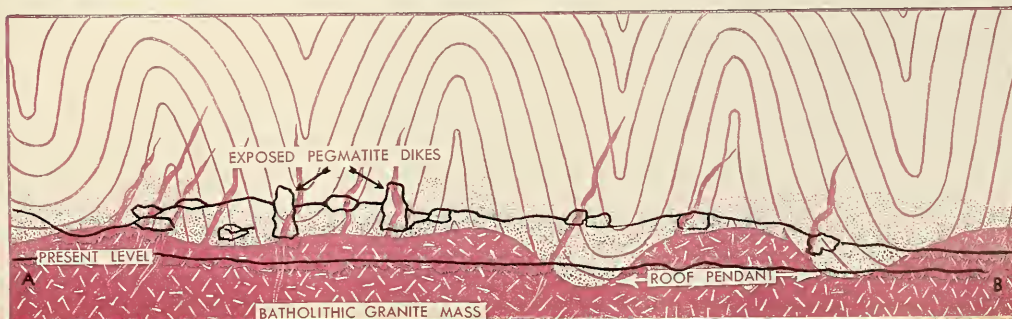
▼ HOW PEGMATITE DIKES ARE FORMED

The dark area represents a mass of once-molten rock. The projections thrusting upward from it are dikes in the making. They are highly fluid portions of the larger mass, charged with rare and sometimes valuable minerals. Pressure from below has forced them up through cracks in the partly solidified mass, into the folded layers overlying it. There they cool and harden. In the stippled

band immediately above the dark area, the folded rocks have been altered by heat and gases.

Long ages of weathering and erosion wear away most of the overlying material. The dikes are thus left projecting above the surface of the ground, where prospectors can explore and sample them for useful minerals, among which tantalite is today one of the most important.

In this drawing the present level of the ground would run roughly from A to B, depending on the extent to which the overlying material had been removed by erosion.





Frederick H. Fongh photos

▲ AS MINERS excavated the material from the staked-out leases in the Malhada de Angicos tungsten mine, the original boundaries were preserved by rope markers stretched across the old surface. Several thousand workers rushed to this mine in a few months



▲ SHOWING how the barren quartz core (right) is avoided in pegmatite mining, which follows the ore-bearing areas on each side. This is the Alto do Giz, source of simpsonite and one of the oldest mines in the region

buying stopped, and a little mica, are salable. The production of beryl was many times that of tantalite, and it served as a nice profit-maker for a mine that did not pay well enough in tantalite alone. Some operators claimed that they were losing money on both and that they could maintain tantalite production only by tying in ten tons of profitable tungsten ore (scheelite) with each ton of tantalite. The scheelite represents one of the most interesting new developments of the northern mining area. It is mined from metamorphosed impure lime-

stone beds of the residual roof pendants.

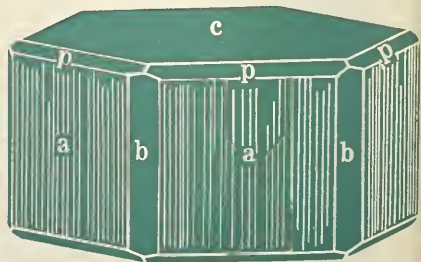
Native mining methods in the northern country are primitive in the extreme. Labor is drawn from the cotton farms in the region, and the population is surprisingly large for a land that seems so barren. There is also stock raising, and in parts of Ceará the wax of the carnauba palm is gathered.

The cotton is of the finest quality, with a long fiber that separates easily from a smooth seed. One planting about every 15 years suffices. The

plant would grow into a small tree if allowed to, but it is kept to shrub size by pruning. The maximum yield is from the fifth to the fifteenth years, and the plant may live as long as 20. Interspersed with the cotton one often sees the spineless *Opuntia* cactus, developed for regions like this where cattle feed is hard to find.

Tropical Brazil is frequently pictured as a steaming jungle with heavy rainfall, but in this section lack of

A.M.N.H. photo



▲ A TYPICAL SIMPSONITE CRYSTAL, from the first known source of measurable crystals of this rare mineral, at Alto do Giz, Brazil

◀ AN EXTRAORDINARY two-inch crystal of simpsonite from Brazil: a rare mineral first discovered in Australia in 1939 and named for E. S. Simpson, Government mineralogist of Western Australia

water is the chief problem. The rainy season comes in January and February, but some years it fails to materialize at all. Attempts have been made in some places to drill artesian wells, but little water has been encountered. An ambitious federal department, the *Inspeccoria Federal de Obras Contra as Seccos*, is planning to build dams and develop large irrigation projects as funds permit, and in the few that have been completed, some of the finest gardens and rural homes anywhere in Brazil are seen. Eventually there will be many more people living in the area, with a far higher standard of living than the average there today.

The water shortage makes working the alluvial deposits a real problem. Water is carried in on donkey back and used over and over again in operating the primitive washers. A washer is seen in the photograph. Ore-bearing gravel is placed in the middle box, and water poured in the upper. A paddle works back and forth, giving the effect of a jig. The light material floats over the top of the paddle, and the heavy mineral piles up on the floor of the box, from which it is periodically removed. Most of the tantalite recovered in this way is in small fragments. The alluvial beryl, most of which has decomposed anyway, is lost.

After the alluvial portion of the dike has been worked over, mining may commence on the part still intact. Weathering has been very deep in this region, and in many cases the "alto," or hill, has been preserved by the resistance of a solid quartz core, a characteristic of many of these almost vertical dikes. Along the outer walls, there is usually a mixture of moderately coarse-grained feldspar (now often turned to clay), coarse-grained quartz, and a dark mineral, tourmaline or mica. A foot or so in from the outer edge we find a greater separation of the constituents. The quartz and the feldspar crystals have

➤ A PRIMITIVE JIG for separating out tantalite. Water is poured in at the top and washed down through the ore. The material is worked back and forth so that the lighter dirt floats out over the paddle and the heavier concentrate is left in the bottom. In this arid region, the precious though muddy water is used over and over



Frederick H. Pough photo

▲ LOOKING DOWN UPON Parelhas, a typical small town and local center of mining in the dry interior of northeastern Brazil. In the foreground are beautifully tinted outcrops of rose quartz

become much larger, and with them are the valuable minerals. This band may be six or eight feet thick, sometimes more; and it frequently abuts against a barren core of solid white or rosy quartz which may be as much as 20 feet thick. Then the succession, in our ideal pegmatite, may begin again and continue to the farther wall, making a dike 50 or 75 feet through. These pegmatites are longer

than those we know in many other areas. The Alto Mamoés, for instance is over half a mile long. Most North American pegmatites are measured in terms of a few hundred yards.

The primitive mining methods result in the dumping of refuse without regard to future operations and the creation of dangerous working conditions by digging under overhangs. But the United States Government

Photo from Coordinator of Inter-American Affairs



has attempted with great success to increase production by supplying technical advice on the soundest methods of operation. Machinery has been supplied, money lent for payrolls, and roads built so that the ore can be more conveniently shipped out and machinery brought in. Tantalite production increased several hundred percent during the two years that this program has been in operation.

Experience has shown that the pods of tantalite are most likely to occur near the margin of the quartz core and in the coarsely crystalline altered feldspar. Although the feldspar in some of these deposits is largely altered to clay there is still enough hard quartz and fresh feldspar left to make the work difficult and to involve considerable blasting. The greatest physical contribution of the North Americans to this work came in the form of air compressors for drilling the holes for blasting. These greatly increased the speed with which a stretch of dike could be opened up.

Beryl and tantalite are carefully picked out by hand and promptly carried to the hut that serves as mine office. Beryl may be piled up outside, but the tantalite is stored in locked chests. When enough has been accumulated, it is shipped off to the nearest buyer, who may pay \$2.50 to \$5.00 a kilo (2.2 lbs.) for it, depending upon the value that experience has shown him should be put on the ore from a particular mine. This ore, purchased from many little producers, is periodically shipped to the railroad and export center, Campina Grande in Paraíba. There it is reworked by careful crushing and washing in gently sloping conical pans, after which it is sacked and shipped to the United States. Over 90% is said to pass through the hands of Silveira Dantes of the Silveira Brazil Company, the principal producer.

Beryl, too, is reworked at Campina Grande, because feldspar, quartz, and tourmaline are often intergrown with it, sometimes inside the very crystals. The beryl is broken up by a hammer into fist-size chunks, sacked, labeled, and shipped in the same way as the tantalite. The tungsten ore comes in almost as a sand, but it, too, is usually reprocessed by the same simple hand methods and sacked for shipment.

The refractory nature of the compounds of tantalum make them min-

eralogical problems that the chemist is loath to tackle, and the relative rarity of the ores has meant that few samples have been available for study. One would think that with the present production, many fine specimens would have been collected, but this phase of the work has regrettably been neglected. Most of the men, both the Brazilians and the North American engineers, are little informed in mineralogy and have not appreciated the importance of collecting typical samples and all unusual varieties in as large, unbroken pieces as possible. Hence, a fine opportunity has largely been lost, and only an occasional specimen has been spared by some discerning engineer or buyer who took the trouble to keep it intact. Still fewer specimens have got into the hands of competent mineralogists, who would appreciate their importance and save them until happier world conditions might permit a detailed study of the Brazilian ores. For tantalite is not the only Brazilian tantalum mineral; there are many others.

The most interesting is probably simpsonite, a little-known and poorly described hexagonal aluminum tantalate, first found in Australia in inconspicuous, partly altered crystals. A strongly kaolinized dike known as the Alto do Giz, in Rio Grande do Norte, has produced the finest crystals of this mineral ever seen, better even than those from a second source recently discovered in Africa. The sharp, fresh looking, six-sided crystals of the Alto do Giz are yellow-brown in color and well developed. Unfortunately, none were saved in aggregates; perhaps, indeed, none were found this way. However, fine loose crystals were found in several places and will serve for crystallographic work.

A few broken fragments of a heavy white mineral were seen in the town of Equador at the office of the owner of this mine, Jose Marcelino de Oliveira, and X-ray examination has shown that this white mineral, too, is simpsonite. Before they were broken, they must have been of considerable size, several inches across. Associated with the brown simpsonite crystals are many tiny green octahedra which proved to be microlite, a calcium tantalum oxide and one of the commonest of the tantalum minerals.

Columbite occurs at this mine, in

black orthorhombic crystals, and there are also some small but sharp reddish-brown crystals of what seems to be manganotantalite, a manganiferous variety of the commoner, usually black mineral. Large crystals of manganotantalite were seen from many mines, most notable from the neighboring Alto Mamoes and the Varzea de Vassoeira. A very rich and interesting mine not far away across the hills, but many miles by road, is Onça Mine, where a rare black tantalum mineral tapiolite, is veined by white streaks of an alteration product, for it is changing to microlite. Simpsonite is said to have been found at this mine, too, and the crystalline masses coming from there show other crystal faces from those of the Alto do Giz and look quite different.

However, it will be some time before all these interesting minerals can be studied, and at the end of November purchases of the too expensive tantalum were stopped because considerable stock-piles had been built up in this country and because African and Australian production had increased.

During my journeys in the region, travel in the desert states was greatly facilitated by the work of the United States Commercial Company, a branch of the FEA; and the houses maintained by the staff of their engineers made a pleasure of what would otherwise have been arduous and uncomfortable work. I am greatly indebted to the division engineers E. H. Page and his successor James E. Moore for their help during my studies in the area.

The secret of much of Brazil's production of strategic minerals lies in the fussy, painstaking, and time consuming work that is performed by poorly paid laborers, whose standard of living is far below the North American scale. Even now, poor as the wage scale is, much of the tantalite is produced at a very low profit. Clearly the mines could not be worked if wages were much increased, without a great rise in tantalite prices. Perhaps one should expect to pay more for this valuable metal. Certainly anyone who has seen the poverty of the miners and the terrible gamble the operators take feels that tantalum is one of the valuable substances of this earth, hard to find and hard to work, and surely worth more than the higher prized but more abundant metals like silver and gold.



▲ REWORKING tantalite and tungsten ore by hand-washing at Campina Grande. All the ore is reworked thus before being sacked for shipment

Photo from Coordinator of Inter-American Affairs

Frederick H. Pough photo

➤ THESE FINE GRAINS of tantalite are the result of rewashing tons of fragments from the old dump. Disappointments are many, but the lure to prospect new dikes is strong, for the discovery of a rich "pod" sometimes repays months of barren work





▲ THE YOSEMITE FALLS provide the background for this scene, but California mule deer are apt to be seen in many places along the western slopes of the Sierra where timber or brush offers concealment. They are called mule deer because of their long ears. The upper surface of the tail has a black line and white edging, and is longer than that in coastal black-tailed deer

THE *California* Mule Deer

By JOYCE and JOSEF MUENCH

► ALL THE STRENGTH and alertness that are typical of the California mule deer are found in the posture of this grand old buck of the mountains. When startled, the animal launches himself into the air with all four feet, as though propelled by steel springs, clearing bushes and low trees as he bounds off in rapid flight

▼ A YOUNG BUCK caught by the camera in his native woodland. Summer finds his antlers still in the velvet. This covering of thin skin and soft hair will be shed with the coming of fall and the mating season. Early in spring the hardened antlers will be shed





◀ THE GENTLE EXPRESSION in the eyes of the mule deer gives little indication of the powerful, explosive action of which the animal is capable



◀ DURING the mating season (October to December) the male collects as large a harem as his strength permits. After that he leaves the does and joins the other bucks, usually in lower ranges where food is plentiful. They do most of their feeding early in the morning and late in the evening, or even by moonlight

A toad is like *THIS*

By

ROY L. ABBOTT

Iowa State Teachers College

Photos by

HENRY B. KANE

Strange things happen when the little defenseless tadpole forsakes its slimy pond for a life on land as a complex and effective organism



IN THE MIDDLE OF A HOP: a toad leaping. Note that the fast camera caught the animal with its eyes shut

IN the dampness and dense shade of the great rhubarb leaf, the toad sat half-buried, her brown, warty skin blending imperceptibly with the crumbly soil. Now and then some big black ants hurried across her broad back, but except when one chanced to pass an inch or so in front of her head, she gave them no attention, for the sun was yet high, and although she couldn't resist snapping up any small fry that came within range of her quick tongue, she would not set out on any active hunting until sundown.

Not that the toad wasn't hungry. Except when hibernating, she was always hungry, and now particularly so, for she had just returned from a two-weeks' pilgrimage to a near-by pond where she had deposited her first eggs—some five or six thousand jelly-covered, shot-sized things left there to hatch and shift for themselves as best they might.

The toad had spent nearly all of

her four years in this garden, and, save for the long journey just completed, had never once left it. The egg-laying trip was a new experience, a response to new urges, such as the high, shrill voices of male toads calling from the pond, and the quiet but equally insistent pressure of the many eggs in her body—the voices, as it were, of potential toads clamoring to be born.

The toad herself had begun life in this same pond. But now, squat, pop-eyed, four-legged, and nearly as large as a man's fist, she looked little like the chuckleheaded fishy mite who, along with several thousand others, had wriggled free from the gelatinous, rosary-like egg-strings left there by her mother.

In fact, at that early age, the toad was really a fish, for she breathed air from the water through delicate, feathery gills on each side of her head, and propelled herself by means of a broad tailfin. But, strangely enough,

she was a fish who couldn't eat, for her mouth had not yet broken through into her intestine, and until that necessary thing occurred some six days later, there was little for her to do except to cling to some water weeds by means of a pair of head suckers, or to make short, wriggling journeys from one plant to another. But when her broad-lipped mouth with its two rows of teeth above and three below finally appeared, she and the rest set out with ravenous appetites to make up for lost time, scraping the tiny green plants from their supports, biting off fragile, tasty bits from the ends of larger ones, and even sucking in minute animals from the ooze at the bottom or the slime at the top. If a dead fish or a worm was found, she joined the hungry crowd about it, shouldering the rest aside and holding her place at the feast by sheer muscular power until sated.

As a result of all this food-taking she had grown mightily. By the end



2 NOTHING MOVING, NOTHING EATEN. The toad strikes only at a moving object

of six weeks she was an inch-long tadpole, black in color with a fine stippling of gold, and breathing now by internal gills instead of the external ones, which had disappeared.

And at this juncture, strange things began to happen to her. Upon each side where her tail joined the body, rounded buds of flesh protruded themselves and grew steadily backwards—the beginnings of her hind legs. Soon joints appeared in these stumps, then toes and feet, and she then began using her newly formed legs along with her tail in swimming. Meanwhile, internal changes were also occurring. Her long intestine, coiled like a watch spring, began to shorten. And from the front end of her food tube two saclike growths appeared and pushed backward. These were lungs. They were to fit her for land life, and since her internal gills had already begun to fail, she was even then using these new organs, gulping them full of air at every trip to the surface.

Seemingly, she was to have no front legs. But two weeks after the forma-

tion of the hind ones, the front pair appeared suddenly. Quite ready for use, they broke through the gill coverings which had concealed their development, and now for the first time, the embryonic toad really looked like a toad. For even before her front legs appeared, her head had changed greatly. Her tiny mouth had been replaced by a huge one, its wide opening extending far back under her eyes, which in turn had become large and elevated and covered with lids, and which appeared bright and beautiful as a toad's eyes should.

But for all these transformations she was still a rather strange creature—a toad well enough, but a toad with a long fishlike tail. Nature soon disposed of this incongruity, however, by allowing her to resorb the tail and use its materials for other purposes. So, freed at last from all semblance of a fish, she was now a complete toad in all respects except warts; they were to come later.

With the loss of her tail, the toad left her pond, with her several thousand brothers and sisters. That is,

with those who had come to real toadhood. For although the sticky, jelly covering had protected the eggs well enough for most of them to hatch, the tadpoles had been less fortunate. Once outside the protective jelly, a host of predators had assailed them. Hundreds perished in the masked jaws of ferocious dragonfly larvae, other hundreds were sucked dry of blood by the grooved fangs of the water tigers; and the piercing beaks of the pearl-colored backswimmers had taken a great toll. To say nothing of those gobbled up by the bullheads and the snapping turtles and by the wide beaks of ducks, shoveling the mud of the shallows.

But in spite of all this, when the toad left the water, a whole army went with her, a host of fleshy, cricket-sized mites, hopping hopefully into the wet grass, each in search of a corner in which to live. Many never found that corner, for outside the water there were hungry grackles and hens, and minks, and frogs, and—one of the worst of all the toad's many enemies—the garter snake.



3 THEN THE AMAZING TONGUE, attached in front and free behind, flashes forth

Yet day after day, still managing to escape the fate of her fellows, the toad hopped farther and farther from the water, until she came at last to a place where there was soft earth, and cutworms, and leaf hoppers, and lettuce and radishes, and wide, shady leaves of rhubarb. Here she settled down to live.

Thus the toad came to her garden in the spring.

The garden was the toad's universe. It was a tiny one, but as she prowled it of evenings or early mornings, she became increasingly aware of its texture and problems. It was a universe comprehended in part through her skin, which told her of variations in temperature and moisture, of things rough or smooth, and of those pleasant or painful to touch. As a tadpole, food had often meant a thing of odors; now these played little part in her life. When she did show discrimination, in either taste or smell, it was usually only to reject—sometimes when half-swallowed—certain noxious or foul-smelling bugs. Likewise, her ears told her that

sounds played a part in the world. The singing of a cricket brought her a certain emotional and muscular awareness manifested by the quick cocking of her head or a slower rate of respiration.

But most of all, the toad's world was one of objects, of things seen. Her great golden, black-centered eyes gave her sharp images of the medley of forms around her—the plants, the gardener, the dog, garter snakes, other toads, and a whole assemblage of crawling things, the earthworms, the snails and slugs, and the insects. The toad's daily life was chiefly a complex of responses to these and to things felt through her skin.

Each evening, when the sun had dropped below the western rim and its glare had gone from the earth, the toad emerged from whatever leaf or cranny had concealed her during the daylight hours, and set forth upon a round of the garden. Hunger was the impelling motive of these nightly quests, but she always started off slowly, as if she knew that game was plentiful and that she had plenty of

time. After a succession of short hops she would stop dead still and peer keenly about. When prey was sighted, she moved quickly toward it, her gait often changing to an awkward crawl as she drew near. If at the instant she was ready to strike a caterpillar, it suddenly decided as a defensive measure to curl up and play dead, the toad waited patiently until it again showed signs of life. Sometimes, indeed, she gave it up entirely as a dead thing and moved in search of something alive and active. For no matter how hungry she might be, she never struck at a non-moving object. The creatures upon which she fed, of course, didn't know of this strange "nothing moving, nothing eaten" peculiarity of the toad. Hence, when one moved, ever so little, within two inches of her head, her mouth would open, and her marvelous tongue—fastened at the front and free at the rear—would flash forth with the speed of a striking snake, its sticky surface winding about the victim and drawing it swiftly into her wide mouth.



4 THE TONGUE'S STICKY SURFACE captures the prey, and . . .

The toad had no teeth, hence everything entered her stomach in the same form it entered her mouth. The swallowing process, unbelievably enough, was greatly aided by her eyes, which invariably rolled deeply inward and backward during the act, thus forcing the struggling creature into her broad gullet. The number of animals captured of a night depended, of course, upon their size. She could swallow 50 ants or more without discomfort, whereas three or four average-size earthworms or several June beetles would temporarily gorge her to repletion. But her strong digestive juices worked rapidly, and if food was plentiful, she often ate enough to fill her stomach completely four times in 24 hours.

The toad's days were much alike. In her life there was probably little joy and little pain, but now and then came something to interrupt her quiet round of living: the gardener or his dog, for example. The gardener often dragged her bodily from her shady retreat to watch her sleepy eyes blink

in the blinding sun. Sometimes, too, he carried her to the screen door and laughed as he held her in his hand, watching the house flies disappear like magic to the Lilliputian whipcracker reports of her flashing tongue. Sometimes he teased her by tickling her nose, chuckling gleefully as she lowered her head and butted clumsily at the offending straw.

The gardener's dog, also, now and then diverted himself with the toad by fishing her from the soil and barking and poking at her gingerly with tentative paws.

Often she inflated herself hugely as he mauled her, behaving as she did when a small garter snake attacked her. Sometimes, when overturned by his quick paw, she would play possum, lying belly up and quiet as if dead, even her breathing seemingly suspended. Once, when the dog had hurt her with his teeth, she had shown him one way a toad protects herself by giving off into his mouth a whitish fluid from the big glands on the back of her neck, and the memory of its

awful taste had taught him never to take her in his mouth again.

The extreme heat and dryness of summer also affected the toad. She never drank in the manner of other animals; all the water her body required had to come to her through her food or directly by absorption through her skin, this last chiefly from wet plants or the damp soil. Also, since she was cold-blooded, her body warmed or cooled with the rise and fall of the temperature of the earth and air about her. Hence, hot, dry air and dry soil took water rapidly from her skin and made her miserable, so on such days she burrowed deeply to come to the earth's dampness, and remained hidden until the sun was well down and the dew had fallen.

Four times yearly there came another interregnum. This manifested itself to the toad's awareness by a sort of general tightening and pulling and constriction all over her body, as if her outer skin had become dry and shrunken. This told her that the moulting period had come; so to rid



5 THE TIP of it returns to the back of the mouth, and with it the caterpillar

herself of her old skin, she would sit with her back strongly arched, head bent downward, and feet drawn under her body. Her outer skin, already loosened beneath, would then split along the midline of head and back and belly, next from side to side at her rear, and lastly from arm to arm across her breast.

After the skin had split along these lines, she freed her hind legs from their covering by bringing them forward and then rubbing them forcibly backward against her belly, all the while opening her mouth widely and expanding her body in a kind of shrugging motion. The whole effect was to drag the loosened skin forward to the corners of her mouth where it was still attached and gradually sucked in. Next she would drag her front legs free, and then after a few prodigious gulplings she would swallow the skin all in one piece as the final act of the moult. Then as her discomfort passed and her new skin dried and darkened, she would sit erect once more, open her eyes widely,

and go on about her living as if nothing unusual had happened.

Each year, usually in October, the toad found herself heavier and slower and sleepier, with less desire to eat, and pervaded by a vague uneasiness. Unknown to her, the fat of her body, a product of her many nightly feastings, had piled itself into two huge orange-colored masses near her kidneys, and sugar from the same source gorged her liver. The fat and sugar were her food reserve. Some of it would be built into the eggs she would lay in the spring, some would be slowly burned to warm her as she slept. For the time had now come to hibernate.

So, just as in summer she had burrowed backwards into the soil to avoid the heat and dryness, she now backed even deeper into an old burrow or, mayhap, even into a new one, to avoid the frost, boring deeply backwards and downwards until the earth dropped in and covered her head and half-filled the entrance, this later to be plugged yet further with leaves and snow.

Here she slept. As the days grew colder, she grew colder until she was stiff and insensible to her surroundings but never quite frozen. Her heart slowed until her blood barely moved through the vessels; the fires of her life burned low but never quite went out. She was sleeping against time—against the coming of April. Then, when the red-shouldered blackbirds were singing in the swamps, when the cowslips yellowed the meadow, the ferns were unrolling, and the new red leaves of the pond lilies were struggling upwards, she would awaken from her trance, come forth from her cell, cock her head, and listen once more to the shrill voices of male toads calling from the pond.

Then, too, possibly because of these voices and the pressure of the many eggs within her, she would journey again to the pond, place her eggs there in the water, and without once thinking of their further welfare, return again to her home in the garden. This is the way of the toad.

Upon this tiny stage, strange insects, with a brutal but effective precision, enact an even stranger drama of life—and death

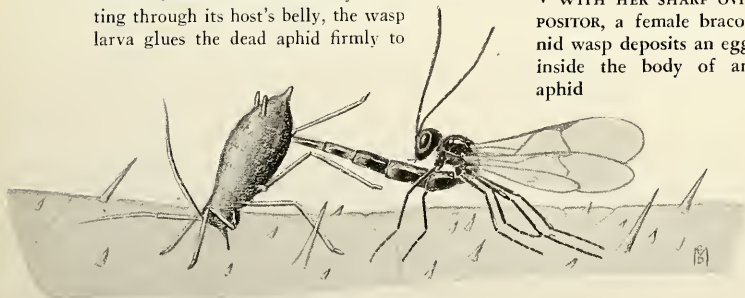
THERE is a sudden movement among the sluggish aphids. Several of the fat plant lice are rearing their bodies up and down in vain efforts to avoid a hurrying black menace. The enemy is a female braconid wasp no larger than the letter i. As she runs about she frequently stops behind an aphid to tap it with her rapidly vibrating antennae. If the aphid is suitable, she rises high off the leaf surface on her legs, curls her abdomen forward between them, and with her sharp ovipositor drives an egg into the body of the aphid. Then away she flies, leaving the aphid to return to its monotonous sucking of sunflower plant juices apparently none the worse for the stabbing.

In a very few days, however, the wasp egg becomes a larva which proceeds to eat the aphid alive from within. It is death for the aphid, which becomes bloated and dry. Cutting through its host's belly, the wasp larva glues the dead aphid firmly to

an aphid already is housing an egg or a larva, or it may be that only one larva can survive in case two or more eggs happen to be placed in one aphid.

All this occurred on a large leaf of a sunflower plant (*Helianthus annuus*) just outside our back door in Pasadena, California. The leaf is about midway up the stalk, green and as yet almost unblemished except for a slender, pale, serpentine streak which we recognize as the work of a leaf miner. The leaf miner, a tiny fly larva, left a narrow trail at the beginning, but we can see that it broadened as the growing miner ate its way between upper and lower surfaces of the leaf. At the broad end there is a pale blotch where the larva stopped to pupate, and in the lower epidermis of the leaf we see a tiny tear through which the little fly escaped.

▼ WITH HER SHARP OVI-
POSITOR, a female braconid wasp deposits an egg inside the body of an aphid



the leaf. Its meal finished and home made secure, the larva draws back inside and rests for several days as a pupa. From this resting stage the wasp emerges as a winged adult ready to leave its aphid house. It cuts a neat round hole through the upper surface and crawls out. The disc cut out often remains weakly attached at one side like the lid of a tin can not quite cut free.

Now we see that in the aphid colony on our sunflower leaf there are many brown and bloated skeletons of parasitized aphids. Sometimes whole colonies of plant lice are destroyed by these braconids, but on our sunflower leaf less than five percent of the aphids have been parasitized.

Apparently only one wasp ever emerges from any one aphid. Perhaps the mother braconid can tell whether

These aphids (or aphids) are known as sunflower aphids (*Aphis helianthi* Monell), a dark green or greenish black species especially common on this plant in southern California in the late summer. Some parts of the leaf are almost covered with them.

Exploring for a new homesite, a few winged aphids from another plant arrived on this leaf during the summer. Here they settled down to rear families. One by one the babies are born, active little nymphs, each looking much like its mother except for smaller size and lack of wings. We do not see the eggs, for they hatch within the mother's body.

All these youngsters are daughters, plump and green, who will never have wings. And strangely enough, all of these daughters are fatherless, for the mother aphid is able to produce young

Life on a Sunflower Leaf

By CHARLES D. MICHENER
and
MARY H. MICHENER

without mating. This process is called parthenogenesis. It is only in the fall of the year after numerous generations of females that, in most species of aphids, some sons are born to grow up and father the next generation. The eggs fertilized by these males do not hatch in the body of the female but are laid and survive the winter unhatched. Of course, our sunflower plant is an annual and will not be able to support the aphid families during the winter and next spring. In the fall, winged females leave the sunflower and fly to other plants on which the species can winter, perhaps only as eggs. The sunflower aphid in some places winters on dogwood, a plant which, however, is very scarce where our observations were made.

Looking closely at the sunflower leaf we see that both winged and wingless aphids are present. It seems that winged females are produced not only for the fall migration to a different species of plant but also from time to time in the course of the summer generations. Just what the needs or stimuli for the production of winged individuals might be, science does not yet fully understand, but these are some of the conditions that

▼ BOTH WINGED AND WINGLESS aphids are seen together on the sunflower leaf. Most of them are on the under surface, but a few are among the minute spines of the upper surface



may influence it. There may be overcrowding in the aphid community and some will develop wings and leave, or the sunflower plant may weaken from disease or from the draining of its juices by the aphids themselves or poisoning from injected salivary substance. There is no carefully planned food rationing here; some must die or shove off and look for greener pastures. And in such emergencies nature issues wings to some to enable them to travel.

Life is just one long drink for an aphid. Its "cider" is plant juice and its "straw" a special arrangement of four slender mouthparts or stylets, which are enclosed in a heavy sheath when not in action. The stylets taken all together are far more slender than a human hair, yet they can penetrate plant tissues and they enclose a pair of tiny channels. Through one of these channels juices are sucked, and through the other saliva is injected into the plant.

After proteins and other food elements have been strained out of the plant juices in the aphid's body, the remaining sweet fluid is excreted through the anus. This liquid is known as honeydew, a soft drink

much favored by certain ants and other insects. Just how the aphid's inside filtering system works we do not know, but it is clearly associated with the unique arrangement of the intestine characteristic of the Homoptera, the group of insects to which aphids belong. The gut (a perfectly respectable term in scientific circles) is looped back upon itself so that a very thin portion of the wall adjoins an equally thin wall of the fore part of the same tube. We may suppose that much of the water and sugar in the plant juice passes through these thin walls, taking a short cut to the anus, while food substances scarce in the plant juice but needed by the aphid are sent the full length of the gut,

where they are digested and assimilated.

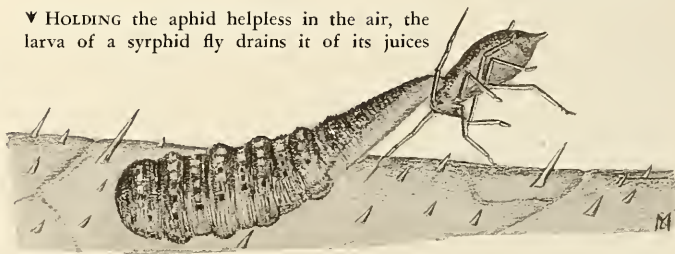
Honeydew is produced in great quantities, covering a large part of the leaf surface and providing food for many insects. It also serves as a nutrient medium in which various molds can grow. That dark band of little Argentine ants (*Iridomyrmex humilis* Mayr) which is flowing up and down the sunflower stem and branching out on each leaf petiole is in search of honeydew. We can see that each ant collects the fluid directly from aphids, its antennae patting each little "cow," apparently to induce it to excrete a drop. At once the drop is taken up by the ant. Abdomens of ants leaving the sunflower leaf are often noticeably paunchy compared to those of new arrivals, for ants store honeydew in their crops to carry it home to the nest.

Other visitors come to the bountiful syrup spread, such as stunning blue-green cuckoo wasps and the males of black and yellow wasps of the genus *Crabro* with their forelegs oddly expanded into large shields. These do not gather from the aphids directly but lap the honeydew from the leaf surface.

We have already seen that the braconid wasp (*Lysiphlebus*) is an insect that uses the aphids for its own benefit but, unlike the honeydew eaters, destroys the aphids. Another wasp that takes considerable toll of aphid lives is *Stigmus*, five or six times as big as the braconid but nevertheless under three-eighths of an inch long. It is black with a heavy squarish head. *Stigmus* does not parasitize the aphids but preys upon them as food for her young. In some near-by dead and broken stem she tunnels out a nest for her larvae. When the burrow is complete, it is stocked with an abundance of fresh aphid meat. We can watch her collect aphids from our sunflower leaf. With her jaws she grasps an aphid, stinging it almost at the same moment. Then she flies

Continued on page 144

▼ HOLDING the aphid helpless in the air, the larva of a syrphid fly drains it of its juices





A vast land whose problems are lack of irrigation and transportation rather than man-power, stirs with the desire for a place in the modern world and gives promise of rapid progress

IN the heart of Asia lies a vast and remote area, approximately the size of our own United States, which for thousands of years has remained little known and little touched by the outside world.

I entered this land with my companion, Major William J. Morden, after two months of trekking over the Himalayas and the high Pamirs of Russian Turkestan. We dropped down through rugged gorges and were welcomed at the border by couriers dispatched by the Chinese Governor to meet us. As darkness fell amid a threatening thunderstorm, we galloped ahead for the nearest habitation, leaving our caravan to follow.

Riding rough trails at dangerous speed, I could see nothing in the utter blackness, not even my own horse beneath me. My only guide was the sound of hoofs ahead and the occasional sparks cast by their iron shoes.

Flashes of lightning weirdly outlined rugged canyon walls, giving me glimpses of my companions ahead. In this intermittent blue light and amid the peals of thunder they were strangely like the Four Horsemen riding into a valley of death. Far below me to my left I caught the occasional glint of a mountain torrent. One misstep of my horse could plunge me to unknown depths.

Long, long afterward, we stopped by a ray of light. It came from a felt

tent, or yurt, an official way station along the trail. We entered, wet and cold, and sat by its little but welcome central fire, while Turkomans in long, quilted robes and frizzly, furred caps made gestures of welcome in behalf of their Chinese superiors. There was much talking and activity. A great metal bowl filled with water was brought in and placed on the iron standards above the glowing fire of dried yak dung.

A bleating sheep was next dragged in. It was thrown to the floor in front of us, and its throat quickly cut with a long, sharp knife. Wooden bowls caught gushes of steaming

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1930 he was awarded the Speyer Memorial Prize in Sculpture. He is the author of *Trails of the Hunted* and is a contributor to many magazines. In 1942 and 1943 he served as Special Consultant, Army Air Forces Materiel Command, at Wright Field. He is responsible for the designing and construction of the American Museum's celebrated African and North American habitat exhibits.—Ed.

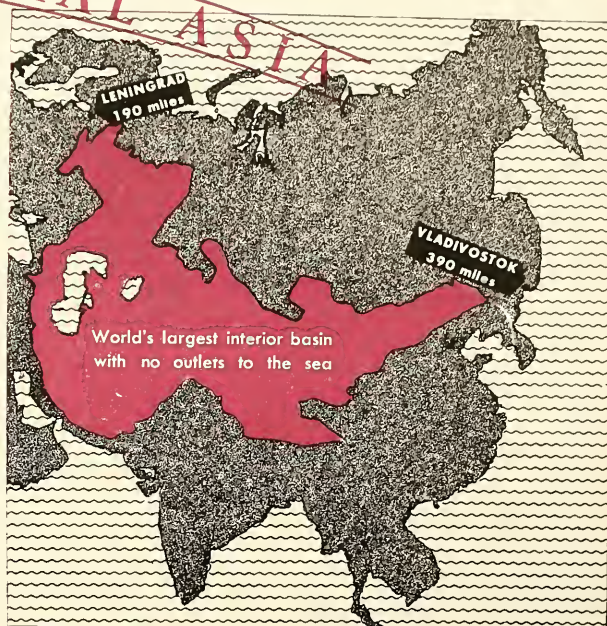
NEW HORIZONS IN CENTRAL ASIA

By JAMES L. CLARK*
Director of Preparation and Installation,
The American Museum of Natural History

PHOTOGRAPHS BY MORDEN-CLARK EXPEDITION

◀ SOUTHERN GATEWAY TO CENTRAL ASIA: the Russian Pamirs, northwest of India. The photograph was taken at 15,000 feet, but the word "Pamirs" refers not to the mountains but to the high valleys. Into them come the nomads with their flocks for grazing through the summer. This is the land of the famous wild sheep, *Ovis poli*, or Marco Polo's sheep

► YOU CAN TRAVEL from about 190 miles east of Leningrad to within 390 miles of Vladivostok without ever finding a river that flows to the sea. What rivers there are in this vast interior basin either flow into salt lakes or dry up on the arid plains. Water is the major problem in the heart of Asia, as seen by the map below showing rainfall within the boundaries of this basin



blood. We were offered a drink, which we reluctantly sipped, in politeness. The sheep was rapidly and artfully skinned and cut up right before us, and chunk after chunk was cast into the cauldron. The odor of fresh blood was not pleasant.

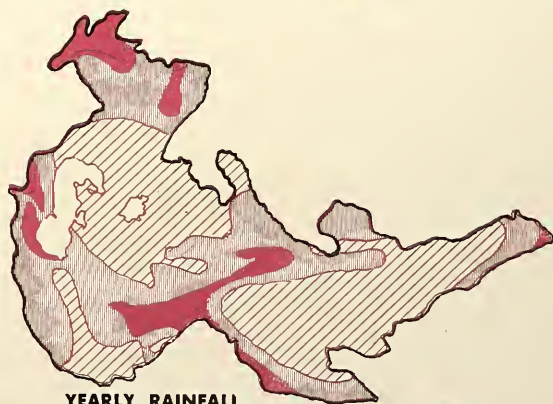
"What is this all about?" we asked of our own guide.

"In your honor, sirs," he replied. "The highest honor these people can pay you."

The light of the fire modeled the strong, brown faces of these mountaineers about us. Their long, maroon-colored coats, with sash about the middle, and baggy pantaloons tucked into the tops of sturdy leather boots, seemed to suit them well.

The framework of sticks and the thick felt covering of the yurt were stained brown with smoke. Chattels and articles of clothing hung on the latticed palings that supported the wall, while felt bedding and wooden chests lay scattered about the edges. Our hosts jabbered and smoked, as we sat courteously partaking of dried raisins, currants, almonds, and a native wine, while awaiting the real feast that was to come. Well could we have been with Marco Polo, for the centuries that had passed had brought not a single change to this dim and primitive setting of Central Asian hospitality.

This vast area, surrounded as it is



YEARLY RAINFALL

Under 10 inches 10 to 20 inches Over 20 inches

by the "golden fringe" of the fabulously rich countries of China, Malaysia, India, and Persia, with immense expanses of steppe country to the west and Siberia to the north, has been, by its very geographical position, deprived of easy trade routes that might have brought to it the benefits of a more progressive outside world. Distances from within were too great for

its people to venture much beyond their own borders, and it was only by relays of caravans from without that foreign contacts were made at all. To the south lay the world's highest mountain wall, an effective barrier to intercourse with the prospering peoples around the Indian Ocean. To the north stretched Siberia, a land of primitive hunters, uninviting and with



▲ THE RECEPTION COMMITTEE of Kirghiz gentlemen who greeted the author on the Morden-Clark Expedition. Airplanes now bring western civilization to some of these remote sections, which a short while ago could only be reached by long and difficult travel on horseback. Note the lattice framework of this typical yurt or felt tent, whose construction is shown below

little to offer. Only from China and from Russia and the Near East were contacts at all possible, and then only after tediously long caravan journeys.

Protected thus by this ring of space, strife came to them from within rather than from without, and their tribal and religious wars were quite bad enough. It was here that the great hordes of horsemen of Attila, Tamerlane, and Genghis Khan surged back and forth, spreading terror and death while conquering all before them. These horsemen of the Huns, trained to sleep in the saddle and live off the land as they passed, ruled intermittently for centuries, safe from the dangers of invasion or defeat. They alone were able to move with such strength and swiftness that the foot armies of other peoples were no match for them.

Geographically, this vast area is a tableland divided through its center by the western end of the beautiful Tian Shan Mountains, rising to some 20,000 feet. To the east lies the Chinese territory of Sinkiang, sloping gradually to join the borders of the Mongolian Gobi and the western provinces of China. To the west, the steppe countries of the Tartars and Turkomans roll on to the Caspian Sea and the Ural Mountains.

Although the Chinese filtered through to this promised land as far

as the Tian Shan early in the third century, and possibly long before, and predominated as the most cultured class, they have only intermittently ruled it for something less than five centuries.

To Marco Polo came the first opportunity of penetrating this little-known land, while on his way to the silkened courts of China; and of its peoples and their secluded world he has very ably recounted.

It was still to remain unchanged, however, for there was nothing to alter the slow pace of the camels or shorten the distances they had to travel. There were no ships to come from across the sea, nor roads by which a more progressive civilization could gradually encroach upon them.

These people early took to irrigation above the banks of the rivers and at their very ends, where the silt-laden waters deposited great fans of deep and rich alluvial soil. Here they built their bazaar cities and trading centers and lived largely the life of agriculturists. In the more fertile valleys of the hill country, there were nomads and hunters. In the flat country, dust bowls and deserts stifled their progress, but they found a balance under which they could perpetuate themselves, if not grow.

Not until the latter part of the nineteenth century did infiltration

▼ TO MAKE THE FELT COVERING or "munda," wool of sheep, goat, or camel is sprinkled with water and rolled up on a long pole. The ends of the pole are harnessed to a camel, and it is rolled over flat ground to entwine and compress the hair

▼ THE FRAMEWORK is collapsible, and the whole house can be transported on the backs of bullocks, camels, or yaks. The yurt is the nomad's home over most of Central Asia

▼ THE FELT COVERING is good insulation from the cold, so the dwelling is warm as well as roomy. For temporary stops, a shelter shaped like the Indian tepee is sometimes erected (*foreground*)





▲ KALMUKS OF SINKIANG: a strongly Mongoloid type of wholly nomadic people. The big switches of horsehair tied to her own locks show that the woman on the left is married; the other two are not. The Kalmuks are fine hunters and bring in the furs from the mountains. They are Buddhists



◀ KALMUK CHILDREN on the pasture lands of the Tian Shan

▼ THE KALMUK WOMAN in the center wears a switch of horsehair across her eyes, which in this case are probably weak or sore. Throughout Central Asia this primitive but effective method is used to protect the eyes from glaring snow. The Kalmuks number something under 200,000 and live in the uplands. Some of them have a fondness for appropriating the horses of other people



from without begin to change their future. In 1868 the Russians took serious interest in the potentialities of the region and moved down with their armies. Many hard battles were fought before the last great oasis city of Samarkand finally fell under their dominion, which gave them control of the whole western area up to the Chinese Tian Shan.

Europeans now became interested, and courageous explorers ventured in over long and wearisome routes to study the land and its people. With their protective belt of vastness penetrated, their isolation began to wane, but their mode and tempo of life followed the same pattern as it did in Biblical times.

Not until World War II, which has left no portion of the globe untouched, did Central Asia really become conscious of any change. Now its people, in parts at least, shaken violently from their ancient slumber, are becoming a part of our world. Now vast changes are beginning to take place. All of Asia is awakened—aroused and quickened by the reverberations of war.

Ancient caravan routes have become highways. Fleets of heavily laden trucks now speed across the old silk routes in clouds of dust, doing in a day what the caravans did in a month. On the Russian side, railroads are reaching their tentacles ever farther, and planes shorten months into hours. Central Asia is now shrinking with the rest of our world. The change has come upon it with a sharp crescendo in the last two or three years.

The transition is not a slow one. These people are being swept right off their feet and, dazed by it all, are no doubt wondering what it is all about. Gradually they will adjust themselves, for many are of a sturdy and progressive type, who can and will accept a progress that will bring benefit to all. Development will be rapid, for everything that the outside world has to offer will be all new to them, and they will absorb it at a fast rate, in their old homes and new industries.

Education, which has had a good start under the Russians but somewhat less in the Chinese territory, is now expanding. The old and fiery religious antipathies, which have burned so deeply, will now wane, and more concerted action will result.

Since Russia took over the western-most steppe countries, this area has

been politically divided on the maps as Russian and Chinese Turkestan. Sinkiang (the New Territory, as the Chinese prefer to call it), lying to the east, holds the still primitive bazaar cities of Khotan, Yarkand, Kashgar, Aksu, Karashahr, and Urumchi, its capital. In the Russian domain are the larger and somewhat more sophisticated cities of Samarkand, Tashkent, Bokhara, and the lesser ones of Andyan, Verny, and Kuldja. A few years before the present war, the Soviet Union through intrigue, was successful in extending its political influence into Sinkiang, but recently, by a most promising gesture of good faith toward mankind, it has returned complete control to the Chinese.

To this newly opened land, trade will flow from Russia, from Siberia, and from China. The great barrier wall to the south, more effective than oceans or deserts, precludes even in modern times a free intercourse in this direction.

Specialists, engineers, and technicians of many kinds and from many lands, will be needed for vast new enterprises in road building, hydro-electric power and irrigation projects, mining, large-scale agricultural developments, and many other activities, for it is wide open for all modern improvements and the benefits they offer. Now, with but a few million people, there is room for many more. Good and sturdy labor is already at hand, and the people will serve well to enjoy a prosperity never before known to them.

When the development of this new land joins with the potentialities of Russia, Siberia, and China, there will come into being one compact sphere of influence with resources so varied and extensive as to stagger the imagination.

But for the present, water is the sad story and will continue to be for some time. No rivers that flow from within this whole great area ever reach the sea. Waters that are not sapped for irrigation finally dissipate themselves into thirsty sands. Engineers can and will remedy the water shortage by going back in the mountains where there is an unlimited supply from perpetual snows. They will dam the deep gorges for power and irrigation projects. When this is done, great areas of arid waste will become lands of plenty. New industries, with raw materials and power at hand, will bring progress and wealth.



◀ A KIRGHIZ HUNTER with matchlock rifle and forked rest. The Kirghiz are a herding people of the mountains in Southwestern Sinkiang. They are quite Mongoloid but are Mohammedans

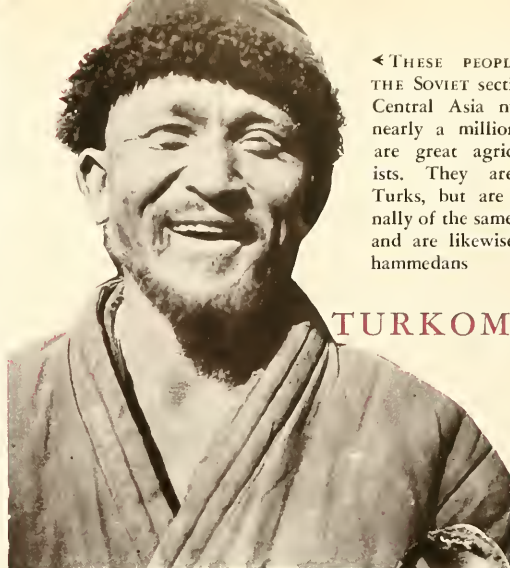
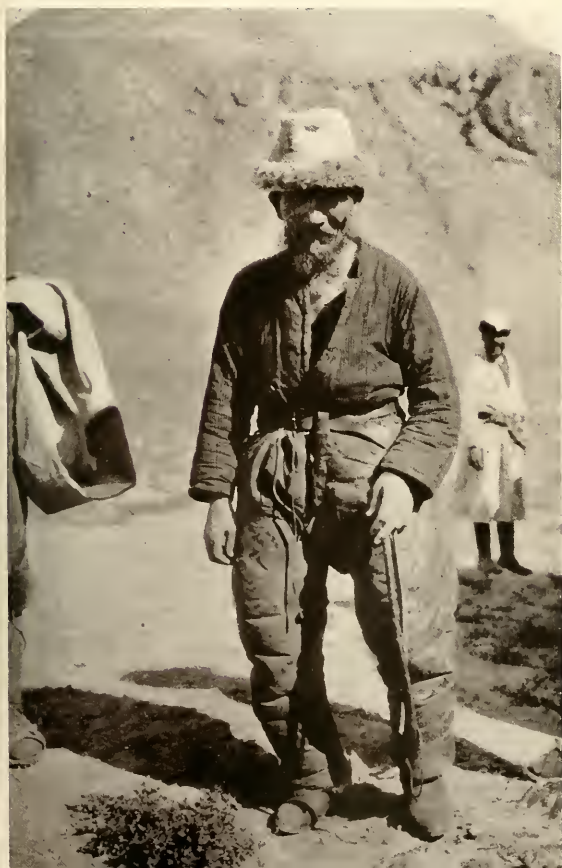
▶ TYPICAL of the Chinese ruling class is this Amban (magistrate) of the walled city of Karasha, Sinkiang. The Chinese of Sinkiang number some 200,000 and predominate also as merchants

▼ A KAZAK FAMILY in the Tian Shan. While the men are out hunting or herding the cattle and horses, the women do chores at the camp. Children herd the sheep and goats near-by. The Kazaks number about 800,000. Some of them live in Sinkiang, but most are in Soviet territory to the west





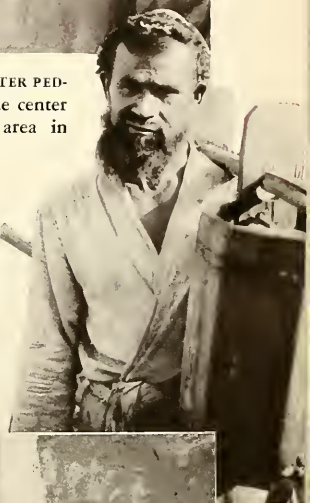
▼ THE EXPEDITION'S KAZAK HUNTER, "Tulabai," of the Tian Shan. The Kazaks are nomads and live in the grasslands of the higher country. They are only slightly Mongoloid in appearance. Many have light skin and blue eyes



◀ THESE PEOPLE OF THE SOVIET section of Central Asia number nearly a million and are great agriculturists. They are not Turks, but are originally of the same stock and are likewise Mohammedans

TURKOMANS

▶ A TURKOMAN WATER PEDDLER of Kashgar, the center of the Turkoman area in Sinkiang



▼ TURKI WOMEN AND CHILDREN of Sinkiang. They have straight black hair, and many are attractive. Their garments, either homespun or procured through trade, are cotton cloth



TRANSPORTATION



➤ THIS VAST SECTION of Asia the size of the United States has almost no railroads. Many people in it will make their acquaintance with the airplane long before they see a locomotive or automobile



▲ A MONGOLIAN DANDY on his well-bred camel. These riding camels travel at a much faster rate than the ordinary freight camels and are sometimes referred to as express camels

Some of the larger, strictly desert wastes must remain as such for a long time, but they may eventually prove to hold their potential wealth below the ground instead of on its surface.

As regards minerals, the whole region is untouched, yet many resources are known to exist there. Coal is mined from shallow shafts, and oil is already taken and crudely refined from surface wells, with indications that it is present in vast quantities.

Much of the country will remain as grazing lands, for there is much rich pasture. Lying in the same latitudes as the United States, the temperate climate has produced in the valleys some marvelous grasslands, where the Kazaks and Kulmuks already raise

fine horses, cattle, sheep, and goats.

Unfortunately the Asiatic is hard on forests, for he is forever cutting down but not planting; and the first thing that Central Asia must be taught is conservation. There still remain in the Tian Shan stands of fine big spruce, some five feet in diameter. But these are only a fraction of the timber that once covered large areas. Evidence shows that many of the now barren grass stretches were once entirely forest grown; but fires, which burn unchecked and sometimes are set by natives for reasons unknown, are rapidly reducing what is left.

Here in this temperate belt is enjoyed the same healthy, invigorating

climate as our own, in which a great majority of man's food supplies can be produced. Varying altitudes and soils provide a wide range for both food and industrial crops.

As a field for research in natural science, Central Asia is as yet quite virgin territory. Here we may find, in fossil form, remains of earliest man.

Now that there is come to the New Territory of Sinkiang and Russian Tartary a younger and more progressive group of Chinese and Russians, educated and trained in agricultural, industrial, and governmental affairs, this long-dormant land can look forward to an unbounded period of progress and prosperity. A real future lies before it.

▼ THE SHIPS OF THE DESERT take on water at widely spaced wells. In much of the flat desert country, water can be found eight or ten feet below the surface. When it is brought up, it is emptied into shallow enclosures where many heads can be watered at one time

▼ THE OPENING TO THE SHALLOW WELL and the vessels with which the water is bailed out can be seen in the foreground



▼ A CAMEL TRAIN with pack saddles waiting to be loaded. The hay stacks are piled atop the roof of the compound, safely out of reach of the ever hungry beasts of burden



▼ CAMEL TRAINS that carry freight up to 600 pounds to a camel travel day and night, winter and summer. In the extremely low temperatures they increase their average of two-and-one-half miles an hour to three



▼ OCCASIONALLY CARAVANS encounter difficult and dangerous going. Here the natives are helping one of their loaded beasts across a treacherous river flowing from the mountain gorges



▲ THE FAST EXPRESS OF CENTRAL ASIA: *telagas* drawn by three horses. These little wagons carry the mail, light articles, and a few passengers. The horses are kept at a trot and frequently changed. These four carts with the same horses made 150 miles in three days with the expedition's baggage



▲ HEAVY FREIGHTING is done by the Chinese with primitive carts. The heavy wheels (here being repaired) have a stationary axle, and the load is carried in a bathtub-shaped basket. A single bullock draws each cart. These carts travel mostly in the cool of the night, and frequently 100 or more of them move in a group, presumably for protection from bandits



▲ THE INDIANS "TRAVOIS" in Central Asia. These wheelless conveyances are mostly used for hauling hay from the fields



▲ FINE GRASS LANDS and timbered slopes are found in the valleys of the Tian Shan Mountains. Here in an area as large, as fertile, and as beautiful as Switzerland a great many people can live in health, happiness, and prosperity, for the country has everything

▲ (Upper right) THE WELL-WATERED TEKES VALLEY in the Tian Shan Mountains abounds in rich pastoral land, but trails, bridges, and other facilities for travel are primitive

GRAZING LAND



▲ KAZAK HORSEMEN in the grazing country of the Tian Shan. The Kazaks are nomads and have great herds of horses, as well as cattle and sheep. They ferment mare's milk and make kumiss, which is used as an intoxicating beverage

▼ KALMUK CHILDREN of the Eastern Tian Shan on their riding bullocks, on which they follow the herds of sheep and goats during the sunlight hours

▼ AMID UNSURPASSED ALPINE scenery these Kazaks likewise perform the duties of the herdsman on the backs of bullocks

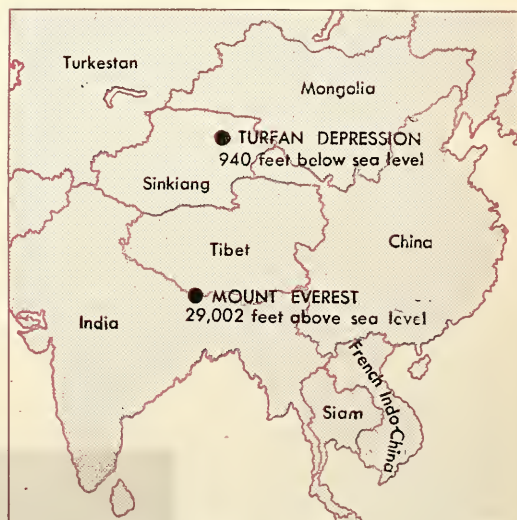


➤ OUTSIDE THE WALLS of Kashgar, the farmers grow their garden crops between irrigated ditches laid lengthwise through their fields

▼ A VIEW SHOWING only a part of the rich irrigated fields around Kashgar, a city of some 80,000 inhabitants. The Kashgar River flows through an area of about 2500 square miles that is largely made up of windblown soil, or loess. In the center of the city a very large spring of clear water flows from the earth and is properly protected and guarded from contamination



➤ THE TURFAN DEPRESSION is a flat, arid basin that reaches a depth of about 940 feet below sea level at the lowest point. It is 1000 miles almost due north of the world's highest mountain



◀ PRIMITIVE METHODS of tilling the soil linger. Here is shown a native with his bullocks drawing an all-wood plow in the great Turfan Depression



➤ THIS VIEW IS TYPICAL of the flat, arid plains that cover much of Central Asia. Water would transform some of them into great agricultural areas, and they may prove to be even richer beneath the surface, in minerals or oil

◀ THESE CANYONS in the mountains flanking the plains could be dammed and stored with permanent water for irrigating the sections suitable to agriculture



▼ THE NATIVES have appropriately called this area "Trees of Rock" (Kargai Tash). Its interesting topographic features remind one of arid mountain sections in our own West





▲ A DONKEY CARAVAN stops for a rest in a grassy valley of the Tian Shan. Much of this beautiful and fertile country, now utilized only for grazing, is potentially valuable for many other uses

➤ A SWEEPING VALLEY that would satisfy the eye of anyone seeking mountain scenery. To the left can be seen a flock of sheep



◀ A CAMPSITE along the route of the Morden-Clark Expedition, in the big spruces of the Tian Shan. Abundant wood, water, and grass make this area perhaps the biggest and best garden spot in Central Asia



▲ TYPICAL OF the bazaar cities of Central Asia are these little shops or stalls of Kashgar, in which the vendors spread their goods

wherever traffic will permit. Melons, grapes, apricots, pears, and apples are sold here, as well as dried fruits and almonds

KASH

▼ MARKET DAY. This city in the southwest corner of Sinkiang is inhabited almost entirely by Turkomans. The brushwood greens shield the narrow streets from the intense heat of the summer sun



▲ THE HOME OF THE BRITISH CONSUL in Kashgar. Only foreign officials have such pretentious habitations



▲ THE CITIES are built of sundried brick over a structure of beams and sticks. A view looking over the housetops of Kashgar

GAR

➤ BIG TREES shade the adobe houses of the city's "residential" section. Ladies and gentlemen of the better class ride their donkeys while shopping. The very wealthy ride in their closed *mappas*, highly decorated carts of the elite



◀ DONKEYS are the typical carriers on Kashgar's boulevards and byways



▲ THE LITTLE CHINESE military post of Shutta lies in the Tekes Valley of the Tian Shan and controls this area close to the Soviet border. Remnants can be seen of a magnificent forest, which once covered all these hills. Although the slopes are now turned into grassland, erosion will soon start to wash away the rich soil

◀ RESIDENCE of the Chinese Amban, or magistrate, of Kara-sha. It is customary in this region to build around a yard or compound, which is entered through a gateway from the street



▲ AN OPEN-AIR RESTAURANT in the streets of Urumchi. Eating places of this sort are typical of the Chinese cities and are always well patronized

► THE GREAT WALL around Urumchi here separates some residences and gardens from the domain of the "outcasts" outside the enclosure



◀ THE MAIN GATEWAY to the city of Urumchi, seen from within. The architectural pattern of these inland cities, like the tempo of life in them, is linked closely to the days of Marco Polo. But the era may not be far off when visitors will be whisked through this ancient portal from the local airport

nature *through the* CAMERA

▼ Crab Spider and Fly



Three insects with their prey

S EYE

By RICHARD L. CASSELL



▲ Robber Fly and Honey Bee

▼ Black Widow Spider and Jerusalem cricket





By THANE L. BIERWERT
Acting Chief, Division of Photography,
The American Museum of Natural History

TRAMP, tramp, tramp, the photographers are marching from store to store, searching for a roll of film or a sheet of paper. It's a great day when they find something in stock. And we have been warned that the situation will become steadily worse.

The important thing today is to hit every exposure squarely. Gone are the days of shooting twelve in order to get one good picture. You can't hike from store to store all the time. Remember that good shoe-leather is among the missing, too.

Suppose you do run across some film. Do you know how to make every exposure good? Improve your methods by carefully analyzing each subject. The old "by-guess and by-gosh" technique is too haphazard. Use your notebook and pencil again, as you did in the beginning days of your photographic hobby. If you have already mastered your technique, that is, if you know how your equipment operates, how your favorite film is exposed, and what you can photograph best, then you will have few difficulties. However, not all of us are so fortunate. Here is what can be done to conserve film and still have many pictures.

We should resolve to make no landscape or pictorial exposures if there is a possibility that we can return to the area at a more propitious time. If you must expose, diligently consult the exposure guides that come with the film. If possible, use a precise exposure meter, taking care to measure only the light in the sections of the picture that are most important. Even then, check the meter reading against the exposure guides to catch any slip on your part. Before making the exposure, be certain that your viewpoint is the best possible for the scene. Make only one exposure, whether you have color or black-and-white film.

When you have a new baby in the house, or if you are making pictures of the family to send to a man overseas, it is imperative that every exposure count. The way to get good exposures is by having enough light to work with, ensuring short exposures that will stop movement of the subject. Sunlight makes for short exposures, but we cannot have it every day, and we cannot move it around very easily if we wish to vary the direction of the lighting. However, we can use "canned sunshine," in the form of flash bulbs. Fortunately these are

procurable once again. If a few simple rules are followed, every exposure can be correct. It is then merely a matter of exposing at the crucial moment.

Correct exposures are possible because we are working with known elements: (1) the film has a definite emulsion speed or rating; (2) each flash bulb has a uniform brightness and duration, and (3) we work at measurable distances. With these three factors we are able to find our unknown quantity, the exposure. In order to understand how flash bulbs can guarantee good exposures, let us follow the steps in an example.

Flash bulbs can be used on ordinary house current, unless marked otherwise, and they have a flash duration of about one-fiftieth of a second. A flash synchronizer is not necessary for flash pictures; "open flash" pictures are possible indoors with every camera. They are taken by opening the shutter on "bulb," setting off the flash with the other hand, and then closing the shutter. Buy several G. E. 22's or Wabash "Press 40's." These are medium-size bulbs with a retail price of 17 to 18 cents. They can be used in a gooseneck desk lamp or a photoflood reflector, as can most of the smaller or larger bulbs. Make certain that the switch is in the off position when inserting the bulb. A searing burn results if the hand is on the bulb during a flash.

Our subject is a year-old, lively youngster, never in one place for long. Have him stand on a chair holding on to the back for support; this confines him to one spot. The chair should be placed a few feet from a background of your own choosing. Set up the camera on your tripod about five or six feet from the subject. Use the flash bulb in a reflector near the camera, slightly above and to one side of the camera, the location for soft modeling. This will mean that the flash bulb will be six feet away from the subject. Verichrome or Plenachrome film, whose speed rating is G. E. 32 or Weston 24, is in the camera. We are ready to compute the exposure for this set-up and capture on the film a good likeness of our "wild animal."

The manufacturers of flash bulbs supply data sheets which can be picked up from the literature rack in your dealer's store. On the sheet are charts similar to the one illustrated. As mentioned before, we find our exposure from known quantities. A correlation of film speed with the flash bulb used results in a flash ex-

posure guide number, which remains constant as long as we continue to use this same film and same bulb. This flash exposure guide number is used to determine the proper lens aperture for a selected shutter speed. In this case we are using an "open flash," which is the equivalent of a 1/50 second shutter speed, because that is the duration of the flash. The lens aperture is found by dividing the guide number by the distance in feet from flash bulb to subject, six in this case. Our mathematical steps then are quite simple. The film rating is G. E. 32 or Weston 24. The bulb used is "Press 40." The exposure is to be an "open flash." Dividing 210 (the proper exposure guide number) by six (the distance in feet), we get f:32, the correct lens aperture for this home studio arrangement. Our exposure is therefore "open flash" at f:32. Result, perfect negative.

The procedure is to work in normal living room illumination, waiting for a good expression to come. In one hand we hold the cable release ready to make a bulb exposure. In the other we hold the reflector switch ready to flash the bulb while the lens is open. The room light will be so weak in comparison with the brilliant flash that the camera shutter can be open for a second or more without having an image register on the film.

It is a simple matter to compute flash exposures for faster films or for synchronizers by using this exposure guide method. The main point to remember is that the guide number is divided by the distance in feet from the flash bulb to the subject, regardless of the camera location, be it six feet or sixty feet from the subject.

As with so many things, the technical end can be solved. The human element rests entirely with the individual who operates. If you can flash the bulb at the instant of best expression, the flash will preserve that moment for you with the least waste of film.

Flash bulbs may seem to be an expensive way to make photographs, but on close analysis the cost is not at all great when you can consistently produce the pictures.

If readers of NATURAL HISTORY have specific questions regarding photography in the realm of natural history or science, we shall be happy to try to answer them.—ED.

FLASH EXPOSURE GUIDE NUMBERS

Film Speed		Shutter Speed	"Press 40" Guide Number
G.E.	Weston		
32	24	Open Flash	210
		1/50 (synchronized)	210
		1/100 (synchronized)	180
100	64	Open Flash	340
		1/50 (synchronized)	340
		1/100 (synchronized)	290

STRENGTH OF LIONS



By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

THE event on which this cartoon is based took place in the Masai country of East Africa.¹ The natives here count their wealth and importance in their cattle, but these are a great temptation to the lions of the region. To protect their herds from these great cats the Africans build *bomas*, walls of thorn brush piled six or seven feet high, around their huts, thereby enclosing a space for their animals. When night falls the cattle are driven in and the entrance is closed by thorn brush like the rest of the *boma*. The herdsman and his cattle pass the hours of darkness behind this barbed entanglement. As a rule this keeps lions out, for they are afraid of getting thorns in their sensitive feet, but sometimes one of them, more daring and powerful than his fellows, makes off with an animal in spite of all precautions.

The man was sleeping inside his

hut when he heard two lions outside his *boma*. The cattle huddled together on one side of the compound, terrified by the lions. Picking up his spear, the herdsman ran out between his stock and the danger; although one man with a spear is no match for a lion, the big cats can sometimes be driven off by a brave front. A splendid young lion leaped in over the barrier. The native could not bluff him and dared not close with him in unequal battle, but was forced to watch while the lion quickly killed a young animal, seized it in his jaws, and jumped back over the *boma*. Thus far, the story depends on the evidence of the Masai herdsman, but there was no other way for the lion to have carried off the bullock. The lion, his companion, and the victim were trailed the next morning by Dr. James L. Clark and Mr. William Leigh and were found two miles from the raided *boma*. The cow was larger than the lion and must have weighed nearly as much.

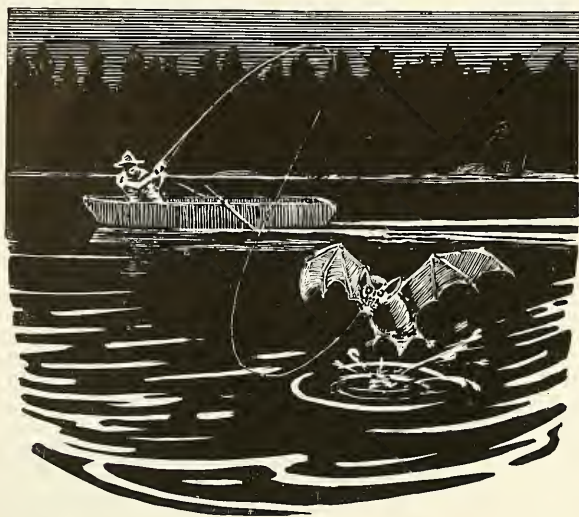
Other great cats perform feats of strength that are equally astonishing. A tiger is known to have swum across

a river with a medium-size cow in its mouth. Another was watched while it dragged a half-grown buffalo up a steep river bank. This was the more difficult because the earth was soft and at each step the tiger sank deeply. Gaur are the largest of the cattle tribe, weighing up to a ton, yet a tiger dragged a large gaur more easily than several men could.

Leopards are only about a quarter of the weight of lions and tigers, but for their size they are quite as powerful. One, carrying in its mouth a ewe (a wild Indian sheep), sprang to the top of a ten-foot rock; and the sheep must have weighed nearly three-quarters as much as the cat. Another leopard, in Somaliland, leaped over the thorn fence around a native camp, seized a sheep, and jumped back out of the enclosure. Leopards often cache their kill in the crotch of a tree, out of reach of hyaenas and other scavengers. How they get animals weighing almost as much as themselves up in a tree is a puzzle, but such animals as the Indian swamp deer, partly-grown hartebeest, and a large reed buck have been found high in trees.

¹See William R. Leigh's *Frontiers of Enchantment*. New York, 1938, Simon and Schuster.

Fishing for Bats



By C. R. PARTIK*

LAST August 29, after work, I rowed out on Lac Long, near Ste. Agathe Des Monts, Quebec, to cast a festive fly to the big trout that had begun to come in to inspect their spawning grounds and were rising to nothing in particular.

Among my Numbers 10 to 16 there was nothing that roused their interest, and I knew that further effort would be wasted. It was one of those rare early autumn evenings for which the Laurentian hills are famous, and I let the breeze take my boat where it might. The sun had disappeared over the purple hills and the shadows had crept across the lake when the boat halted near the mouth of the creek.

Presently in the waning light I noticed what looked like a small minnow wriggling to the surface; it was the last stage in the metamorphosis of the May fly (Plecoptera). The little creature's back split open immediately and from it emerged the now complete insect, ready to take to the air within a few seconds when its wings were fully straight.

Then from nowhere in the semi-darkness appeared a bat. Without hesitation it dove to the surface of the water, cleverly picked up the newborn insect, and disappeared.

I happened to have in my fly box

an excellent imitation of the May fly on a No. 10 hook. (This fly is known to fly fishing enthusiasts as Green Drake.) I put it on my leader, gave it a good coat of fat to make it float, and cast it about 20 feet from the boat.

Hardly had my artificial creation dropped on the water, and before I could twist my wrist enough to pull the fly under, the bat reappeared, picked it up, and was hooked. It made one or two attempts to get up into the air, but without success.

Slowly I retrieved my line to release the bat, being careful not to set the hook more than necessary; but by one last effort the creature freed itself and flew away.

I made several more casts in various directions. Every time the fly landed on the water, this or another bat was back. Only by close attention and immediate action could I prevent the creature from getting hooked. And I was reminded that, at least in this light, it would be wrong to say "as blind as a bat."

*Mr. C. R. PARTIK, a native of Quebec Province, lived for 20 years in the country north of the St. Lawrence River, where he says "the winters are really old-fashioned." He is one of the few persons who has succeeded in breeding and raising fishers (*Martes pennanti*).

Recently he has moved 50 miles south to be a little nearer civilization.—Ed.

LETTERS

Continued from page 97

for the sake of protecting ships intending to discharge or take on cargo. Ascension Island and St. Helena, both in the South Atlantic, are also famous places for waves of this type. On one or more occasions in the past, practically all ships in the harbor of St. Helena have been wrecked by the unforeseen onset of such rollers. It is now known, however, how long the barometric waves require to travel from the latitude of Ascension to that of St. Helena, and cable or radio information gives sufficient warning to enable vessels in port to seek the safety of the open sea.

* * *

SIRS:

In a review of *Birds of the Central Pacific* in the November 1944 issue of *NATURAL HISTORY* the reviewer brings up the old question as to how the fairy tern, and other birds, manage to make the latest capture when there are already several small fish in the bill.

A possible explanation has occurred to me. The fish are held in the bird's bill by pressure between the tongue and the upper mandible, thus allowing the lower mandible to open without losing any of the fish.

Edmund Selous in *A Birdwatcher in the Shetlands* offers a different explanation in the case of the puffin. I do not have the book with me here but, if I remember correctly, he suggested that each fish, as it is caught, is moved to the back of the bill and held there by the sharp edges of the bill slightly cutting into the fish.

With many thanks for your most interesting magazine,

J. D'ARCH NORTHWOOD.

Okeechobee, Florida

* * *

SIRS:

Your magazine has come to me through the Maryland Academy of Sciences since 1939, and I find it very interesting.

I would like to ask you a question. Why is snow *white* rather than clear like ice? . . .

BEULAH MUMMA.

Waynesboro, Penna.

Snow is white because the light striking it is diffused by the many tiny crystals composing it. The individual crystals are transparent, but owing to their fineness they scatter the light when taken in the aggregate. For the same reason, clear ice becomes white when it is shaved. Similarly, glass or clear rock-candy when powdered becomes white like sugar or snow.

Red or pink snow of the Arctic regions is a different matter. The color is due to a tiny alga that lives on the surface of the snow.

CLYDE FISHER.

* * *

SIRS:

The following quotation is from a letter from my brother, who is stationed in Liberia. I would be very grateful if you

could identify the fish he describes and give me further information concerning it.

"Alighting from the canoe at a native village, we saw things move on the bank. I thought they were lizards, but Wray looked closer and said they were something he had seen in movies taken in Australia. . . . They varied from two to five inches in length and were shaped like a wedge. They had two reddish eyes set on a short stem above the head and two limbs more like fins than anything else, just behind the head. They used these as legs and hopped toad-fashion or crawled slowly. We couldn't catch any, because they all moved under the bank or into the water, but they wouldn't stay in the water long. We saw them quite close up, and Wray is sure they look like what he saw in the movies. Maybe you can find out for me what they are and what they are called: . . ."

JAMES L. JOWETT.

Norristown, Penna.

We are informed by the American Museum's Department of Fishes and Aquatic Biology that Mr. Jowett's brother in Liberia was observing the Mudskipper, *Periophthalmus*, probably *Periophthalmus koelreuteri* (Pallas). This fish is one of the Gobies and is famous for leaving the water and walking or hopping about on sand or mud in pursuit of food. It is found in tropical waters in the eastern Atlantic (West Africa) and the Indo-Pacific.

The late J. R. Norman in his *A History of Fishes*, page 79, says: "It chases its insect prey among weeds and rocks, and on land is quite as agile as many lizards. The pectoral fins are specially modified in relation to this habit, each being attached at the end of a kind of muscular arm, which can be moved backwards and forwards and is used exactly like a limb. Among other structural peculiarities designed to assist its progression on land, the low anal fin and the stout lower rays of the caudal may be noticed. Dr. Regan writes: 'When walking on the mud each step is accomplished by a forward movement of both pectoral fins, which are then put on the ground and draw the rest of the body after them; these steps are repeated rapidly, and as each results in an advance of about half an inch, very fair progress is made; the pelvic fins support the body during the turning forward of the pectorals. But, as their name implies, the Mudskippers often leap along the mud, or from one stone to another; short jumps may be accomplished by the action of the pectoral fins alone, but longer ones, which may be as much as a yard long, are made by a stroke of the tail. This is their way of getting along when they are in a hurry, and they may



▲ THE MUDSKIPPER, *Periophthalmus*, on mangrove roots. (See letter at left)

often be seen playing on the mud, jumping about in chase of each other."—Ed.

SIRS:

May I express my appreciation for the articles on "Homes of the World" by Dr. Shapiro. This series alone is worth many times the annual membership dues.

INA CORINNE BROWN,
Professor of Social Anthropology,
Scarritt College for Christian Workers
Nashville, Tenn.

SIRS:

. . . I enjoy your Magazine more and more all the time. Everything about it is a joy—the pictures so beautiful, the paper so fine . . .

(Mrs.) J. WARREN CUTLER.
Rochester, New York

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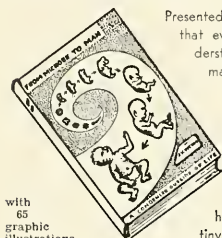
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BOOKS

Continued from page 101

have long needed the information brought to light by its author. It cannot, however, be said that they will receive with equal enthusiasm the cumbersome presentation of the record. Unfortunately the author apparently had little or no use for the refinements of archaeological technique. At least he betrayed no concern with them so far as the reading of this book reveals. Despite those defects, it will be indispensable to scholars.

H. L. S.

THE MURMUR OF WINGS

by Leonard Dubkin

Whittlesey House, McGraw-Hill Book

Co., \$2.50

14 illus., 167 pages

OF books on birds there seems never a scarcity, nor are they all cast in one mold. Many are meant to teach the novice to call each species by its proper name. But

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the impact of wings on human personality brings out many another response.

Leonard Dubkin dreamed from boyhood of writing a book about birds. His schoolmate Berny felt confident at first of making his fortune out of bird study. The need of paid employment, however, pushed Leonard into journalism and publicity, while Berny forsook birds for Hollywood, where subconsciously he put birds and more birds into films. Leonard continued to watch his favorites from Chicago windows and bridges.

Psychoanalysis might help us to understand the book that Leonard Dubkin finally brought forth. Yet it is amusing without that effort. If one wishes to learn more about birds, even those of a great city like Chicago, he need not try here; but if he likes to look into the minds of people who are attracted by birds, then there is good fun packed between its covers.

The birds discussed are those that cannot escape notice: pigeons, gulls, grackles, starlings, and sparrows. Others get scant mention. People's reactions to birds, or their attitude toward their neighbors who are positively ornithotropic, are wittily dissected. The confirmed "bird lover" who writes indignant letters to the newspapers, or who tempts birds to linger overlong at his northern feeding station, is the person Dubkin likes least. He has more sympathy for the schoolboys who stamp the life out of a crow because they thought it laughed at them. Strangely enough, the author has overlooked the professional ornithologists, whose acquaintance he disdains. If he contemplated another book he might do well to extend his studies to that neglected corner of his field.

JAMES P. CHAPIN.

THE WORLD AND MAN AS SCIENCE SEES THEM

Edited by Forest Ray Moulton

Garden City Publishing Company, \$1.98
178 illus., 533 pages

THIS is a Garden City reprint of the book originally published by the University of Chicago Press in 1937. The passage of a few years has not made the work out-of-date, and it is a pleasure again to recommend it and to hope that this issue will reach a still wider audience.

The book is a compendium of science for the intelligent layman. I know of no better or more authoritative work in its important and useful field. A certain unevenness in style is the inevitable outcome of the fact that the work is so authoritative, each of the eleven chapters being written by a specialist in one particular branch of science. Indeed, the different methods of exposition add a certain pleasing variety that tends to sustain interest.

The subjects covered are astronomy, historical geology, atomic physics, chemistry, and various aspects of biology; the nature and origin of life, plant evolution and reproduction, invertebrate behavior, vertebrate evolution, physiology, microbiology, and racial anthropology. The reader who wishes to dip into the volume

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thus has a fascinating choice of topics, although it must be admitted that a really well-rounded treatment of the subject stated in the title is not achieved. For instance that part of physics most truly pertinent to our daily lives is omitted (a fault of most recent popularizations of this science), and so are such highly important aspects of the world and man as heredity, psychology, and social anthropology. In contrast, such relatively abstruse or remote problems as wave mechanics, the evolution of sex in plants, and learning in protozoans are treated in some detail.

G. G. S.

THE GREEN CONTINENT

A Comprehensive View of Latin America

By Its Leading Writers

- - Selected and Edited by Germán Arciniegas

Translated from the Spanish and Portuguese by Harriet de Onís and Others

Alfred A. Knopf, \$3.50, 533 pages

AGAINST the general "good will" background of the moment, the book *The Green Continent*, skillfully edited and co-ordinated by Germán Arciniegas, and translated by Harriet de Onís and others, stands out like a true oasis, not a mirage, in the desert lands of mutual hemispheric ignorance. Here in some 500 pages are presented selections from the best writings of 33 authors, all citizens of the variegated southern nations too often indiscriminately lumped under the phrase "Latin America." In these pages, none of which were written for any immediate or propagandistic purpose, there is presented a sample, in vivid English, of the rich and complex physical and intellectual worlds of Mexico, Central America, and South America as seen and interpreted by their own people.

For the North American reader who, like the reviewer, is no linguist, but wishes to know what our southern neighbors actually are like, here is an introductory key. "Landscape and the Man" gives a firsthand view of the variant southern lands, their incredible beauties and rigors; "The March of Time," the Colonial background; "Bronzes and Marbles," the continuing fight for freedom, physical and intellectual; "The Cities," the background, charm, and modern significance of Rio de Janeiro, Buenos Aires, Mexico City, Lima, and Cartagena; and, "The Color of Life," the human atmosphere of racially and culturally complex but vitally important civilizations. Each section includes several authors, who write intimately on the basis of intimate knowledge. Each deals with geography and the past in such a way that the human present stands forth in clarity and the future assumes vital challenge. We can only hope that some of the translations of North American literature now being made in Spanish and Portuguese share in part the vividness and reality of the book under review.

WM. DUNCAN STRONG.

First . . .

IN WORLD-WIDE BANKING

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Continued from page 119

away, so small and so quick on the wing that she seems to disappear in the air.

After stocking the burrow with 15 to 20 or more aphids, she lays an egg among them. Then she walls off that portion of her burrow with bits of pith and begins to provision a new compartment above the first. So she continues to supply as many as six or eight separate cells in a single stem. If we were to split a stem containing a nest of *Stigmus*, it is likely we would find the larva on the ground floor full-grown while the upper story tenant was not yet hatched from the egg. Sometimes one or two rooms will be deserted and the aphid stock dried and brown, with no sign of egg or larva. Apparently the mother wasp simply failed to lay an egg.

The larvae are at first curled, gray, covered with white spots. After the larder has been emptied, the larva straightens to become the bright yellow prepupa and later the yellow pupa. It gradually turns black before the emergence of the black, winged adult.

Unlike the subversive tactics of the parasite or the kidnapping technique of *Stigmus* are the frankly predatory activities of the larvae of a syrphid fly and the aphid lions or larvae of lacewings, as well as both larvae and adults of ladybird beetles.

The syrphids, also known as flower flies and hover flies, have peculiar children. They are legless larvae, greenish marked with brown. The hind part of the body is broad, while the fore part is slender, tapering, and extensible. As they crawl slowly about on the leaf, they wave the front part of the body from side to side, stretching it out and again retracting it. When one of them encounters an aphid, it grasps the prey with its mouth hooks and, extending its forepart upward, holds aloft the hapless aphid. The aphid may struggle, waving its legs in the air, but to no avail, for it cannot reach the leaf surface or anything else. While held thus in the air the aphid is drained of its body juices and soft parts by the syrphid larva. Then the dry remains are cast away, and a new victim is sought.

When mature, the syrphid larva pupates in a hard brown puparium (the last larval skin) firmly attached to the sunflower stem or hidden in

a curl of the leaf. Usually in due course a yellow and black syrphid fly emerges. Sometimes, instead of the expected fly, a red and black ichneumonid wasp cuts its way out. Few, indeed, are the insect species free from the attacks of such parasites.

"Golden eyes" and "green lacewing" are common names for *Chrysopa*, and these names are appropriate to the dainty beauty of the adult, but aphid lion is the most fitting name for the larva. On the sunflower leaf that we have been observing, there are no lacewing eggs, but they may be found elsewhere on the plant. Each tiny white egg is fixed to the top of a hair-thin stalk nearly half an inch high. As each little pole-sitter hatches, it descends the stalk and sets out in search of prey. Aphid lions have disproportionately huge jaws and outspread legs, and the gray body tapers to the rear. Aphids so unfortunate as to be in the path of their prowling are quickly seized and sucked dry. When fully grown, the tiny brute rolls up in a spherical, tightly spun, silken cocoon which resembles a rather dull pearl. From the resting pupal stage in this cocoon the fragile, slender, green, lacy-winged adult emerges. The adults take no food; they rest by day beneath leaves and flutter about in the twilight and at night. They are possessed of a foul odor which may help to protect them from their enemies. Some species of green lacewings, however, appear to lack odor entirely.

But probably the most important of the aphid enemies are the ladybird beetles or ladybugs. So much has been written of these interesting insects

that we need describe them only briefly here. Commonest on the sunflower leaf is the convergent ladybird beetle (*Hippodamia convergens* Guérin). The adult is mostly red with small black spots. On the black prothorax are a pair of convergent white dashes which give it its name. In a general way the alligator-shaped larvae resemble aphid lions, but they are much more strikingly colored in their black dress spotted with orange. Unlike the lacewing, both adults and larvae feed on aphids, and they chew them up instead of merely sucking out the juices. It is said that one larva may eat as many as 25 aphids in one day, and one of its parents may consume 55. The eggs, like tiny, fat, yellow cigars standing on end, are laid in small clusters on the leaves and stem of our plant.

Adults of several other species of ladybird beetles are frequently seen on our plant and probably eat a small share of the aphids. A few larvae as well as adults of a species of *Scymnus* are found occasionally on the sunflower leaf. The adults are small blackish ladybird beetles. The larvae, however, are conspicuous among green aphids, for they are covered with long filaments of white wax. These larvae are ordinarily found among groups of mealy bugs, upon which they feed. Since mealy bugs are likewise covered with filaments of white wax, *Scymnus* larvae are very inconspicuous among them. There is no doubt, however, that the larvae on our plant were feeding on sunflower aphids.

As autumn approaches, our leaf becomes darker. Patches along its edges turn brown and die, and other parts where the aphids have been feeding curl somewhat. Finally the whole leaf becomes yellowish, then brown, as it dies.

Clearly the aphid colony is the center of activity on the sunflower leaf. Other colonies at other times are harassed by different parasites and predators not observed on this leaf. Yet unwilling hosts and defenseless prey though they be, they maintain the colony until cool weather and the gradual death of the plant, now in seed, drive away or kill the remaining individuals. Each aphid is a helpless atom; yet the colony is strong, for it fights back by simply producing more and more young. In the long run the victory is often the aphids', for some species become so abundant as to damage severely man's cherished crops.

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LETTERS

SIRS:

If possible, I should very much like to know the greatest length to which kelp grows. I have tried for several years to find out from local sources but with no results. . . .

(MRS.) A. B. KRECH.

Denver, Colorado

Some of the Olive-brown Seaweeds, sometimes called kelps, attain quite a gigantic size. According to Dr. E. Warming's *Handbook of Systematic Botany*, *Macrocystis pyrifera*, for instance, is said sometimes to attain a length of more than 300 meters. However, this kelp is given a length of from 30 to 50 meters (approximately 100 to 164 feet) in Josephine E. Tilden's recent book, *The Algae and Their Relations*. It appears likely that the latter figures give a more accurate representation of the size of this abundant species of kelp, which is common on the western coast of North America and elsewhere. Other kelps also attain comparable lengths, such as "bull kelp" or "sea otter's cabbage" (*Nereocystis lutea*), which is found from the Shumagin Islands, Alaska, to Santa Barbara, California.

CLYDE FISHER,

*The American Museum of
Natural History.*

* * *

SIRS:

. . . I have been reading Audubon's *Birds of America*, and found that he left out the pheasant. I would like to know why. I have heard that pheasants were imported from Asia. I think it is because pheasants were not imported to America until after Audubon's time, but I do not know for sure. I wish you would tell me. . . .

JONATHAN HALL,

(Age: 10 years).
Bristol, Conn.

The Bird Department of the American Museum confirms Jonathan Hall's assumption. Pheasants did not become established in America until after Audubon's time. Earlier attempts failed.—ED.

* * *

SIRS:

We wish to express our appreciation for the magazine which you recently sent us for the patients at Halloran. This has been passed around amongst the boys and enjoyed by many. . . .

(MRS.) FLORENCE K. PETERSON,

Admin. Asst. Field Director.

Halloran General Hospital
Staten Island, New York



FIND THE BIRD! An unusual photograph of a blue grouse that hatched out eight chicks amid the activity of a lumber camp

SIRS:

This blue grouse built her nest at the base of a big pine tree directly in the path of the timber fallers at the Brooks-Scanlon Lumber Company's camp near Bend, Oregon. So carefully was the bird concealed by its natural protective coloring that the loggers almost stepped on her before they saw her.

When the tree was felled, she flew back into the woods a short way, but returned as soon as the fallers had moved on. A logging railroad was built within 50 feet of the nest, and huge caterpillar tractors roared back and forth past it as they hauled out the logs, but the bird never moved.

Toughened old loggers shared their lunch pails with her every day until she finally came off the nest with eight little chicks, which immediately scurried into the underbrush and hid until the loggers retired to a distance. PAUL HOSMER.

Bend, Oregon

* * *

SIRS:

It has been my great pleasure to have your excellent magazine in my school room for several years. I have been delighted at the immediate interest and enthusiasm which it has aroused in the students. Many boys and girls have asked their parents to subscribe to it. I think it is much the finest magazine published.

I teach three classes in geology . . . (and) for several years *NATURAL HISTORY* has carried at least one article of geological interest in every issue. One year there was a series of article on gems; another year a series on strategic minerals. In addition there have been countless articles on fossils, and on such things as the Ice Age, laccoliths (Devil's Tower), Krakatoa, Shiprock (volcanic neck), Paricutin. I know of no other source which presents such material so attractively and at the same time so accurately.

I have been disappointed to observe the falling off of such material in the last few months. The current issue contains nothing of a geological nature. I trust this is only incidental and is not to become the permanent policy of the magazine.

(MISS) JENNIE LIVINGSTONE.

Central High School
Tulsa, Oklahoma

NATURAL HISTORY hopes to keep pace with Miss Livingstone's lively and welcome interest.—ED.

* * *

SIRS:

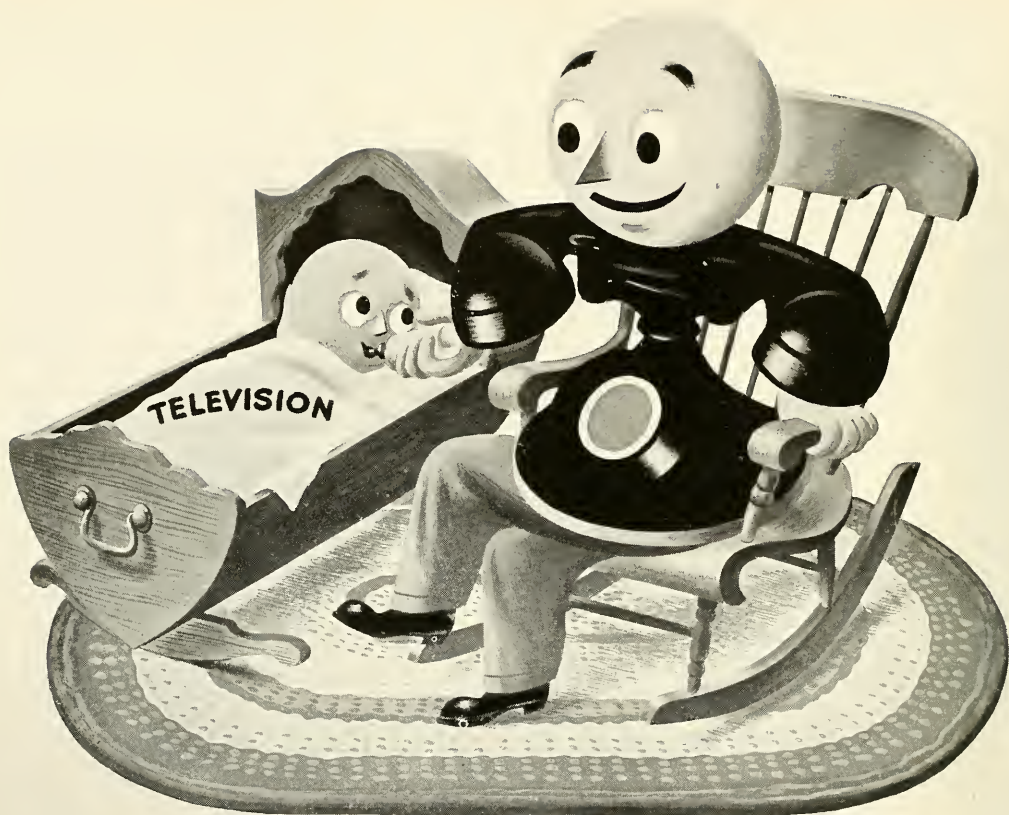
. . . It seems that every issue is better than the others before it. . . . Your article on Corn and Early American Civilization is most illuminating.

N. L. BRIGGS,

Chicago, Illinois

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.

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VOLUME LIV—No. 4

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APRIL, 1945

Red Maple Blossom.....Cover Design

From a Kodachrome by J. R. Swain

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Showing that these fascinating animals have minds of their own

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*There is wholesale emigration when lemmings overpopulate
their homeland*

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On the grandeur and mystery of Cambodia's famous ruins

If You're Short on Photographic Paper....Thane L. Bierwert 192

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Guide to Periodical Literature* in your library

THE COVER THIS MONTH

The Kodachrome of a Red Maple blossom, *Acer rubrum* (Linn.), that decorates this issue was taken by the Reverend J. R. Swain of Bridgeport, Connecticut. It illustrates the beauty that is offered in abundance by a common tree yet passed unappreciated by most people unless they take a little trouble to examine it.

The enlargement on the cover shows the flowers at approximately nine times natural size. Like all other maples except the Box Elder, this tree has both male and female flowers on the same tree. The picture shows three clusters of male flowers. The double-celled pollen-sacs (anthers) are clearly evident on the ends of the rodlike filaments.

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WE KNOW the world as it appears to us, but how does it appear to a bird, a fish, a dog? This popular introduction to animal psychology, the first of its kind, gives the answer telling how animals perceive and "think", and why they behave the way they do.

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THE NATURE OF THE BEAST

By RUTH CROSBY NOBLE

This book is based largely on the scientific publications, lectures, and notes of the late G. KINGSLEY NOBLE, Ph.D., of the American Museum of Natural History.

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BLACK WIDOW: America's

Most Poisonous Spider

- - - by Raymond W. Thorpe and
Weldon D. Woodson

University of North Carolina Press, \$3.00
36 illustrations, 222 pages

THE spiders of the genus *Latrodectus* have long been regarded as poisonous by many different peoples, who have given them such picturesque names as "malmignatte," "karakurt," "red-back spider," and "black widow." All these creatures, the majority of which are gayly colored in shining black and splashed with red, have a neurotoxic venom that is capable of causing grave systemic symptoms in man and other warm-blooded animals. The victim usually experiences acute pains centered chiefly in the abdominal region, which may become excruciating within an hour or two and remain so for twelve or more hours before they gradually abate. According to Dr. Bogen, the best treatment is the intravenous injection of gluconate, which largely precludes the need for the serum which has become available recently. The authors list 1291 cases of black widow bite from the United States during more than two centuries and report that 55 resulted fatally. There has been little question of the venomous nature of

these spiders for more than 20 years, but many of our data still lack exactness.

The principal American species is *Latrodectus mactans*, our black widow, hour-glass or shoe-button spider, which is now known to occur in every State and in various Canadian Provinces. Hardly known to the layman until after 1934, this colorful spider quickly seized the imagination of a credulous and indiscriminating public and gained a reputation for deadliness that is largely unjustified. The authors have brought together an imposing number of citations and references on this spider, but in limiting themselves to the United States they have missed much lively and important information on this same species in South America. The best part of the book is the verbatim reporting of such investigators as Dr. Emil Bogen, who should be credited with much of the pertinent medical research on the spider.

The early chapters on "Spider Lore and Legend" and "Tarantism" will be found most interesting and will to some extent compensate for the latter ones which are dull and repetitious. The importance of this spider and its poisonous bite have been greatly overemphasized.

W. J. GERTSCH.

THE TEN GRAND-MOTHERS

- - - - - by Alice Marriott

Norman: University of Oklahoma Press,
\$3.00, 306 pages

THIS is a book about the Kiowa, a plains tribe of Indians, whose territory is in what is now western Oklahoma around and to the north of the Wichita Mountains. The Ten Grandmothers are ten medicine bundles, sacred symbols of power. Although dating from the dim and distant past, the bundles themselves

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still exist,—as sacred and as valued as ever. They were tribal safeguards, protection against evil. From them the Indian believed he received power, as he conceived the word. As Chief Sitting Bear said to his sons, "You've got to have power working with you all your life, or everything you do will go wrong."

Beginning nearly one hundred years ago with the war party against the Utes in 1847, down to the war party that set out in uniform to fight the Germans and the Japanese in 1942, we are given a clear and convincing word picture of these people,—from a primitive culture to assimilation into the white man's way of life. The interesting and carefully prepared Kiowa calendars in the back of the book carry the record back to 1826. The running story is essentially the oral tradition of the Kiowas, given to the author by elder informants of the tribe. It has been set down with fine literary skill in all its artistic simplicity. The writing has a strong Indian flavor, reflecting real understanding. The story is full of beautiful figures of speech, often translations of Indian thought, always poetic prose.

This book is number twenty-six in the Civilization of the American Indian Series, and a worthy one. The author, Alice Marriott is a trained ethnologist. She has served as specialist in the Division of Indian Arts and Crafts for the Department of the Interior, and as a field research fellow for the Laboratory of Anthropology at Santa Fe, and for the Department of Anthropology of the University of Oklahoma. In addition to two summers residence among the Kiowas, she has devoted more than eight years to research and to writing this story.

TE ATA.

LOOK TO THE FRONTIERS

----- by Roderick Peattie

Harper and Bros., \$3.00
246 pages, 22 maps and diagrams

MR. PEATTIE rather aptly characterizes his own book when he speaks of "planners and their compact little books which are flooding our bookstores." They are, he goes on to add, if "not definitive," at any rate "thought provoking." Definitive is certainly not the word for Mr. Peattie, and the thoughts he provoked in this reader were not entirely in agreement with his own.

His aim, the author explains, is to examine the geographic foundations to a lasting peace. To this end he discusses regionalism as the natural outgrowth of geographic circumstances. Nationalism comes in for analysis and, although he recognizes its value, he deprecates the extremities to which it has been carried. Modern wars, says Mr. Peattie, are the result of nationalistic competition and are frequently fought over boundaries. Remove these boundary problems and much of the tension is relieved. Boundaries of various kinds—mountains, strand lines, rivers, and political agreements—are often unsatisfactory and all too infrequently solve the problems of national ambition and expansion. Mr. Peattie would substitute a series of zonal boundaries consisting of small buffer states with international communications neu-

tralized, thus weakening the political significance of the boundary line and relaxing the pressures that lead to war.

The future of transportation by air Mr. Peattie sees as likely to engender additional troubles unless we take steps to internationalize air sites and guarantee the freedom of the skies.

In spite of his inclination to set up international mechanisms, he is not prepared to advocate a world state. Instead, he proposes a series of federations based on land continuity and community of interests. Within such frameworks, economic communication might be facilitated and boundary concepts weakened to the strengthening of peace.

H. L. SHAPIRO.

BURBANK AMONG THE INDIANS

----- by E. A. Burbank
as told by Ernest Royce

The Caxton Printers, Caldwell, Idaho,
\$5.00, 232 pages

BURBANK, or "Many Brushes," as the Indians called him, made many portraits of Indians, mostly during the closing years of the last century. He was an artist of talent, as attested by the 56 paintings that are reproduced in this book. The frontispiece is of the Apache Chief Geronimo, and is in color. This makes the reader wish that all the rest could have been in color. The illustrations are a most valuable feature of the volume.

The book is somewhat marred by careless slips in editing and proofreading. On the jacket the story is presented as told to Ernest Royce, on the cover by him: In the publisher's blurb on the jacket an unfortunate slip occurs in crediting Charles F. Lummis as the author of the anthropological classic, *The Delight Makers*, which was really written by Adolf F. Bandelier. Scattered through the book are a number of misspelled words and inconsistencies in spelling. The name for paper-bread (piki) is sometimes spelled "pike" and at other times "peki,"—both incorrect. The Smithsonian Institution is always referred to in this book as the Smithsonian Institute.

Burbank's portrait of Rain-in-the-face is marked "Ft. Yates, S. Dak.," but Ft. Yates is in North Dakota. The artist's hearsay story of the killing of Sitting Bull is somewhat at variance with the most authentic accounts, and, in his story of Custer's last fight, he admits that all he could get out of one of his best informants, who had participated in the fight and had promised to tell him all about it, was "Heap big fight. Heap dust."

According to his own count, Burbank lived and worked among 128 North American Indian tribes. During the time he was painting, he set down many a revealing episode in connection with his work among the Indians. He had abundant opportunity to learn the Red Man's point of view on many subjects. He felt that Chief Joseph, the Nez Percé, was the greatest Indian he ever knew. His personal experiences with a wide range of important Indians makes fascinating reading.

TE ATA AND CLYDE FISHER.

SPORT FISHING IN HAWAII

----- by Edward Y. Hosaka

Bonds, 1360 Koko Head Avenue, Honolulu, T. H., \$2.75, 198 pages, 114 drawings by the author, 34 photographs

MR. HOSAKA, as the reviewer discovered while his guest on fishing excursions to Hawaiian beaches, has a knowledge of this sport that must rival that of the early island natives. The first half of his handbook discusses all phases of shore fishing: kinds of hooks, leaders, knots, and lines; making a casting pole, securing bait, etc. There are also chapters on the less usual methods of fishing such as torch fishing, spearing and netting, as well as on trolling and deep-sea fishing. A map shows the best fishing grounds, and there are abundant illustrations.

Hosaka, while traveling among the islands as botanist and agronomist for the Bishop Museum and other institutions, has been able to fish in a variety of places and to converse with Hawaiians and with the half dozen other peoples comprising the bulk of the secondary population of these islands. In this way he has gathered much interesting lore that is here recorded for the first time. His chapter on methods of cooking fish (or eating them raw!) will be read with profit by even the most experienced "stateside" cook.

In the second half of the book the 73 most important game fishes of the Hawaiian Islands are figured and described. A few celebrated in song or story rather than for sport, such as the humuhumunukunuaopua, are permitted to go drifting by with the others. There is a simple key that will be of general use, since most of these species are of wide distribution in warm seas. The habits of many of the fish are discussed in remarkable detail, which will be appreciated by scientists as well as fishers. Hosaka is expert at the fascinating sport of swimming and diving along the reefs well offshore to spear fish. Since goggles are worn and the water is very clear, much can be learned of fish in this way, perhaps too much if a barracuda or man-eating shark, both not uncommon, is encountered.

Sport Fishing in Hawaii will be of interest to fishermen everywhere, particularly to shore fishermen. It can be especially recommended for servicemen on South Pacific islands, to many of whom fishing is one of few available diversions.

DEAN AMADON.

TEMPO AND MODE IN EVOLUTION

----- by George Gaylord Simpson

Columbia Biological Series XV
Columbia University Press, \$3.50

THERE have been a number of recent discussions of those aspects of evolution that are accessible to the geneticist and neozoologist, but a modern analysis of the problems of long range evolution was wanting. Simpson's volume fills this gap admirably. Two aspects of evolution especially are treated by him because they concern subjects on which the paleontolo-

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gist has accumulated a great deal of evidence. A study of evolutionary rates under natural conditions ("tempo") is one of these topics; the genetical and morphological bases and consequences of various forms of living ("mode") is the other.

In his treatment of these topics Simpson has succeeded not only in summarizing and making available much of the results of the widely scattered and rather technical paleontological literature, but also in correlating these facts and in giving them a new meaning. It has been claimed sometimes that paleontology was more closely akin to history or archaeology than to the other subdivisions of biology. This is true, of course, only as far as the working methods are concerned. In all three fields a reconstruction of past events is attempted on the basis of

incomplete evidence. It needs an original and imaginative thinker like Simpson to do such an interpretive job satisfactorily.

Whenever possible the author correlates the paleontological evidence with facts derived from neighboring fields, such as ecology and genetics. He finds no conflict between paleontology and the results of recent genetic research. Special attention is given to the phenomena that have given rise to such terms as "orthogenesis," "explosive evolution," and "preadaptation." Some of the unsolved problems of evolution are brought in sharp focus. The findings of each section are summarized concisely.

The author's hope that his study might suggest "new ways of looking at facts and new sorts of facts to look for" will surely be fulfilled. It has opened new worlds to the reviewer. A far-reaching influence of Simpson's book on evolutionary thought and on the field of paleontology can be predicted. E. MAYR.

TELESCOPES AND ACCESSORIES

----- by George Z. Dimitroff
and James G. Baker

The Blakiston Company, \$2.50, 309 pages

THIS is the seventh in the series of the new Harvard Books on Astronomy, edited by Harlow Shapley and Bart J. Bok. For a long time there has been a need for such a book, which gives a brief, clear description of astronomical instru-



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ments and their uses. It explains not only the fundamental principles of the tools of the astronomer that have been in use for generations, but also the instruments developed in recent years.

Students of the physical sciences naturally are eager to know how the astronomer has discovered the facts about the celestial bodies, and such questions are answered here in a non-mathematical treatment of the various subjects. The book will prove of especial interest to amateur astronomers and amateur telescopic makers as well as teachers of astronomy.

There is a brief but practical discussion of light as a "tool," with attention to light waves, color, polarized light, reflection, refraction, and quanta. The chapter on visual telescopes considers the human eye as an optical instrument, the various types of reflecting and reflecting telescopes, and the different kinds of eyepieces. A brief account of the history and development of the photographic process, or the storing of light, with especial reference to its use in astronomy, is given. Then follows a chapter on photographic telescopes, including the Schmidt camera, the Schwarzschild reflector, the Ritchey-Chretien reflector; and also the finest lenses, including the photographic doublet, the Cooke triplet, the Ross lens, and the Zeiss Biotar. Here, however, I missed

the Apochromatic three-lens objective.

The history and development of the science of spectroscopy from Newton's classical observation down to the complicated spectrographs of the present day are described together with explanations of the revelations of these instruments. Photometers, the spectroheliograph, the spectrohelioscope, the spectroheliokinematograph, the coronagraph, and other instruments of the astronomer's workshop are clearly explained. Finally there is a fascinating chapter on building some of the great telescopes.

The abundant excellent illustrations throughout the book add much to its value.

CLYDE FISHER.

A STORY OUTLINE OF EVOLUTION

----- by Charles W. Grimes

Bruce Humphries, Inc., Boston, \$2.00
244 pages

THIS book is devoted to the thesis that the results of scientific research are compatible with theism and that evolution, accepted as a proven fact, is to be interpreted as God's method of creation. That such an exposition is useful and has an audience is attested by reissue of the work after seven years and by favorable remarks on the first edition by religious educators.

The author's aim is commendable. The sincerity of his desire to present science fairly and without bias is unquestionable. His piety is beyond criticism by scientist or theologian. It is, then, with regret that recommendation of the book must be withheld. The author has so completely failed to present the facts as now known and to understand the modern theory of evolution that his account is, at times, little above the level of travesty. The curly hair of the Negro makes him immune to sunstroke; ostracoderms had two or three sets of jaws, and their armor became the feathers of birds and the skin of mammals; flying crocodiles prepared the way for birds; mammals suck in the memories, instincts, traditions, and experience of the species from their mother's milk; mother-love is the most potent force in the world; each step in the development of the human embryo shows where one ancestor stopped and the next, better equipped, began—these are only a few random examples of the hundreds of statements that are rather a burlesque

than a popularization of present scientific knowledge.

That the author does not understand his subject and that theologians do turn to such a poor source for knowledge of evolution are perhaps indictments as much of the students of evolution as of this unfortunate book.

G. G. SIMPSON.

FLOWERS IN BRITAIN

----- by L. J. F. Brimble

Macmillan and Co., \$4.50

393 pages, 67 figures, 17 colored plates

HERE is a most attractive book for the layman, which assumes no technical knowledge of botany. A wealth of information about plants is here gathered together and logically arranged,—always from the beginner's point of view. Some 40 pages are devoted to a general discussion of the flowering plants, of flowers, and of the classification of plants. The main part of the book,—more than 350 pages,—consists of descriptions of plants by families. Under each family they are grouped as wild plants, cultivated plants, herbs, economic plants, and weeds in case there are unwanted members.

The book is copiously illustrated both by black and white cuts and colored plates. The former consist of clear, helpful drawings, and excellent photographic illustrations, while the latter are fine drawings in color. Altogether there are seventeen colored plates, each with eight or ten flowers,—about 150 flowers in color, each surprisingly good in spite of its small size. These colored plates show the distinctive features of the plants whether it be the inflorescence, leaf-arrangement, fruit, or seed,—and only common names are used.

Scattered through the text are scores of well-selected quotations, mostly poetic, from the great writers, which add much to the beauty and interest of the treatment. Apparently all the flowers of English literature have been included. At least this reviewer did not miss any. As is well known, a goodly number of these have been introduced intentionally or accidentally into America.

The author is a Fellow of the Linnean Society of London, joint editor of the English magazine *Nature*, and formerly Lecturer in the Universities of Glasgow and Manchester. The book will appeal to field naturalists who are interested in plants, to gardeners, and to horticulturalists in general.

CLYDE FISHER.

ABC'S IN VICTORY GARDENING

SUCCESS for Victory Gardeners is considerably more probable if they will observe five simple rules or principles which have proved helpful both to old hands and to inexperienced gardeners in recent years, according to Victory Garden Headquarters at the U. S. Department of Agriculture.

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2. Have everything ready before the garden season opens—seeds, fertilizers, insecticides, and tools. Avoid waste of good gardening weather in doing last minute shopping.
3. Get an early start, and plant early crops early. Hold later crops—such as tomatoes and lima beans—until the soil and weather are warm enough to favor quick growth.
4. Feed the crops—with fertilizers of one kind or another—and protect them from insects and diseases with the dusts or sprays that have proved their value.
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When these lovable little rascals suddenly decide to have minds of their own—which is not infrequent—anything can happen. It may be humorous, or it may be tragic, but one thing is certain—it will not be dull!

By WILLIAM H. CARR

*Director of the Bear Mountain Trailside Museums,
Associate Curator, The American Museum of
Natural History*

IT was the girls' own fault to begin with, and not the raccoons'.

If the children had not left chocolate bars lying about their tent platform, the raid would never have occurred. Toward midnight, a very large raccoon mother, accompanied by several infants, invaded the campers' quarters and caused no end of confusion. There were eight girls present, and one of them must have concealed some edibles beneath her mattress, for the old 'coon actually walked across her blankets, waking her up and causing her to shriek long and loudly for help. Her cries brought a Park Patrolman, the Camp Director, a number of Councilors, and, in addition, it awakened some 150 children in adjoining tents and cabins. The disturbed raccoons stalked away into the darkness but were identified by several of the girls before they disappeared.

RACCOONS

we have known

Incidents of this sort are not unfamiliar in the 42,000-acre Bear Mountain-Harriman State Park preserve. Many raccoons have learned that camp kitchens, refuse collections, and candy boxes are available during summer months when 6000 children in 92 different camps arrive for their woodland vacations. As a consequence, many hundreds of city dwelling children and others have become familiar with the animal that wears a black mask across its eyes.

At the near-by Trailside Museums, we have exhibited raccoons for years. Many and varied are the experiences

we have had with these intelligent American animals, in captivity and out. We have had raccoons that showed real antagonism toward one of our staff yet accepted all others with pleasure and would play with us literally by the hour. The principal actor among them was a large, yellowish animal which remained tame for more than a year.

The first time the unfortunate boy noticed the female 'coon's strange resentment was when he unsuspectingly entered the cage one day for the purpose of cleaning it. He had no sooner closed the door from the inside than

All photos from Palisades Interstate Park Commission by Harold K. Whitford

◀ "THE CONTENTED HOUR" at the Bear Mountain Trailside Museums. A sound recording has been made of the animals when feeding from the bottle. Anyone who has raised a 'coon from infancy may recognize it, but no one else

▼ HAVING no mother of their own to nurse them, these little 'coons were quickly introduced to the cat in a near-by garage. And the cat apparently welcomed the opportunity to become their "service station"



the 'coon was upon him, a growling, biting fury. Before the boy could escape, he had received at least two dozen bites upon his legs and hands. Thereafter, whenever he approached the cage, the raccoon would rush at the wire and try to attack him, with ears flattened and entire body trembling with rage. Yet the animal was so tame that she would permit other members of our group to place their fingers in her mouth and would behave like a puppy under these circumstances. As far as we know, the boy who aroused her anger had never abused her in any way whatsoever. Events of this kind are difficult to explain.

In the course of providing room and board for raccoons, we have had a number of escapes from our cages. Quite often they were animals that had been kept for a number of years, had been handled like the others, and were equally tame. On escaping, particularly at night, some would rush off into the woods and never appear again. Others would remain in the vicinity until recaptured. One in particular sat upon his cage roof all night and morning until we saw him and lured him back home with the aid of a dry roll.

The difference in sex and the time of year have had little to do with this discrepancy in behavior. Happenings of this sort serve to emphasize the fact that raccoons, together with many other animals, are often individualists. Certain forms of behavior seldom apply to all individuals in equal degree. It is this variation that makes the study and care of animals interesting, for one is constantly on the alert and learns to expect the unexpected. One who has lived and worked with animals seldom makes glib, generalized statements concerning their habits and behavior patterns, unless he has a story to tell and has difficulty marketing it.

On several occasions, with one hand filled with the raccoons' food trays and the other engaged in opening the cage door, we have had animals slip out and away. Some would instantly climb to the very top of high trees near-by, while others would dash through the woods, apparently with no thought of climbing. They seemed to rely entirely upon their speed to effect an escape. One such animal, upon escaping, was pursued through the woods, over cliffs and hills, for more than a mile before it was finally

captured. At no time did this animal show the slightest inclination to scramble up available tree trunks.

The behavior of captive parent raccoons toward their young has always been of importance to us, for complications frequently arise to test our ingenuity. When Ginger, our tame raccoon mother, commenced to lose interest in her three very recent offspring, we were faced with an emergency. We had raised infant 'coons with medicine droppers and small nursing bottles, but these squalling babies were just too much. We were at the time responsible for three dependent young woodchucks, six gray squirrels with their eyes just opened, two kit beavers, and a tiny gray fox, all in the Trailside nursery. Soon there would be a pair of Virginia Deer fawns to bring up, to say nothing of several demanding bear cubs. The milk bill was too high as it was, and our hands were full.

Every day that went by demonstrated that Ginger was no proper parent. She dragged her young ones about the large cage by the tender scruffs of their necks. Despite their wails of protest, she would climb the wire with their limp forms hanging from her mouth. She pushed them through the small entrance hole of one of her nest boxes, only to reappear with them the next moment and continue her perambulations. When the little 'coons tried to feed, the mother would become impatient and shake them off. Something had to be done at once if the offspring were to survive.

We found the answer to our problem in the feline presence of Gloria, the friendly and intelligent cat which occupied a place of honor on the staff of our Bear Mountain State Park Garage. Gloria had just lost her kittens and was still looking for them when we arrived with the three little 'coons. We prepared a box, lined with an old sweater, in the warm paint room of the garage and placed the hungry 'coons within. Then we sought the bereaved cat, picked her up, and brought her to the nest box. Without hesitation she stepped daintily into the container, very carefully inspected the strangers and then, when one of them whimpered, she commenced to lick its face with her rough, warm tongue. She lay down in a corner of the box, and the little ones quickly struggled over and climbed upon her. She offered no re-

sistance whatever, and soon the searching 'coons discovered the source of liquid nourishment that their rightful mother had all but denied them. From this point, all was well. Gloria became a perfect foster parent, faithful, affectionate, and gentle.

Eventually, the 'coons reached the stage where they commenced to wander abroad. At night they would investigate the precincts of the paint shop, and the watchman observed that Gloria would accompany them on their travels. When the wanderers strayed too far, the cat would pick them up as she would her own kittens and return them to the nest box. This propensity to explore at last brought an end to our happy relationship. They had grown almost too large for Gloria to feed and were becoming a very real burden, when fate stepped in. One morning the garage men came to work to find Gloria all alone. An examination of the nest box showed that there were no 'coons in evidence. A patient search by the garage personnel failed to reveal the slightest trace of the missing youngsters. Gloria was very restless. By mid-morning she was observed sitting in a certain spot beside a little ramp connecting two parts of the garage on different levels.

Beneath the ramp was a large, uncovered hole which everyone had forgotten. The opening led to a culvert that served the purpose of leading a brook under the building and down into the near-by Hudson River. Planks were ripped up but no trace of the 'coons was ever found. Gloria approached the edge of the hole and peered into the rushing water beneath. She returned to the spot several times during the afternoon and evening and the next day as well. We might add in passing, that Gloria has raised numerous progeny of her own since then, with complete success.

We have had far better fortune raising our own raccoons than did the garage cat. There was Herman, for example. Herman and two of his brothers were picked up one night while strolling through the dining hall of a large children's camp in the interior of the Park. By coincidence, a very young skunk was also collected on the same night in the same camp. The director of a near-by nature museum, on being presented with the pair, decided to raise them together. Accordingly, he placed the two in a cage and started them off on a milk



▲ 'COON AND SKUNK, on another occasion, became great pals, and the skunk remained a perfect gentleman through many scuffles with its stronger companion

▼ IN THE WILD, most animals do not get as close as this to a skunk, but these two missed each other when separated



formula with the aid of the inevitable nursing bottle.

From the very first, the two became excellent companions. They ate, slept, and played together hour after hour, dashing about the cage in pursuit of each other and staging mock battles during which the 'coon would hide behind the little log in the cage and the skunk would wait expectantly for the charge that followed. The 'coon would rush forward and simply bowl the skunk over by sheer weight and power. The black and white one would squeak in protest and bite wherever his teeth could find a biting surface. Then the 'coon would retreat to a corner and literally hide his head as the skunk nipped him here and there. As soon as this procedure ceased, the 'coon would start the play all over again.

No matter how rough the action became the little skunk was always the perfect gentleman. At times he would stamp his feet as loudly and as furiously as he could and raise his chrysanthemum-like tail on high, but when his play-fellow approached, he would dive beneath the 'coon's on-rushing body and do his best to bite where the biting would do the most good.

As time went on, the 'coon outgrew the skunk in size, and we became alarmed for fear the smaller animal would become injured during one of the spirited contests. In fact, the 'coon developed the unfortunate habit of grasping the skunk by the tail and pulling it about. We noticed, one day, that the skunk was beginning to lose some hairs from his tail and, at this juncture, we determined to call a halt. Fun was fun and the skunk still appeared to enjoy the engagements, but we decided to separate the two. This occurred some nine months after the pair had originally been brought together.

From the beginning, the little skunk had determined the final outcome of each "battle." In his own good time he would invariably back Herman into a recess and cause the chastened 'coon to "cover up" with forepaws over his face in ludicrous fashion, like a small boy told to stand in the corner until directed to join the social world once again.

Herman was very unhappy after the removal of his companion. He would pace the cage and was not at all friendly toward those who cared for him. The skunk, when released

▼ TRAILSIDE MUSEUM visitors regard 'coons as individuals, not as co-partners in the manufacture of a raccoon coat! This pair enjoy water trickling from a bubble fountain cut in rock



upon the floor of the animal building for a daily promenade, would wander over to a spot directly beneath the 'coon's cage and endeavor to reach it. We could not resist the temptation to place the two together once more. Our good intentions were ill fated, however, for we found it necessary to separate them about a week later. The 'coon had really become too rough, and the skunk now showed definite signs of being prepared to use sterner and far more formidable measures whenever Herman stepped beyond the bounds of gentle play.

Both of the animals are still with us but they now occupy quarters far apart. Herman soon became angry with the person who looked after his wants and sank his long teeth into the man's forearm. Raccoons really know how to bite and are thoroughly capable of demonstrating this fact. Gone were the days when the once friendly animal would perch upon our shoulders and, with his clever forepaws, investigate our hair and our ears while his soft quavering voice kept up a continuous "conversation." His disposition had suddenly changed, and he was no longer to be trifled with.

We have had more than one evidence that raccoons will accept strange bed-fellows. Herman and the skunk were not our only example. Our 'coon cage is really a very elaborate affair with a large sun area and a covered portion, beneath which an artificial brook flows constantly. Next door is a similar compartment dedicated to the comforts of a very beautiful, semi-tame red fox. On several occasions, the fox has contrived to raise the sliding door that divides the cages. We have discovered him in the morning in the same nest box with our three 'coons, his bright red head contrasting strangely with the grayish yellow fur of the uncomplaining 'coons. There was every sign that the 'coons accepted his presence without any strenuous objections.

When we entered the cage, the 'coons would leave him. They would come over to us to see what was going on and, on being satisfied that there was no food in sight, would re-enter the little house and join the fox once more. Whether the lone fox was prompted to seek companionship or whether he simply escaped from his cage for the sake of escaping, we

do not know. There were a number of other nest boxes in the enclosure, but the red fox invariably chose the one that contained the 'coons. And in order to return the fox to his rightful enclosure, we found it necessary to drive him from the nest box.

Of the several score of raccoons that have come and gone in our Trail-side Museum cages, very few have been vicious either toward us or toward other animals with which they came in contact. Nevertheless, we did have one once that would actually pursue any of us and do his level best to tear us to bits. The majority, however, permit one to take certain liberties with them, despite some years of captivity. We have succeeded in taming 'coons that were caught when thoroughly adult, to the extent that they would reach in our pockets for peanuts and would not resent it when we scratched their ears while they were engaged in seeking food elsewhere upon our persons.

Raccoon young are not at all difficult to raise, provided one has the requisite time. They accept milk eagerly, almost from the very first, and do not object to cod-liver oil, lactose, or other necessary dietary novelties which we introduce for their wel-

fare. The vocal accomplishments of 'coons, especially during the early stages of their growth and when food is in the offing, are amazingly varied. 'Coons succeed to a remarkable degree in informing their human nurses as to their wants and especially their dislikes.

We once made sound recordings of young 'coons as they cried lustily for their bottles and then we added the contented sounds that came when the nipples were firmly in place and warm milk flowed freely. We played the records for a number of naturalist friends and were surprised to observe that only one man could identify the sounds. The answer was that he had brought up a family of 'coons himself and, to him, the sounds were unforgettable. The anticipatory sounds were high pitched, muffled shrieks, and the "contented hour" was signaled by soft purring-like noises which certainly bespoke happiness or, at least to human ears, indicated pleasure resulting from the fulfillment of a desire. Anger is expressed by growls, rasping barks, and "coughs."

The small masked fellows are appealing pets and, like many young animals, show their dependency upon their owners in numerous ways. When

old enough, they will follow human companions about and climb upon available clothing. They seem to enjoy riding about in one's arms and will go to sleep with perfect confidence in a convenient lap whenever the occasion and the desire coincide. When weaned, they will accept about the same food as a dog, including meat, fish, bread, apples, melons, bananas, oranges, and peanuts. Incidentally, it is by no means true that raccoons always wash their food before eating. One who contemplates keeping a 'coon as a pet would do well to check with his State Conservation Department, for many of our states have restrictions and require special licenses.

We have released more raccoons than we have kept, for we do not believe in the wholesale collection of animals that belong in the woods and not in cages. Furthermore, the ones we have maintained in captivity have mainly been brought to us as helpless young, as injured adults, or as pets whose owners had become tired of them. Anyone who raises an animal from infancy to adulthood, assumes a definite responsibility, and it is well to remember this when one adopts a young 'coon which will one day pass beyond infancy.

▼ A YOUNG 'COON that has learned to trust human companions will curl up without fear at one's feet or in the lap. But their reactions are not always predictable, and they know how to bite





▲ WITH A SIMPLE DIGGING STICK, a woman of central Australia excavates the nests of the "honey ant." The implements in evidence here are almost her only possessions

► THE "HONEY ANTS" are carefully removed from the underground galleries as food—the principal source of sweetness in the diet of these tribes

Australian News and Information Bureau photos

Australian Natives eat "LIVE" SUGAR

By CHARLES P. MOUNTFORD

ANTS that conceal a quantity of sugar in their abdomens are a vital part of the diet of aborigines living in sweet-starved Central Australia. Despite the ants, however, the average hinterland native is able to get in one year only about as much sugar as is contained in a small piece of candy. Sugar to these primitive people is as precious as salt to the Bedouin.

The honey ant, for which aboriginal women dig through many feet of hard-baked earth with primitive digging-sticks, looks like a tiny amber-

colored cherry that has grown a tiny head and struggling legs. But it starts life looking very much like other ants. Science knows very little about these insects, and the natives themselves have taught me more about them than I have learned from books,—which is little enough. *Camponotus inflatus* is the textbook name for the species, and its method of food storage is rather exceptional. The honey ant lives under mulga trees—a variety of acacia restricted to the arid parts of Australia—, and it is from the mulga flower that the ant collects its honey.

Most people are familiar with the bee's method of storing honey in waxen cells against the time when none can be gathered, but honey ants select certain members of their own colonies as repositories. The chosen are fed with what the others collect until their abdomens are inflated to a diameter greater than their original length. They become little golden balls of honey, about the size of peas, on which head and thorax wag helplessly. When they are inflated, the ants are no longer capable of locomotion. In the nest of the honey ant there

is a vertical shaft, often six or seven feet deep. At intervals of from nine to twelve inches, this opens out into circular chambers. In these the *ji-rumba*, as the natives call the ants, are found.

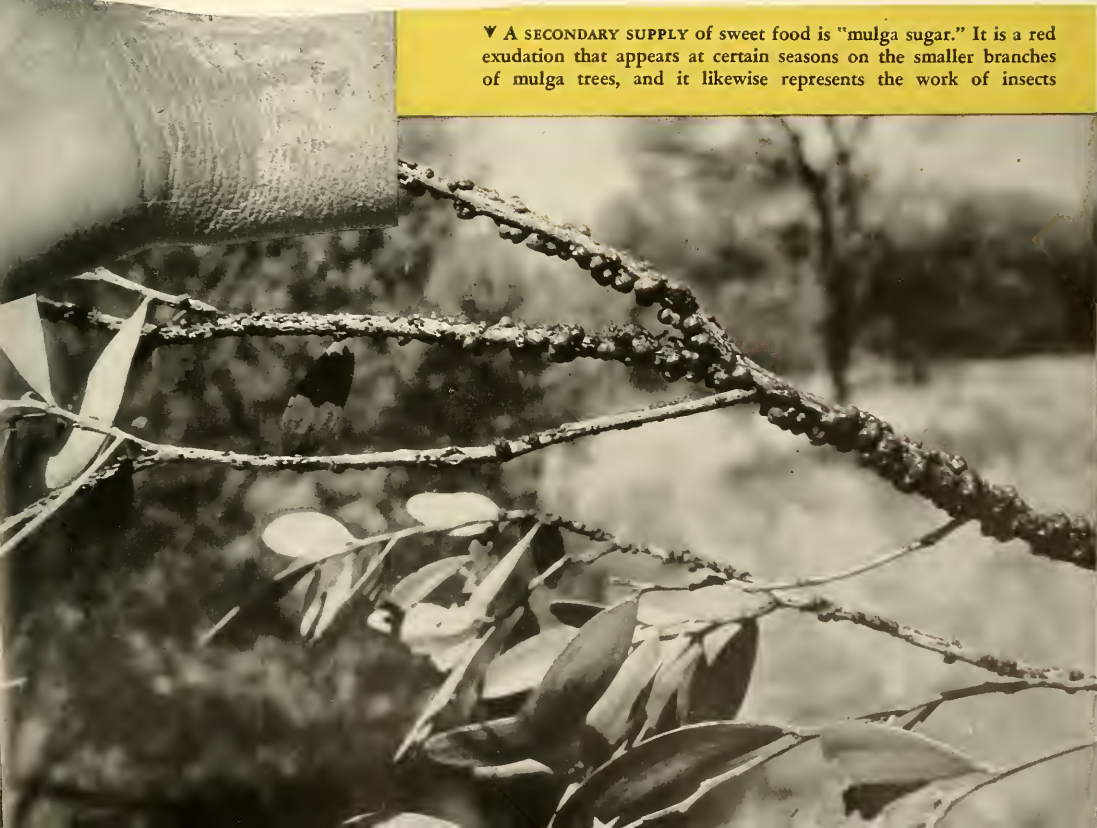
When a native woman detects signs of a honey ant nest, she scrapes the surface of the earth very carefully with the edge of her wooden dish until the loose top sand has been removed and the vertical shaft revealed. Then she uses the dish and a chisel-pointed digging-stick to follow the shaft down. She digs cautiously, because the abdomen of the honey ant is thin, tightly stretched, and easily broken. As she reaches each gallery, the woman carefully removes the ants with her finger and places them in her carrying-dish.

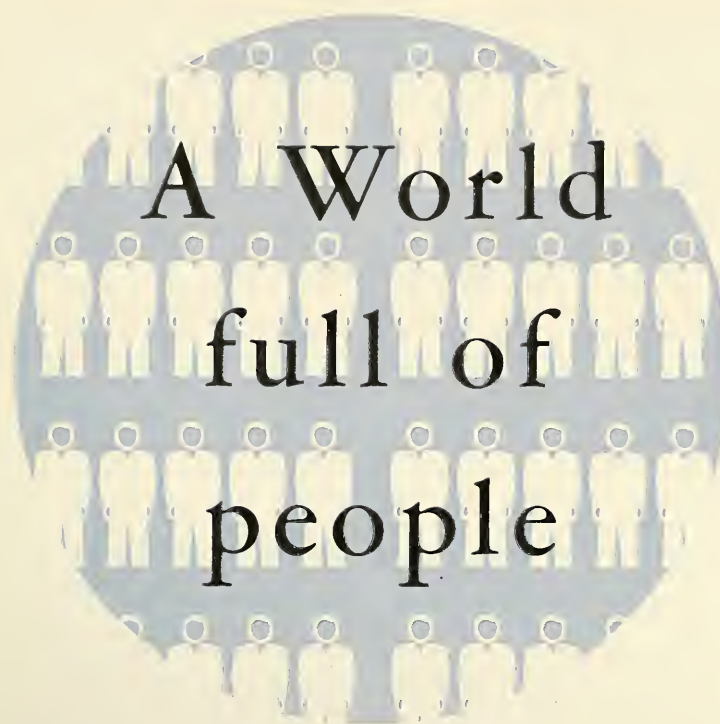
Strict tribal rules of food-distribution forbid the food-gatherer to eat what she collects. All must go to the camp for fair sharing. When the ants arrive at the camp, there will be joy, and the woman digger will be compensated for her hard work by the luscious taste of the ants and the satisfaction of her people. The natives take the tasty morsels by the head and bite off the honey-filled abdomen.

I have taken part in such a feast and have found little difference in taste between the honey of the ant and that of the bee. Sometimes, the natives eat the whole ant. "Makem taste better," they say. Personally I prefer my honey with as little ant as possible.

Another meager supply of sweetness for the aborigines comes from mulga sugar (the aborigines call it *woma*), a red exudation that appears at certain seasons on the smaller branches of mulga trees. This, too, results from the work of an insect, of which little is known, which pierces the mulga bark and buries itself underneath. As far as I know, the aboriginal has no name for this insect. "Bleeding" from the wound and excretions from the insect itself, produce small drops of sweet red gum. The natives pick the branches at the right moment and steep them in water to produce a sweetish liquor, which they drink. Small sugary coverings of certain insects can be found on the leaves of gum trees, but the only other source of sweetness for the natives is desert flowers, which they suck on dewy mornings.

▼ A SECONDARY SUPPLY of sweet food is "mulga sugar." It is a red exudation that appears at certain seasons on the smaller branches of mulga trees, and it likewise represents the work of insects





A World full of people

For who can count the multitude of men?
They are like grains of sand.
And who can know their diverse nature
and condition,
From the most base to the most exalted?

PEOPLE are the most valuable of natural resources—and the most universal. Perhaps this very ubiquity, together with mankind's propensity to replenish itself with little or no encouragement, accounts for the tendency in many quarters to take population for granted. Indeed, it is probably fair to say that the existence of any problem in this connection would have seemed novel a few centuries ago. If any problem existed then, it was apt to be merely one of stemming the flood of mankind that threatened the available means of subsistence.

We have, however, become aware in recent times that there is more to population than its mere size or its growth, important as these are in a national economy. Population, we now recognize, has a complex structure, with a dynamic balance between the component elements. Alterations in one of these elements, can lead to significant changes in the whole. But more than these quantitative aspects of numbers and rates, population has

a qualitative side. Two populations of equal size and of similar age structure may yet be vastly different in biological fitness. This is a phase of population much less known or understood, but obviously one of the utmost importance. To study the behavior of aggregates of people, how they maintain their size, why they increase or decline; to analyze such aggregates into their significant elements and to determine their mutual adjustments; to ascertain if such aggregates are improving or degenerating in quality—these are the aims of the biology of population. It is a subject of the greatest practicality for the welfare of a nation.

A population is the total number of individuals who may be embraced

*DR. HARRY L. SHAPIRO was born in Boston, Massachusetts, and was educated at Harvard University, from which he received the degree of Doctor of Philosophy in 1926.

He has done field work in the West Indies, our own Southwest, China, Japan, and Alaska, and has been on a number of expeditions to the Pacific, particularly to Polynesia. Dr. Shapiro's particular interest is physical anthropology, and he has done much research work in this field and on such related subjects as race

By HARRY L. SHAPIRO*
*Chairman of the Department of Anthropology,
The American Museum of Natural History*

The facts of population are vital to every nation and to the international adjustments of the world. Here the basic principles and their significance are discussed in non-technical language

within a given classification. Thus we may speak of a school population, the population of New York City, the male population, or the population of the United States. Statistically considered, these populations may be described by various mathematical devices, and, when chronology or comparison with similar groups is added, we may deduce from such mathematical summations certain trends and tendencies. Because all the units or subdivisions of a nation are influenced far more by each other than any one is by similar units in other nations; because intermixture is more common within national boundaries than across them; because the national destiny combines all the subdivisions into a kind of biological as well as cultural, political or economic entity, we have come to think of the total national population as a biological expression susceptible to scientific study and analysis.

I have frequently speculated a little on the origin and evolution of our

mixture, population, etc. His publications include *Heritage of the Bounty*, *Migration and Environment*, and numerous articles and papers, both scientific and popular. He is active in several scientific societies.

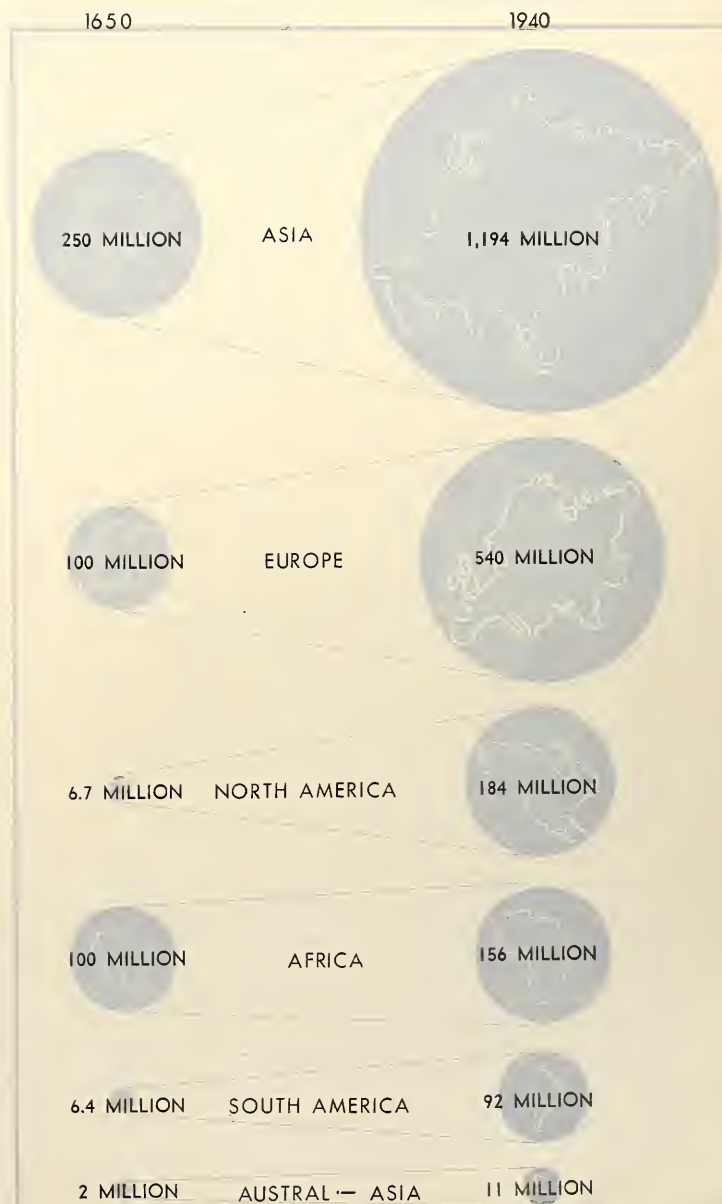
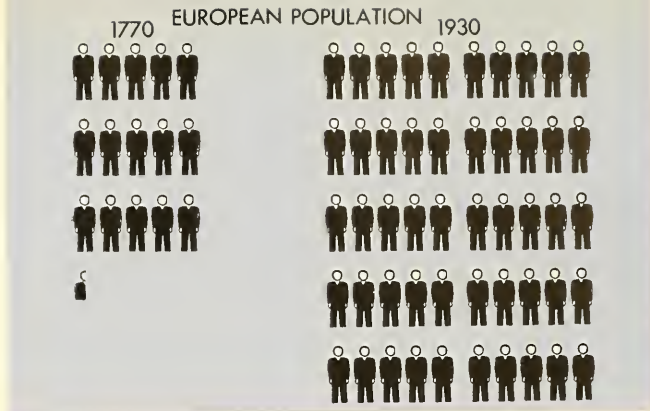
Since 1942 Dr. Shapiro has been Chairman of the Department of Anthropology of the American Museum, where he has worked since 1926. He is also Professor of Anthropology at Columbia University and Associate on the Staff of the Bishop Museum in Honolulu.—Ed.

► **RAPID GROWTH** of population due to industrial development, lowered death rate, and the development of resources in the New World

interest in the biology of population, and it seems to me that much of it has been stimulated by the accumulation of data provided by the census. Before the notion of census taking became an established function of national governments, little if any attention was directed toward the study of population as population. What enumerations were in existence were outgrowths of other concerns. Tax lists had to be drawn up, or man power resources for military uses had to be mapped. Enumerations of people also had value for the church and were significant for various political and economic purposes. But these counts were never primarily instituted for biological reasons and were rarely employed for such ends. Although they go far back in recorded history, they were with few exceptions, desultory and unsystematic. Not until fairly recent times did the notion become established that periodic and systematic enumerations of the population are valuable and necessary enough to warrant their being a fixed function of the government. The earliest official census, as distinct from estimates, seems to have been initiated in New France in North America and was continued there from 1665 to 1754. The United States was among the first of modern nations to establish, in 1790, a regular census repeated at fixed intervals. Its purpose was primarily political, since it was designed to serve as a basis for representation in Congress. Great Britain began periodic enumerations in 1801; and by the end of the nineteenth century, the economic and political necessity of census taking was recognized in most civilized countries in the world. The necessary organization, however, for an accurate census in a large country still proves a stumbling block for many governments, with the result that even official national censuses vary widely in their reliability from country to country. But whatever the origin of the census

► **GROWTH OF POPULATION BY CONTINENTS.** Note that the increase has been much greater in some continents than in others and that the distribution of population throughout the world is quite different than it was a few centuries ago

A WORLD FULL OF PEOPLE



may have been—political, economic or military,—the study of population problems proved to be one of its unforeseen and most valuable by-products.

Since the first censuses provided little more than total counts, the pioneer students were restricted, by the very data available, to the problem of the total growth of national populations. It happened, however, that the trends revealed by these initial enumerations were startling enough to warrant serious thought. As early as 1755 Benjamin Franklin was commenting that the population of the United States was doubling every 25 years, and by the end of the eighteenth century Malthus already had enough available data to be impressed by the dangers of a population growing beyond its means of subsistence. How rapidly various European nations were growing may be seen by comparing Europe's population in 1770 and 1930. In 1770 it was 152,500,000; 160 years later it had increased to about 500,000,000—something like 3 times. This remarkable expansion seems to have begun in Western Europe and to have gradually spread throughout the continent. In America the rate of growth was

even more rapid than this, as it also was in the British colonies in New Zealand and Australia.

The phenomenon was so widespread and so decisive that at first expansion was assumed to be the natural condition of all populations, and alarm was frequently expressed for a future in which a world bursting with people would find its means of subsistence inadequate to support them. We now know that this increase was merely one phase of the world's population history and that expansions on this scale had never occurred before. Indeed, a little arithmetic demonstrates how unlikely it is that populations in the past have grown at a rate anywhere near their full reproductive possibilities. If, for example, reproduction were uncontrolled, a woman could give birth to 5 or 6 children between her 17th and 27th year. If 4 of the children survived and reproduced in their turn at the same rate, the population would double every 27 years. But this is not the highest rate possible by any means. If a woman survived to her 35th year, she could easily bear 8 or 9 children. With only 6 offspring surviving, the population would triple every 35 years. Thus a single couple

reproducing at the first rate would yield in 540 years, 2,097,000 descendants, and at the second 45,956,000. In 1080 years the respective number of descendants from one husband and wife would reach 2199 billion and 1,656,000 billion. Obviously, then, mankind has not been increasing at anywhere near its full potential. And the acceleration in recent centuries cannot have been going on for very long. If we project backward the modern population of Europe, reducing it by the same rate that it has increased over the past 160 years, we would find ourselves in an empty Europe at the beginning of the Christian era.

When we recall that man is estimated to have an antiquity of about one million years, it is obvious that he has neither increased steadily nor at his full capacity. Over much of this period the human population must have remained static or even retrogressed. Although statistical evidence of this nature does not exist for mankind's early history, we have some fragmentary evidence to prove that populations are not forever expanding.

Japan, for instance, had a population of 28.1 millions in 1721, and 135 years later her population was roughly the same (28.9 millions). Spain, in the seventeenth century, had passed beyond one growth phase and was in a state of decline, a circumstance rarely mentioned in connection with her political decline and her colonial policies.

Why is it then that populations increase, decrease, or remain static? There are various reasons given, but let us first examine the direct mechanism by which the process itself is controlled. There are four functions whose mutual adjustments determine the curve of a population. These are birth rate, death rate, immigration, and emigration. By the rates of these and by these alone is the size of a population determined. The differential between birth rate and death rate

if

one husband and wife had six children and each pair of children had six children, they could populate the entire world in 19 generations



One Husband and Wife

FOURTH GENERATION
162 persons, comparable to



all the Delegates to the League of Nations

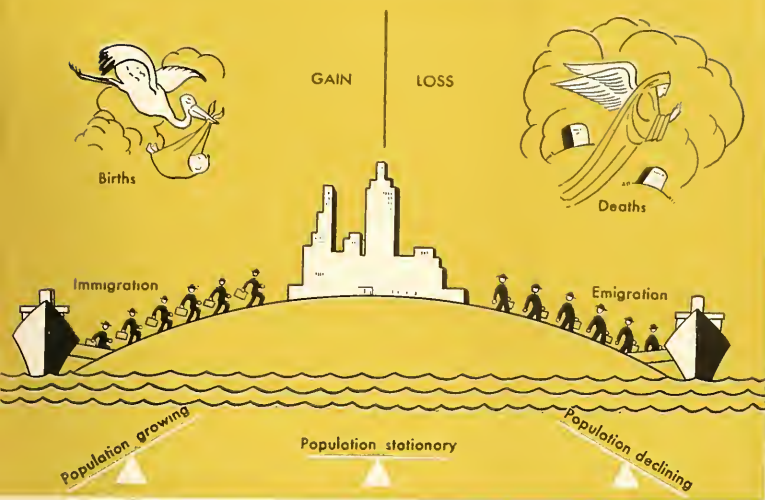
ELEVENTH GENERATION
354,294 persons, comparable to

The City of Zurich

THIRTEENTH GENERATION
3,188,646 persons, comparable to

Most of Switzerland

FOUR FACTORS DETERMINE POPULATION GROWTH OR DECLINE



gives us the natural increase or decrease—the amount by which a population, by the success or failure of its own efforts, is adding to its numbers or losing them. Ordinarily birth rate and death rate alone are the decisive factors, but under certain circumstances the displacement of population from one country to another may strengthen the national trend of a population or counteract it. Immigration to the United States during most of its history was a significantly positive contribution to its remarkable growth. Ireland during the famine years was unable to replace by its own natural increase the losses suffered by emigration. France in recent years has sought to redress her unfavorable balance between births and deaths by permitting the immigration of Italians and Poles. But in most countries, and during most of the time, the balance of births and deaths determines the issue.

Natural increase is achieved when the birth rate surpasses the death rate, and the greater the difference the larger the increase. But birth rate

need not be increased to attain this favorable balance, it may be accomplished by a decline in the death rate. Where both rates are changing the natural increase will be proportional to the relationship between them. During the past century the birth rate of western Europe was dropping steadily, but the natural increase was maintained because the death rate was also dropping and in some cases more rapidly than the birth rate. Since the drop in death rate has slowed down and the drop in the birth rate threatens to approach it, the natural increase is shrinking away. It is apparent, therefore, that an explanation of why populations increase or decrease must be based on the factors that govern not only the birth rate but also the death rate and the balance between the two.

Among the variables that one might expect to be most effective in determining differences in birth rate is innate fertility. We are so accustomed to having the high birth rates of the Japanese or the Russians or the South-east Europeans contrasted with the

dwindling families of the French, English, and Americans that almost insensibly we come to assume a difference in fertility. Similarly we are apt to attribute a greater power of reproduction to primitive people than to the highly civilized. Some authorities, however, deny that any real distinctions can be drawn between the various races or peoples of the earth in this respect. They maintain that unhampered reproductive rates are approximately the same for all mankind, somewhere between 40 and 50 per thousand, and that whatever deviations occur are attributable to inhibiting factors. For all practical purposes, according to this view, we may neglect any possible variation in innate fertility and speak only of limiting circumstances. The following chart, based on figures published by Raymond Pearl, supports this contention, but it should be stressed that the available data are by no means adequate for a universal generalization. Sterility, however, in so far as it lowers the average fertility of a population does seem to occur more frequently in highly civilized societies than in primitive ones.

Leaving aside therefore the question of any inherent differences in reproductive powers, there are two principal sets of limiting influences on birth rates. One is social and long term, the other is catastrophic and short-lived. A study of primitive as well as civilized sex customs reveals a diversified series of habits and rites that limit in varying degree the natural fertility. Sexual taboos of diverse descriptions, for example, are commonly practiced among primitive people. Sexual intercourse may be forbidden before ceremonial occasions, before battle, for ritual reasons, and for varying periods in connection with menstruation. In extreme forms, a woman may actually be excluded from the possibility of reproduction during half her child-bearing period. The custom among certain primitive



women of nursing children for an extended time tends to reduce the chances of conception, and in fact the practice is deliberate with many of them who desire to keep their offspring at a minimum. It has been reported that some primitive groups who cultivate this device keep their children down to 4 or 5 per woman.

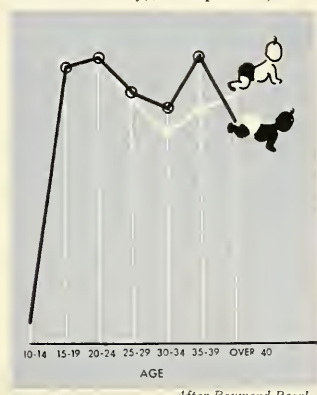
Abortion is by no means universally accepted, of course, as a method of birth control; nevertheless it is commonly practiced in many societies, our own not excepted. How effective or how extensive a method it is we do not know, since accurate information is lacking. Certainly in most primitive societies knowledge of it is widely disseminated, and inquiry readily elicits specific details of procedure as though recourse to it were frequent enough. Estimates for a city such as New York run into colossal figures. One estimate suggests that as many conceptions terminate in abortions as in live births. There can be little doubt that this method of limiting births is one of the most significant in human history.

Another method of reducing the population if not the actual birth rate is by infanticide. This resource is to our minds a revolting practice, yet in certain countries it has been adopted and has received social approval or at least tacit tolerance. It is apt to occur where the pressure of population has become a serious problem. In Tahiti, for example, Captain Cook found the natives openly abandoning female children to exposure and death. The teeming population confined within its narrow island presumably could not expand further and the excess had to perish. Those who doubt Malthus have here an object lesson on the reality of population pressure. China, too, has countenanced female infanticide, and in times of stress its practice increases. So common a thing is it in China that its profound results may be read in the marked excess of males over females ranging from 10% to 50%.

Less direct than these is the effect of various other by-products of social custom. Among them I might mention the increasing age at marriage which, at least until very recently, was evident in highly civilized societies. Economic causes are generally assigned to the tendency to delay marriage among us, but in at least one primitive group with which I am familiar this delay arises from a

gerontocracy where the old men are dominant and pre-empt most of the young maidens for themselves, leaving the young men to make the best they can of the old ones or wait for their turn with advancing years. The tendency to delay marriage, other things being equal, results in smaller families.

Concubinage, which one might expect to enhance the birth rate, is said on the contrary, to depress it, since



▲ THE FERTILITY OF NEGRO AND WHITE WOMEN appears to be similar. The chart shows mean pregnancy per 100 ovulations in women who married only once, had no gynecological disease, and did not use contraceptives

a large number of women are removed from the full exercise of their reproductive possibilities. Women under this system are individually unlikely to have as many children as they would if married to one man, in spite of the impressive totals of offspring that a sole male under such a system may pile up. Similarly large scale prostitution has the same consequences but for a different reason or reasons, one of which is the prevalence of social diseases among the practitioners of this profession. But social disease apart from its existence among prostitutes is also a very significant factor in reducing the birth rate in the general population. This alone was responsible in large measure for the rapid depopulation suffered by Polynesia in the nineteenth century. Let me cite a single instance. The Marquesans at the time of Cook's visit toward the end of the eighteenth century, possessed a population estimated at around 100,000. In 1920 there

were about 1600 natives left—less than 1/50th. A survey I made there ten years ago, disclosed a large number of sterile marriages and a high prevalence of miscarriages. Gonorrhea and syphilis were rife. The prospects looked very bleak indeed that this handful of once magnificent Polynesians could long survive. About 15 years ago, however, one of the government physicians began to combat social diseases in a few localities, and in a relatively short time the birth records began to show a remarkable increase. For the first time in over a century a favorable balance was established precisely in the localities where modern medical treatment had been administered.

It has frequently been suggested that urbanization, with its attendant nervous tensions, may be one of the causes of sterility and reduced reproductive capacity. If it is, we cannot assess its role in the complex of factors which are operating toward this result. One of New York's most distinguished gynecologists once told me that he was able in a fair proportion of sterility cases to achieve cures by prescribing rest and travel.

Perhaps the most effective curb on the birth rate is the various techniques of contraception. The idea of contraception is a very old one. It was known in antiquity. But only in recent times has its practice become almost universal in some countries and in certain classes in most civilized societies. Probably no other single factor has been so effective in cutting down the birth rate. Certainly the present drop in birth rate coincides with the adoption of contraception, and this rate is lowest where contraception is most widely used and highest where it is unknown.

In the long run, the catastrophic checks on birth rate are less potent than those already mentioned. Their immediate influence may be more drastic, but, unless a population is already in decay or sharply reduced in number, recovery from them is fairly rapid. Thus famine, which has swept over China and India repeatedly, carrying off millions to death and cutting back sharply the birth rate, seems to have affected but little the general reproductive rate. It has been calculated that between 108 B.C. and 1911 A.D. China was subjected to 1828 famines, or almost one a year. Britain between 10 A.D. and 1846 suffered 201 famines, or 1 every 9

years. India endured 34 between 1769 and 1878, or 1 every 3 years. While these disasters may temporarily reduce the birth rate, they seem to have no permanent or long enduring consequences on reproductive tendencies. In other words the recuperative ability of a population soon makes up losses suffered from such causes when the short-lived cause itself is removed. Long continued war may also exercise a depressing effect on the birth rate. There has frequently been observed a sharp but temporary rise in birth rate at the initial stages of warfare, but this spurt declines into a lag as war continues, and its consequences extend into the post-war period. In the present conflict, the magnitude of the dislocations are beyond our experience, and it would be hazardous to base predictions on the past. After the last war, however, birth rates adjusted themselves fairly rapidly to the pre-war positions and continued their evolution from that point.

The other component in the equation of natural increase is the death

rise of a population than fluctuations in the birth rate. Conversely, the amelioration of living conditions, improvement in public health, and advances in medical care permit a rapid increase in population by reducing the death rates. The phenomenal expansion of the population of Europe and, indeed, of the world during the nineteenth century may in large part be attributed to these factors. Only as the birth rate begins to follow suit and to overtake the decline in death rate is a static or declining population once more established. This has already happened in France. It seems about to happen in England and the United States.

The extraordinary growth which the populations of the world have undergone in the past century or more has stimulated a good deal of speculation on the nature of the phenomenon. Raymond Pearl has reduced it to an equation and has generalized it to the form of a sigmoid or S-shaped curve. Such curves begin by rising slowly, reach their steepest slope at the middle of their spans and then decelerate gradually. Their application to populations is based on the thesis that a population becomes static when it has reached the limit of the current means of subsistence. When these sources of subsistence are increased, growth takes place. But the new spurt is proportional to (a) the absolute amount of growth already achieved and (b) the amount of unutilized or unexhausted means of subsistence. Such curves fit quite well the history of modern populations and have served many students in their predictions on the future size of existing aggregates.

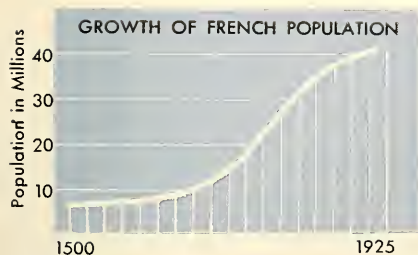
But to describe the phenomenon does not explain it. Corrado Gini has a somewhat anthropomorphic explanation. He considers a population to be something like an organism—that it has a youth, a middle, and an old age. During its vigorous youth it grows rapidly. Then as increasing age makes itself felt, it begins to lose its reproductive force and becomes static or even declines. It would be difficult on this basis to explain the vigor in the ancient loins of China and Italy.

Warren S. Thompson, on the other hand, stresses the importance of environment, by which, I take it, he means agricultural and technological improvements. Looking at the full sweep of man's history, we do see definite increases in the density

of population when new procedures or inventions permit the support of larger numbers. Hunting or food-gathering societies are not usually able to maintain a population as large as an agricultural community in the same area. In aboriginal America, the largest concentrations existed precisely where settled agriculture was well organized. Cities and large populations in the Old World first appeared in the rich valleys of the Nile, the Tigris, the Euphrates, and the Indus, where agriculture received its initial development. The remarkable expansion of population that is so striking in recent centuries coincides with the advent of industrialism, the expansion of trade, and the exploitation of the New World. These events have enriched the sources of subsistence and permitted a new growth of population.

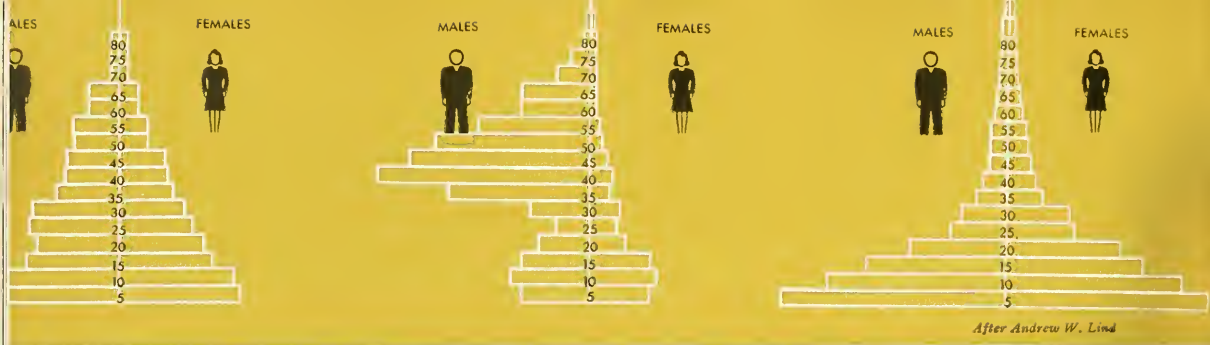
To list the total number in a population or even to define its rate of growth does not tell the whole story. A population not only has size; it also has structure. By this I mean that populations are composed of different kinds and categories of people, the numbers and relationships of which vary from time to time and from place to place. If we classify a given population according to sex and age, we can plot the percentage of the population in every category. Normally, the result is a pyramid with the most numerous class where one naturally expects it, in the youngest age at the bottom, and the least numerous among the most aged at the top. Such a pyramid tells us much about the past, present, and future of the population it represents. If the pyramid has a relatively broad base, we may anticipate, other things being equal, a rapidly growing population, since the future reproducers of the populations are to be found in the youngest generations. On the contrary a population barely replacing itself will have a relatively narrow base.

The profiles of the populations of the United States and various western European countries reveal a striking change during the past century. As the death rate has declined, the number in the older age classes has increased. At the same time the base has contracted due to the reduction in birth rate. We see, therefore, a change in the age structure of these populations that has had a profound significance not only on the growth



▼ THE TYPICAL S-SHAPED CURVE of population growth, here represented by France, shows a slow beginning followed by a rapid rise and finally a gradual leveling off. The curve for the United States, rising from just under four million in 1790 to 132 million in 1940, would show a rising slope that has scarcely begun to flatten out

rate. In pre-industrial societies and among most primitive groups, this perhaps more than the birth rate is responsible for the dynamic status of a population. There are exceptions, to be sure, but in general a population not appreciably affected by artificial checks on the birth rate will increase as its death rate drops, and will become static when the death rate approaches the birth rate. In the past, the rise of the death rate through epidemics, famines, war, or disease has been more effective in reducing the



▲ UNDER NORMAL CIRCUMSTANCES there are more young people than old ones in a given population, and the age groups between show a fairly regular decrease in numbers. Note also that the number of males (*left of mid-line*) is approximately equal to the number of females (*right of mid-line*). This diagram shows the total population of the Hawaiian Islands in 1930

▲ BUT WHEN YOUNG and middle aged men without wives or families move into a region, a bulge appears on the male side of the population pyramid. The diagram above shows this in the Chinese population in Hawaii in 1910

▲ WHEN YOUNG PEOPLE predominate in a population, the pyramid has a wide base and thin top, as in the case of the Asiatic-Hawaiian population in 1930. This diagram shows that mixed marriages have been fairly recent and productive, and the children have not had time to grow up

of the population but also on its biological and sociological characteristics. As the senile and old increase, the rest of the population have to shoulder a greater burden, made up of those who not only are non-productive but are also in need of care. The social agencies to tend the chronically ill and the incurable, and the financial obligations to support the superannuated increase at an alarming rate. The number of productive workers to discharge these growing social responsibilities becomes relatively fewer. This in itself might have a ramified series of reactions on the social organization, but how far their effects may be modified by technological advances that make up for the relative loss of workers cannot be easily estimated.

An aging population, or to be more exact a population with an increasing proportion of middle-aged and senile individuals, may influence the social, political, economic, and intellectual orientation of a nation not only directly through its voice in the government but also indirectly by more subtle means. Even though we may not have at hand objective evidence on this possibility, it is a legitimate field of inquiry. One cannot help but wonder whether a young Elizabethan England would have approved of the cautious, elderly appeasers of Chamberlain's England. I do not, of course, wish to imply that the difference between these two eras was simply a matter of the age of their respective leaders. I am aware, moreover, of the complicated back-

ground of the pre-war situation. And I know that Mr. Churchill celebrated his 70th birthday just the other day. But is it altogether unreasonable to expect the policies of nations to reflect the age of the policy makers and of the electorate?

Age and sex, however, are not the only components of population. Indeed, the only limit to the breakdowns and the classifications to which a national aggregate may be subjected lies in the records available. Most of them, however, are temporary and ephemeral characteristics of little or no biological importance. Even much of the census information serves no biological ends. It may be valuable, for example, to know the extent of illiteracy by states and other things about the educational status of the populace. Economists may find statistics on home ownership extremely useful. But these data have no bearing on biological structure. Even the age and sex classifications fail to tell us much of the biological quality of the people. Yet it is of paramount interest to know what hereditary differences in quality exist and whether the superior or inferior individuals are increasing more rapidly.

For example, the composition of a population divisible into 3 distinct groups, would undergo changes proportional to the rates of growth of each group. The accompanying diagram indicates the magnitude of change in a hypothetical case within the bounds of probability.

Such changes in the relative strength of diverse components in a

population are much more common than we have come to realize, because our data are rarely presented in this form. Yet we may see in the course of the nineteenth century the Scotch drop from 15% to 10% of the combined population of England, Wales, and Scotland. In the United States, immigration and differentials in birth rates changed the population from a predominantly English one to one in which German, Irish, Italian, Polish, and other continental nationalities represent considerable percentages, with a relative if not an absolute loss in the English contingents. It is interesting that this tendency, in force for a century, and one that alarmed certain writers, seems now likely to be reversed to some extent. At present the agricultural south, largely British in origin, is furnishing a disproportionate share of the national increase. The high birth rates of the newer immigrants, formerly viewed with foreboding, have dropped below those of the mountain whites of the South. I cite these figures not because I consider the groups significantly different but to illustrate the possibility of a rapid shift under the influence of persistent trends.

If therefore, a total population may radically change its group composition, is it not possible that its biological quality may also undergo alterations? If the Kallikaks and the Jukes, overburdened with degeneracy, outbreed the Edwardses, may not the qualitative character of the total population suffer? To deny the possibility would be purblind, to affirm the

reality would require, however, more knowledge than we possess. Our measures of quality, however, are still so nebulous and are complicated by so many non-biological factors that I hesitate to accept any conclusions drawn from such inadequate yardsticks.

It is true that the poor are breed-

ing more rapidly than the rich, that the rural sections are supplying the populations for our cities, that the agricultural south is increasing at a higher rate than the agricultural north, that Catholics have larger families than Protestants and Jews. But such differentials can only alter the biological character of a population

if they are correlated with inherited, qualitative distinctions. Such correlations based on reliable evidence are lacking. The only trustworthy associations seem to run in family lines and not by groups. This is perhaps the key, as it is in so many group statistical studies. We must consider the individual and not his group.



JUKES



EDWARDESSES

USEFUL
CITIZENS

Socially successful 14%

BURDENSOME
CITIZENS

Mentally deficient 5%

Criminals 6%

Paupers 8%

Intemperate 9%

Illegitimate 14%

Prostitutes 18%

College graduates 21%

Lawyers over 7%

Theologists 7%

Officers in Army or Navy 5%

Men of Letters 4%

Doctors 4%

Judges 2%

Professors 1%

USEFUL
CITIZENS

No criminals or
mentally deficient

▲ WHEN EXTREME examples are analyzed, it is clear that families differ widely in their contribution to society. The "Jukes" family, embracing 2,094 descendants, have cost the State over \$2,000,000. The Edwards family, of whom 1,394 descendants have been traced, have given the nation an impressive number of intellectual leaders. The relative importance of heredity and environment is not evaluated in this analysis

► A POPULATION can change its composition profoundly in a few generations if the various components increase at different rates

1945 A.D.

100 years later
(2045 A.D.)

25%

25% increase
every generation

55%

25%

stationary

25%

50%

23% decrease
every generation

21%



Photo by Josef Muench

By RUFUS MATHER BAGG

*Geologist Emeritus, Lawrence College,
Appleton, Wisconsin*

AMONG the various types of vacation lands, none may seem less attractive than the hot, dry desert or treeless plain. For ages, such arid regions have been shunned by man, crossed only with difficulty, and avoided for habitation. They symbolize suffering and have cost thousands of human lives.

Yet the American public has come more and more to look upon deserts as "playgrounds"—places for recreation, relaxation, and the pursuit of outdoor hobbies. What is the peculiar fascination of these once forbidding areas and what has made it possible for man to enjoy himself in them?

Today the luxurious Furnace Creek Inn in Death Valley looks out upon a scene that is fascinating in its utter desolation—a region haunted

by the ghosts of pioneers who strove and perished without reaching their goal beyond.

The history of the struggle of both Indian and white man to conquer or even cross this most paradoxical valley would fill a book, and its story has never been fully told.

Long before white men hurried westward to California in the gold rush of 1849, some two hundred Indians are said to have lived in this scorching alkali basin, and they must have watched some of the passing trains of immigrants with ox teams and mules whose members were dying of thirst. The old Indians knew where to find the trickling springs, learned to migrate from place to place along the base of the Panamint and Funeral Ranges, and follow the lines of ripening vegetation. Grass seeds, piñon nuts, cacti lobes, and the huge chuckawalla lizards, one of which the

writer saw about a foot in length, formed part of their diet.

In September, 1849, a wagon train left Salt Lake City under the guidance of Jefferson Hunt of the Mormons and tried to go through Death Valley. The story of the tragedy has been told by a survivor, Louis Manly. All sorts of troubles arose. Attempts to make a short cut entailed a long delay that gave rise to anger and sickness. When the wagons were stopped by a narrow gorge, the feeling ran so high that the men fought and neither side would give up until they sawed one wagon in two. Then they split into two groups, with the majority joining Hunt, who later reached San Bernardino but not till after a long, hard struggle.

The other men with Manly went headlong on. Further difficulties caused this group to split three ways. From then on, suffering and tragedy

◀ SUN AND WIND are forever at play among the dunes of Death Valley. Endless patterns are woven and then erased

Long of interest only to prospectors and pioneer caravans, the hottest, driest and most tormenting depression in the surface of our land now invites the vacationist with recreation and an amazing array of educational attractions



Photo by Josef Muench



▲ FROM DANTE'S VIEW, 6000 feet above the floor of Death Valley, a scene of utter desolation greets the visitor. The salt deposits far below look like foaming breakers on the shores of an ocean. The farthest mountains in the background are 150 miles away as the crow flies. The highest and lowest points in the United States can be seen to the westward from this spot on clear days

▼ A LIFE PRESERVER might seem out of place in a region where many have died for lack of water, but not at the attractive swimming pool at Furnace Creek Inn, where one can have a refreshing dip after a hike among the dunes

By Burton Holmes, from Ewing Galloway

stalked the unfortunate travelers. It fell upon the shoulders of Louis Manly, the most hardy, vigorous, and resourceful of the party, to keep the various scattered parties going and, by eventually going ahead and bringing back supplies, to save the survivors of this unfortunate expedition. One group struggled for five days to reach the opposite side of

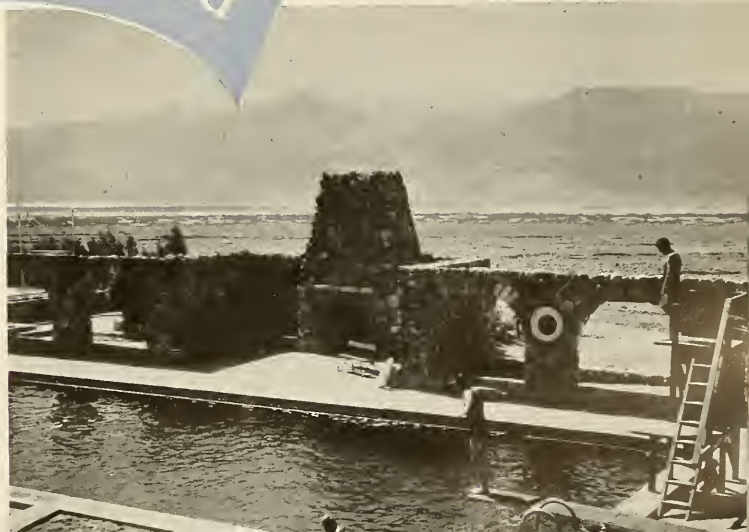




Photo by Josef Muench

▲ SPECTACULAR TITUS CANYON wanders through several ghost towns and then lets the traveler out through this gateway onto the floor of Death Valley

▼ PRECAUTIONS are necessary on the scorching roads in Death Valley. Without adequate water and a dependable motor, danger threatens the traveler even today. Approximately 3000 square miles are included within Death Valley National Monument

By de Cou, from Ewing Galloway



WARNING
DO NOT
ATTEMPT
THIS ROUTE
WITHOUT
AMPLE SUPPLIES
OF
WATER
GAS - OIL
GET INFORMATION
WHERE SUPPLIES
MAY BE OBTAINED
AUTO CLUB OF SO. CAL.

Death Valley, and the route beyond was by no means easy, because there they found, not the rich California they had hoped for, but the barren desolation of another narrow salt-encrusted depression surrounded by towering ranges. Louis Manly eventually reached settlements beyond, and help was sent.

A new era for Death Valley was ushered in by this tragic series of events, because a piece of glittering rock had been picked up near the scene of so much hardship. It was widely told that a gunsmith, to whom the rock had been taken for use as the sight of a gun, had declared that the ore was solidly veined with silver. Here began a search that lasted for years. Jacob Breyfoggel, a Nevada blacksmith, prospected in Death Valley and brought back pieces of gold veins but could not relocate his find. No traces of it have yet been found, and many other stories of rich prospects have circulated freely. Prospecting continues down to the present day.

Death Valley is the hottest and deepest valley in the United States. Folded downward between gigantic mountain ranges flanking it both on the east and west, its bottom at Bad Water lies 279.6 feet below sea level. This narrow elongated trough was once an inland sea whose evaporating water deposited the thick beds of various salts, especially *true* salt, borax, and heavy spar, called barite. All of these have been commercially developed but generally on not so large a scale as in the Mohave Desert to the south. As the salt crystallizes and rises in irregular masses above the thick bottom layers, it presents a weird appearance, as one of the accompanying illustrations shows.

What are the attractions of so arid a region as Death Valley? For one thing, it offers some of the most spectacular scenery in the United States. What strike the geologist and scientific tourist are the varicolored rock formations, their fantastic shapes, the rich lake deposits of curious minerals, and the borax beds crystallized in such complex forms.

Approaching Death Valley from the east across the Amargosa Desert Valley, one rides over forbidding jagged mountains and gets his first glimpse at the panoramic gap called Dante's view. It is indeed like a picture of Hades. As far as the eye can reach toward the north lies a shimmering white salt bed. Snowcapped

ranges tower above, while far below on the eastern side one looks down upon Bad Water, the lowest point of land in the Western Hemisphere. From the crest of the ridge at Dante's View, 6000 feet high in the black mountains of Death Valley, it is possible on clear days to see both Bad Water and snow-capped Mount Whitney, the highest peak in the United States.

Only since the days of modern automobile travel has it been possible to pass over this desert safely in summer. The region has been made a National Monument, and the Rangers, who patrol the roads even in the hot season, told us that each year in normal times upward of three thousand people wandered bravely through Death Valley, whereas in the early '70's hardly anyone could have traveled over this depression and lived to tell the story. With temperatures that reach 134° F., one does not generally linger in the valley in summer. The radiator is apt to boil with slight exertion, and if one does not relieve the pressure in the hot tires, a blowout can cause a most uncomfortable and even dangerous delay. But in the cooler seasons, the modern conveniences of autos, fine roads, hotels, and camp grounds attract more and more visitors to Death Valley as a vacation resort.

One sees here some extremely fantastic rock formations that have resulted from erosion by wind and water. Not far from the Natural Bridge and only a few steps higher



K. Stephen photo, from Black Star

▲ IF YOUR FOOT SINKS into the soggy salt deposits near Bad Water, as is likely, you will be more than 280 feet below sea level

▼ BAD WATER. The pool that lies farther below sea level than any other point in the Western Hemisphere, was named by an early traveler who found its water very unpalatable. The snowy scarp of the Panamint Mountains, culminating in Telescope Peak at 11,045 feet, is reflected in the water

Photo by Josef Muench

▼ A SIDE ROAD winds its serpentine way through Golden Canyon, one of the rugged and bizarre sections near the valley floor

By Ewing Galloway





Photo by R. M. Bagg

▲ AN EXTINCT WATERFALL, 50 feet in height: a remnant of wetter days in Death Valley.



Hubert A. Lowman photo

up the canyon is an extinct waterfall that is even more spectacular than the bridge. Though no water now runs over it, the waterfall must have been 50 feet high. The rock is gouged to a depth of ten feet in a groove ten to twenty feet wide. Possibly at long intervals it flows again, but in late Pleistocene time, when the region was experiencing a humid climate at the close of the glacial period, it must have flowed in quite a torrent.

Another curious sight is the Devil's Corn Field, where bushy growths of drought-surviving desert plants manage to persist like shocks of corn, dotting the salt flat. This weird sight is not to be found in any other southwestern American desert.

Here and there a reminder of Death Valley's troublous early days stops the traveler, such as the burial place of prospectors Dayton and "Shorty" Harris. The marker reads: "Bury me beside Jim Dayton in the valley we loved. Above me write: 'Here lies Shorty Harris, a Single Blanket Jackass Prospector.' Epitaph requested by Shorty (Frank) Harris, beloved gold hunter. 1856-1934. Here Jas. Dayton, pioneer, perished 1898." At the bottom we find: "To these trailmakers whose courage matched the dangers of the land, this bit of earth is dedicated forever."

The writer's visit to Death Valley was thrilling. Leaving Boulder Dam early in the morning, we drove through Nevada's gambling center of Las Vegas and thence on into Death Valley to Furnace Creek Inn for the night. As we arrived, men were unloading twenty big black mules, and movie actors were coming in by autos to stage the desert scene of "Twenty Mule-team Borax." The four-ton wagons used so long ago to haul borax to the railroad near Barstow were outside the camp. The wood-burning steam engines that followed the mule teams were standing near the curious gateway to the Inn, and the colorful movie crowds were milling around the hotel and cabins. Wallace Beery was here, and we saw the salt pool down at Bad Water into which he was to be thrown during the filming of a modern panorama

◀ THIS NATURAL BRIDGE was formed when water poured over the waterfall shown above



Paul J. Schoenfeldt, from F. P. G.

▲ **DESERT LOGGING WHEELS:** one of the many picturesque remnants of man's earlier attempts to master Death Valley. Two sets of the huge wheels were coupled together, and the logs were

slung in the chains. Ten to 20 mules hauled the load. Because of the extreme heat, much time was lost trying to keep the metal rims on the wooden wheels



Josef Muench photo

▲ **EVENING SHADOWS.** The incomparable play of light and shadow on the sand dunes in Death Valley comes to an abrupt close when the sun drops behind the mountains. Night swallows first the dunes, then the Funeral Mountains behind them

John L. Blackford photo



◀ **"GOLDEN CATHEDRAL"** rises like a stately edifice above Golden Canyon, sharp against the deep sky

By Ewing Gallows





Josef Muench photo

▲ SHADOWS ON THE DUNES are like a turbulent seascape—caught and frozen by the low rays of the sun

► BLAZING REDS and yellows run riot in the Golden Canyon section of the Funeral foothills

Photo by Hubert A. Lowman



◀ THE TWENTY-MULE TEAM became inseparably associated with Death Valley when traction engines failed owing to the quantity of fuel and water required. These are some of the original wagons that the mules made famous



Paul J. Schoenfeldt, from F. P. G.



John L. Blackford photo

▲ IN A SETTING so arid and desolate, one is stupefied by the vision of the elaborate castle of Death Valley Scotty and his partner, Mr. A. M. Johnson, an easterner. Hidden springs provide the water for its indoor fountains. Visitors welcoming its cool shade are courteously shown through this man-made wonder for an admission fee

▲ THE PATIO of Scotty's Castle, looking toward the inner court. Many of the artistic furnishings were brought from Europe, and one almost feels that this remote "kingdom" is a piece out of the middle ages. But there is every modern convenience and comfort. The hot-water system needs no fuel, because it utilizes the heat of the sun

▼ DESERT FLAGSTONES. In the valleys between the knife-edge ridges of sand, moisture has sometimes collected and dried to form these paving blocks

Josef Muench photo



of a pioneer mining project of 50 years ago.

The mules were driven back of the date palms, which yield large quantities of dates and grow fast when supplied from the big springs. During the evening the Ranger described the wonders of Death Valley. He explained how a piece of iron in the hot sun would sear the hand, much as frost does in sub-zero temperatures, and he told how tires expand and burst unless air is periodically let out as the temperature rises. Even in the relatively cool months of March, our tire pressure rose from 30 to 37 pounds during a morning's run to the Mohave.

If anyone thinks the Badlands in South Dakota have remarkable coloring, he should go to Death Valley. Not even the Grand Canyon can show such shades of color. Black volcanic masses, purple porphyries, and bright red and gray granites delight the eye with their untold wealth of color, along with pink, blue, green, red, and white sandstones. And to one who familiarizes himself with the geology, these colors tell the story of the physiographic changes. Looking over these banded rocks with their rainbow hues from Dante's View and Zabriski Point at an elevation of over one mile above sea level, you can see far below the long white basin of Death Valley filled with evaporated salt beds 15 miles wide and 150 miles long. To the west one gazes at the eternal Sierras and to the east the

snowy Charleston Mountains of Nevada.

If ever one should have a color movie camera, it is while driving over this basin. One place is called the Devil's Golf Course, where the salt has lifted in crystalline masses like icicles. By digging six inches deeper at Bad Water, one is 280 feet below the level of the Pacific Ocean, which is only 250 miles away. It seems strange that within the shadow of the highest snowcapped pinnacle in the United States there should be some 500 square miles of subsea basin.

The rainbow colors of the rocks are permanent, but in winter and spring one has the additional display of gorgeous flowers. In February the slopes not far from Bad Water are literally covered with masses of white verbenas, white evening primroses, daisies, and all sorts of other flowers springing up in every gorge and canyon. If one has time to study the vegetation, it will reveal the many interesting ways in which nature attempts to conquer severe climatic

handicaps. How so many wild flowers can find root and then spring up quickly in the desert is hard to understand. Their seeds must lie dormant, perhaps for years, before some unusual storm provides the needed moisture. More than 560 species of native plants have been found in Death Valley. Salt usually kills vegetation, but in Death Valley there have developed a few unique plants that cannot grow without salt.*

The problem of getting fresh drinking water is, of course, the foremost one in the desert. As late as August, 1940, Dr. J. E. Wolff, 82 years of age, Professor Emeritus of Harvard in Geology, died of thirst and exhaustion in the Mohave Desert. Death overtook him when his car got stuck in the sand. The announcement in *Time* stated: "While waiting death or rescue, Professor Wolff

*Fish are even found in Death Valley, in the alkaline waters of Saratoga Springs, 20 miles from Bad Water. They are believed to have survived from the Glacial Epoch, when drainage was different. An article describing them was published in *NATURAL HISTORY* for September, 1936.—Ed.

wrote a codicil to his will, leaving a bequest to his gardener." Perhaps death in the desert brought vividly to mind the wonderful gardens of his homeland.

Were it not for the fearful heat and hot dry wind, man and beast would not require so much water. Only those who have experienced desert drought know what the suffering is like. Springs do occur in deserts but only at long intervals. They are to be looked for in margins where rocks begin their uplift and permit water to seep down from higher slopes. Every important spring in the deserts of southern California is known, and routes are marked to desert watering places that they may prevent travelers from perishing.¹ Vegetation is sometimes a clue to water, but one must know his plants, because some send their roots to great depths to tap the subterranean water far below the surface. The mesquite tree and the ubiquitous greasewood

¹Water Supply Paper 490 of the U. S. Geological Survey, also numbers 497, 498, and 499.

▼ A FAMOUS VANTAGE POINT from which to view Death Valley is Zabriskie Point, which presents this chaotic landscape. The jagged eminence at the right is

named Manly Beacon, after the resourceful member of a pioneer group that met partial disaster in the Valley. Beyond rise the Panamints, across the Valley floor

Josef Muench photo



have been known to send their roots nearly 60 feet deep.

Only in dry air can a human being endure the temperatures of Death Valley, which range in summer up through 120° and 130° to an official 134° F. in the shade. Such heat dulls the mental processes, causes fever, and makes one lose all initiative and appetite.

The search for minerals ushered in the modern story of Death Val-

ley, and its name is inseparably connected with borax; but today it is achieving fame as a vacation resort. Here one hears the weird saga of Death Valley "Scotty," who has built a palatial mansion at the upper end of the valley and is supposed to have an unlimited supply of pure gold coming from a hidden mine. Others, probably correctly, say that Scotty's million dollar castle was built with money coming from a Chicago capi-

talist and friend, Mr. A. M. Johnson, who was once helped in the West by this wandering miner. The mystery goes on, and hundreds and thousands of tourists continue to pay a dollar fee to visit the spectacular mansion. It is a showplace of the first magnitude. The architecture is for the most part a free adaptation of the provincial Spanish. Some of the finest wrought iron in the United States is to be seen here, and many



➤ LOOKING back into the Valley. After ascending the Panamint Mountains to Aguerberry Point, one can scarcely realize that he is about 7000 feet above the valley floor

▼ DEATH VALLEY is one of the few places in the United States where one can observe the formation of desert dunes

Josef Muench photo



Josef Muench photo



of the rugs, tiles, and draperies are imported from the Old World. There are indoor fountains, and men were brought from Austria to carve great doors and woodwork. All this in forbidding Death Valley. It has been asserted by the owners that the castle cost them two million dollars. Death Valley Scotty himself, whose real name is Walter Scott, spends most of his time secluded in smaller quarters at his lower ranch on the borders of Death Valley, or lingering in desert towns.

The mining of borax, the chief commercial product of Death Valley, goes back to the "twenty mule-team borax" outfit of the early '80's, which mined and shipped out the first borax, near Harmony Mills. This was two miles north of Furnace Creek. The discoverer, Winters, sold the properties to Coleman for \$20,000, and this deposit was worked for 20 years.

Not far to the south, at Ryan, lie important beds of borax ore in stratified layers,—colemanite and ulexite—, which have been extensively mined.

There is now only a guard at the Ryan mines, an Irishman, who takes pleasure in carrying tourists around the mountainside in his baby-gauge railroad. The trip takes two hours, and as we wind dangerously around the curves and approach a tunnel 1800 feet in length, the miner calls

back, "We'll go through if we don't run off the track." His open cars squawk and squeal on the ungreased rusty rails. The ride is rough for the tenderfoot, and all are wise to hang on when the cars whirl around hair-pin curves above a steep precipice. The engine is unique. It is run by gasoline, and the drive is by friction, like the old Carter automobile, which had a big brass disk rubbing against the vertical wheel. It is something of a curiosity, and tourists who want a real thrill can get it on this elevated railroad at Ryan. These older workings have been superseded by the richer Kramer bed in the Mohave Desert, producing kernite (otherwise known as rasorite) and tincal.*

From every angle deserts offer exceptional interest for both layman and scientist. Mining may come and go, but these unique lands of our far Southwest are destined year by year to become better known as places for recreation. Rare is the traveler whose intellectual curiosity will not be stimulated by the weird and wonderful things he sees in Death Valley.

*Kernite enjoys the peculiar distinction among ores in that it produces more end-product (borax) than its own weight. Ten tons of pure kernite, if dissolved in water and recrystallized by evaporation, will produce about 13 tons of borax. In actual practice, however, insoluble impurities which are removed from the solution, lower this yield in varying degrees.

LEMMING HORDE



By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

IN 1868 a ship was coming into Trondhjem Fjord, Norway. The captain noticed that the water was covered with small brown objects, like fallen leaves, but these on closer inspection proved to be lemmings, swimming out to sea. For fifteen minutes the ship ploughed through the mass of rodents.

Every three or four years the lemmings overrun parts of the Scandinavian Peninsula. They are stout-bodied relatives of our meadow mice, about five inches long, with very short tails. In color they are rusty brown, with a black stripe down the back and yellowish sides. Normally they live above timberline on the mountains or on the arctic tundra, far from cultivated fields, feeding on grass, moss, and dwarf birch. Periodically, however, the lemming population reaches a density far beyond the food supply in their homeland. Since each pair may produce five or six young, several times a year, and the offspring reproduce when only a few weeks old, this is not surprising. The animals that normally prey on lemmings are few—weasels, foxes, hawks, and owls. They do not reproduce nearly

*See Elton, Charles. 1942. *Voles, mice and lemmings*. Oxford.

so rapidly as the rodents, and once the lemmings gain a head start their enemies cannot catch up with them.

When conditions in their homeland become too severe, millions of young lemmings emigrate, moving down to the valleys and eating up nearly every green thing as they go. The hordes journey chiefly at night, but sometimes they continue their march by daylight. They multiply as they go, but now their destruction begins. Snowy owls and arctic foxes from the high mountains and tundra follow them; skuas leave the seacoast to nest where the lemmings abound; and al-

most all the animals of the lowlands are their enemies. Even those that usually eat plant food—pigs, cattle, goats, and reindeer—turn carnivorous and eat lemmings. The larger fishes in the rivers and lakes they cross also gorge on the multitude of lemmings.

Then disease strikes the lemming hosts, and hundreds of thousands die of "lemming fever," probably tularemia. This is sometimes transmitted to the people of these areas, perhaps through contaminated water. Wells and streams become filthy with the waste products and dead bodies of the rodents.

The survivors, in bad years still to be counted 'in millions, finally reach the seacoast. They have crossed streams and ponds before and there is nothing to tell them how wide the sea is. Their eyes are short-sighted, suited better to detecting the movements of enemies than to guiding the little animals on their journey. At any rate, the lemmings plunge bravely into the salt water and swim out to sea. The Norwegian lemmings swim toward the west, and writers with more poetic feeling than scientific knowledge have supposed they were urged by instinct to go to Atlantis, the fabled lost continent in the Atlantic. However, those that migrate from Lapland swim north, and the Swedish lemmings swim out into the Baltic.

ON YOUR RADIO

This Wonderful World—Bob Emery and John Saunders.

WOR and the Mutual Network,
April 7, 10:30 A.M.

Curfew Trails—Rita Ross and Julius Postal, by transcription on Maurice Dreicer's "Midnight Philosopher" series.

WWRL, Mondays, 12:15 A.M.

Science for the Seven Million—Lucy Clanssen and Julius Postal.

WNYC and WNYC-FM,
Wednesdays, 3:30 P.M.

Science for Freedom—Julius Postal.

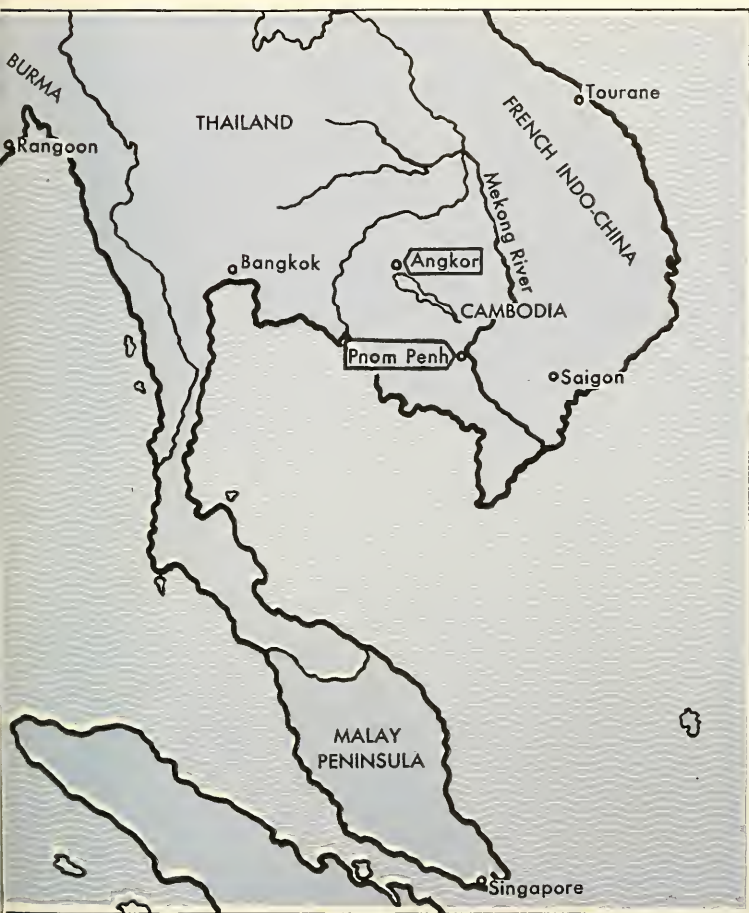
WNYC and WNYC-FM, April 5.

Television Quiz—Bob Emery and Julius Postal.

WABD, April 10, 8:30 P.M.

ANGKOR-

ramblings and recollections



▼ SAMPANS on the Mekong River



To capture the grandeur and mystery of Angkor is to embrace all the elusive beauty of a past that persists and still haunts us today

All photographs by the author

By MARTIN BIRNBAUM

LOVERS of Cambodia and its art have been anxiously wondering for the past few years whether the agreements entered into by the Nipponese with the Vichy regime and the Siamese government, have spared the region from devastation. It would indeed be a major war calamity if the Japanese ravaged the temples and jungle bowers where peaceful orange-clad priests meditated on the relative values of their philosophy and the white man's chaotic activity.

Before the war, there were various ways of entering the country, and after my first visit in 1926 I tried most of them. If you traveled by railroad via the Malay Peninsula and Thailand, the tinsel towers of Bangkok left a rather cheap theatrical flavor in your memory, but you might enjoy the opportunity of making a preliminary study of the fine Cambodian or Khmer bronzes and sculptures in the Bangkok museum. There were similar advantages in coming south overland from Indo-China. One motored for the most part over the old Mandarin road, and in the museums of Hanoi and Tourane the cultural remains not only of the Khmers but also of their ancient enemies and neighbors, the Chams, were seen at their best. These two approaches made the traveler realize the enormous influence exerted on the Cambodians by India on the one hand and China on the other.

Our favorite method of travel, however, was by steamer to Saigon and then by motor to Angkor through Pnom Penh, the seat of the native government. From the sea, the flat reaches of the great delta of the Mekong River took form slowly. As we steamed along the coast, there were no swaying date palms or golden sands, no rhythmic swells breaking on coral reefs as at Tahiti or Samoa. In the fog we hardly knew where the muddy river waters stopped or that



▲ A STREET IN PNOM PENH, Indo-China, leading to the monumental tower

we had reached the docks of Saigon. The wharves were crowded with female coal porters, their heads protected from the sun's rays by broad conical hats made of plaited pandanus strips or dried grasses. As soon as we

were made fast, these women were running up and down the gangplanks, their shoulders balancing flexible bamboo poles to the ends of which two heavy baskets of coal were attached. They were fueling the steamer for

her return voyage. Their mates, the pestiferous rickshaw boys and other lowly laborers, often slept through the night on the unpaved streets, wrapped in ragged blankets. As we landed, they milled about us in search of customers, and as soon as they found one they ran off, grinning with their human load, to a European hotel.

Saigon is a typical French colonial town, with an ugly Opera House, pretentious government buildings, and cafes and shops, many owned by Hindus, offering familiar European wares. At nightfall the streets, lined with tropical trees, are lively and quite attractive. The fine archaeological museum always held me for a day or two, and I could never resist the zoological garden, even though I strongly resent the caging of wild animals in small prisons. The fauna of Indo-China was well represented,

Notable Sculptures from the

▼ ONE OF THE BALEFUL GIANTS guarding the road into Angkor Thom. The ruined blocks are parts of the body of a gigantic many-headed serpent, or naga



▼ A DIGNIFIED EXAMPLE dating from about the eleventh century: a head of Buddha protected by a halo of serpents. Like the other two sculptures at right, this piece is in the Metropolitan Museum of Art



and I had a special friend there. He was a small elephant who "kowtowed" when you threw him a copper, marched off with it to buy a banana, and never failed to return and thank you again before eating it. He was the fruit vendor's best customer, for he was a favorite of the children on school holidays when they came with their gibbons. These pet apes walked almost erect beside their young masters and were remarkably clean. Their behavior was fastidious—I was about to use the word "snobbish,"—and when one of them, clinging to the neck of its owner, deigned reluctantly to shake hands with me, its fingers seemed as sensitive as a musician's.

Overland to the great ruins

Soon a car, always old and dilapidated, would be hired for the trip to Angkor via Pnom Penh over a sec-

tion of the country as flat as Yucatan. The monotony that most travelers complain of, however, was relieved for me by great flocks of birds. Since the Mekong River overflows its banks annually, the region is marshy and forms a natural sanctuary. When I returned in subsequent years, the marshes were in part drained and the neighboring jungle cleared to make way for plantations, and the birds were far less numerous. Wild animals, too, were being driven away. Near the villages we saw water buffaloes hidden in the mud almost to their immense horns, to evade flies and mosquitoes. A watchful bird (the *merle buffle* the French call it) was usually sitting on their backs. When the powerful animals emerged, driven by little children to work in the rice fields, cakes of dried earth on their flanks protected them from insects.

Their owners lived in flimsy houses raised on stilts or piles to escape the floods, and when we reached a stream too deep to ford, these natives would ferry us across on primitive floats. Now and then, where a permanent bridge was being constructed, we would stop to watch the trained elephants handling the giant timbers.

Pnom Penh, the native capital, dominates the plain with its central mound and tower. It usually serves only as a resting place for the night, but its important museum (Musée Albert Sarraut) deserves careful study. Its display of ancient jewels, headdresses, weapons, golden trimmings, animal trappings, and rich textiles arouse one's admiration and imagination. Even more important are the stone sculptures and bronzes, and this museum is the most comfortable place in which to study the vari-

Vicinity of Angkor Thom

▼ A BEAUTIFUL MUTILATED HEAD dating from about the end of the ninth century



▼ THE IMPRESSIVE FRAGMENT of a many headed divinity from the end of the twelfth century, found near one of the gates of Angkor Thom. It had many arms and legs and probably eight heads





▲ HISTORIC OR RELIGIOUS EPISODES are depicted in intricate detail on the walls of the Bayon

➤ THESE DANCING CELESTIAL NYMPHS, or apsaras, are typical of the temple wall decorations of the Bayon

ous styles and epochs of Cambodian art. Guides insist that even the most casual tourist must see the solid-silver-floored room of one of the pagodas containing a life-size standing figure of the Buddha, made of pure gold and lavishly encrusted with jewels. In an adjoining chamber is the "Prah Khan," a magnificent sword and scabbard. It is the finest relic of ancient Khmer lapidary and metallurgic art still preserved, and the blade inlaid with gold is said to be drawn only when the ruler declares war.

Arrival

How should one attempt to describe the grandeur and mysteries of Angkor without seeming to overstate its beauties? Those who lodge at the comfortable hotel a few miles from the ruins have time to unpack and catch their breath. If, however, you prefer—as I did—the more primitive accommodations of the bungalow, you immediately face the imposing pile known as Angkor Wat, and you could not be persuaded to waste a moment indoors.

How vividly I still recall that momentous first arrival! Heavy morning



▼ ONE OF ABOUT 50 similar towers on the Bayon. The four-headed deity may be Brahma



vapor interfered with any clear view of my immediate surroundings, and through a semitransparent bluish haze the memorable vista of sculptured pinnacles took form not far away. When I hastened to examine them more closely, many-headed serpents, fortunately carved of stone, reared up as though to bar my way. Soon the enchanting towers were bathed in torrents of sunlight.

I had been scientifically advised to commence my studies with the earlier and more distant buildings. This meant shutting my eyes to the beauties at my very door and starting off in a flurry for Angkor Thom, the walled city built in part by the great ruler Yaçovarman the First, at about the end of the ninth century. My intelligent guide avoided the nearest of its five gateways and took me to the entrance known as the Gate of Victory. The approach across the dried-up moat that once surrounded the city walls reminded me of the roadways at Karnak lined with stone rams and sphinxes, but here, instead of shifting sand, we walked through the encroaching jungle along a wide paved avenue between rows of about 50 kneeling giants!¹ The faces of one line wore a benevolent aspect. The row opposite had round protruding eyes and wrinkled brows and were comically defiant and fearsome. On one of their knees each group supported and held in check the long body of a powerful serpent or naga, rearing its multiple heads. On either side of the gate, gigantic three-headed elephants supported a roof from which a four-faced titanic spirit looked down upon the visiting pilgrim with eyes that pierced all human frailties. Tapering crowns cover his heads, delicate Virgins stand on his shoulders, and other praying female spirits are strung like necklaces around the all-powerful idol's throats. Overwhelmed by your first impression, you pass into the city proper, the "noble capital," or as the modern Cambodians call it, Angkor Thom.

For a long time this was thought to be the oldest town of the region, but the excavations and studies of the learned staff of the *Ecole Française d'Extrême Orient* had already put us on the right track when the war interfered with their labors. On my last trip to the ruins, I had the good fortune to have as my cicerone,

¹ Tchou-Ta-Kouan, the Chinese chronicler of the thirteenth century, says there were 108 figures at each gate.

Victor Goloubew, from whom I learned that the earliest known Khmer architectural remains at Sambor Prei Kuk date from the sixth and seventh centuries. It was not until about the ninth century that the ruler Yaçovarmā established himself permanently at Angkor Thom. The excavations and researches of Goloubew, together with the discovery of inscriptions deciphered by Professor George Coëdes, director of the Ecole, proved that the ruined Pnom Bakheng, dedicated to the worship of Siva in the guise of linga, was the real *Mont Central* of a vast quadrangle of which the adjacent Angkor Thom and its amazing Bayon forms only a part. The Pnom Bakheng, with its steep staircases and ornamental guardian Nandins (as Siva's bulls are called), is well worth careful study. However, the strange temple known as the Bayon, built at the end of the thirteenth century during the reign of Jayavarman the Seventh, will perhaps remain the most exciting feature of the region to the average layman.

One must be endowed with the pen of a scientist and of a poetical romancer like Pierre Loti, to describe the Bayon adequately. Coming suddenly upon its remains, which have thus far withstood floods, fires, and the elemental fury of tempests, a modern visitor is overpowered as he stands under a green jungle canopy gazing up at the wierd ruins, which reach a height of approximately 150 feet. How much more strongly moved must have been a superstitious people brought up on the complicated mythology of Brahminism! They may well have worshipped here in a spiritual frenzy, for they believed that the temple had been built by the gods themselves as a terrestrial abode.

It is a kind of step pyramid from the terraces of which approximately 50 gigantic four-faced heads once looked down, each visage about ten feet high from chin to brow, not counting the mukuta or Khmer tiara headdress. Even at high noon when the heat is suffocating and infinite calm prevails, an air of diabolical mystery invests the strange building. When the mists hang low, they seem like poisonous exhalations from the mouths of the enormous images, and it took courage to venture into its nightmare-inducing precincts when night was falling. After a gold and purple sunset, the dreamy mind expects the incredible and the giant fea-

tures assume a threatening, contemptuous aspect.

The bas-reliefs, carved with notable precision of touch, are gay, eloquent, and lively pictures of the entire Khmer reel of life—their pageants and royal elephant hunts, their wars with the Chams, the fishing parties, wrestling matches, cock fights, dances, and innumerable domestic scenes. However, like the Bayon itself which they decorate, they simply must be seen; and after the war many Americans will doubtless want to journey to this wonderful land.

The more important sculptures in the round, which once stood in the small rooms of the temple, have been removed to museums to save them from vandals, but occasionally new works are still found by the patient excavators of the Ecole. A kind of supernatural agency seems to spur these courageous scientists. One of them, the late Monsieur Trouvé, having discovered an ancient brick temple on the shores of a distant lake, where we used to bathe, found that its central tower was hollow. This was a characteristic of most Khmer edifices, and buried in the debris at its base was a statue of the Buddha, which had been deposited by Hindus centuries ago. Knowing that the principal tower of the Bayon was similarly constructed, he shrewdly suspected that a statue on which some sculptor had lavished his genius and religious passion must at one time have crowned the great building. Trouvé therefore insisted on digging through the deep rubble to the very foundation, and in 1933 his labors were rewarded with magnificent results. I shared his enthusiasm; for this was indeed the discovery of a work of aesthetic importance. All the fragments of a fine Buddha seated on a naga were there, and Trouvé had already put the pieces together when he told me the story. That very year the reconstructed statue, about fifteen feet high, was unveiled in the course of a festival, and the Enlightened One, no longer an outworn idol, was worshipped as of old, before the Brahmans dethroned him.

Exploring the timeless jungle

After you have climaxed a day of wonders in a place like the Bayon, your impressions may be intensified by wandering on the jungle roads among the minor ruins or marvelous

structures like the Prah Khan. These are still robed in the fantastic beauty of desolation and decay. Melancholy envelopes you here instead of the ecstasy that thrills you in the light halls of Karnak on the Nile or beside the magical fountains in the dreamy gardens around the Taj Mahal.

It should be pointed out that not only the natural elements and warring neighbors but also the ignorance and carelessness of the Khmer architects have had much to do with the ruin of the buildings, which are not older than our medieval churches. They evaded difficult engineering problems and often used soft rubble as a foundation. They also used wood to support very heavy stones, and when the beams rotted or were eaten by insects, the structure was doomed. Perhaps it would be wise not to attempt to restore Prah Khan but leave it as an impressive monument to the devastation that time wreaks on the work and vanity of men.

Here you are in a fabulous forest in which Arthur Rackham would have reveled. The sun is a thing forgotten in this haunted dreamland. Tall, buttressed tree trunks and distorted branches are almost smothered by murderous clinging vines, and untamed Nature spends herself in an effort to destroy the creations of man. The roots of the false banyans crawl above ground hundreds of feet, like pale pythons, probing the weak spots in the architecture to destroy it. Patches of deep moss and swiftly sprouting fungi, brilliantly colored, cover the prostrate forest giants and ruined fragments. Crumbling heaps of masonry interfere with your progress, and you must move cautiously, because what seems to be a green tendril may come to life as a slender viper. Hairy spiders, mottled toads, lizards, and laughing geckos lurk in crevices from which orchids spring luxuriously. The forsaken shrines—rarely profaned by the feet of even the most daring travelers—are known to offer sanctuary to prowling black leopards. Now and then the air rings with the terrifying screams of wild gibbons.

One of my most profitable hours was spent among the ruins of the Prah Khan reading a French translation of Tcheou-Ta-Kouan's² thirteenth cen-

²A French translation of Tcheou-Ta-Kouan's account by Monsieur Pelliot appeared in April, 1902, in the *Bulletin de l'Ecole Française d'Extrême Orient*.



▲ A PANEL on the wall of the Southern Sanctuary of Banteai Srei

▼ THE AUTHOR at Banteai Srei examining one of the fallen door carvings



▲ CENTRAL SANCTUARY OF Banteai Srei, with monkey gods as guardians. Note the small doorways

▼ A "TREASURY" OR "LIBRARY" of Banteai Srei with a characteristic false doorway



tury narrative describing the gilded Khmer palaces and the sumptuous court life of the time. With this book as a companion in such a retreat you can trace the lives of the ancient Khmers, although the gilded metal casings on their temples have disappeared and the proud race is almost gone.

Sometimes the destructive fig trees reach dimensions paralleled by the ceibas of the West Indies. One celebrated specimen seems almost to have been planted purposely by some prehistoric botanist who knew what its roots were capable of doing. It sprouted on the roof of a small architectural gem known as the Neak Pean, built in the center of an artificial pool. At low water you can see the ever-present stone nagas guarding the steps of the tiny island on which the shrine is built. The roots of the huge tree growing on the roof almost completely hide the building and allow only the doorways and some sculptures to be seen. The spreading branches shade the entire pool to its artificial edge, and should a powerful tropical storm ever strike it down, the lovely temple in its toils will be doomed.

In the neighborhood of these fascinating pools, there are many other ruins offering pleasant hours of contemplation. Chief among these are the vast and wonderful walls supporting the Elephant Terrace, so-named because one portion is covered with a royal hunting scene featuring a herd of life-size elephants. It is also referred to as the terrace of the leper king because the mediocre seated figure of a nude male was found and left there. The spots on the discolored stone probably gave the sculpture its name. Near it are walls, perhaps of underground passages, adorned with row upon row of Brahman spirits, garudas serving as caryatids, and hundreds of personages, human or divine. It is all in keeping with the prodigal exuberance that characterized Khmer art. Few stones were left undecorated, and it was our privilege to secure a group for the Metropolitan Museum, where these³ and a modest collection of other authentic examples of various epochs may now be enjoyed in New York.

The walls of the immense galleries that enclose each tier or gradin of the pyramidal temples, are covered

with bas-reliefs often longer than a city block, interpreting the religion of the builders. They trace the legends in their sacred books, immortalize the wars with neighboring enemies, and depict intimate scenes in the life of the populace. The serene Buddhas, whom the Brahmans attempted to destroy, are found everywhere in a more or less fragmentary state, and they often rival in beauty the Chinese and Indian conceptions. One of these sacred, tranquil figures, known as the Tap Pranam, stands on a broad roadway leading from the terrace of the leper king. This huge idol was for me the untroubled ruling spirit of the entire region. He is all we have left of a Buddhist monastery, founded—according to Monsieur Coedes—at the beginning of the eleventh century. I enjoyed sitting before him on a tree stump while the jungle murmured its infinite mysteries, with nothing to disturb me except a few prying paraakeets.

The Citadel of Women

It is really almost impertinent to write about Angkor in a few pages. However, one small unit or group of sanctuaries no one can afford to miss. It is known as the Banteai Srei, or Citadel of Women. All the winning qualities of Khmer art at its apogee are here gathered together, in a cluster of small elegant buildings some 20 kilometers from Angkor Thom. A stele dated 976 A.D. discovered by Monsieur Marchal in 1936 and the temple inscriptions deciphered by Monsieur Finot establish the fact that the buildings were begun during the reign of Jayavarman the Fifth, in the tenth century. In spite of such evidence, the sculptured details are such an advance on the cruder work at the Bayon, that we believe they were created long after the buildings themselves were started. Technically this art is probably the finest achievement of the sculptors, but the buildings are not highly significant as architectural models. For the most part, they stand on raised platforms, the entrances guarded by monkey-gods, Khmer lions, or other monsters, and there are many false portals and windows without any functional purpose. Some of the real doorways of the small buildings (which, without good reason, are called treasuries or "libraries") are so low and narrow that an adult cannot enter the single

room without difficulty. The pilasters and lintels, often telling stories from the sacred books, are particularly fine and may be compared with European works of the Renaissance. Fortunately, one of the publications⁴ of the Ecole Française will prevent a visit from becoming a confused fantasy, although the book was printed before the actual restorations were made and some of Monsieur Parmentier's suggestions in the book were wrong and were not followed.

If the Banteai Srei is the most delicate group of buildings at Angkor, the famous Eleventh Century Wat (or Temple) is certainly the most grandiose. Not even the pyramids of Egypt, the Boro Budor of Java, the towering ruins of Yucatan, or the palace of Versailles, can dwarf its architectural grandeur. One should bear in mind that it is only slightly older than portions of Notre Dame de Paris or Westminster.

Its moats enclose structures roughly three quarters of a mile square. Its towers lead one to believe that its architects, like those of legendary Babel, wanted to soar into heavenly abodes to be in direct communication with their gods, or perhaps, like the Balinese, they wanted to furnish their divinities with fitting terrestrial homes. They certainly understood the subtle relation between a vast edifice and the surrounding terrain. The long approaches, guarded by proud nagas, over smooth artificial sheets of water mirroring the column and towers beyond, were planned by a genius. The early system of building a series of platforms decreasing in area to form a pyramid was still used, especially for the central shrine and highest tower, because the principle of the arch was unknown. Very steep stairways connected the tiers and led to the topmost sanctuary. At Angkor Wat, the tremendous area permitted the artist to leave spacious courtyards at different levels, which were the platforms for a succession of higher buildings. Surrounding the lowest plane are corridors on whose inner walls are endless series of bas-reliefs. Around the windows lighting these are dancing apsaras, borders of tiny rearing horses and marching elephants, all framed in lacelike floral conventions.

⁴ Le Temple d'Ilevarapura (Bantay Srei, Cambodia) par Louis Finot, H. Parmentier, et Victor Goloubetz, Paris. G. Van Oest, Editeur, 1926. Monsieur Parmentier himself, in a later volume, pointed out his first incorrect suggestions for restoring the buildings.

³ Described in the Bulletin of the Metropolitan Museum of Art, Volume 32, No. 4, April, 1937. A few specimens are at Harvard University in the Fogg Art Museum.

▼ AN INNER TOWER of Angkor Wat, with the steep stairway leading to an upper corridor



▲ THE MOAT and long corridors on one side of Angkor Wat, with the central towers in the distance at the right



▲ MAIN ENTRANCE to the lowest terrace of Angkor Wat

▼ CELESTIAL SPIRITS on the walls of Angkor Wat, from an inner terrace



Only at early dawn, or when night is falling, can you catch the great temple in its perfect mood. Especially at the solemn twilight hour, the sombre shadows of the Wat cast a spell over me, and a kind of sinister fascination drew me on to wander through its sculptured halls. Ambling slowly about, I was soon rapt in dreams of the departed builders and the strange procession of countless barefooted pilgrims who had worn down and polished the stone floors of these long corridors. I was always thinking of the dead, but on turning a corner in the midst of my speculations, I would come unexpectedly upon a living priest with shaven head, clad in orange and yellow, mumbling his incantations and attuning himself to his holy mission before the altar of an eight-armed image which wore an inscrutable smile. Wads of human hair had been presented to the idol, whose lips seemed to move in the light of flickering tapers, the votive offerings of his devotees. Wreaths of smoke from incense and scented herbs, enveloped the gaunt stone figure. Suddenly, night had fallen. I found my way back to the bungalow, enveloped in the mysterious atmosphere of this strange secretive region, while the moonlight invested the great pile, tower rising on tower, with silvery wonder.

What remains alive

In the winter of 1935, after paying my respects to Prince Thiounn—an important minister at the native court at Pnom Penh,—I went on to Angkor. One evening shortly after, I was informed that the pupils of a former *étoile* of the King's ballet would dance by starlight on a terrace of Angkor Wat, and I was expected to attend. The Prince was a great dance enthusiast, and I prepared myself for the performance by reading his fascinating book on Cambodian dances,⁵ a copy of which he had given me.

Long before the pantomime commenced, indistinct figures, attracted by the promised spectacle, began to collect on the causeway leading to the main entrance of the Wat. It was a strange, amber-colored crowd, most of them natives from the neighboring

village of Siem Reap. When the play was about to start, the children arranged themselves in a large uneven semi-circle and served the purpose of footlights, for each child held a flaming torch. The silhouette of the gigantic temple and its central tower arose out of the obscurity as an imposing backdrop.

Next to me was the beardless waxen face of an emaciated being, apparently sent to supervise the proceedings. He might have been a eunuch in charge of the ruler's concubines and dancers, for the most gifted and attractive young virgins were destined to play a role in the royal palace. All the performers were girls trained in the great traditions of past generations, and each was submitting herself to a discipline as rigorous as that demanded of the ballerinas in the Russian Imperial Ballet. The girls can move swiftly with exaggerated life, or rise slowly, balanced on one foot, as if floating on air like the thousands of heavenly *apsaras* carved on the temple walls. As a matter of fact, their exercises, the requisite body massages, their costumes and coiffures are all shown on the bas-reliefs of the neighboring ruins.

The plays, usually based on episodes from the Ramayana and other sacred texts, are familiar to the audiences. They are relics of a magnificent past, reflecting the very soul of the dwindling race, its moral sentiment and religion. The sumptuous robes and blazing jeweled crowns of the heroes surpass the most gorgeous occidental stage trappings. The young mimes and dancers performed in a kind of trembling atavistic ecstasy or orgy. Their controlled movements, the symbols formed by their fingers and supple wrists, the heavy march of the baleful giants, the awkward actions of the monkey gods, the magical flight of genii through the air,—all these were clearly understood by the onlookers, who followed the thread of the story with reverent interest. Mystery hovered over the prepossessing troupe, clothed in sparkling stars and fabrics of golden gossamer, and it was not difficult to imagine how resplendent the court life of King Indravarman and his successors must have been.

The nearest approach to an actual ancient pageant that I witnessed was the celebration of the lunar festival at Pnom Penh about the middle of

November, when the waters of the Mekong River recede. His majesty, the late King Sisowath—then about 85 years old—sat in a temporary throne room erected on the bank of the great stream. He was borne there on a gaily decorated litter by eight bearers wearing gold and plum-colored turbans, and he was protected from the sun by ornamented umbrellas. Beside him was his chief consort, while the lesser wives, concubines, and children belonging to the strange royal household, were huddled together in a brilliantly painted dragon-shaped barque, anchored in the river at the foot of a stairway leading to the throne room.

At frequent intervals, one of the women, accompanied by her child, would crawl prostrate on hands and knees up the stairs, and would be rewarded with a casual nod from the white-haired king, who wore dark goggles. I was more fortunate when presented to His Majesty, for I stood erect and was honored with an exceptionally long corona corona. The whole scene reminded me of the now famous Siamese diaries kept by Anna Leonowens at King Mongkut's court. Many long rowboats, each containing about 30 oarsmen and some comedians, raced up and downstream entertaining the courtiers and populace on the river bank. Their clownish antics and shouting seemed to make everybody happy, but the festival was a far cry from the breathtaking beauty, excessive opulence, and sensual decadence described by Tcheou-Ta-Kouan.

The struggle of two overlapping religions,—the cult of the Buddha and the followers of Brahma,—must be understood to trace the decay of these people. The Chams and the Thais, with whom they always had to contend, also helped to sweep them from their bearings. By the end of the fifteenth century, we find them driven as far south and east as Pnom Penh, but even then their humiliation did not come to an end. They were still victims of incursions by their Annamese neighbors, and a final debacle was prevented only as late as 1864, when France interfered on their behalf. What has happened since Japan assumed virtually complete control remains to be seen. Their history is only additional proof of the ephemeral nature of human activity and of the lessons taught by time.

⁵Dances Cambodgiennes d'après la version originale du Samdach Chaufea Thiounn, Premier Ministre du Gouvernement Cambodgien. *Revue et augmentée par Jeanne Cuisinier. Illustrations de Sappho Marchal. Preface par M. P. Pasquier Gouverneur Général de l'Indochine. Bibliothèque Royale du Cambodge.*



▲ THE LATE KING SISOWATH, leaving for the mid-November river festival at Pnom Penh



▲ CONCUBINES AND CHILDREN of the royal household in the dragon boat: a scene at the lunar festival at Pnom Penh, which reflects some of the pageantry of the ancient days

◀ HIS MAJESTY ensconced in the temporary throne from which he witnessed the pageant that is held at the time when the waters of the Mekong recede

▼ A RACING BOAT at the Pnom Penh festival



PHOTO SUPPLIES



By **THANE L. BIERWERT**

*Acting Chief, Division of Photography,
American Museum of Natural History*

ONE square inch equals 500 square inches of photographic materials today. In other words, for every gross of paper you bought five years ago, you will now be able to buy only one-third of a sheet. Small wonder that the amateur photographer suffers when 89 per cent of the entire production goes to the Armed Forces and the remaining 11 per cent must be spread over war industries and other priority-rated photographic users. What can the amateur do with the little that is left?

We could cease our photographic activities. But the number of salons proves that the American hobbyist does not give up easily. We will keep on going even if we have to do things the hard way.

The enlarging paper that we can purchase may not be the brand, the surface, or the contrast that we wish to use. Take it. Ingenuity and experimentation on our part will make the prints.

If the paper has an unknown degree of contrast, or if we are not familiar with its developing characteristics, a test should be made. Select a negative whose performance on enlarging paper is well known. Let us say that it will print with 15 seconds of exposure on No. 2 paper and develop in 110 seconds. From the new package, remove a sheet and trim off a strip about one inch by four. This is our *test strip*. Having adjusted the enlarger to the right position for size and with the lens aperture set correctly, we are ready to work from the known to the un-

known. Lay the test strip on the enlarging easel where it will receive both high light and shadow areas projected by the enlarger. In one hand hold a cardboard, larger than the test strip, with which to cover up one-inch sections of the paper. Begin with exposure of 10, 15, 22, and 32 seconds, covering up more of the paper at each interval. Develop the strip the normal length of time, approximately 90 seconds. On inspection of the test, you will know what sort of paper you have. If the print is tremendously over- or under-printed, a new strip should be made, decreasing or increasing the time. If you prefer, you can close or open the lens aperture and use the same exposure times. When a good result has been attained, write on the package that the paper is comparable to No. 2, or contrastier or softer, and also indicate how much more or less printing time it requires than the paper with which you are familiar.

This method gives us more information about the printing characteristics of negatives and paper than any other system or aid, unless we use whole sheets of paper as test strips, which we cannot do this year. Sometimes a negative has such a wide range of tone values that you may want to print certain sections longer than others. If so, test widely separated areas as described above and determine the proper range of exposure.

A quick way of finding the exposure time for enlargements that do not necessarily have to be excellent in quality is to use the darkroom safe-light illumination for your guide. After arranging the composition on the easel, slowly close the lens diaphragm until the highlights on the projected image disappear. Make a test strip. The best exposure can then be used as the correct exposure time whenever that type of paper is used under the same darkroom illumination, no matter what degree of enlargement or how dense or thin the negative (provided the negative is of the right quality to fit the paper contrast). Be sure that your eyes are accustomed to the dark before making this test.

If we have difficulty determining whether a negative is flat or contrasty, dense or thin, we can purchase a negative chart. We lay the chart over a light box, and match our questionable negative with a similar negative on the chart. The chart is designed so that we can specify the contrast of paper on which our negative should be printed and determine whether the exposure will be long or short.

Some negatives will require softer or contrastier paper than the kind we have on hand. We cannot change the inherent contrast of the paper, but we can change the quality of our developer. When more contrast is needed, we can use a less dilute developer. Mix one part developer with one part water, instead of two parts water; or use the solution undiluted. Full development of the print will always render the shadow areas darker. A pre-soaking of the print in pure water for two or three minutes tends to give a pleasing softness to an otherwise too contrasty paper. If we require softer prints, dilute the developer with four to eight parts of water. Of course, all this experimentation

will be carried out with test strips, each marked on the back as to what sort of juggling it has received. When conducting these experiments, keep the developing times to the standard, otherwise there will be too many variables. Once we have mastered the simple rules, we can do what we please with developing times to achieve the best results.

If we bought glossy paper and had wanted matte paper, squeegee the prints onto sand-blasted glass or coarse ground-glass for the desired surface. Be certain that the paper is in intimate contact with the surface of the glass, because air-bells will make very shiny spots, necessitating re-squeegeeing the print.

Matte surfaced papers can be made more lustrous with the application of a prepared print lacquer or varnish, Syn-Var, clear Duco or Bakelite, or a clear floor varnish.

Single-weight printing paper can be built up to the thickness of double-weight by mounting it on a light card or on a discarded second print.

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If readers of **NATURAL HISTORY** have specific questions regarding photography in the realm of natural history or science, we shall be glad to try to answer them.—ED.

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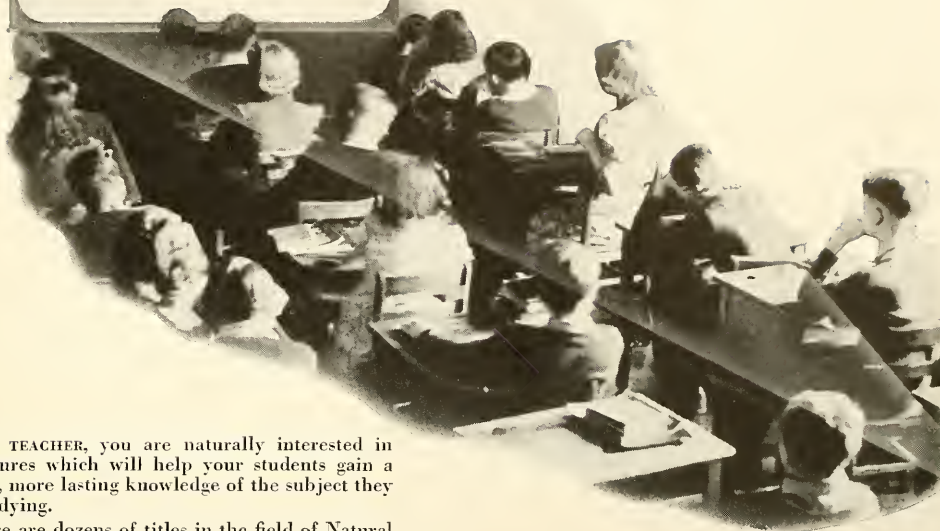
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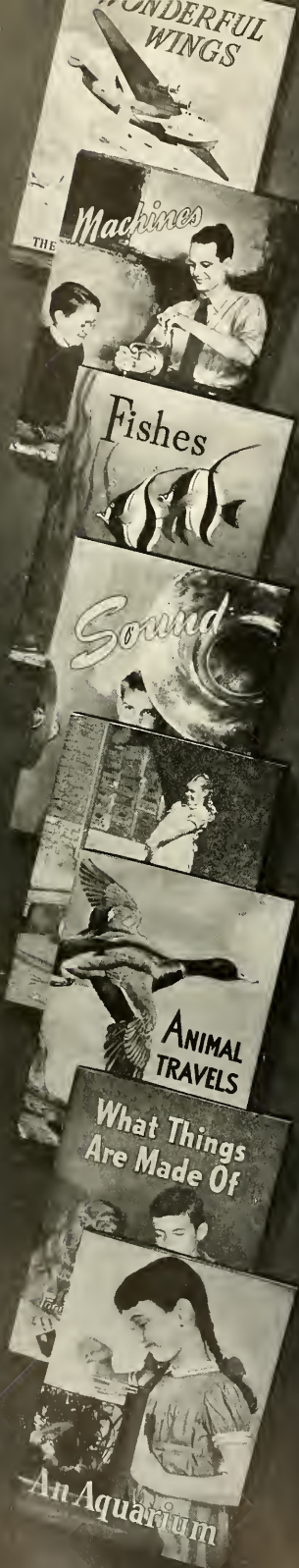
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LETTERS

SIRS:

This is to give you my appreciation and congratulations on the quality of your popular journal *NATURAL HISTORY*, and especially on your wisdom and good fortune in presenting to your readers such socially significant and informing articles as Dr. Shapiro's "A World Full of People." Shapiro's text is excellent but the well-designed illustrations more than double the value of the article, I suspect, for the typical lay reader.

This is not the first time I have expressed my enthusiasm about your journal, but I doubt that I am repeating myself to you, for I have no recollection of addressing the editor previously. With these words of appreciation I send you also my very best wishes for the increasing value and success of the publication.

ROBERT M. YERKES,
The School of Medicine,
Yale University

New Haven, Conn.

* * *

SIRS:

... Mr. Partik's short article entitled "Fishing for Bats" brought to my mind an amusing, and somewhat similar, episode that occurred about fifteen years ago. At the time, I was making a short stay in a small town on the Western Slope in Colorado. Each evening four or five of us would motor up an appallingly steep and rugged road to a large artificial lake-reservoir on the mountain, where we would fish for an hour or two, just at sunset, for the fine, large trout that awaited us there. On the evening in mind we were fishing at the inlet of the lake, and doing very well indeed.

Dusk had fallen when numerous bats made their appearance, darting around on all sides of us, no doubt feeding on the evening hatch of flies that was causing the trout to rise. There was ample room for long casting and I was using perhaps 25 yards of line. On one back-cast I found it difficult to retrieve my cast. At first, I thought my fly had caught upon a twig or a grass blade, but, upon turning to free it, I was amazed to see the leader and several yards of my line floating through the air, attached to a bat. I reeled in my line and, with some difficulty, eventually captured the bat. I found that the fly-hook had become fastened in the wing membrane near the tip of the wing. I suppose that the bat had attempted to capture my fly just at the moment when the forward spring of my rod tip had reversed the motion of the fly, upsetting Mr. Bat's calculations and snagging his wing tip. By the light of a flash we succeeded in freeing him, and he fluttered away into the night. Needless to say, I received considerable "ribbing" from my companions on my prowess as a "FLY" fisherman.

HARRY H. MILLER.

Billings, Montana

SIRS:

Let me first tell you how much I enjoy *NATURAL HISTORY*. It replaces in a great measure both the exhibits and lectures that interested me so much when I lived in New York, and also the long country walks I am no longer able to take.

When I saw people could ask questions that received competent and detailed answers, I thought perhaps I could ask about something I saw far away and rather long ago.

I was walking on a cliff on the northern coast of Brittany. I saw, perhaps half a mile at sea, two porpoise-like creatures, moving with the usual rolling motion, half out of the water. They were much larger than porpoises and snow white. I watched them a long time. From the cliff, I could see their entire bodies, above and below the water. They were an enchanting sight. Then, a little farther, I came to a narrow, deep cove with perpendicular sides, and there, under my very feet, perhaps 50 feet below, was one of the creatures. It was fishing, making quick darts forward to catch, I thought, fish that it had cornered in the narrow cove. It was about twelve or fifteen feet long, gleaming white with a sprinkling of tiny black spots that evidently didn't show at a distance. It had a fairly tall pointed dorsal fin. A local fisherman said the creatures were belugas, which had come after the sardines. But I had seen belugas in the Saint Lawrence and remembered their broad finless backs. A boy who was having science at school thought he had found out what the creatures were: grey grampus. But, back in New York, I saw grey grampus at the museum. They are far too spotty. I would like to know what my glorious white creatures were—grampus, probably, but certainly not the grey kind.

If somebody has the kindness to answer my question, I shall certainly be grateful to him.

JEANNE GIRARDET.

Pittsfield, New Hampshire

George G. Goodwin of the American Museum's Department of Mammals answers this inquiry and offers the accompanying illustrations, useful in identifying whales and their allies:

The observation and identification of seagoing animals in their native element is at best limited to a few brief moments. Trained observers look for outstanding specific features such as the shape and position of the dorsal fin, which may be placed forward, in the middle, or well back on the back, and the shape of the head, whether rounded, pointed or beaked, forehead high or low. The size, color, and markings are also important to determine the species. From the facts presented in Miss Girardet's interesting and colorful narrative we can narrow identification down to two species.

Continued on page 238



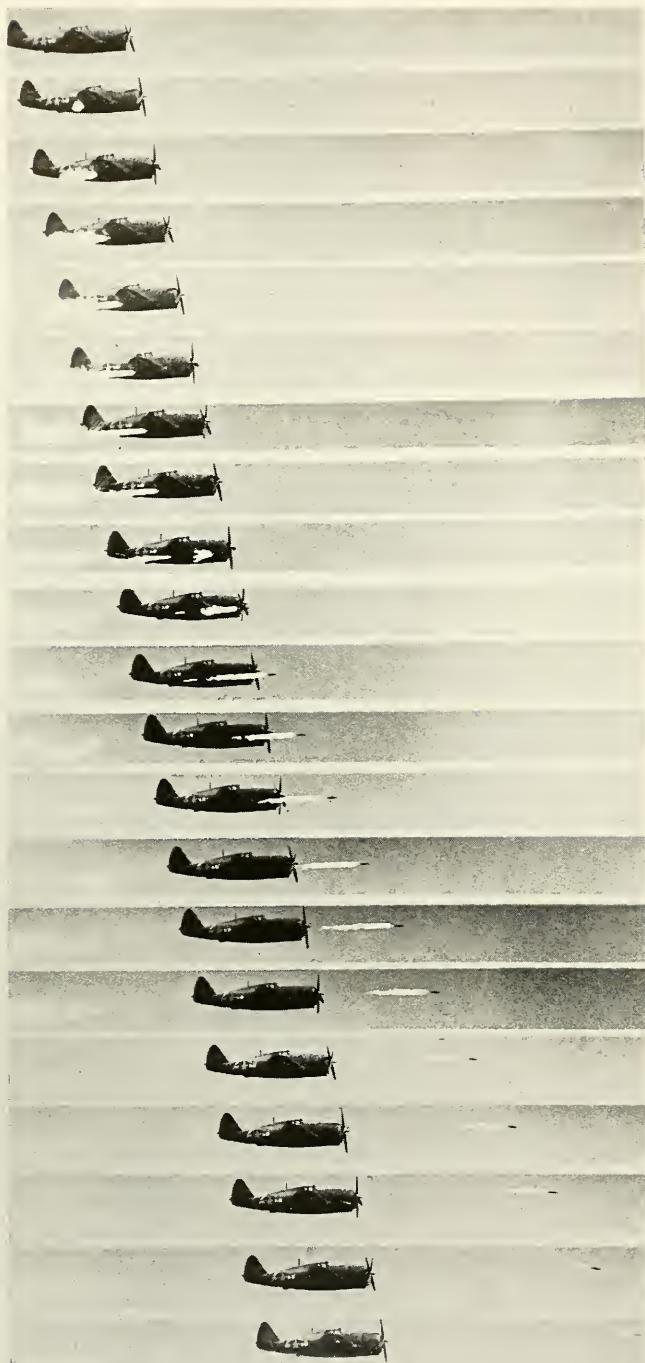
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The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVIDSON, President

ALBERT E. PARR, Director

VOLUME LIV—No. 5

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MAY, 1945

MushroomCover Design

From a Kodachrome by Henry B. Kane

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THE COVER THIS MONTH

The mushroom commonly known as the Fly Agaric (*Amanita muscaria*), portrayed on this issue, is reproduced from a Kodachrome that is an expression of the photographic artistry of Henry B. Kane.

The "Deadly Amanitas" are among the many varieties of poisonous mushrooms, commonly known as "toadstools." Anyone who supposes that a poisonous mushroom is one that will not peel easily should note that *Amanita muscaria* will do so just as readily as the wholesome and delicious Meadow Mushroom, even though it is decidedly in the inedible class. Even more poisonous than *Amanita muscaria* is *Amanita phalloides*. However, the poisonous Amanitas are not easily confused with their edible relatives if care is taken. Definite knowledge of the distinguishing characteristics, as outlined in any of the authentic books on mushrooms, must be the basis of safe mushroom gathering.

Most active among the complex of poisons in this mushroom appears to be muscarine. Its action on the nervous system is rapid and, in severe cases, fatal. Physicians sometimes administer atropine as an antidote.

This photograph of the Fly Agaric was taken early in July at the edge of a wooded area in southern New Hampshire.

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YOUR NEW BOOKS

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OURSELVES UNBORN

----- by George W. Corner

Yale University Press, \$3.00
188 pages, 8 plates, 18 figures

THIS book contains the substance of the twenty-first Terry Lecture Series on "Religion in the Light of Science and Philosophy," given at Yale University in 1944. The author is Director of the Department of Embryology of the Carnegie Institute of Washington and Professor of Embryology in Johns Hopkins Medical School. He presents here the latest information on this subject in terms that those in other fields can understand and assimilate, but it is assumed that the reader will learn as he or she goes on in the book. The excellent illustrations have been chosen to clarify points difficult to explain in the text; they are clear and well labeled.

The history of the individual from the single cell the size of a particle of dust (barely visible to the naked eye), through cell division and implantation, to birth, is told in interesting language. During this development the organism increases two billion times in size. About the third week of life the heart begins to beat. Before this the brain has begun to form, and several weeks later the limb-buds appear. Gradually the various organ systems develop, the structures needed to survive in life after birth.

The nourishment of various types of mammal embryos and the different kinds of placenta are described. Prenatal "influences" are exposed as mythical; on the other hand, the dangers of virus diseases, even mild ones, are real. The risks and vicissitudes of the unborn are such that only about one out of three survives to birth.

The evidences of embryology on the relationships of man with other mammals are also fully discussed. The conclusions agree with those from other fields remarkably well and they are stated with an objectivity and clarity highly commendable.

J. E. HILL.

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SEEING THE INVISIBLE,

The Story of the Electron Microscope

----- by Gessner G. Hawley

Alfred A. Knopf, 1945, \$2.50
195 pages, 71 illustrations

HERE is an up-to-date story of the electron microscope, planned and written particularly for the layman. The author leads up to his subject by an elementary and clear discussion of the optical principles of the simple microscope or hand-lens, followed by an explanation of the compound microscope. He then describes the electron microscope,—what it is, how it works, and how it was developed. In non-technical language, he describes its accomplishments in the field of industrial research and in medical science.

In two most important war-industry problems, namely, synthetic rubber and metal surfaces, the electron microscope has already proved a most useful tool in research. By means of the electron microscope we are able to see for the first time how the active principle of serums and vaccines attack disease "germs,"—bacteria and the much smaller viruses; how the white corpuscles destroy bacteria; and something of what happens to disease-producing bacteria when one of the sulfa drugs or penicillin appears on the scene.

"The average human eye can distinguish no objects smaller than 1/250th of an inch in any dimension; the optical microscope—by which is meant any microscope that utilizes natural light—can penetrate down to 1/125,000th of an inch, which is about 500 times the acuteness of the eye. With the electron microscope, particles as tiny as one ten-millionth of an inch can be detected. Thus it is about 100 times as powerful as its nearest rival, the ultra-microscope, and no less than 50,000 times as potent as the unaided eye." Furthermore, "The superiority of the electron microscope lies in the fact that pictures taken with it have inherently

much more detail than optical-microscope pictures." The book contains more than 70 illustrations, many of them amazing photographs made with the electron microscope,—photographs supplied by General Electric Co., Columbian Carbon Co., R.C.A. Laboratories, Dow Chemical Co., and other sources.

CLYDE FISHER.

THE NATURE OF THE

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----- by Ruth Crosby Noble

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field and laboratory approaches to investigations of animal behavior won him an international reputation and a position as Curator of the Department of Experimental Biology in the American Museum of Natural History. The book is based largely upon Dr. Noble's scientific publications, lectures, and unpublished notes. Because she was closely associated with many aspects of her husband's scientific work, and as a result of her own professional experience as Assistant Curator in the Museum's Department of Education, the author is peculiarly well qualified to bring together many valuable observations and conclusions which Dr. Noble himself was unfortunately prevented from assembling in final form for publication.

As stated in the foreword the book is intended as an informal introduction to the subject of animal behavior, and is not presented as a textbook or comprehensive reference source. Some of the most charming and interesting chapters are those dealing with the field studies and experiments that were conducted jointly by the author and her husband. The interjection of personal adventures, and the generally informal narrative style lend easy readability. The sections dealing with sex recognition, courtship, and social rank are particularly stimulating, and will undoubtedly hold the interest of any reader.

The book is supplied with a number of photographs illustrating animal reactions, and the general excellence of the pictures is so great that one only wishes that more had been available.

A bibliography of 102 titles is appended

so that those who wish to delve further into the technical aspects of the subject may consult the proper sources for more detailed information.

The reader who is anxious to become acquainted with currently accepted methods of objective investigation into animal behavior, desirous of learning about the interesting things that animals do, and at the same time is unwilling to labor through highly technical presentations of the subject will find in this book a great deal to reward his attention.

F. A. B.

SOUTH AMERICA CALLED THEM

- by Victor Wolfgang von Hagen

Alfred Knopf, \$3.75
311 pages, 32 illustrations

THIS book represents a dramatic treatment of four leading protagonists in the scientific exploration of South America. Its period extends from 1735 to 1864. The motives of its principal characters were totally different from the thirst for "gold and souls," which had led during two preceding centuries to the conquest and partial settlement of the continent.

Dr. von Hagen's heroes are La Condamine, leader of the first scientific expedition to South America, who measured an arc of the meridian in Ecuador with the object of determining the precise shape of the earth; Humboldt, foremost among

traveler-naturalists, who, in the words of Bolivar, "did more for the Americas than all of the conquistadores;" Darwin, whose four years in South America were ultimately responsible for the discovery of a mechanism to explain the process of evolution; and Spruce the pioneer collecting botanist of the South American tropics.

In the scale of greatness or genius, these men are by no means of equal rank, and the author makes no attempt to rate them as peers. He does show, however, that they form a natural sequence, each of the latter three being influenced profoundly by the work of his predecessors.

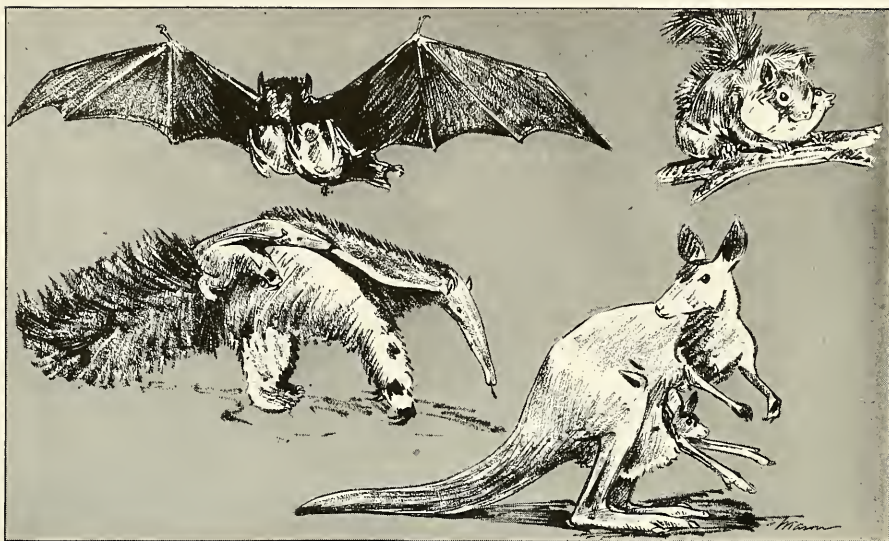
The tale is based upon the writings of the principals and their contemporaries, but the color, realism, and cosmic point of view depend largely upon the author's rich personal experience in South America and the familiarity he has gained with the "background" literature covering all the centuries since the discovery of the New World. The book is well documented, and four short chapters at the end cite the bibliographic references in a form that will prove useful even beyond its avowed purpose.

Certain errors of detail indicate perhaps that the work was completed with undue haste after Dr. von Hagen had entered the Army. The westernmost projection of South America, for example, is not in Ecuador. Sirius is never a "red" star. Atahualpa, the Inca, was baptized before being garroted; his alternative was to be burned. Mount Duida is not granite (although Spruce so reported);

Continued on page 233

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ANIMAL BABY CARRIAGES



By JOHN ERIC HILL
Drawing by
G. FREDERICK MASON

IN contrast to many of the lower classes of animals which lay their eggs in a suitable place and thereafter leave their offspring to their own devices, mammal mothers all take care of their young. Many species not only feed their babies, they carry them around wherever they go and thus are able to protect them from enemies.

The pouch of the kangaroo and other marsupials is an ideal arrangement for carrying youngsters. The mother has a capacious pocket of skin on the underside of the body. Inside are the mammary glands, to provide nourishment. The baby is born at a very undeveloped stage, much like an embryo of higher mammals. The mother licks a path to the pouch, and hand-over-hand the inch-long, pink, grublike creature makes its way through the moist fur. Inside the pouch, the newborn marsupial attaches to a teat, and the mother pumps milk into it by means of special muscles, for the young kangaroo is unable to suck. Here in the pouch it remains until it grows into a miniature kangaroo, the size of a rat; then it comes out to play around and feed on grass. At the first sign of danger, or when it gets tired, the young kangaroo dives headfirst into

the mother's pouch, then turns a sort of somersault, bringing its head out between its hind legs.

Mothers of other orders of mammals have no such convenient pocket for their babies. The anteaters of South and Central America carry their offspring pickaback, just as a human parent may play with a child, but the closely related, upside-down sloths let their babies ride right-side-up on their chests. Babies of lemurs and of most South American monkeys ride on the backs of their parents until almost fully grown, while youngsters of the Old World monkeys and apes hang on the underside of their mother. We wonder why they do not fall off when the mothers jump from branch to branch, or why they do not interfere with the

mother's locomotion. Often the mother sits up on a branch, holding her baby as a human mother might.

Animals that make dens or nests for their young, usually leave them at home while they hunt food, but they may have to change dens through fear of an enemy. A mother of the cat or dog tribe picks up her young, one at a time, by the scruff of the neck and carries them dangling from her mouth. Squirrels pick up their babies by the underside, the young one curling around the mother's head.

One day on the side of a canyon in the Rockies we saw a nest hanging from the bough of a fir tree about five feet above the ground. There was a hole in one side, and a lady reached in to see what might be there. She was surprised when out over her hand and up the tree flashed a mother pack rat with two half-grown youngsters dangling behind. Young pack rats have hooklike, diverging incisor teeth that lock around the mammae.

Some kinds of bats carry their young about with them until they are almost ready to fly. Our red bat usually has two babies, which hang on to their mother with tiny thumb-and-toe-claws, and hooklike milk teeth. How they manage to remain attached during the erratic flight of the mother is puzzling, but so is the way the mother bat can fly with such a burden.

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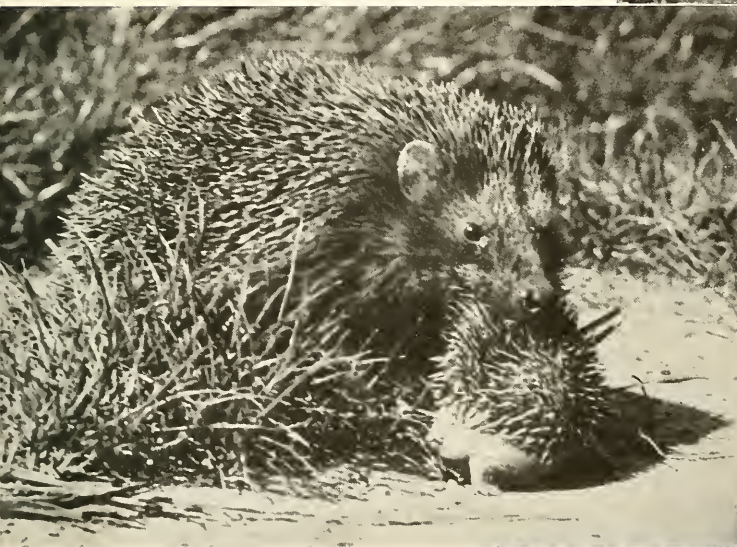
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Mother Hedgehog and her Young

Hedgehogs are about ten inches in length when fully grown, with an inch-long tail. They are insectivores, distantly related to shrews and moles and not in the least like our porcupine, except for their spiny protective armor. They are nocturnal in habits, and feed largely on snails, worms, insects, mice, snakes, and small birds. Two litters of young, usually four in number, are born each year, one in the spring and the other about September. The babies are at first nearly naked, and when the spines appear on their backs they are soft, only hardening after about three weeks

Steiner Photos, from Leon



◀ The mother picks her babies up by the skin of the back, spines or not, as seen in this picture



➤ Here the young are almost large enough to fend for themselves, but they are still following their mother

The Domestication

WHEN you begin to think about the domestication of animals you are moved to make certain assumptions. You take for granted that there was a time when no one anywhere thought of taming an animal; then you may try to guess what animal was the first to be tamed and compose an imaginary set of plausible incidents leading to the acquisition of a fireside pet.

You have a right to speculate in this way and may expect that most of your guesses have been made time and again by hundreds of other people. If you experiment by asking friends their guesses as to the first animal domesticated, you will find that many of them will choose the dog. They will be prepared to defend the proposition by such statements as: "Most savage tribes have dogs," "It seems most natural that man and dog should take to each other," etc.

In modern civilized life the term animal husbandry is used to designate the rearing of animals of economic importance. This, of course, includes those that produce meat, milk, hides, wool, and hair, or furnish power for traction and transportation, such as, cattle, horses, asses, hogs, camels, sheep, goats, reindeer, poultry, etc. While it is correct to say that the first domestications of such animals were prehistoric and therefore shrouded in mystery, we should recognize that paleontology and archaeology do furnish some pertinent data for a few sound conclusions as to when and where the rearing of the most important animals was first achieved. Since we assume there was a time when the ancestors of modern man were in most respects wild men living among the wild ancestors of our domestic animals, it may help us to look backward to see what wild beasts were their contemporaries.

Paleontologists and archaeologists seem to agree that the earliest human bones known are those of *Homo jakertensis*, found in Southeast Asia in fossil beds of Early Pleistocene time, the geologic period that began approximately a million years ago. However, the human bones to which we have referred are from fossil beds in late Early Pleistocene time. Among the wild animal bones in these same beds were earlier representatives of the animals we know today as elephants, horses, cattle, deer (two kinds), and

camels. Pigs appear with man in middle Pleistocene time; sheep, wolves, foxes, etc., appear with other human bones in the late Pleistocene. Thus it is clear that species of the great families from which the world's livestock was derived by domestication were characteristic of Pleistocene time. And the first men we know anything about (six or seven extinct species of man) were a part of the wildlife of that era and preyed upon these wild animals, at least as soon as they learned to use fire and make crude tools. There is every reason to assume that increasing human population spurred early man to hunt in teams and to stalk the larger animals, driving them into bogs, over cliffs, and into pits dug for the purpose. Fire was obviously one of the most powerful weapons in this co-operative trapping and killing of game. Positive evidence of fire appears with man of the Middle Pleistocene in Eastern Asia and persists through Late Pleistocene to the present. Its use may not be as old as stone tools and speech but is relatively very ancient.

Another assumption upon which there is general agreement is that the invention of agriculture and animal husbandry came at a relatively late date and must be credited to *Homo sapiens*, the human species to which we belong. Archaeologists have observed no signs suggesting the domestication of animals or plants by any earlier but now extinct species.

If the reader is interested in possible biological evolutionary changes in man's structure and function, he should note this coincidental advent of a new human species and such a revolutionary way of living as the domestication of plants and animals. There is a puzzle here. The use of speech, fire, clothing, dancing, and many other fundamental inventions are credited to extinct species of man. Was it necessary, then, that the world wait for a new species to evolve before another series of epoch-making inventions were achieved, few, if any, of which appear more difficult than those preceding? If there are such things as true paradoxes, this may be one of them.

Order of Domestication

The usual assumption is that the

dog was the first to be domesticated. One of the supporting arguments is the almost world-wide distribution of the dog. There is a widely accepted theory that the larger the geographical distribution the greater the age, though no critically minded person regards such evidence as infallible. However, the dog is the only domestic animal common both to the Old and the New World in ancient times. Even so, the dog appears late in the archaeological record, about on a level with agriculture in the Old World. In the New World his remains appear relatively late; they are conspicuously lacking in the sites associated with extinct animals, as at Folsom, Clovis, and the Strait of Magellan.

Turning back to the Old World, the pig seems to rank next in extent of distribution, reaching the far western and eastern margins of the land mass, and extending into the Pacific Island area. A number of species with local distributions seem to have been domesticated, whereas with most domesticated animals the tendency was to exploit a single species, which was then spread abroad by man himself, suggesting a single source of origin. In fact, whenever more than one species of ancestor is suspected, the scientist feels impelled to assume independent centers of domestication.

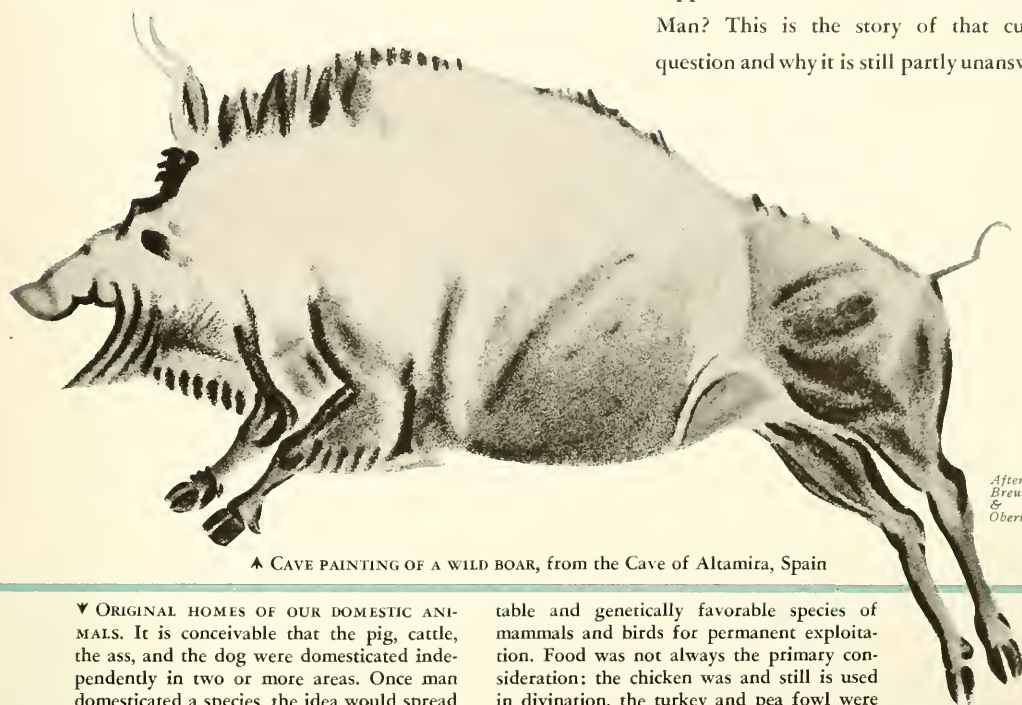
Somewhat smaller distributions belong to cattle. And we have some archaeological evidence suggesting still later dates for the domestication of most of the other domestic animals, such as reindeer, horse, ass, sheep, goat, camel, elephant, poultry, etc. In this way the following time sequences have been proposed: (1) among the first, the dog and the pig, (2) next in order, cattle and reindeer, (3) sheep before goats, (4) the ass before the horse, and (5) the horse before the camel and the elephant.

In much the same way the ranges of the wild species suggest the places of first domestication, as shown in the map on page 201.

For the dog, two separate derivations have been proposed,—jackal and wolf. For horned cattle, three localities are offered, and possibly as many subspecies,—the steppes, the valley of the Euphrates, and forested parklands in Europe. In the case of

of Animals

Was it Man's need for animals that created what was to become one of his greatest sources of pleasure, comfort, and economic support—or was it the animals' need for Man? This is the story of that curious question and why it is still partly unanswered



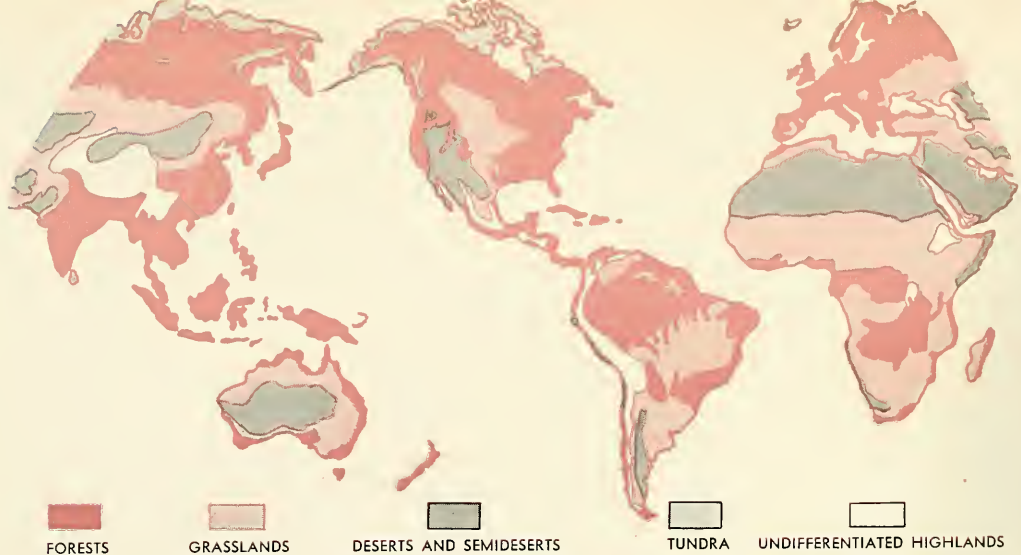
After
Breuil
&
Obermaier

▲ CAVE PAINTING OF A WILD BOAR, from the Cave of Altamira, Spain

▼ ORIGINAL HOMES OF OUR DOMESTIC ANIMALS. It is conceivable that the pig, cattle, the ass, and the dog were domesticated independently in two or more areas. Once man domesticated a species, the idea would spread from tribe to tribe, suggesting experiments with all wild animals. It is probable that by trial and error, man selected the most trac-

table and genetically favorable species of mammals and birds for permanent exploitation. Food was not always the primary consideration; the chicken was and still is used in divination, the turkey and pea fowl were bred for their feathers, the camel, elephant, and horse for transportation, etc.





▲ **GRAZING AREAS OF THE WORLD.** Nomadic peoples frequented the margins between deserts and grasslands, where with expert handling, cattle, horses, sheep, and goats would fare well. Domestication only required substitution of herding for any habitual seasonal migration behavior the wild stock may have acquired. The pig did not thrive well in either desert or grasslands: forests, moist and even swampy, were his natural habitat. His range, in the Pleistocene, was from India to extreme western Europe, including the Fayum in north Africa

▼ **DRIVING DOMESTICATED PIGS TO market:** a scene among the Bontoc Igorots in the Philippine Islands. The distribution of the several wild species of swine was apparently almost world-wide, but domestication seems to have originated in Egypt and far-eastern Asia

the pig, several localities ranging from Spain to Burma are suggested. Yet these are still little more than hypotheses. In the New World the dog seems to have been introduced from Asia.

Habitual Associations between Man and Wild Animals

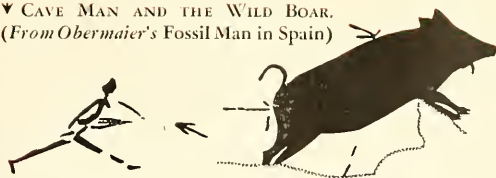
When people argue that it was natural for dogs and men to tolerate each other, they have in mind the differences that are obvious in the inborn behavior of the various other species of animals. For example, one reason for favoring the pig as one of the first wild animals to be tolerated in a camp or village is that in many parts of the primitive Old World, especially in New Guinea, the female pig with her litter moves freely about the village to feed upon offal and scraps of food discarded by the various households. The mother pig learns to look upon individual families as the source of regular "hand outs," and in turn her piglets are fondled by the children of the household and not infrequently allowed to feed from the breasts of the women. On the other hand, the adult boar is not tolerated in the village but banished to the surrounding bush, where



he is hunted like other wild game. However, since the females are not kept in pens but run about freely, the wild boars have no difficulty in meeting them at night or in the edge of the bush by day. In the village the pigs not only destroy accumulating garbage and filth but prey upon crawling and creeping creatures whose presence would be more than a mere nuisance. The natives not only recognize these services but, since the



▼ CAVE MAN AND THE WILD BOAR.
(From Obermaier's Fossil Man in Spain)



► ENGRAVING OF A
WILD REINDEER:
European cave art.
This is the most famous sketch of its
kind



After Keith Henderson,
in *Primitive Man*,
E. P. Dutton & Co.



After Capiton and Breuil

► THE REINDEER is not a strong animal but can carry a medium-size person or a light pack load. Lamoot Woman and daughter, Siberia

pig bears two litters a year, look upon the animal as a steady food supply. In the forested regions of western Europe hogs were herded while feeding on nuts and roots and in time were propagated for food and hides. Read the opening scene in Scott's *Ivanhoe* for an understanding of the economic importance of pig culture in Middle Age Europe. Even then boars seem to have run wild and been pursued by hunters, the head of the wild boar being regarded as the prize of the epicure.

Reverting to the dog, it is usually assumed that its wild ancestors, attracted by discarded food and the warmth of the campfire, gradually wormed their way into human so-



A.M.N.H. photo

ciety and rewarded those who tolerated them by detecting the approach of enemies and volunteering assistance in the hunt. Thus the association between dog and man could grow up naturally, the only surprise being that there is no trustworthy evidence for such mutual tolerance before the ap-

pearance of agriculture, about 10,000 years ago.

Wild cattle and reindeer were grazing animals, inclined to form relatively large herds and to seek tundra, grasslands, or park lands (open spaces in forested areas). Both are adapted to cool climates or seasonable habitats, in which they learn to migrate back and forth from north to south. The reindeer range farther north, even to the margins of glaciated areas, while cattle prefer the milder climates of the temperate zones where wet and dry seasons alternate. Reindeer roamed over middle Europe in glacial times, and since they still survive in wild herds in Arctic and sub-Arctic latitudes, we may assume that they shifted their range with the glacial cycles, northward in interglacial periods and southward in periods of advancing glaciers. No doubt the several species of man were troubled by these same cycles of cold weather. Four periods of alternating glaciation are accepted as having occurred during Pleistocene time. Post-Pleistocene time, in which we now find ourselves, may well be the fourth interglacial period, to be

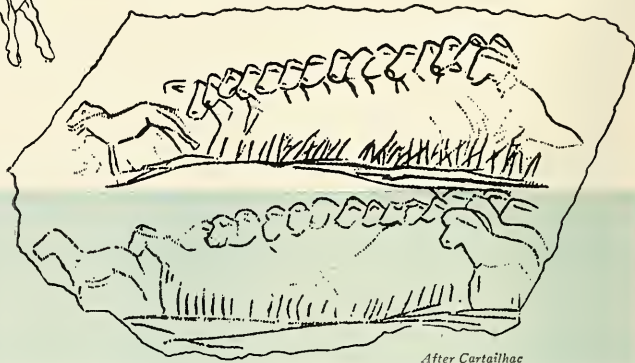
A.M.N.H. photo

▼ CAMP OF NOMADIC KORYAKS, Siberia, with their domesticated herd of reindeer. The wall-tent in the center belongs to an American Museum of Natural History Expedition. The large tents are covered with reindeer skins, which with their poles and the baggage of their owners are transported by sleds drawn by trained reindeer





➤ A CAVE ARTIST TRIES his hand in sketching herds of galloping wild horses. A slab of stone from Cave of Chaffaud, France



After Cartailhac

followed in the distant future by a fifth glaciation. Consistently enough, the earliest known man (*Homo modjokertensis*) appears in Java during the first interglacial period when the climate there was probably tropical, as at present. Middle Pleistocene time seems to begin with the second glaciation, and this is when man in China (*Homo sinanthropus*) began to use fire, probably with good reason.

Whether reindeer were the first large grazing animals to be domesticated is not very important, and there is some reason to suppose that the date was much later than that for cattle. It is probable that cattle were among the first, but sheep may have preceded them, since at the famous archaeological site of Anau, Turk-estan, bones of sheep were found beneath those of cattle. Some weight should be given to priority for sheep on the grounds that they are probably easier to control than either cattle or reindeer. But sheep were probably domesticated in one locality and cattle in another, so that it is difficult to prove which should be given priority in world chronology. Goats, also, may have preceded cattle, but the archaeological record seems to reveal no goat bones earlier than those of sheep or cattle.

Cattle, reindeer, and goats were milked, so we have no basis for deciding whether flesh or milk was the primary consideration. Asses and horses were milked too, but since it is assumed they were domesticated later than cattle, the use of their milk could have been suggested by cattle

➤ PRIMITIVE ARTISTS frequently superimposed one picture upon another, but here women are shown with cattle, suggesting herding. However, the pictures are believed to be early neolithic and are therefore contemporary with early agriculture. Cave of Cogul, Spain



After J. Cabré

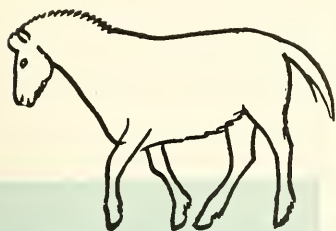
herders. In any case the first domesticated animals to be milked would suggest experiments with other domesticated species.

The chief interest in reindeer is that both wild and tame reindeer survive and that not so long ago some Siberian tribes treated wild reindeer as game, killing them in the chase. At the same time, other tribes, recognizing that even wild reindeer moved in herds, shifted their camps with the migrating deer, taking care not to stampede the herd. Still others exercised some control by gently driving the herd to new pastures, protecting it somewhat against wolves and even against other hunters, thus naively conceiving ownership of a particular herd. At the other extreme is the complete control of the herd

and the use of some individual animals for transportation, by saddle and sled, for milking, etc. It is not difficult to see here all the logically conceivable steps in the gradual domestication of the reindeer. The story for the domestication of cattle, horses, and other animals could have followed the same pattern.

Man's ability to provide protection for animals and supply food in times of scarcity puts the herded animals in his power. For example, the winter-feeding of elk in our National Parks tends to hold them to the feeding ground; the herd will stay around the spot and starve rather than migrate to fresh pastures. When mounted herders drive them to new grounds where feed is abundant, the homing instinct of these erstwhile

▼ DRAWING OF A WILD HORSE from the walls of Font de Gaume, France, considered one of the finest examples of cave art



After Keith Henderson,
in *Prehistoric Man*,
E. P. Dutton & Co.



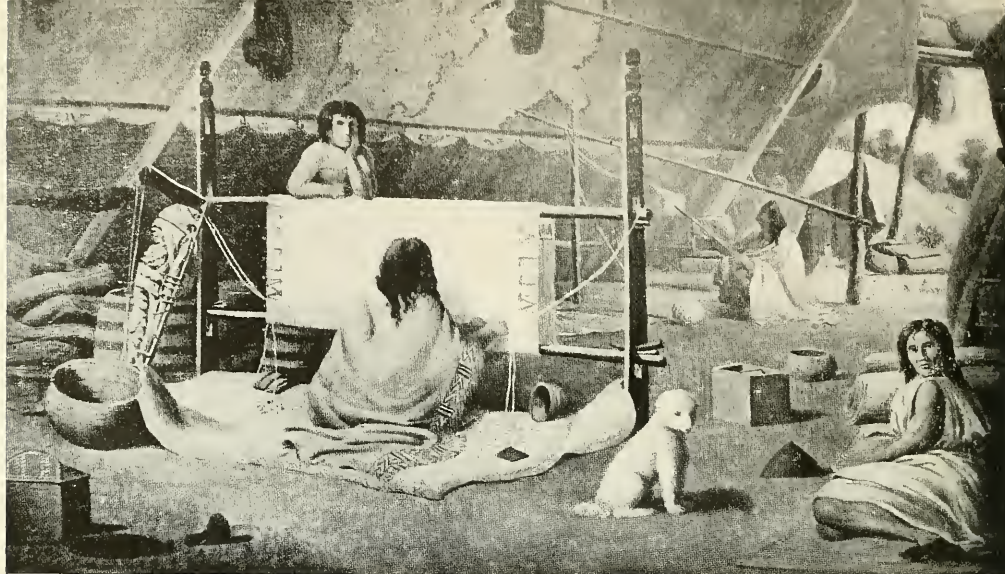
A.M.N.H. photo

▲ THE WILD ASS OF THE GOBI DESERT. The ancestors of the long-eared, heavy-muzzled, droll-visaged donkey ran wild in North Africa, a different species from the more horselike creature of the Gobi. Certain low-relief sculpture of the Sumerians show asses of the Gobi type harnessed to chariots, apparently valued for their speed, whereas the Egyptian artists depict the heavily-laden donkey, plodding beside his foot-going master

▼ THE PRZEWALSKY HORSE of Asia, assumed to be a descendant of the wild horse of Stone Age France, depicted above

A.M.N.H. photo





From a painting by Paul Kane in 1846

wild elk brings them back to the feeding place, where they will die of hunger if not fed, failing to remember the places where pasturage was plentiful. It would seem that in providing winter food for a single season wild elk were essentially domesticated and rendered incapable of survival. If they had been herded on the new range for the season and then returned to their former feeding ground and this process continued year after year, we should regard them as domesticated. After all, there is nothing very mysterious here: we mention it to clarify our understanding of what may have been a natural process.

Tribes specializing in the control of flocks and herds but making no attempt at agriculture, are usually characterized as nomads or pastoral peoples. Some years ago there was a favorite theory that, in the evolution of society, hunters passed first from hunting to herding and later took up farming. This can be made plausible, but it is now realized that the environment determined where herding and agriculture could best be developed and that the first great civilizations were brought about by a combination of stock raising and agriculture. In an earlier article* we suggested that the most favorable locations for such an integration were the narrow valleys of rivers coursing through deserts, as the Nile, Euphrates, and Indus, where, during the rainy season, herds could be pastured

▲ A BRITISH COLUMBIA INDIAN weaving a blanket of yarn spun from the wool of the white dog shown at her right. These dogs, bred and sheared for their wool, became extinct soon after white contact

upon the adjoining desert lands and brought back to the marshes and deltas for winter feeding.

As in the case of plants, man soon learned that selective breeding could rapidly change the body build and the behavior of his live stock, if mating were rigidly controlled. Sheep wool is so different from that of surviving wild sheep that its origin is considered to be due to man's care in breeding. In western Canada the Indians even bred a strain of dog with white woolly hair, excellent for spinning. They also spun the hair of the local wild goat but without domesticating him. The hair of surviving wild sheep in North America is too smooth to be practical. In Peru, the hair of llama, alpaca, and vicuña was used to spin yarns, usually for the warp in cotton fabrics.

In conclusion, it is by no means clear whether the larger share of credit for the domestication of animals can be justly claimed by man. The behavior patterns of the animals to be domesticated may have been the first cause, and the long delay on the part of man may have been due to his own predatory habits, which automatically classed him with the larger carnivorous animals. That man made little effort to domesticate tigers and lions is clearly logical; and in a region where people lived by hunting it is far from obvious that herds of relatively defenseless animals

should seek food and protection around the camp.

Yet there are suggestions that when hunters came to be in part farmers and their food crops lured grazing and root-eating animals to the villages, the villagers would be prompted to adopt one of two expedients in defense of their own food supply—driving the herd away or leading it to pastures farther afield and holding them there. Thus automatically and without thought on the part of anyone, a habitual relationship between the herd and the village would evolve and perpetuate itself. Later, some speculative sage would make an original contribution to social belief by remarking that the herd was now community property. Note that the relationship between the herd and the village first came to be a reality; only later was *thought* applied to it, giving expression to the relationship in words and finally causing it to be taken for granted.

The part that the much vaunted "human intelligence" played in the achievement seems to fade into obscurity. The herders may have been as blind to the initial steps in domestication as were the herded. Why, then, should we be astonished when told that some ant colonies keep herds of "milk-giving insects?" Probably because we consider man very intelligent but look upon the ants as devoid of that quality.

* "Wheat and Civilization," by Clark Wissler, *NATURAL HISTORY Magazine*, Nov. 1943, page 172.

HAWKWAYS

By EDWIN WAY TEALE

A lookout on the Kittatinny Ridge once provided good hawk-hunting during the migrating season. Hawks are still hunted from the Hawk Mountain Sanctuary—but with fieldglasses and cameras instead of guns

SCUDDING low, soaring high, riding the wind on half-furled wings, they came down the long valley, over red and yellow miles of autumn foliage. We could see them from afar through our glasses. Singly, in twos and threes, a dozen at a time, the hawks swept into view. They drew abreast of our cliff. They slid past on almost motionless wings. They grew small in the distance. In this same way, and past this same cliff, autumn hawks for centuries have been riding the invisible tide of the updrafts. Each fall, when the trees of the mountainsides, viewed from afar, seem turned to little puffs of colored smoke, the birds soar down this ancient hawkway to the South.

Early that morning, we had driven out of a valley in the mountains of eastern Pennsylvania, jolting over a narrow, rocky road that wound steeply upward. Leaving the car, we climbed through woods and past great lichen-blotched boulders and into a V-shaped grotto, formed like an amphitheatre and walled in with uptilting layers of Tuscorora sandstone. At its far end, a kind of stairway cut in the solid stone, carried us upward to the edge of a great promontory. All along the brink of this sheer, thousand-foot cliff, dead trees formed a vast Aeolian harp. Their dry twigs and branches hummed, with varying notes, in the rising breeze.

Clambering over great slabs of jumbled, whitish rock, mottled with leathery splotches of lichen, we reached a wild cherry tree that flared away from the precipice and brought to mind the image of a high, green candleflame blown by the wind. Beyond, we came out upon the bare tip of the promontory. This area of tumbled slabs opened on a wide and colorful prospect. The Kittatinny, the "Endless Ridge" of the Indians, stretched away before us.

Below this giant's lookout, farms and roads and woods spread up the valley to the farthest limits of our

vision. They streamed away in the other direction until they were lost in the distance. A toy train, under a toy cloud of smoke, hugged the bank of the river that curved outward from the base of the cliff and wandered across the floor of the valley. Midget cows and horses grazed in tiny pastures or clustered together in Lilliputian barnyards. And all across this wide expanse of farming land, on this October morning, cloud-shadows and patches of sunshine followed each other, dappling the floor of the valley. The harvest was over and hardly a man

could be seen working in the fields. The time of planting and reaping was past. The days of advancing autumn had come. And they had brought, as they had brought from time immemorial, the soaring of hawks overhead.

To take advantage of upcurrents along the western face of the long ridge leading to the South, hawks from all over New England and from above the St. Lawrence in Canada, each year, funnel into the northern end of the valley. In reaching this groove in the Earth's surface, many of them had soared along

▼ **HAWK MOUNTAIN SANCTUARY.** When purchased in 1934 by the Emergency Conservation Committee, of New York City, it ceased to be a hunter's playground and became the world's first hawk sanctuary





▲ BEYOND these giant lichen-spotted boulders, the sheer thousand-foot precipice falls to the valley below. The wind-lashed wild-cherry tree offers mute testimony to the prevailing force of the updrafts

the ridges of the Connecticut valley, past Mt. Tom in western Massachusetts, across the Hudson River near the Bear Mountain Bridge, over the New Jersey countryside and across into Pennsylvania. By choosing terrain with the best updrafts, they reduced their expenditure of energy to a minimum. Once the long valley of the Kittatinny Ridge was attained, they sailed almost without an effort—just as their ancestors had done for hundreds of years—mile after mile on their long journey to a winter home.

During the early years of the present century, and even into the Nineteen-Thirties, many of these birds got no farther than the cliff on which we stood. Taking advantage of the fact that the migrating hawks frequently were forced close to this observation point in hugging the ridge to keep in the updrafts, local gunners and big-city "sports" blasted away, riddling the slow-moving birds as they soared, almost helplessly, within range of their guns.

After such a Roman holiday of "sport," as much as a wagonload of birds, dead, maimed and dying, would often litter the foot of the

cliff. The stench of their decomposition filled the air all during the height of the migration period. Shotgun shells, tossed aside on the rocks of the observation point, accumulated in such quantities that it was worth the while of a junkman to come to this remote spot and salvage the brass they contained. The bill for this an-

nual festival of slaughter was paid by people all over the Northeastern states. Rodents, which hawks that had been killed at this vantage point would have consumed, multiplied in consequence of the activity of the gunners. Some of the latter undoubtedly felt justified in the slaughter through the mistaken belief that "the only good hawk is a dead hawk." But most of the gunners considered the pleasure of exercising their skill and the joy of letting blood justification enough.

This state of affairs continued until the Emergency Conservation Committee, in New York City, raised funds, purchased this ridge-top observation point and turned it into the world's first sanctuary for hawks. That was in 1934. Since then, the now world-famous Hawk Mountain Sanctuary, north of Hamburg and near the village of Dreherstown, Pa., has attracted thousands of visitors. Special excursion trains for bird-watchers have been run to the area during the migration season. Maurice Broun, ornithologist in charge, recorded, during eight autumn seasons, the passage of more than 125,000 hawks.

Different species are frequently more abundant at special times during the migrating season and often at special times during the day. Bald eagles, for example, are seen going south most often in the early days of September. Broad-winged hawks appear in largest numbers between the tenth and the twenty-sixth of that month. During a single September day, Broun once saw 4,078 broad-

▼ ANCIENT HAWKWAY. Over these steep and rocky cliffs, hawks for centuries have soared southward on the invisible tide of mountain updrafts



winged hawks sail past his promontory lookout.

The prevalence of the different species varies widely from year to year. In 1938, the number of broad-winged hawks passing the observation point reached the total of 10,761; in 1934, the total was only 2,020. In 1939, the number of sharp-shinned hawks was 8,528; in 1940, it dropped to 2,407. In 1935, 239 goshawks passed Broun's lookout; in 1938, the number was only nine. Weather conditions during the migration season undoubtedly have much to do with the fluctuations. Only on days when the wind is from a westerly direction, producing strong updrafts along the face of the ridge, do you get a large flight of hawks down the valley.

On the October morning when we swept the valley and the ridge-side to the north with our fieldglasses, it was sharp-shinned hawks that most often came into view. Usually, they were flying low, scudding over the trees, with the autumn colors of the woodland streaming to the rear beneath their wings. One of these hawks, coming up the lee-side of the ridge, met the westerly wind head-on, and it hung for a moment in the air almost directly above the slab on which I sat. Its upper-body, I saw as it slanted away, was blue-gray. This pronounced it an old bird. It also gave point to the common name for the sharp-shinned hawk: The



▲ THE KITTATINNY, "Endless Ridge" of the Indians. Within but a few yards of this rock-strewn promontory skim thousands of hawks each year, while crowds of visitors line its edge to watch

Little Blue Darter. Younger birds that passed close to the edge of the cliff were more brownish in hue.

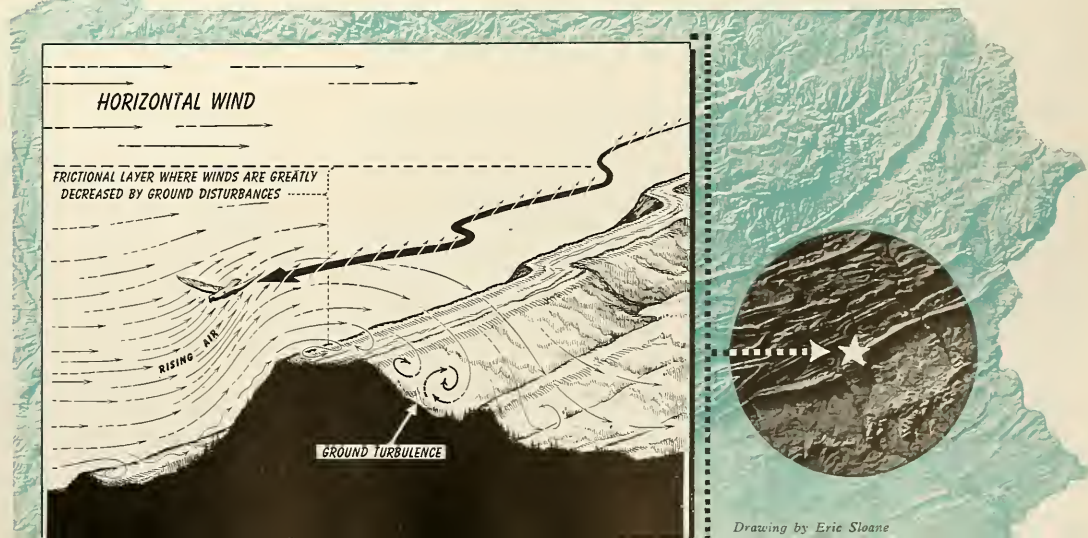
Nine-tenths of the sharp-shinned hawk's diet probably consists of small birds. I remember one adventure of the mind when, for a terrifying moment, I became the hunted, fleeing bird with one of these hawks in close pursuit.

I had been standing motionless in a small grove of tupelo trees watching some late-autumn white-throated sparrows feeding on the ground and

darting among the bushes. Suddenly every bird in the grove became silent and watchful. I had seen nothing, heard nothing. It was minutes before I discovered a sharp-shinned hawk perching motionless in the top of a dead tree an eighth of a mile away. It had slipped silently into position. Yet every small bird in the vicinity was aware of its menacing presence.

Fifteen minutes went by. The sparrows began to feed again, alert and uneasy. Then, without warning, the small birds seemed to explode in

▼ THE HAWKS and other birds follow Kittatinny Ridge in order to take advantage of its updrafts on their long migration flights. The natural currents of air, rising from the land to the west, enable them to soar long distances with little exertion





▲ BEYOND THE RIDGE, the rolling valley and its miniatures of civilization stretch far away. Pleasure-seeking gunners, shooting from the edge, used to send many of the close-flying birds to their death a thousand feet below

all directions around me. The hawk, like the shadow of a bullet, swift and silent, streaked into the thicket. Already, it was in close pursuit of a wildly fleeing white-throat. That pursuit would have ended tragically for the sparrow had I not let out a sudden shout and waved my arms aloft. The hawk veered, shot almost straight up, disappeared. The small bird, whose escape I had mentally shared, dashed into the protection of a bush.

In the open sky, the way of a bird with a hawk is often a mysterious thing. Above the waving cattails of a piece of Long Island lowland, I once saw swallows, two score or more, come together from all parts of the swampy area and begin whirling about in a large, loosely-knit flock. A sharp-shinned hawk had come scudding low across the marsh. The swallows whirled around and around, rising as they circled. The hawk, 30 feet below them, circled too—climbing as it turned, giving quick flaps of its wings between short glides.

The pursued swallows rose continually higher, with the hawk

climbing behind them. Spiraling upward in this fashion, they moved away to the east, over the trees beyond the swamp, above the streets and houses of a neighboring town, higher and higher, until the swallows seemed no larger than bumblebees and the pursuing hawk the size of a small butterfly. And thus they disappeared. How the duel of wings ended, I did not see. But, judging from other observations of small birds that remained in a compact, whirling flock in the presence of hawks, I am sure the swallows outwitted their foe.

On another occasion, I watched starlings performing in a similar manner, but with a curious exception. Half a hundred of these dark birds were circling in a close-knit mass 100 feet or so above the ground. A Cooper's hawk was swinging in slow, soaring circles near-by and at the same altitude. Minute after minute, the starlings and the hawk kept turning like gears of different size moving in synchronization. When the hawk moved closer, the whirling mass of starlings drew away. When the hawk

circled off, the starlings, unlike the swallows, instead of putting further distance between themselves and their enemy, followed as though drawn along in its train.

But the smaller birds never for a moment failed to maintain their compact flock. No single bird made the mistake of separating itself from the safety of the mass. In the end, the hawk gave up, baffled. It straightened out and coasted away to the south. The starlings spun in their narrow circle a little longer. Then the whirling flock broke up so suddenly it seemed blasted apart. The individual birds darted down to the treetops and telephone wires below. The danger was over. Their flocking maneuver had brought them all safely through the crisis.

Unless small birds can flock together in the presence of a hawk, they are likely to be easy victims. A friend of mine once told me of a Cooper's hawk that made a regular morning visit to a barn on his place in the country. Swallows were in the habit of congregating on the eastern slope of the roof to get the full benefit of the early sunshine. Instead of flying toward them directly, the hawk would sail out of the woods, approach the barn from the rear, shoot up along the shadowed side of the roof and, bursting over the ridge, dive down the sunlit slope. This maneuver always took the swallows by surprise. They had no time to dart into the air and form a swirling flock. The Cooper's hawk was always able to pick off the swallow of its choice.

With the coming of noon at our observation point, there was a lull in the passage of the migrating hawks. But, on that October day, in many parts of the country, the hawks of other regions were following other skyways to the South. Some of these aerial trails are ill-defined and little-known. In the East, the most famous hawkway—outside of the one skirting the Kittatinny Ridge—is the route that follows the Atlantic coastline down to that southward-pointing thumb of land, Cape May, N. J. It was at Cape May that Alexander Wilson carried on many of his pioneer studies in American ornithology. Beyond the cape stretches the water of Delaware Bay. Confronted by this barrier, birds of many species hesitate and congregate near the tip of Cape May. Here they provide one

of the great bird-spectacles of the East. I have seen ten thousand and more tree swallows swirling like swarming gnats through the air above Cape May. Everything from golden-crowned kinglets to bobwhites pause in uncertainty before flying on over Delaware Bay.

In connection with the hawks that reach Cape May, ornithologists have noticed an interesting fact. Fully 90 per cent of them are young birds that have tried their wings for the first time during the previous summer. It is suggested that these inexperienced migrants have been carried off their course by prevailing westerly winds and so have missed their mark—the hawkway along the Kittatinny Ridge—and have had to follow the coastline south. The older birds, such as we saw passing our lookout point, are better navigators. They have made sufficient allowance for wind drift and so have reached their goal, the mouth of the long valley.

As the afternoon advanced, the sharp-shinned voyagers decreased in numbers. The hour of the larger hawks had come. Broad-winged "mouse-hawks" now predominated. Soaring past us came the red-shouldered and red-tailed hawks. With their white rump-patches shining in the sun, lightly-loaded marsh hawks drifted by. Cooper's hawks skimmed below us. Once a pigeon hawk, following the more direct path of its flight, passed close to our rocky promontory. Among them all, it was the red-tails that now far outnumbered the others.

From time to time, our attention was drawn to some smaller migrant following the ridge on its flight southward. Song sparrows, robins, and even several tiny golden-crowned kinglets, fluttered down to rest in the branches of the ridgetop trees. After a short pause, they started on again. The hawks paid little attention to these fellow-travelers. They were taking advantage of the favoring wind; they were covering every mile possible on their journey. During the hours of early morning and evening they probably paused to hunt for food.

By two o'clock in the afternoon, we had counted a total of more than half a thousand hawks. And the aerial parade continued. The floor of the valley, a thousand feet below us, suggested the bed of some vast, transparent river on which the birds were floating. Other hawk-watchers kept

arriving, from as far away as Philadelphia and New York City, to enjoy the show. With fieldglasses instead of shotguns, they were engaged in a thrilling outdoor sport. Someone set up a cry of excitement. Far out over the valley, he had caught sight of a large, dark bird soaring toward the South. It moved steadily, like an air liner, its wide wings seemingly unaffected by the minor gusts. All the fieldglasses on the observation point swung in its direction. It was the first golden eagle of the day.

Ten minutes later, in a long wedge, snow geese cut diagonally across the valley, high above our heads. For their heavily-laden and laboring wings, updrafts had little of the significance they had for the soaring hawks. Throughout the afternoon, crows trailed past in ragged, cawing flocks and in twos and threes. Well out over the valley, and alternating flapping their wings and soaring, the first ravens I had ever seen passed by. And, all the while, the hawks kept streaming past. Many of them flew by us hundreds of feet below our eyrie. They gave us an unfamiliar, a truly bird's-eye view of their passage.

Before we left, that October after-

noon, we had seen well over 600 hawks. Our final sight, the most thrilling of the whole adventure, came as we were working our way back along the edge of the cliff, past the breeze sculptured wild-cherry and the dead trees, still producing their Aeolian harp music in the wind.

We were nearing the steep descent into the white-walled chasm when I turned to look back. At that moment, the six-and-a-half-foot wings of a golden eagle carried one of these rare and spectacular birds almost directly over the observation point. As it burst above the ridge, the eagle caught sight of the watchers on the jumbled slabs below it. In an instantaneous, spine-tingling stoop, it streaked downward along the sheer face of the cliff. No other bird has the speed of a golden eagle in its dive. The great bird, as it bolted downward, passed me like a black smudge against the landscape. That glorious plunge through space provided a mental picture that remained with us long after we had clambered down the rocky trail and reached the car below. It, of all the varied sights we had seen that day against the background of the autumn trees, stood out in later memory.

▼ THE DUCK HAWK, rated as the fastest straightaway flier in the bird world and possessing a sharp tooth in its beak that enables it to cut its meat, is one of the more illustrious of the many varieties of hawks that stream past the Kittatinny Ridge



Many are harmless, but dog owners, cattle raisers, and others are becoming increasingly aware of them as carriers of certain diseases. The simple preventive measures outlined in this article will prove valuable

TICKS — a

By C. H. CURRAN

*Associate Curator,
Department of Insects and Spiders,
American Museum of Natural History*

TICKS, those little things that get on you when you walk in the fields or woods, are repulsive creatures, and few people can suppress a shudder when they find one on their person. These animals are encountered over most parts of the world, and in some places they are greatly feared by natives. The famed Doctor Livingstone found during his travels in Africa that the natives of the Congo region lived in deadly fear of certain kinds of ticks, claiming that their bites resulted in death. This was in 1857. Scores of years passed before it became known, in 1904, that certain kinds of ticks in that region were capable of carrying the often fatal relapsing fever. This is but one of a number of diseases carried by ticks and there was a time when ticks threatened to destroy the great cattle industry of Texas and adjacent states.

To understand why ticks can be such a menace and why they are, on the whole, increasing in America, it is necessary to know something about how they live and grow. There are many kinds of ticks and there is a great deal of variation in the way they live and develop. Some ticks, including those causing relapsing fever, lay only a few hundred eggs, but other kinds may lay as many as 40,000. Fortunately, those that are the greatest menace lay not more than 3000 or 4000, and of these only a small percentage can be expected to reach maturity. When an animal lays as many as 40,000 eggs, the chances are that only something like one in 15,000 will grow to maturity, since Nature provides a natural balance. No kind of animal is likely to show any permanent increase in numbers unless the normal conditions under which it lives have been changed. An increase in the number of animals upon which ticks feed will cause an increase.

Ticks have been increasing in the United States and Canada for two decades or more. However certain kinds have been reduced, owing to studies made by the Department of Agriculture and the application of specific control measures.

Most ticks require two or three

different kinds of hosts upon which to feed, and these hosts are usually of different sizes. Notable exceptions to this rule are the brown dog tick, the winter tick, the fowl tick, and the Texas fever tick. These can all develop to maturity on a single animal, and two of them (the fever tick and the winter tick) never leave the host once they become attached to it. They are therefore known as one-host ticks. Ticks that become attached to animals only twice are known as two-host ticks. The brown dog tick drops off the host after feeding, so it is either a three- or four-host tick, even though it can develop to maturity on a single dog. Other ticks, such as the Rocky Mountain spotted fever tick and the Eastern dog tick, require animals of different sizes in order to reach maturity and are usually three- or four-host ticks.

When the young of these latter ticks hatch they are smaller than the head of a pin and are known as "seed ticks." Although ticks are not insects, they have at this stage three pairs of legs, like insects. Since the eggs are laid in masses of a thousand or more, the young seed ticks scatter as much as possible over the soil and among the blades of grass and leaves of low plants. They crawl up on the foliage and await the coming of some small animal, usually a mouse or ground squirrel. If such an animal comes within reach of their clutching legs, they grasp it and quickly work their way through the fur to the skin. Once there, they immediately begin to bore through the skin with their specially adapted mouth parts. It may take them two to six days to obtain a full meal of blood, but when fully satiated they withdraw their mouth parts with apparent deliberation and satisfaction, and seek a place of quiet where the meal can be digested.

When the tick drops from its host it is several times larger than when it began to feed, and assimilation by the digestive system may take from a week to two or three months. Steady growth occurs as the meal is digested, and the "stomach" decreases in size while other parts of the body increase. Since the skeleton of a tick is on the outside, there must be some relief, and to relieve the pressure, a new skel-

eton, quite expandable, is formed within the old one. When the original skeleton becomes exceedingly tight, it splits open and the emancipated tick crawls laboriously out. There is much pulling and tugging, because it is not easy to withdraw the new and larger legs and body from the confines of a skeleton that has a very definite limit of expansion.

There is one marked difference between the seed tick and the creature that emerges from it. The seed tick had only three pairs of legs. The "new" creature has four pairs (like spiders), and is flattened and leathery instead of being full-bodied and fairly soft. It also has aspirations. It will no longer be satisfied with a blood meal from a small animal. If it can find nothing else, it may feed upon one, but this is rare. Almost always it will die of starvation after a few weeks or months if it cannot find a larger animal, depending upon the kind of tick.

The tick has now become a nymph, and it is no longer satisfied with its former outlook on life. It now seeks low herbs or long grass. Here it sits upon the top of its world, waiting for a rabbit or coyote, or some other animal neither too big nor too small. If a suitable victim comes along within a month or two, the nymph attaches itself and gets another meal. If no suitable host should come along, the tick dies of starvation, and this is what happens to 99 ticks out of 100.

Ticks shed their skins and become mature after varying intervals, depending upon the kind of tick and the availability of food. Some kinds become mature in less than two months, after shedding their skins only twice. Others require two or three years and may shed their skins five or six times. Among those that seek larger hosts after each moult, it is only the mature ones that attack man and large animals. Few kinds of ticks complete their life cycle on a single host, but a large proportion of those that do are a menace to animal welfare.

Back in the days when the West was in its infancy and great herds of cattle were raised on the lush grasslands that still supported innumerable bison, the cattle fever of Texas was well known. Large herds driven north from Texas in search of fresh

menace to animal life

THE TICK AND THE ANIMAL

By no means all of the many kinds of ticks are carriers of disease. But one of them that is and has received much study in this country is the Texas cattle fever tick (*Boophilus annulatus*). Around the turn of the century, herds driven northward to new pastures were spreading the disease each year over a larger area of the middle Southern States when remedial measures were undertaken. Control of this tick depends upon a complete understanding of the tick's life cycle, outlined in these pictures.

In the animal's blood, the parasite goes through a series of changes. The sick animal leaves the herd, stands with arched back and lowered head, and shows various systemic disturbances. Death rarely occurs, but the value of the animal is much reduced.

The only way that cattle become infected with Texas cattle fever is by having a tick whose salivary glands carry the protozoan parasite attach itself to the animal.



CHANGES OF PROTOZOAN IN COW'S BLOOD STREAM

ENLARGEMENT OF COW'S BLOOD STREAM



The protozoan parasite continues its life cycle in the blood stream of the cow. Then, when an uninfected tick bites the afflicted animal, the tick acquires the ability to transmit the disease to other cattle.

ENLARGEMENT OF COW'S BLOOD STREAM



CHANGES OF PROTOZOAN IN COW'S BLOOD STREAM

THE TICK AND THE PROTOZOAN



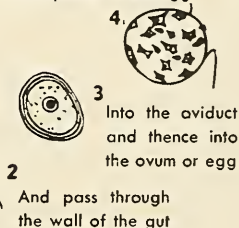
The tick that causes Texas cattle fever lays on the average 2,000 to 4,000 eggs. Some of the seed ticks that hatch from these in about 30 days, "inherit" the disease organism from their parent. How they do this is shown at right.

Other changes in the organism occur during development of the egg

And it lodges in the salivary gland of the seed tick



Thus the organism causing the disease is ready to infect a healthy cow as soon as the seed tick attaches itself for its first meal.



1 In the tick's digestive tract, two cells unite

2 And pass through the wall of the gut

3 Into the ovum and thence into the ovum or egg



pastures were known to carry the disease, and northern cattle that came in contact with them often contracted it. Each year the disease was carried northward with the migrating cattle, and each year the infected area spread over a larger part of the middle southern States.

In 1889 it was discovered that Texas cattle fever was carried by the cattle tick (*Boophilus annulatus*). Shortly after, the Bureau of Animal Industry began investigations to control the cattle tick. In 1906 this Bureau and the states concerned instituted a co-operative plan for tick control. After more than ten years of study it was found that ticks could be controlled by either of two methods: (1) by use of cattle dips, which would destroy the ticks, and (2) by a rotation of pasture lands. This latter method proved practicable because the seed ticks die in a little more than two months if they cannot find large animals, such as cattle, deer, sheep, or horses upon which to live. By employing five fields and moving the herd from one to another on certain dates it was found possible to clear all the fields of ticks in from two to eight months. Although this method alone would bring the desired results, most ranchers also drove their cattle and other domestic stock through specially prepared dipping yards at regular intervals.

In order that the program might prove completely successful, it was necessary to remove all deer from the areas undergoing treatment and to prevent further entry of deer. After the areas were freed of ticks, tick-free deer were again liberated in them.

Everyone co-operated — if not wholeheartedly, at least with good

grace—and the success of the program is evidenced by the fact that today cattle ticks have been eliminated from the United States.

Unfortunately, not all ticks are so easily destroyed. Up to the present, attempts to eliminate other kinds of ticks have met with little success, because their life cycles do not offer a vulnerable spot. The winter elk or horse tick (*Dermacentor albipictus*) could easily be controlled if it confined its attentions to domestic animals. But in addition to horses and cattle it attacks moose, elk, and deer. Its life cycle differs from that of most other ticks, because it develops during the winter months. Like other ticks, it lays its eggs in the spring and they hatch in about six weeks. Then, instead of going in search of an animal upon which to feed, the seed ticks bunch themselves closely together—1000 to 3000 of them in a mass—and wait until the first frosty days of autumn before they are ready to attack an unwary host that may come along. Once they find a suitable victim and attach themselves to it, they remain there until they are mature and find a suitable mate. Then the fertile females drop to the ground and find a protected place, such as a clump of grass or dried leaves, in which to pass the winter and begin the cycle all over again in the spring. The ticks remain on the animal for only six or seven weeks, so the poor victim has something to be thankful for by the time Christmas rolls around. But it may have provided meal tickets to several thousand of the bloodthirsty parasites.

The winter tick often occurs in such great numbers that it causes the death of animals. At least 20 per cent

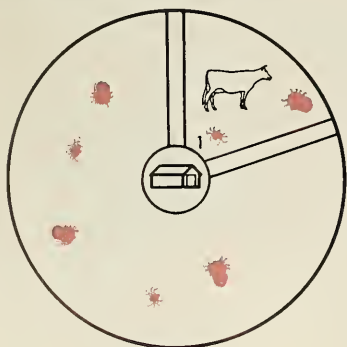
of the moose population of Nova Scotia was killed by it a few years ago. Animals attacked become weak and sickly, resulting in a condition that is known as "tick poverty." Domestic animals can be freed of the ticks by dipping them and then keeping them warm until they have become thoroughly dried, but there is no practical way to treat the wild animals that roam our northern woods and those of Canada. It would be of indirect help, however, to dip the domestic animals annually before stabling them for winter. The winter tick also carries a disease known as tick spirochaetosis, from one animal to another, and spread of this disease may cause further reduction in our game animals.

The poultry tick (*Argas persicus*) is a serious pest in many parts of the world. It attacks its victims from June to September and passes the winter as a fertile adult. When abundant it causes tick poverty among poultry, and in the case of heavy infestation, the loss of blood may cause death. Turkeys are especially subject to its attack. In other parts of the world this tick transmits avian spirochaetosis, but not in America.

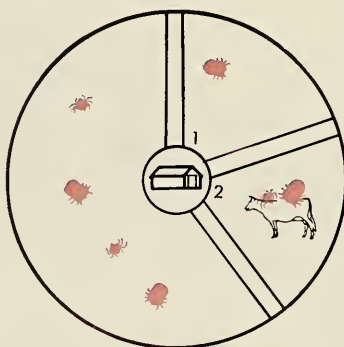
To control this pest, all roosts in the poultry house must be thoroughly soaked with kerosene, including every crack and crevice, every three or four weeks during the tick season. The birds themselves may be treated with an ointment made of kerosene, lard, and sulfur to prevent attack.

The spinose ear tick (*Ornithodoros megnini*) occurs in subtropical parts of the United States. It very commonly enters the ears of domestic animals and man, and causes deafness, serious illness, and even death, particularly when young animals are

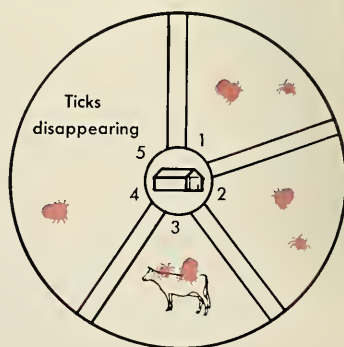
▼ AS SUMMER APPROACHES, entire pasture is found to contain ticks dangerous to cattle. Section 1 is therefore fenced off with double fencing 12 feet apart



▼ ON JUNE 1, the herd is moved to Field (2). Developing ticks are present in Fields (1) and (2) and attach themselves to cattle



▼ ON SEPTEMBER 1, the herd is moved to Field (3). In Fields (4) and (5), most of the ticks have died for lack of a host, without laying eggs



attacked. To destroy this tick, a mixture of one part of cottonseed oil and two parts of pine tar oil is injected into the ear, at a temperature slightly above that of the victim.

Although the ticks described above may affect our economy most seriously, dog ticks are the ones that come most commonly to our attention. There are two kinds, the eastern dog tick (*Dermacentor variabilis*), which occurs east of the Rocky Mountains, and the brown dog tick (*Rhipicephalus sanguineus*), which is known from the Atlantic coast regions and the eastern southern States, and has now become established in numerous northern cities. Both are common in the regions where they occur, and their numbers seem to be increasing each year.

The eastern dog tick is the one usually found on dogs that are allowed to run through long grass, weeds, and shrubbery. In its early stages it is found on mice, squirrels, rabbits, and other rodents. The adults attack a great many kinds of animals, from the size of dogs to deer and moose.

The brown dog tick was probably introduced from the Old World on dogs or cattle, and until a few years ago it was known only from tropical and subtropical regions in America. It is now extremely common in the New York region and is the cause of almost all the complaints in the Metropolitan area and Long Island. Since this tick is able to develop from seed tick to adult upon dogs alone, it is the one commonly found in dog kennels. When heavily infested, the dog becomes lethargic, and its coat loses its gloss. Dogs removed from infested kennels usually carry hundreds of seed ticks with them. When these drop off after completing their meal, they

may cause considerable alarm, but very few of them reach maturity. They disappear into cracks and crevices in order to digest their meal and moult, and only a small percentage are able to locate the dog again. Those that do, usually attach themselves around the ears and between the toes. The adults will also attack man, and they are capable of carrying Rocky Mountain spotted fever. In removing ticks, tweezers should be used, rather than the bare fingers.

Elimination of ticks in kennels and homes is not difficult if a proper routine is followed. Since the seed ticks and nymphs remain attached to the animal for five or more days, it is possible to eliminate the ticks by employing a dipping schedule for all pets every two weeks. Ordinarily an infestation can be cleaned up in less than two months. It is good practice to dip all dogs before they leave the kennel. Similarly, when a kennel has been cleaned up, all dogs brought to it for any reason should be dipped. The dip is allowed to dry on the dogs, and it prevents re-infestation for a week or ten days.

When a large number of dogs must be treated, a vat large enough to hold sufficient material to completely cover the largest dog may be used. In the home, a boiler or tub may be employed.

The following formula and procedure has proved effective in the New York area in keeping dogs free from ticks and fleas.

Sodium bicarbonate	2¼ pounds
Arsenic trioxide (white arsenic)	6 ounces
Pine tar oil	½ pint
Water	50 gallons

Dissolve the Sodium bicarbonate in one gallon of water and mix in the white arsenic. Add the pine tar oil and agitate until thoroughly mixed. This concentrate may now be placed in quart jars to be used as needed. One quart of it will make 12 or 13 gallons of dip. This dip will retain its strength and may be used several times if the container is covered and if sufficient water is added each time to make up for evaporation.

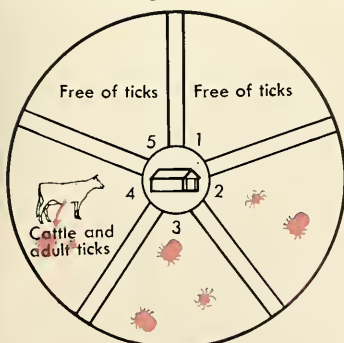
It requires only a minute or two to completely soak a dog. Care must be taken to see that the head becomes thoroughly wet by pushing it under the liquid two or three times. At the dilution recommended there is no danger to dogs, cats, rabbits, or other pets. However, the arsenical used is a dangerous poison, and the concentrate is highly poisonous. It should be so marked and placed in an absolutely safe place out of reach of children.

In using this dip or any of the commercial tick dips, it must be remembered that the solution must be allowed to dry on the animal, and the treatment must be continued until all trace of infestation disappears. During the warm months if a dog is allowed to run in the open, it is excellent practice to dip it every two weeks. When pets are bathed or allowed to swim, the protection provided by the dip is lost.

The presence of one or two ticks on a dog or cat is no cause for alarm. But large numbers may be present without any indication, because the ticks do not cause irritation while feeding. Dog owners may therefore be comforted to know that they can be quickly eliminated by these methods.

Certain other aspects of ticks and human welfare will be discussed in the next issue of NATURAL HISTORY Magazine.

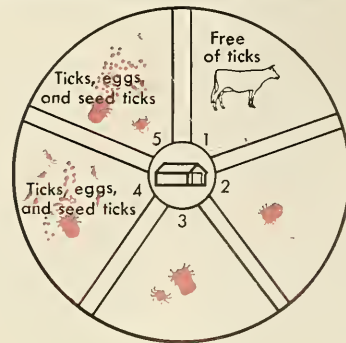
▼ ON SEPTEMBER 20, the cattle have been in Field (3) 20 days and are moved to Field (4), where ticks have died for lack of a host. Ticks on cattle drop off to lay eggs



▼ ON OCTOBER 10, the herd is moved into Field (5), which is free of ticks. Cattle are left there 20 days until remaining ticks have dropped off to lay eggs



▼ ON NOVEMBER 1, the cattle are free of ticks and can safely be moved back into Field (1). Field (2) will be free by July 1 the following year, and others in rotation. Tick's life cycle varies with climate, and this diagram is somewhat generalized; but with minor adjustments the procedure is successful



The Netherlands East Indies — ISLANDS OF THE PAST

A Photographic Series by HORACE BRISTOL

From Three Lions

Today the Netherlands East Indies, constantly in the news, are very much in the present—yet the customs and economy of their people reveal an elaborate ancient culture that has resisted centuries of turbulent change throughout the rest of the world. Few influences of modern civilization have intruded—present-day curiosities among the ancient and eternal rice terraces that grace the land like giant stairways from the valleys to the sky





▲ AN AERIAL VIEW of West Java, showing rice fields and hamlets near Limbangan

◀ RICE TERRACES of West Java. A hamlet lies among the trees in the curve of the railroad track

RICE is the great staple fruit of the East Indies. Its cultivation seems to have originated in China, where it goes back to the late Stone Age. Remnants of rice have been found in neolithic pottery in China, dating probably from the end of the third millennium B.C. There are good reasons to assume that the ancestors of the Malayo-Polynesian peoples brought the art of rice cultivation with them when they invaded the East Indies Archipelago from the mainland of Asia in the third or second millennium B.C.

Rice is grown either in dry fields planted in clearings in the woods, or in flooded fields (*savahs*). The latter system prevails in Java and Bali. Sometimes whole hillsides are converted into terraced and irrigated fields. The water is often brought by channels from considerable distances. Its proper distribution among the individual farmers, as regulated by customary law, is one of the chief tasks of village councils and village officials.

◀ FIRST STAGE in the planting of rice in central Java: plowing the field with oxen



▼ THE RICE PLANTS are first grown in seed beds and later transferred to the *savabs*. The Javanese woman shown here is engaged in this work. As can be seen, the rice terraces are in various stages of growth





▲ RICE FIELDS IN JAVA. The men working in the fields wear bamboo hats known as *chapil*. Both men and women carry small knives, called *ani ani*, with which each stalk of rice is cut individually

► A YOUNG BALI-NESE GIRL, probably tending the ducks in the upper right-hand corner. In the back-ground is a wet rice field



◀ TYPICAL RICE TER-RACES in East Java. On the top of the moun-tain, corn has been planted. The trees in the background are cocoanut palm, betel nut, and sugar palm. Bananas and mangoes are growing in the foreground



▼ HARVESTING RICE. This is the traditional way of bundling the rice and carrying it in. In the right background is seen a small watchhouse, or *gubug*

▼ AFTER being carried in from the field, the rice is put in tall stacks, built up around a wooden base. A scene in the northern part of West Java





▲ A CLOSER VIEW of the huge rice stacks shows their nice symmetry. In the background is a rice mill



▲ POLISHING rice in the *gubug*, or watchhouse. Women pound rice stalks in hollow wooden blocks, using large wooden pestles. The chaff is fed to fishes that are bred in the flooded rice fields as a secondary crop

◀ RICE SHEAVES in West Java. The fields are privately owned, and women as well as men work in them. This Javanese woman is wearing a batik skirt and a printed cotton blouse. Batik is a form of dyeing in which all parts of the cloth that are not to be dyed are covered with melted wax. The cloth is then dyed and put into boiling water to wash out the wax

▼ SORTING rice in West Java: an occupation in which the entire family is sometimes engaged. Rice is grown throughout the island





◀ A FRUIT VENDOR in West Java, with his baskets of bananas, avocados, and tomatoes, which he carries on the long pole. Each day he serves his regular clientele. The cook is making her selection

▼ BALINESE GIRLS. The ear-lobes are pierced in infancy and the holes gradually enlarged. Usually the ear-plugs are rolls of *lontar* (dried palm leaves), as in this photograph. More rarely bamboo ear-plugs are used. On festive occasions they are replaced by cylinders of beaten gold



▼ WHITE WATER BUFFALO in Java. Favorite sport of small boys in Java is to herd water buffaloes and ride on their backs, playing flutes. In the rear are cocoanut trees



▼ A BALINESE MOTHER dressing her daughter's hair. The ear plug is of bamboo in this instance.





▲ BALINESE GIRLS between the ages of 8 and 15 preparing themselves for a festival

▼ A PURA, OR TEMPLE, on Bali. Corn can be seen growing in the yard at the left. In the background is a minor temple





▲ BEGINNING OF THE "KECHAK," sometimes called the "monkey dance drama," in front of a Balinese temple. The dance is performed solely by men and normally by night in the flickering light of a lamp, which is in the center of the circles of crouching dancers. The Kechak takes its story from the Hindu epic Ramayana. Sita, the wife of the hero Rama, has been abducted by the demon king Ravana. The monkeys help Rama to invade the demon island and to recover Sita. The Kechak dance represents in a rather vague way some of the battle scenes in the war between the monkey armies and the demons. Originally it may have been developed as a rite intended to exorcise and drive away evil spirits



▲ A TEACHER in Bali instructing a young boy in the Kebyar dance. The word "kebyar" means to burst or explode: the bursting open of a flower. The Kebyar was developed by the famous Balinese dancer Mario less than 30 years ago. It is performed in a sitting position. The musicians on the left are playing the *reyong*, an instrument consisting of a set of gongs, while the musician on the right is playing the *cheng-cheng*, a kind of cymbal

THE Balinese are the only people in the East Indies Archipelago who have retained the Hindu religion, which in the other islands has long since succumbed to Islam. The Hindu religion and the caste system were introduced into Bali during the first centuries of our era, possibly directly from India, and later were reinforced and modified by influences and immigrants from Hinduized Java.

Balinese Hinduism is strongly



mixed with old indigenous elements, animism, ancestor worship, the cult of minor local godlings, etc. The number of temples is very large. The one illustrated on page 225 is a modest village temple. It contains a *meru*, a pagoda-like tower with tiered roofs covered with palm fibers. Its name, as well as its form, implies that it is a symbol of Mount Meru, the mountain that according to Hindu cosmology rises in the center of the earth and bears on its summit the abode of

the gods. A *meru* contains no idols. In accordance with its symbolic meaning, the gods are supposed to dwell on its summit. They are represented by nine precious stones which are placed in a cavity at the top of the central pillar supporting its roof: one in the middle, for the highest god, Shiva, and the other eight surrounding it and corresponding to the eight gods believed to rule over the eight main directions of the world.

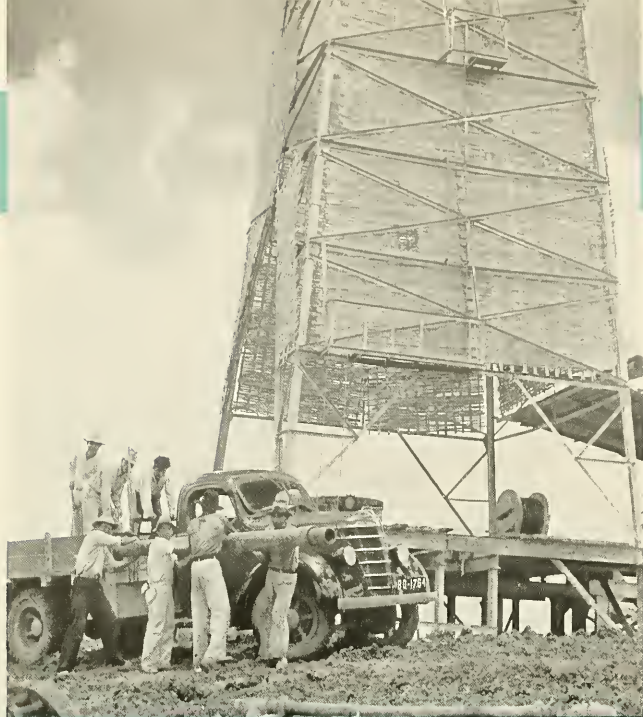
The gate giving access to the court-

yard resembles a tower split in two halves and pushed apart. This gate, too, is mostly explained as a symbol of the cosmic mountain. According to Balinese legend, God Shiva transferred Mount Meru to Bali, at the same time splitting it in two and setting the two halves down as the island's highest peaks, Gunung Batur and Gunung Agung.

The minor temple in the background of the photograph on page 225 lacks the *meru* but has a "split gate."



MUSICAL ACCOMPANIMENT to the Javanese "fighting" dance, consisting of two gongs and a *kendang*, a wooden drum covered with leather at both ends and tapped with the hands



▲ OIL DERRICK in Sumatra. The derrick is made of bamboo, and the small cage projecting from the upper front is known as the *gedek*

▼ OIL REFINERY at Palembang, Sumatra, near the Moesi River



▼ A RUBBER PLANTATION in Java. In the lower front are the workers' homes, to the right of which are the small plots of cultivated land used by the rubber workers. Beyond is the administration building





▼ **TAPIOCA AND STARCH FACTORY** owned by Chinese in West Java, near Pedalarang, on the road to Batavia. The white areas are the cassava (starch) plants drying, and the dark, dotted areas are the growing plants. In the foreground are wet rice fields. A water reservoir is visible in the background



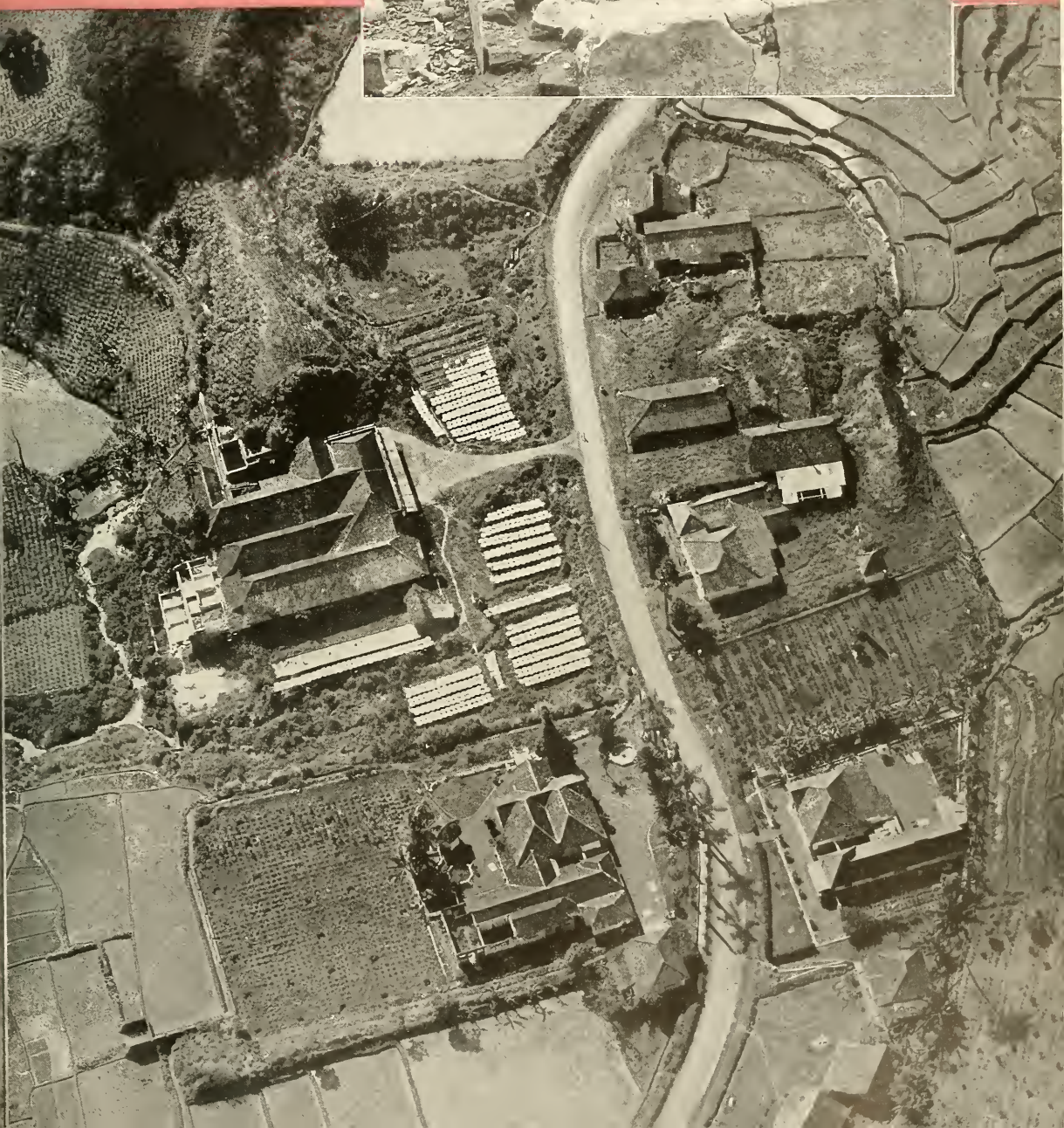
▲ **SHEETS OF CRUDE RUBBER** being stretched in a small rubber factory in Java. Both men and women are employed

▼ **CINCHONA TREES** in West Java. The native is cutting selected trees down at the roots. The bark is then peeled, and quinine is made from it



► **COCONUT FACTORY** in Java. The coconuts are first cracked across the shell, then the meat is cut out and dried to copra, from which coconut oil is extracted. The wooden and glass frames seen in the rear and along the sides are the drying frames, upon which the coconuts are placed at night when they are taken inside the factory.

Thus do the customs of a rich and colorful culture blend with modern ways in a region whose future is being strongly molded by the rapid flow of current events



ARE YOU AFRAID OF SNAKES?

By WILLIAM CARR

Director of the Bear Mountain Trailside Museums and
Associate Curator, The American Museum of Natural History

WE were seated at luncheon, with a group of newspaper people, in the Bear Mountain Inn, overlooking the Hudson River. Somehow or other the conversation swung around to snakes, no particular snake, just snakes.

A reporter from the *New York Times* told the story of a small, persistently struggling snake caught in a spider's web, a story that had appeared in virtually every newspaper in the land a short time before. Photographs of the web, the snake, and the spider had been published in Europe and in far-off Australia.

A man from the *Herald Tribune* said that his paper had received so many letters of inquiry regarding the authenticity of the account that news bulletins were published day by day. The Association for the Prevention of Cruelty to Animals finally ended the story by removing the unhappy snake from the web. He remarked, "People are certainly interested in anything that has to do with snakes."

The *World-Telegram* spoke up "People may be interested, right enough; still they don't like snakes."

We inquired of the *New York Sun* representative whether or not she liked snakes. She answered, somewhat peevishly, "No, as a matter of fact, I despise them. Is it necessary to care for them whether you want to or not?"

"Of course, it's not necessary!"

"Well then, why is it always said, 'Really now, you should overcome your fears, it will be good for you.' As a matter of fact, I believe that people who profess to like snakes are abnormal! And while we're at it, I think you should know that I really don't fear snakes. I simply dislike them!"

"I'll wager you visit the snake house in the Zoo just the same," laughed the *Herald Tribune*.

The *Sun* admitted that she did and also conceded that snakes were often beautifully colored.

The *Times*, amused by this, was of the opinion that people who abhorred everything concerning snakes frequently visited snake houses regard-

Like the newspaper reporters who took time out in this article to ask some basic questions, you may find that, though you don't have to learn to love the lowly snake, he isn't such a bad fellow, after all

less. He believed that some persons enjoyed shuddering.

"Many people shudder because they think it is the 'thing to do,'" said the *Tribune*, cynically.

The *Associated Press*, quiet until now, put down his soup spoon. "I can trace my dislike for snakes back to the time when I was a little boy playing in a hay field up in northern New York. I'll never forget the terrible experience of having a defunct Garter Snake tossed at me by a farmer, raking near-by, who had just killed it. You couldn't get me near one of those things after that."

The *United Press* failed to see anything abnormal about people who were interested in snake habits or who handled snakes. He thought that small boys who carried snakes in their pockets were as "normal" as could be.

The *Sun* had an answer, as usual. "I suppose you were one of the aforementioned 'small boys' who endeavored to frighten the teacher to death by bringing snakes into the classroom. Now confess, weren't you?"

"Well, what of it!" admitted *United Press*. "What if I did? Was that so much out of the ordinary?"

"No, not at all, but just because you don't happen to dislike snakes, please don't lose sight of the fact that others do!"

"I was fully aware of that fact! Why do you think I brought them to school!"

"One of the most unfortunate things one may do is to force a snake upon someone unexpectedly or against

their wishes," we said, "especially if you are trying to help them overcome a fear of reptiles."

"Oh! So you're one of those people who try to make people like snakes whether they want to or not!" said the *Sun* witheringly.

"Absolutely not!" we returned with what we hoped was sufficient indignation to overshadow the wither.

"We are just here, and so are the snakes, that is all. When visitors come to us and exhibit interest, we merely like to assist them in any way possible. We have a large snake pit near the Bear Mountain Trailside Museums, a ten-minute walk from where we are now seated."

"I suppose you go forward with the idea that a little genuine information may aid people whose fear is largely the result of wrong impressions," said the *Times* understandingly.

"Exactly!"

"Lack of information isn't the only thing that is responsible for snake fear," said the *Sun*, persistently.

"We are well aware of that," we replied. "Nevertheless, when a visitor to our Zoo tells us that one of the principal reasons she dreads snakes is because she believes them to be slimy, we think that the very simple expedient of convincing her that they are not slimy is decidedly worthwhile."

"Then what?" inquired the *Sun*, a newspaper woman to the core.

"Well, after that we encourage the new recruit to hold a snake so that she may discover at first-hand

exactly how it 'feels.' Mind you, we suggest this idea. We don't force it."

"I should hope not! How many converts do you make?"

"About eighty per cent."

"I don't believe it!"

"You really don't have to, you know. You're nothing if not frank."

"I am surprised, that is all!"

"So were we when we commenced this type of work."

"Are you more successful with men or with women?" asked the *Tribune*.

"Women are by far the most easily convinced."

Disbelief once more crossed the face of the *Sun*, but she remained silent.

"You have only told us a slight bit about your methods of introducing snakes to people. What is the

whole procedure?" asked the *World-Telegram*. "You probably couldn't convince me anyway, but let's hear it!"

We explained, to begin with, that all of our staff who lecture about snakes, know beforehand that there are about twelve questions that the average visitor is apt to ask in relation to the snake exhibit. We added that as a consequence of this, when a crowd has assembled at the pit, the man in charge gives a preliminary talk during which he includes the points already on people's tongues.

"Don't you take quite a lot for granted?" asked the *Sun*.

"No, experience has proved that we do not."

"What are your twelve points?"

"The absence of slime is one, and

the difference between poisonous and harmless snakes is another."

"Somebody tried to tell me that all snakes are venomous in one degree or another," said the *Herald Tribune*.

"Even I know better than that!" said the *Sun*.

"Good!" returned the *Tribune*.

"There are only two poisonous snakes here in the Northeast, the Rattlesnake and the Copperhead. All the rest are harmless."

"I'll wager you have that on a label near your snake pit," laughed the *Sun*.

"You win the wager," said the *Associated Press*. "I saw the sign there myself! By the way, how do you tell a poisonous snake from a harmless one?"

"In this section of the country, the two poisonous snakes we mentioned are known as 'pit vipers.' This is due to the presence of a small depression or 'pit' between the nostril and the eye. Also, the Copperhead and the Rattlesnake both have elliptical eye pupils. In other sections, you have to look out for some other kinds of snakes."

"That's fine," said the *Sun*, "but how often does a person come close enough to a snake to look into its eyes and examine its pupils? If I saw a Rattlesnake, how would I know it?"

"It might help if you would stop, look, and listen for the rattles!" suggested the *World-Telegram*. After all, Rattlesnakes do have rattles, I suppose!"

"How about Copperheads though," asked the *Sun*, no whit abashed. "I've heard that you can identify them by the 'cucumber smell,' but suppose the wind is blowing in the opposite direction?"

"It doesn't make the slightest difference which way the wind is blowing. There is no 'cucumber' odor anyway! The best system is to learn to know the Copperheads' markings or color patterns. The colors vary, by the way, from browns all the way through to copper and amber. However, there is an 'hour glass' pattern on the snake's body that once well observed, is not easily forgotten. Also the snake's body is usually rather large in relation to its length. The tail is short and thick."

"Is it true that you can always know a poisonous snake by the 'diamond shape' or 'triangular shape' of its head?" asked the *Tribune*.

Photo by Frederick Poestoke



"No indeed. Many perfectly harmless snakes have a so-called 'triangular shape'! The harmless hog-nosed snake and the equally non-poisonous common water snake are two examples. You cannot consider the shape of a snake's head as a criterion to its being poisonous or non-poisonous."

We further explained that there were poisonous snakes that lacked 'triangular' shaped heads, for example, the Coral Snake of the far South.

"How about snakes jumping up and biting your hand?" asked the *Sun*.

We answered this by telling that the question of snakes' aggressiveness or lack of aggression usually came second or third on our list of twelve. We added that as far as we knew, there was no local snake that would jump up and bite.

In the first place, the reptile finds it necessary to keep a good portion of its body on the ground when it strikes, and secondly, none of our local snakes go out of their way to make trouble. Their principal aim seems to be to escape detection and avoid danger. When cornered, some of them will do battle, but when unmolested they behave in a most exemplary fashion where human beings are concerned.

"Don't tell us that you are one of these fanatics who think that snakes should not be killed!" exclaimed the *Sun*.

"Harmless snakes should most certainly not be killed, fanatic or no fanatic. It is a matter of common sense."

"I didn't believe any mind could be so warped!" mourned the *Sun*. "Honestly now, is there any legitimate reason why snakes should not be killed? If I were crossing a field and were to come upon a Garter Snake in my path, would it not be the right thing to pick up a stick and destroy the snake once and for all? I've often done it! Don't try to tell me that I should leave the snake alone simply because its ancestors traveled the earth long before mine did, or that it has as much 'right' to life as I have!"

"There are more reasons than that. The truth is that snakes have their own economic value. They really 'belong' in the scheme of things and should no more be exterminated than should hawks or owls, for instance."

"I thought hawks and owls were

considered harmful and that they should be killed off," said the *United Press*.

"Confound it! That's what really makes us angry! Why is it that people who should know better take it upon themselves to sit in judgment upon various species of animals, simply because they have 'heard so and so'? When man takes over a section of woodland for a park or for other 'game protective' purposes, he only too often feels that he must 'help out' the creatures he likes best by slaughtering their supposed enemies.

"Furthermore, if you fellows would publish a few pictures of snakes once in a while, it would help to dispel a lot of needless fear. You refuse to have anything to do with a snake story, and as a result we have the same erroneous superstitions about snakes that we did generations ago. It's positively medieval . . ."

"Gather around boys, we've got him going," laughed the *World-Telegram*.

"Why can't things be left as they are—snakes, hawks, foxes—they all contribute definitely to the balance by naturally reducing species that might become too prolific. They feed upon mice, small birds and many other creatures, and, on occasion, upon each other. We really do not know exactly how much good or harm they do. However, there are so many reasons for not molesting them that the arms manufacturers' plea for bigger and better extermination would be rather pathetic were it not for the tragedy of the thing. We could talk for hours about this."

"I could believe that!" said the *Sun*, "but how about your snakes?"

"I suppose that people ask many questions about the snakes' inner workings," said the *Times*.

"Yes, they do. You would be amazed to know how many visitors seem to regard a snake as a sort of tube or hose without any notion whatever of inner organs! When we tell people that snakes have lungs, hearts, stomachs, slender ribs, and a backbone, we often hear comments such as these: 'Oh! I thought snakes only had stomachs!' 'I didn't know snakes breathed,' or 'I didn't know snakes were delicate!'"

"There is nothing startling about that," said the *Sun*. "I told you before that you take too much for granted about your visitors. Why should you expect your onlookers to

be well versed as to a snake's anatomy?"

"We would at least think that our visitors would know that a snake breathed!"

"You're wrong."

"I can see that."

"You should have discovered it long ago!"

"What about this 'living until sundown' business?" asked the *Times*. "Is there any truth in the story that if a snake's head is removed, the body will survive until dark? I know it sounds like a stupid question, but I've heard it often."

"I'm surprised at you!" said the *Sun* scornfully, "and you from the *Times*, at that!"

"Then it isn't at all true?" persisted the *Times*, with less confidence.

"Of course not! They wiggle for a time, but that's only because their muscles and things are contracting," offered the *Sun* condescendingly.

"I can see that you have been hiding your knowledge under a bushel basket," said the *Times*.

"Just an egg crate," returned the *Sun*.

"And then there is the one about snakes being frightened of horse-hair ropes," said the *Associated Press*. "I've frequently heard that cowboys, preparatory to sleeping on the ground in Rattlesnake country, will take care to place a horse-hair rope on the earth around their bed, the belief being that no snake will cross the magic circle. Naturally, I don't suppose this is true, but is it?"

"The answer, again, is no!"

"I guess it's equally untrue about a snake's ability to charm people," said the *Associated Press*.

"Some folks are easily charmed!" remarked the *Sun*.

"That was not intended as a facetious question."

"I'm glad to hear it!"

We took advantage of this lapse to secure a mouthful of food and then told the *Associated Press* that according to our observations, it was quite impossible for a snake to charm a person even if the reptile so desired.

"How can you tell whether or not a snake desires something?" asked the *Sun*.

We let this pass and settled down to enjoy our lunch. We had learned, long since, that snake questions, once well under way, may flow on and on for hours, and we were really hungry!

The End

YOUR NEW BOOKS

Continued from page 197

its rocks are sandstone and quartz. A ship's sails are not "reefed" as she comes into port, nor should speed be reported as "six knots the hour."

Such slips hardly affect the over-all picture, which is eminently entertaining as well as illuminating. Dr. von Hagen has a vigorous pen, lively imaginative power, and a feeling for drama. No other source, unless it be the voluminous writings of the subjects themselves, reveals more convincingly the "divine afflatus" that drove the pioneers of science through years of toil, peril, and suffering in a wilderness. Furthermore, while we usually think of Dr. von Hagen's heroes as elderly or old men (Humboldt lived to be 90), the author reveals them in all the hope and joy of their youth.

R. C. M.

HIAWATHA

with its Original Indian Legends

- - - - by Chase S. Osborn and
Stellanova Osborn

Jaques Cattell Press, \$2.50
235 pages, 10 plates

THIS edition of *The Song of Hiawatha with its Original Indian Legends* is presented as an abridgment of the 700-page *Schoolcraft-Longfellow-Hiawatha*, a joint production of the same editors. The senior editor is a former governor of the State of Michigan, the Lake Superior region being the "Hiawatha Country;" the junior author,—for they are more than editors,—is his daughter. The introduction was written by Justice Frank Murphy of the Supreme Court of the United States, also a native of Michigan.

The earlier book, we are told, "included an exhaustive final refutation of the theory that Longfellow used the Finnish *Kalevala* as his source for the Hiawatha story rather than the Indian legends as recorded by Henry Rowe Schoolcraft." It is difficult to understand how it can be more of a "plagiarism libel," as the authors call it, to claim that Longfellow got his material from the *Kalevala* than to state, as the authors admit, that he got

it from the writings of Schoolcraft. In either case it would hardly be plagiarism.

Whether or not the *Kalevala* was to any extent the source of Longfellow's *Song of Hiawatha*, one cannot read the former without being overwhelmed with the conviction that here is where our American poet in all probability got his meter and the form of his poem, some of the lines being almost identical. The *Kalevala* was first published in 1835, antedating the *Song of Hiawatha* by 20 years.

It was a happy thought to include in one volume, as has been well done here, the full text of Longfellow's poem, together with parallel-passage inserts from the legends of Schoolcraft. In addition there are three essays, namely, "The Hiawatha Country," "Hiawatha's People," and "The Genealogy of Hiawatha." The writing of these introductory essays is rather journalese, with many statements that verge on exaggeration. In "The Hiawatha Country," we are told that "the grandeurs of the Lake Superior region are unsurpassable;" that "the air is the clearest and most vitalizing on earth;" that "before the white men came, with pork and whisky poisoning, there were no such things as syphilis, cancer, and tuberculosis known among the Indians." It is probably impossible to prove or disprove this statement concerning cancer and tuberculosis, but, based on osteological as well as historical evidence, it is commonly believed by physical anthropologists that syphilis was here before the white man came.

In their foreword the authors say that Longfellow drew the bulk of his material from the works of Schoolcraft; and in the essay on "The Hiawatha Country," they state: "Then Henry Wadsworth Longfellow created *Hiawatha*, a diadem of literature, from the jewels that Henry Rowe Schoolcraft discovered on the shores of Lake Superior."

CLYDE FISHER.

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WILL YOUR GARDEN PHOTOGRAPH?

By THANE L. BIERWERT

*Acting Chief, Division of Photography,
American Museum of Natural History*

START your gardening this year by using your camera as diligently as you use your trowel. Visualize your garden photographically. Some views will have pictorial possibilities, others will lack interest or composition. When you have taken the pictures and studied the prints or projected slides, you will see details that have escaped notice because they were lost in the garden as a whole. Rearranging a flower border, moving a shrub, or placing more plants in a certain area may be just what is needed to improve the general appearance of the yard. Next year, when spring comes, your garden will blossom better than ever before.

Garden photography is primarily record-photography, and the results will be filed in one of several categories. We can group the prints or slides as records of plant growth during the season, as a progress series showing the stages of improvement in the attractiveness of the garden over a period of years, or to illustrate new ways of working in the garden. Visits to other gardens will provide an inspirational pictorial collection of new ideas. We do not need fancy or expensive equipment. A box camera with a chair as tripod will do. We need only an interest in our garden and a desire to have a good looking one.

If we do not use color film, we shall want panchromatic, so that every color, including red, will reproduce in its proper shade of gray. A filter is not necessary; 99% of the pictures can be made satisfactorily without one when using panchromatic film. Some sort of tripod is needed to hold the camera while we patiently wait for the breezes to subside. A cable release to trip the shutter without shaking the camera is helpful. Gather together your close-up attachments or the

telephoto lens if you have one. Last and most important, keep a critical eye that will select the proper viewpoint for each photograph. It might be wise to carry along a trowel just in case a bit of transplanting will help the composition.

Now that we are equipped, let us wander into the garden. This one has a small lawn surrounded by colorful flower beds, with a tree here and there and a refreshing pool nestling at the base of a rock garden. Narrow paths guide us from house to garage, and chairs are grouped under the trees. The ever-present telephone poles and garage offer a familiar problem. Out of this mixture, we wish to picture the restfulness and peace that the garden typifies.

Fortunately, the day is slightly hazy, with soft, transparent, well-illuminated shadows. It is immaterial if the sky is not blue; we are gardening today, not shooting special effects.

For general views, a position along the pathway from the house to the garage, at a point where the garage will be outside the picture, is good. We are near a gnarled apple tree that casts a broad shadow that forms an excellent base for the picture and informs us that coolness is found on this side of the garden. Across the path from the tree is a bench, an inviting place to sit and read. Beyond is a sunlit section of the garden. This creates distance because of the change in tone and color. We stop the lens down to a small diaphragm, f32, and give the correct exposure for that aperture. Everything in the picture must be sharp; hence the small aperture.

Now turn around and photograph toward the house. We'll have to move down the path into the sunlit area. As a foundation for this view, include in the foreground some of the dark plant masses. We can use the tree shadow again to create separation of planes. Since it should not dominate the scene,

SPRING EXHIBIT ON BIRDS

The dove that Noah sent out to see if the waters had subsided, the wandering albatross, Long John Silver's parrot, the ugly duckling who became a swan, and the bird on Nellie's hat are only a few of the scores of birds famous in literature and music that are featured in a new spring exhibit, "Birds from Noah to Now," open to the public at the American Museum of Natural History.

As early as 50 B.C. the common sparrow inspired the Roman poet, Catullus, to write "On the Death of Lesbia's Sparrow." Ever since, birds have played prominent parts in fables, verse, and prose, and many of these famous birds in literature and legend can be seen in the current exhibit located in Roosevelt

Memorial Hall. The exhibit will also contain examples showing the influence of birds in music. Rimsky-Korsakoff's opera "Coeq d'or" celebrates the adventures of a rooster, and in the "Mikado," Gilbert and Sullivan immortalized the small Tom-Tit by means of Coco's comical-doleful song of Tit Willow.

An appropriate gesture to spring, "The Bird on Nellie's Hat," is illustrated by an Easter Bonnet of 1903, a concoction of biscuit-colored straw, brown ribbons, and sweeping plumes weighing more than three pounds. Another popular song of the early part of the century is depicted by a small, sad goldfinch perched in a gilded cage.

The exhibit will be on view through May.

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we shall screen the house behind the tree. For both of these pictures, it is imperative that the yard furniture be artistically arranged or removed entirely.

Little things like dead branches or weeds that may not be noticed in daily life are all too evident in a large print or when the slide is viewed from the screen. We can readily make our garden look better than it actually is, because we can hide the undesirable elements and clean up the grounds as we go along.

If we are photographing across sloping lawns, the camera should be looking uphill to give height to the composition. Paths will sweep more gracefully; trees and shrubs will stand straighter and higher. Rock gardens, too, are photographed best from the lower side because then we can see the ledges and look into crevices where plants are nestling.

Small vistas in the garden should not be neglected—sections that may not figure in the bolder composition of broader views.

For close-ups, the technique is similar to that for wild flowers. Fill the picture area with the flower or plant. Photograph from near "plant eye level" where possible. This angle of the view shows the stem and the surrounding verdure to better advantage. If the camera is pointed down at the plant, it is fore-shortened. Natural backgrounds are preferred. To darken a sunlit area, cast a shadow wherever you need it. There should be no doubt as to the best hour in your own back yard. You will soon know the precise minute when each plant looks best.

Close-ups are the accent or spice of a garden series. The soft, subtle views that blend are much more fascinating. It is the flower that fills the picture that is remembered, not the screaming colors. As soon as a gardener sees a strong color clash in a color film he will do a bit of transplanting. Only perfect specimens should be used. It will be necessary to photograph before the insects and the wind and rain have had a chance to damage the flowers. In making a sequence of pictures of one subject, take each photograph from the same spot. Drive a stake in the ground as a marker. If each exposure embraces the same area and is illuminated from the same angle, the plant will not appear to jump around but will gradually grow in one place.

The greatest pleasure of garden photography is visiting other gardens. Neighbors are always honored when someone shows an interest. If you belong to a garden club and have successful results with your photography, you should show your pictures to the members. Both your photographic and gardening knowledge will grow, and you will soon know how to protect tulips from mice as well as how to make the strong colors register in all their glory on color film or as subtle shades of grays.

If readers of NATURAL HISTORY have specific questions regarding photography in the realm of natural history or science, we shall be glad to try to answer them.—ED.



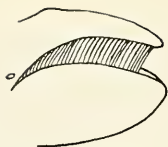
▲ FLOWERS and bushes make a rich and appealing foreground, while just enough of the house appears to stabilize the background. The combination of trees, bench, and angular pathway offers an interesting picture, and the alternating planes of light and shadow add variety to the composition



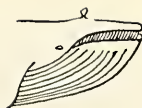
▲ WHEN PHOTOGRAPHING a sloping lawn or rock garden, a better effect will be obtained if the camera is looking uphill. This imparts height and makes the various levels of vegetation more easily distinguishable



➤ A PATHWAY, the cool shade of a large tree, and some attractively arranged lawn furniture provide an inviting scene. The patch of sunlight in the background relieves the composition and gives greater distance to the picture



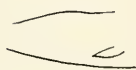
1. WHALEBONE IN THE MOUTH
(Right Whales)



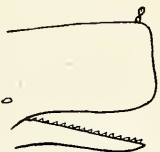
8. THROAT WITH FOLDS
(Finback and Rorquals)



2. TEETH IN BOTH JAWS
(Certain Porpoises
and Dolphins)



9. BACK WITH A HUMP
(White Whales and
other species)



3. TEETH IN LOWER JAW
ONLY, BUT MORE THAN
TWO OR FOUR
(Sperm Whales)



10. BACK WITH A FIN
(Certain Porpoises
and some whales)



4. TEETH, ONLY TWO OR
FOUR, AT THE END OF
THE LOWER JAW
(Bottle-nose Whales
and other species)



11. BACK SMOOTH
(Right Whales)



5. TEETH, ONLY TWO OR
FOUR, IN THE SIDE OF
THE LOWER JAW
(Beaked Whales)



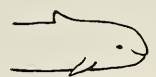
12. HEAD ROUNDED
(White Whale, Grampus
and others)



6. NO TEETH NOR WHALE-
BONE IN THE JAWS
(Narwhal, female)



13. HEAD WITH A BEAK
(Dolphins and others)



7. THROAT SMOOTH
(Black Fish and
other species)



14. HEAD POINTED
(Pigmy Sperm Whales)

The two porpoise-like creatures, much larger than porpoises, snow white, and seen half a mile off the coast of Brittany can have been none other than the Bottlenose Whale. This is the only white cetacean with a dorsal fin occurring in the North Atlantic, and the only white whale of any kind that would normally frequent this latitude.

During the summer this whale travels as far north as Greenland and in winter migrates south at least to the Mediterranean. Full-grown specimens range from 20 to 30 feet in length, but the tendency is to underestimate their size at a distance. The front of the head in a male Bottlenose rises abruptly from a rather short beak, housing a storage tank containing clear pure oil of the finest lubricating quality. Strangely enough, the color of this whale changes with age—much like that of the Beluga or White Whale. In infancy, they are grayish-black, but as they mature, yellow-white patches appear. Confluence of these patches in adult females produces a yellowish marbled effect; some old males are pure white or yellowish white. It is claimed that when harpooned, a Bottlenose Whale may stay under water for two hours and that a herd will never leave a wounded comrade. However, as soon as the whale is dead the herd moves on.

The third specimen seen below the cliff must have been a Risso's Dolphin, often confused in literature with the Grampus. The Grampus, a killer whale, is the dread tiger of the seas and does not hesitate to gang up and murderously tear apart great Baleen Whales. Risso's Dolphin, a moderately large species, about thirteen feet in length, has a high slender dorsal fin, a rounded face, and high forehead. The general color is gray but the shade is extremely variable and often mottled, head and shoulders becoming more or less white with maturity. This dolphin is widely distributed in the temperate and warm waters of the Atlantic. Usually solitary, they occasionally travel in pairs. The famous "Pelorus Jack" of New Zealand was a Risso's Dolphin. He accompanied vessels entering Pelorus Sound for about 32 years, and his popularity won for him protection for the period of his natural life by order of the New Zealand Council.

«These sketches illustrate the most useful features for distinguishing the various whales, porpoises, dolphins, etc. They are numbered according to a standard system. This is so that if one of these animals is found stranded on a beach, its characteristics can conveniently be dispatched by letter or wire to the U.S. Coast Guard or to any of the larger biological institutions interested in such matters. The identification can then be made, and the animal can be disposed of or receive scientific attention.

For example, if the animal has whalebone in its mouth (1), it must be a Baleen whale. If it has the pointed head shown in number 14, it is a pigmy sperm whale. But generally a combination of two or more features is necessary for specific identification, because 37 recognized species are included in this assemblage of animals. Size and color are valuable additional clues.

The sketches will prove useful to one observing marine life from the deck of a steamer, and will point the way toward definite identification, especially if used in conjunction with a handbook describing the various species in more detail.

The example of Risso's Dolphin on exhibit at the American Museum was prepared under my supervision from an illustration by Sir William Flower of a freshly-caught specimen. The numerous white streaks on this animal were battle scars inflicted by the tentacles of the giant squid and octopus, favorite food of this dolphin.

SIRS:

Your issue of NATURAL HISTORY with the article by the Muenches on the Yuccas interested me greatly. The pictures were especially fine. I have often wondered how the Joshua Tree got its name. Perhaps someone at the Museum could give me this information.

(MRS.) ELIZABETH C. SMITH.
Kennett Square, Penna.

The following explanation is given in C. J. Hylander's *The World of Plant Life* (The Macmillan Company, New York 1939), page 564: "Our Southwest is the home of many strange and curious plants, none more grotesque than the species of *Yucca* known as Joshua Tree, which frequently reaches a height of thirty or forty feet. The woody trunk branches to form an irregular head, the terminal branches being bent and twisted in various direc-

tions and covered with an armor of short stiff narrow leaves. The name is said to have been given these trees by the Mormons when they were crossing the California deserts on their way to Utah, the bizarre branches seeming to the wanderers to look like the outstretched arms of a Joshua leading them on their way out of the wilderness. . . ."—Ed.

SIRS:

I thought you might be interested in the way NATURAL HISTORY works here. First we read it, then I pass it on to the neighbor boy. He is a freshman in Springfield High. After he reads it, he passes it on to what he calls his boys. He is in charge of a Cub group. When they have seen it, it goes out to the Springfield High for the Library. . . .

I have enjoyed the magazine for some years and hope to continue.

FRANK MORRIS.
Springfield, Oregon

SIRS:

I am very pleased to have this opportunity to contribute in some small measure to the educational program of the Museum. I regret that such a possibility was not brought to my attention before. From my own vivid recollections of the profitable and wonderful hours of boyhood spent in the awesome halls of the Museum, I know that the pleasure and instruction which the institution affords cannot be measured in dollars and cents. Surely, there are many others who would welcome an opportunity to assist in your worthwhile work.

KENNETH J. MOSER.
Paterson, New Jersey

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.

BLUE JAYS at mealtime: an unusual photograph by W. Bryant Tyrrell of Takoma Park, Maryland. Their parents had been killed, and the young birds were fed by hand.

From Frederic Lewis



SIRS:

... Some months ago there was an article in your magazine telling about the disease that was killing the saguaro cactus in Arizona. Would you tell me what success the government has had in combating this?

ETHEL M. BASS.

Los Angeles, Calif.

An article giving further information on this subject is now in preparation and will appear shortly—Ed.

SIRS:

I was much interested in the "Toad" story by Roy L. Abbott in the March issue of NATURAL HISTORY. One feature of the toad's action, which I have experienced, was not mentioned. That is the singing, which can be heard if one holds the toad in one hand and gently strokes its sides with the other.

I have noticed that not all toads react. Does this mean that the male will sing and the female will not?

Any information on this point will be appreciated.

J. W. HOLLISTER.

Schenectady, New York

The following answer is given by Charles M. Bogert of the American Museum's Department of Amphibians and Reptiles:

There is indeed an answer to Mr. Hollister's question concerning toads. In fact, Dr. Lester Aronson in American Museum Novitates No. 1250, published in 1944, has a rather lengthy one. It has been known for some time that female toads, probably of all species, are mute in contrast to the males. Dr. Aronson recognizes three distinct calls in males of the American toad, and in Fowler's toad, the two common species in northeastern United States. First, Aronson points out, there is the sex call or trill uttered by males which congregate in suitable ponds during the breeding season. To some extent at least, this call attracts females as well as males of the same species to the breeding site.

The second call distinguished by Aronson he calls a "chirp," and the male toad utters it when touched on the back. It is very nearly of the same pitch as the trill, but it is of much shorter duration although it may be repeated continuously if the toad is stroked as Mr. Hollister describes. Why the toad makes this noise under such circumstances is not clear; no obvious purpose is served, and of course it may not have any, much as naturalists like to interpret behavior in such terms.

Aronson ascribes a function to the third call that he was able to recognize, and he calls this "the male warning vibration." This is a dull, vibratory note that is barely audible unless the toad is held within a few inches of one's ear. Like the chirp, it can be elicited by stimulating the back of the male toad, and under natural conditions the warning vibration plays an important role in sex recognition. After toads have assembled at the breeding site in some numbers, there is a certain amount of confusion. Perhaps you will recall a cartoon that appeared in the *New Yorker Magazine* which showed two turtles, and one of them say-

ing "I'm a girl." Rather succinctly this poses the problem that confronts both amphibians and reptiles during the breeding season. At a distance a toad cannot distinguish the "boys" from the "girls." Unlike the unabashed turtle in the cartoon, the voiceless female toad cannot proclaim her sex. However, if a male attempts to clasp another male toad, the latter responds with the warning note and

the vibrations are transmitted through the body to the limbs of the misguided male, which thereupon ceases his attentions and continues his search for a toad of the opposite sex.

So Mr. Hollister's observations are correct, and his inference can be verified—the females do not sing, but the males do, with a trill, a chirp, or a warning vibration, to suit the occasion.

MUSEUM COLLECTIONS TO BENEFIT MEDICAL SCIENCE

Plans for an Institute of Human Morphology in the American Museum of Natural History, which will make extensive skeletal archives available to students of all sciences concerned with the structure and form of the human skeleton, has been announced by Dr. Harry L. Shapiro, Chairman of the Museum's Department of Anthropology.

The first stage in the organization of the new project is made possible by a special grant from the Viking Fund. Dr. Erwin H. Ackerknecht, former research fellow at the Institute of the History of Medicine, Johns Hopkins University, and recently appointed Assistant Curator of Physical Anthropology in the Museum, will be in charge of the Institute of Human Morphology under the direction of Dr. Shapiro.

In speaking of the purpose of the institute and its work, Dr. Shapiro remarked:

"Although New York City is the greatest medical center in the world, comprehensive collections for the study of variations in the human skeleton have never before been made available to students and professional people. The American Museum of Natural History hopes to fill this need by establishing such a collection, which would be accessible to doctors, dentists, physical anthropologists, and general biologists who seek material pertaining to their specialties.

"The need for large, fully classified skeletal data is evident from recent requests from research projects concerned with the obstetrical study of the female pelvis, with the orthopedic investigation of malformations of the spine, and with evidences of dental erosion. We hope to make these archives of increasing benefit to medical and biological research."

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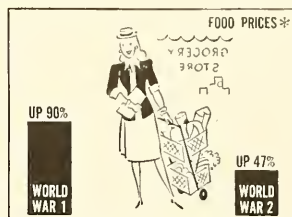
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NATURAL

HISTORY

June

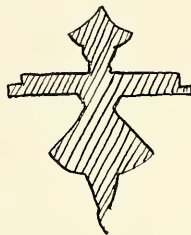
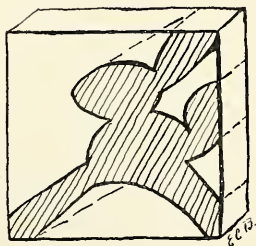
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handicrafts

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of business, but we may, with the aid of basic principles, create things with a personal touch that will have their own value. We now have, in the Book Shop, a section on Handicrafts, which is becoming very popular. Perhaps some of the books listed below may inspire you.



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This little book shows you how to build book-cases in any corner of your home—even the bathroom and the kitchen.

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by Joseph Leeming

These books are well-illustrated and furnish explanatory texts.

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SIRS:

Having done field work for about six years in and around Death Valley in connection with research on living and fossil fishes, my attention was naturally drawn to the fine article by Rufus Mather Bagg on Death Valley in the April issue of *NATURAL HISTORY*. The excellent photographs brought back clearly memories of many trips in and out of the "Valley of Death."

I observed your footnote regarding fish life and had read William V. Ward's article on Death Valley fish. In addition to the well-known population at Saratoga Springs, there is a far more striking fish inhabiting the briny waters of Salt Creek, in the very heart of Death Valley, 180 to 250 feet below sea level. Both species belong to the genus *Cyprinodon*, which comprises a group of small, brightly colored, tenacious fishes inhabiting the fresh, salt, brackish and mineralized waters from the United States, Mexico, and the West Indies to South America.

Cyprinodon salinus, the species confined to Salt Creek, reaches a length of nearly three inches. The males are deep blue, with spangles of purplish iridescence reflecting from the scales along the back, and they have a black band on the tail fin during spawning time. Females are more somber, generally brownish, with irregular vertical bars and a black blotch near the base of the dorsal fin. In midsummer, these fish have been found in water as warm as 100° F.

During Late Pleistocene time, when the great ice sheets were retreating in North America, a vast body of water named Lake Manly covered the floor of Death Valley to a depth of about 600 feet. This was roughly 20,000 or more years ago. At that time, it is assumed that *Cyprinodon salinus* and *Cyprinodon nevadensis* (the species now found in Saratoga Springs) were represented by a common ancestor, and the evolution of each dates from the desiccation of Lake Manly.

Before the advent of the white man, and until recent generations, the Panamint Indians utilized the Salt Creek fish for food, gathering them in large porous baskets, aided by "tule" brooms, during springtime when this species swarms in the creek. The fish were baked between layers of tule reeds alternating with layers of hot ashes.

The old desert prospectors tell fantastic tales of immense underground rivers that populate the springs with blind fish, but although such mythical stories add to the lore of the region, the fish are not blind and their present distribution in this arid waste dates from the Pleistocene.

ROBERT R. MILLER,
Associate Curator of Fishes,
Smithsonian Institution.

United States National Museum,
Washington, D. C.

IMPORTANT NOTICE

Readers are reminded that *NATURAL HISTORY* is not published during July and August. Those who expect to be away after September 1, however, and wish to have their September issue sent to a temporary summer address are requested to notify the Membership Secretary. Please give the date of expected return to permanent address.

NOTICE—Readers are encouraged to submit their 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.

As an example of the unusual exploratory experiences in which our Army fliers sometimes engage, Miss Caroline Mytinger, the well-known artist, who herself has done exploring in the Solomon Islands and elsewhere, gives us the following letter from New Guinea:

DEAR MISS MYTINGER:

... Your remarks about the pygmies up in these mountains bring to mind something that may be of interest to you. A while back I was called down to operations. They had asked for a pilot with experience in flying over jungle territory and, as I was the only one available at the moment, I was sent down. It seemed there were some survivors of a Dutch peacetime garrison living up in the hills with the natives, who were to be brought down for information as well as safety. The garrison had escaped from Manokwari two years ago. They pushed their way into the hills to the southwest, and after a terrible journey the party, including women and children, was found by some natives, who were now taking care of them. One of the natives had been per-

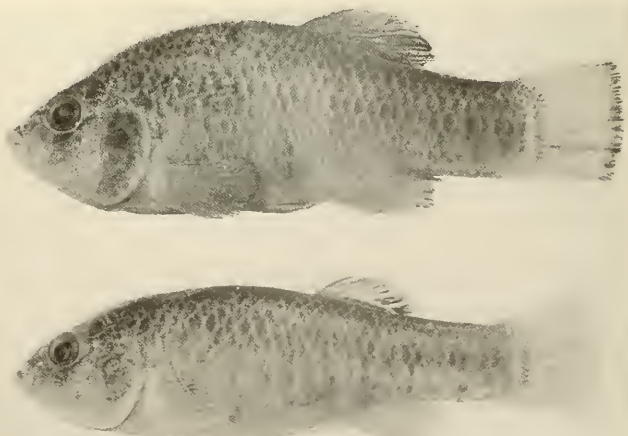
suaded to make the long trip down to the coast to contact the Dutch, which he managed to do after being gone for about three months.

Rescue parties were organized immediately but they were all doomed to failure because of the impossible ground that had to be traversed. Finally C-47's were sent up and managed to drop food and medicine and a radio set, and—to make a long story short—the natives were asked to build a landing strip. My orders were to measure the field and find out if it were suitable for the big cargo ships to land there and pick up the Dutch women and children. I was given all the available information and provided with a native scout who knew the lay of the land although he had never been up that far, and we checked out in a small L-5 (Stinson Valiant to you).

The most exact information I had was that I would find the strip somewhere toward the southern end of the Kebar Plains, but as you know, no two charts of this country are the same. Three charts I looked at showed the Plains in three different locations. Later, checking over the fuel consumption and time, I figured the

Continued on page 292

MALE (*above*) and female (*below*) of a fish that survives from the Ice Age in the heart of Death Valley: *Cyprinodon salinus*. The fish inhabits the briny waters of Salt Creek, 180 to 250 feet below sea level



YOUR NEW BOOKS

GARDENING • HAWAIIAN FISHES • GEOLOGY
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PRINCIPLES OF PHYSICAL GEOLOGY

----- by Arthur Holmes

Ronald Press Company, \$4.00
532 pages, 262 figures

POPULAR writers on scientific subjects often excuse their efforts by saying that someone must explain technical subjects in simple terms for beginners, and that if the scientists are unwilling to do so, less well qualified authors must. And often the author who is more gifted in writing than research can do a better job of simplification than the scientists endeavoring to explain his specialty to the layman. Occasionally we find the fortunate combination of an author who is a genuine authority as well as a capable simplifier, and from these people stem our best general works. Arthur Holmes is one of England's best known geologists, and he stands high in his field. His latest book is obviously intended as a textbook for an elementary course in geology, but it is so comprehensive and readable that the general reader would not consider it too dry for his attention.

The subject matter of any geological text, is, of necessity, always the same, though the approach may vary. Here we find first a discussion of the materials and nature of the earth, followed by an account of the shaping processes on the surface; the running water, winds, and ice. This is followed by a description of the internal processes, as deduced from the observed effects in ancient rocks and in the living geology of volcanoes and earthquakes.

The book is well illustrated. Many of the pictures show American formations, with which readers in this country will be familiar, while others show some of the classic features of England and Europe, less well known to Americans. To some this may seem a drawback, but it is desirable for us to realize that we have no monopoly on remarkable manifestations of geological processes. Dr. Holmes is to be especially commended for two features of this book: first the bibliographies for further reading, which are placed at the close of each chapter—and second, for his open-minded attitude toward admittedly unproven and perhaps unprovable theories, which we find in the speculative part of the book. An admission of ignorance regarding the many things still to be learned about our earth is probably the

most stimulating thing that a beginner can read, for he knows that he has a long and fascinating road to travel and need never fear that it will end before his vehicle runs out of gas.

F. H. POUGH.

HAWAIIAN FISHES

(A Handbook of the Fishes found Among the Islands of the Central Pacific Ocean.)

----- by Spencer Wilkie Tinker

(Illustrated by Gordon S. C. Chun and Y. Oda.)

Tongg Publishing Co., Honolulu, \$3.50
404 pages, 8 color plates

THE purpose of this book is to help persons without special knowledge or recourse to technical terms to identify Hawaiian fishes. For this it relies largely on profuse illustrations. There are eight plates showing 85 different fishes in color, each of course small, but in general pleasing and satisfactory, besides black-and-white text figures, varying in excellence, of some 500 different fishes. The book is of a convenient small size, attractively made, and very timely.

There has recently been a continuous demand for something of this nature from the many Americans now scattered over the tropical Pacific. Since some of the common characteristic fishes range all the way from the Hawaiian Islands to the Red Sea, and other East Indian species are obviously closely related to their Hawaiian representatives, it will be helpful over the breadth of the ocean.

Where several similar and closely related fishes are concerned, it may not be possible to differentiate them with a book of this kind. It also has certain weaknesses of the sort that can occur in a compilation from diverse sources. For in-

stance, of the two common market "uluas," the name *Caranx melampygus* has formerly been used for one which is here figured twice, as *C. melampygus* and *C. stellatus*, and the other, for which *C. melampygus* is now current, is confused with a different fish. There are other errors, similarly caused, which prevent exact determination of a few species.

Whatever its shortcomings, *Hawaiian Fishes* is evidently the product of considerable serious work. It should be a boon to persons interested in Pacific fishes yet having no great knowledge of them, and it should prove a helpful stepping stone to a more ichthyologically authoritative treatment of the subject in the future.

J. T. N.

PERENNIALS PREFERRED

----- by Helen Van Pelt Wilson

M. Barrows & Co., Inc., \$2.75
256 pages, 26 illustrations

THIS well-planned book starts the gardener with the fundamentals of flower culture, such as the nature of soils, the value of compost, the use of fertilizers, and methods of propagation, and then, with the understanding of basic principles thus gained, guides him through the seasons with helpful advice on what to plant, how to arrange it, and the care to give in order to secure the best results. All of this information will be useful to anyone who grows flowers but especially to those meticulous and conscientious souls who can plan an orderly garden and then stick to it through the ravages of insects, invasions of grass and weeds, and the capriciousness of climate long enough to see the wishful thinking materialize.

The author has a practical and humorous treatment of her subject. She recommends a species, for example, and while its merits are sung the reader is also cautioned that in his particular yard the plant may not grow as enthusiastically as it does on the pages of a seed catalogue. "In most cases if plants cannot thrive under the average conditions I offer, we simply part." This can well serve as a guiding principle for most flower growers, and the author's rich experience, as conveyed through the pages of this book, will assist one in making the selection of what to grow on his own premises.

The portfolio of perennial plants and their arrangements in the garden and in the house should convince anyone of the

NATURE ENCYCLOPEDIA

Edited by G. Clyde Fisher; five volumes bound in De Luxe Green Keratol lettered in Gilt, pages are 5 3/4 x 8 inches. Lives and habits of Birds, Mammals, Fish, Reptiles, Flowers and Trees; described by renowned Naturalists: 700 illustrations, 200 in Natural color. The Literary Mart, 8 East 33rd St., New York 16, offers this set for \$7.50, remittance with order, returnable for full refund within five days.

soundness of the author's ideas. The half-tone illustrations are well executed and the results are stimulating. The charts, tables, and plans show careful preparation.

And, finally, the clever sketches with humorous captions are worth mention. "Never let your husband play with the hose in the evening" is an excellent idea. It might even be extended to forbid him to play with the lawn mower. I am all for it.

H. E. ANTHONY.

THE LONG JOURNEY

----- by Johannes V. Jensen

Alfred A. Knopf, \$3.50
677 pages

THIS innocently small-looking volume is the Nobel Prize edition of a well-known work, first published in Denmark and shortly after in translation in this country, all of 20 years ago. Awarded the 1944 prize "for Literature," the performance has claim to notice here only because it is actually a brief fictionalized version of the fundamental biologic and cultural aspects of human history.

The author has long been recognized as a prolific and versatile literary artist; but he is directly known to the reviewer only as a cosmopolite who has read much and traveled widely. Thus gifted and armed with a vast range of facts about nature and the life of man, past and present, he has here written with undeniable power but at the same time rather lengthily and solemnly and therefore, in one sense, probably less successfully than our own Jack London and Hendrik Van Loon.

The Long Journey is a poetically conceived prose-epic of human progress ranging from preglacial and prehuman times up to the discovery of America by Columbus. Each of its originally six or seven separate books describes the human scene at some particular stage of cultural development, and the drama—in conformity with the Carlylean concept of progress—is supplied chiefly by the inventive activities of the contemporary guiding genius and by his struggles with the normally conservative group. Thus in the first book the culture hero, in spite of protests, introduces the use of fire and invents the first simple implements. In the second he devises, among other things, a method of producing fire. And in the third he appears as boat-builder, navigator, and explorer—the forerunner, as it were, of Columbus. Near this point the tale rises to the historic and biographic level and so passes beyond the immediate interest of prehistorians.

Pointed criticism is here impossible. Besides, a work of art is primarily an ad-

venture in esthetics, rather than in logic or science—in short, is an appeal to the heart as well as to the head. Naturally, therefore, in such a work as this the scientifically-minded and the poetically-minded are bound to find points of disagreement, whether justifiable or not. Consequently, the reader had better judge for himself. Indeed, for those who believe in a living, eternally becoming world, and especially for those who are interested in the origin and destiny of man, no more illuminating or trustworthy book of fiction has been written.

N. C. NELSON.

PINE, STREAM AND PRAIRIE

----- by James Gray

Alfred A. Knopf, \$3.50
312 pages, 34 illustrations

"IT is an old habit with people of Wisconsin and Minnesota," Mr. Gray says, "to vibrate between the civilized world and the world of the wilderness," and that is exactly what his book does. It is not merely a static collection of facts, as many regional volumes have been of late; here is a vibrating, living knowledge of a country, which, moving from its past through the present into its great future, shows it clearly and sympathetically in all three stages.

The range of subject is wide—the land

itself; its people, from great financier to jack-pine savage; ways of life in forest and farm and mill; types of culture; the arts; recreation and social life. But these myriad facts are not simply stated,—they are interpreted with sound judgment. Here is stimulating analysis as well as authentic information, amusing anecdotes, and keen wit. In a description of the University of Wisconsin's theatre, Mr. Gray says lightheartedly, "It is the very model of a modern auditorium." And after a penetrating evaluation of Frank Lloyd Wright's contribution to architecture he adds pensively, "He has a great deal to say about doom. . . . At breakfast doom is presented as cheerfully and casually as though it were a hot buttered roll." His characterizations throughout the book are a delight.

One striking aspect is the weighing of imponderables as well as the material values. "Nothing defines the character of a time or place quite so clearly as the quality of its abstract thinking," Mr. Gray says. So he describes six creative and independent minds in Minnesota and Wisconsin and their contributions to the world of thought.

To me the most beautiful and satisfying chapter is the one called "Short Retirement, Sweet Return," describing the wilderness region along the border between Minnesota and Canada, where the world is still "what it has been since the beginning of the time when earth began to sustain life." Not in this chapter, for it is idyllic, but somewhere in the book, I

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The Pacific World

BIRDS of the SOUTHWEST PACIFIC



BIRDS of the SOUTHWEST PACIFIC

by Ernst Mayr, American Museum of Natural History

This practical handbook is the first in English on the birds found on the main islands of this rich and remarkable area. Identification keys are simply and clearly worked out for the beginner. There are 3 color plates illustrating 39 birds by F. L. Jaques; 15 line drawings by A. Seidel. Published. \$3.75

MAMMALS of the PACIFIC WORLD

by T. D. Carter, J. E. Hill, G. H. H. Tate
American Museum of Natural History

Here is disclosed the origin, life history, and distribution of an astounding array of mammals found on the islands of the Pacific and the East Indies. Some of the mammals described are unique and are found only on these islands. A geographical index is included. \$3.00



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by Felix M. Keesing, Professor of Anthropology,
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SHE IS MODELED from recent measurements of 15,000 women from many parts of the United States and from various walks of life, including series of college students and other thousands of native white Americans. She is slightly heavier yet more "athletic" than her grandmother of 1890 and has lost the shrunken waist induced by tight corsets. As to the beauty of her figure, tastes will vary; fashions change ideals from one generation to the next. Norma is not meant to show what ought to be; she shows what is.

Dr. Robert Latou Dickinson, who drafted the proportions and posture of the figure, has devoted six years with Abram Belskie to the planning and finishing of anatomical, obstetric, and

surgical models which might be widely distributed for teaching purposes. In this work, at the New York Academy of Medicine, he has consulted the great anthropologists in person and tapped all the statistics to ensure accuracy in all details. He shows in Norma the average American girl of our day, 18 years of age. The sculpture has been done by Abram Belskie, member of the National Sculpture Society.

The statue, like that of Norma's "brother" on page 252, is reproduced for the first time in NATURAL HISTORY Magazine through the courtesy of the sculptors and the Cleveland Health Museum, which will take over production of the series.

A.M.N.H. Photo

A Portr

Scientific studies reveal that we have changed considerably since the days of our forefathers. The typical American is certainly quite different from what other nations have predicted for us, also perhaps different from what we ourselves have imagined

MOST Americans, in conversation with representatives of other nationalities, have probably found themselves discussing what it is that distinguishes the people of the United States and as frequently, no doubt, attempting to define the character of the other nationalities in such a mixed company. In this world of self-conscious nationalism, almost every country has acquired a personality and a type—often enough, a kind of Janus or split personality, one face as the country sees itself and the other as seen by its neighbors.

The British, collectively, in their national self-portraiture, are inclined to emphasize quite naturally the traits they regard as lovable, worthy, gentlemanly, or noble. Their native spokesmen describe them as reserved, sensitive, poetic, devoted to fair-play, fond of sport, inclined to "muddle through," and eminently law-abiding. Foreign and less generous observers are more likely to dwell on their pig-headedness, their snobbishness, their perfidy, and various other less agreeable human traits.

The French, too, take pride in their catalogue of national virtues, which they sometimes imply are uniquely theirs, such as their logic, their intelligence, their thrift, their capacity for passion; while in the hands of their critics, their thrift becomes parsimony and their passion a form of immorality and lack of restraint.

We Americans, also, have a fa-



ait of the American People

By HARRY L. SHAPIRO

*Chairman, Curator of Physical Anthropology,
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vorite chromo of ourselves that we like to hang in the family parlor. We picture ourselves as idealistic, honest to the point of being easy marks for our devious neighbors, generous, hospitable, friendly, inventive, efficient, competitive, and progressive. Many Europeans look darkly at this picture and take on their own account a few candid camera shots that are as flattering as passport photographs, revealing us as dollar-chasing Shylocks; insensitive to culture, meddlesome, flippant,

boastful, and preaching; gangsters who are ridden by a mania for speed, gadgets, and law-breaking.

Although these characterizations are stereotypes, which at their best are merely acute generalizations and at their worst malicious and inaccurate, they are symptomatic of the trends of national differentiation that arise from differences in history, environment, and culture. Even if we cannot measure it objectively, the reality of national patterns of char-

acter structure is patent enough from experience.

An American, even of the purest English descent, who reverses the trail of his ancestors and hopefully transplants himself in England, is likely to encounter some difficulties in recrossing the line that now divides an Englishman from an American. The experience of some of our most celebrated expatriates illustrates how American Americans have become. Henry James, for all his love of the English and their ways and for all his efforts, never succeeded in passing as an Englishman among Englishmen, although it must be admitted that he sometimes fooled Americans. Sargent and Whistler, utterly different as they were in so many things, always remained Americans as far as the English were concerned, except when they were claimed as ornaments of British painting. Sir Osbert Sitwell recalls that



One American Ideal

ONE IDEAL in the feminine figure is represented by Rosemary Sankey, chosen to epitomize the "high fashion girls" of John Robert Powers. These models, constituting a very uniform physical type, are significant because they are eagerly sought after as dress models and are obviously much admired by the public. In this group, bust, waist, and hip measurements of 34-24-34 are considered close to the ideal. The greatly increased height, the notably wide shoulders and the slender hips of the "high fashion girl" combine to differentiate her from Norma; but these same characteristics may also be regarded as the extreme of a tendency that has been noted to a lesser degree in the average American girl in recent generations. Miss Sankey herself shows a figure that is further in this direction even than the average "high fashion girl." Her measurements are: shoulder width, 14.9 inches; bust, 33½ inches; waist, 23 inches; and hip width 11¼ inches. She is 5 feet 7 inches tall and weighs 117 pounds.

Photograph by Don Selchow.

when his father commissioned Sargent to paint a conversation piece of the Sitwell family, Lady Londesborough, the maternal grandmother, distinctly disapproved of the choice of Sargent on the grounds that he was an American. I should perhaps add that Sitwell, père, did his best to find an English painter and only settled on Sargent after discarding several English candidates as inadequate.

Personalities, however, although they seem to persist like the smile of the Cheshire cat long after the body has vanished into thin air, do enjoy ordinarily a physical embodiment. Certainly no picture of the American people as a whole can omit this vital component, which, unlike its abstract personality, is much more susceptible to exact description and objective measurement. The existence of a physical type, distinctively American, has for a long time been quite generally accepted both by Americans themselves as well as by foreigners. Indeed, regardless of any scientific support for such an opinion, one would have to be singularly impervious to suggestion to escape sharing it. Hollywood presents us with an inexhaustible parade of "typical American" beauties. Charles Dana Gibson delighted our mothers and our fathers with the apotheosis of the American girl of the 1900's. Lord & Taylor advertises "that American look" as the product of our native soil. And who is not familiar with the lineaments and aspect of Uncle Sam, our national portrait. If our artists, our impresarios, and our copy-writers had failed to convince us, our own observation could not. Americans, visiting Europe before the war, were easy to spot, not only by fellow Americans but also by natives and by those whose business flourished by virtue of their skill in this species of detection. No doubt clothes, manners, and speech contributed to make it relatively easy to distinguish an American from the indigenous population; but frequently enough, recognition was possible even without these adventitious aids.

I have been unable to determine precisely when Americans, or Europeans for that matter, first became aware that there was something that could be called an American physical type. Discussion of a generalized American character, it is true, appears well established by the middle of the eighteenth century. Franklin,

for example, speculative as he was on many topics of general interest, held views on this, too. And even earlier one can find such colonial worthies as Colonel Byrd and the Mathers speaking of local manners and behavior as if they already recognized an American pattern, although not designating it in such broad terms. Certainly, by the end of the eighteenth century, interest in the American character, stimulated by the Revolution and the birth of a new nation, occupied the attention of almost every writer who ventured to discuss and describe the United States.

English visitors were particularly aware of our national personality; with few exceptions they found it unattractive and, of course, inferior to their own. Isaac Weld, Mrs. Trollope, Charles Dickens, and Captain Hall, among a host of other English travelers in the nineteenth century, standardized the excrescences of the portrait. In fact, one is somewhat amazed in reading this literature to reflect how analogous it is with the recent writing on Russia. The United States at the end of the eighteenth century and the early nineteenth represented to the Europe of that day a reprehensible and dangerously radical departure from political decorum. European and particularly English observers loved to dwell on the less attractive side of life in America. Democracy was not what it was cracked up to be. The democrats chewed tobacco; they entered into conversation without waiting the formality of an introduction. As servants they were forward and insisted on regarding themselves as good as their masters. Their offspring were independent and pushing. Democracy was noisy, aggressive, and lacked the refinements of traditional societies. Table manners were appalling and public conduct beyond words. Public and private conveniences, roads, carriages, trains, hotels—all were inferior to their European counterparts and uncomfortable.

Life, manners, and character altogether were so unsatisfactory that they seemed to take up all the attention, and little or nothing was left over for observation of the physical traits of Americans. When comments were made, they were apt to be disparaging. American girls had poorer color than the rosy-cheeked English girl. Americans had poor teeth, or the

women were pretty enough as girls but faded quickly. But the American as an emerging subtype, neither English nor Dutch nor French but American, was slow in being recognized, or at least less obtrusive to foreign visitors than the facets of our national behavior. Crèvecoeur, however, a sympathetic French observer of American life in the latter half of the eighteenth century, commented enthusiastically on most aspects of it and with reference to Americans as a people wrote "here individuals of all nations are melted into a new race of men, whose labors and posterity will one day cause great changes in the world." This is one of the earliest references I have been able to find to the famous assimilation process that was to become widely known as the "melting pot."

Americans themselves, no less than Europeans, commented little, if at all, on the existence of an emergent physical divergence from their European forebears until the latter part of the eighteenth century when political events were beginning to weld a sense of nationality among the scattered colonies along the seaboard and to stimulate a feeling among Americans that they were a distinct people. Since exact evidence is lacking and contemporary observations are scanty, we cannot, in fact, be positive that there was in colonial times any obvious deviation among the colonials from the physical standards of their ancestors. Perhaps one of the reasons for this inattention sprang from the circumstance that for well over a century after the first settlements, the colonists were accustomed to think of themselves not as Americans but as Englishmen, Hollanders, Germans, or Frenchmen. They had come to the New World as Europeans, bringing with them not only the biological heritage but also the manners, customs, and ideas of their native lands. So conscious were they of their Old World origins and ties that even after a century of residence in the New World, they continued to call themselves Englishmen, Frenchmen, Swedes, or Hollanders. Their settlements were named New England, New Amsterdam, New Sweden, Nova Scotia, or, in loyalty to their sovereigns, Virginia, Carolina, Maryland, and Georgia. They fashioned their houses after models familiar in the countryside from which they came. They reproduced, as far as the

new environment permitted, the life they knew in the old country; with such success in the Pennsylvania Dutch country that an eighteenth century traveler was amazed at the fidelity of the reproduction. Even after generation had succeeded generation, a native Virginian or New Englander of colonial times might still speak of "going home" when he merely meant a visit to England.

One of the earliest commentaries on the physical characteristics of Americans seems to have occurred in the latter part of the eighteenth century. The principals were our own Thomas Jefferson and the Abbé Raynal, a French popularizer and encyclopedist. Raynal, adapting Buffon's ideas on American fauna, had applied them specifically to the Europeans transplanted to the New World. The thesis was briefly this. Buffon, the grand panjandrum of French scientific circles, had come to the conclusion that American animals were smaller and inferior to their European equivalents. In addition, he cited reports widely current in Europe that domestic animals brought to America rapidly degenerated. It was firmly believed that not only did cows, horses, pigs, and other barnyard denizens become smaller and runtier, but they fell off in production. Cows in America, it was said, produced milk in quarts where in Europe they yielded in gallons. Speaking of the indigenous tribes of America, Buffon wrote:

"The American Savage, it is true, is little less in stature than other men, yet that is not sufficient to form an exception to the general remark—that all animated nature is comparatively diminutive in the new continent. In the savage, the organs of generation are small and feeble; he has no hair, no beard, no ardour for the female; though more nimble than the European, from being habituated to running, he is not so strong; possessed of less sensibility, yet he is more timid and dastardly; he has no vivacity, no activity of soul, and that of the body is less a voluntary exercise than a necessary action occasioned by want. Satisfy his hunger and thirst, and you annihilate the active principle of all his motions; and he will remain for days together in a state of stupid inaction."

To account for this degeneracy, Buffon spoke like a true eighteenth century naturalist and attributed it to the American environment and in

particular to the fact that America, having only recently emerged from the sea, possessed a "watery climate" which was less favorable as compared with the presumably drier and more invigorating climate of Europe.

This then was the hypothesis that Raynal took up and expanded to include all the human fauna of America, aboriginal and transplanted. At this point, Thomas Jefferson took up the cudgels and belabored Raynal and Buffon with tables of comparative weights that left no shred of comfort to his opponents. In instance after instance Jefferson demonstrated that the American species were distinctly heavier and that, if weight alone were any criterion of quality, there could be no doubt that the superior article was to be found over here. Whether our climate were watery or not, Buffon and Raynal were certainly all wet.

Although this footnote in our history is amusing in view of what has actually happened to the physical development of our population, it throws no light on eighteenth century opinion on the progressive development of a native type except in so far as it was alleged to be a degenerating one. Local differentiation to some extent was recognized, to be sure, and the Yankee as contrasted with the Southerner was becoming a stock figure; but the distinctions were based largely on manners, attitudes, and way of life, although physical differences seem not to have been completely ignored. In this period, too, the frontiersman began to crystallize as a physical type, although the characteristics that marked him are not always consistent or explicit. It is, however, only after the Revolution that one becomes aware of a growing tendency of Americans to think of themselves as a nation—as Americans, despite the tendency of the Virginian or the New Englander to cling to a local allegiance. This increasing sense of a common nationality found expression in the opening years of the nineteenth century in the discovery of a representative type in Uncle Sam, who rapidly gained a national personification that has continued to the present day.

How much truth there was in Uncle Sam is a matter of conjecture. Tall, lean, long-legged figures seem to have become frequent enough among Americans of this period to have attracted comment as sympto-

matic of a national trend, but it is unlikely that Uncle Sam approximated anything like an average of the total population at the time of his creation. Perhaps, like a caricature, he owes his being to a deliberate exaggeration of an actual but subtle tendency in the population. He was, in other words a type of some frequency in the general population but not an average, and his selection to represent the nation rested on the fact that as a type he was to be found more characteristically here than in other countries.

Since Uncle Sam was not the *average* American of 1800 (at least we have no evidence that he was), it would be profitless to compare him with the American of today in an effort to determine whether or not the American people have altered appreciably in the course of 150 years. We have, fortunately, for our contemporary population the kind of data that was completely absent in 1800. Although the material now available falls short of perfection, it is extensive enough to give us an excellent idea of the average dimensions and proportions of the American man and woman of our own times,—the kind of summation impossible for earlier periods in our national evolution. The principal sources from which the reconstruction of the average American male and female may be drawn are varied. They include the information made available by a survey of a couple of million men in the army during the first World War, special studies of the old American stock, series of college men and women from various parts of the country, a sample measured at the recent World's Fair in Chicago, insurance company records, and extensive data obtained by the Bureau of Home Economics on 15,000 American women who were measured in detail to provide more accurate dimensions and proportions for sizing women's ready-made garments.

Recently, a distinguished team of co-workers, Dr. Robert L. Dickinson and the well-known sculptor, Mr. Abram Belskie, who have collaborated in the past to produce a unique series of anatomical models, turned their talents to creating models of the average American male and female in the full flush of early maturity. Their results, embodied in the two handsome figures sculptured at one-half life size, which are reproduced on accompany-



▲ NORMA'S TWENTY-YEAR-OLD "BROTHER" is also a product of Dr. Dickinson's studies and was modeled by Abram Belskie. Both of these statues and the measurements on which our knowledge of physical trends is based, leave little doubt that the figure is improving esthetically

A.M.N.H. photo

ing pages, translate into three dimensions a composite of the available data. The female figure, named "Norma" appropriately enough, represents the norm or average American woman of 18 to 20 years of age. "Normman," her male counterpart, is modeled on averages for 20-year-old males.

The effect these figures convey is one of a body that is tall, long-legged, and well proportioned, and far more favorably impressive, at least esthetically, than might have been anticipated from casual observation. In fact, Norma and Normman, although they were designed to conform with the average adult before the onset of the ravages of age, exhibit a harmony of proportion that seems far indeed from the usual or the average. One might well look at a multitude of young men and women before finding an approximation to these normal

standards. We have to do here then with apparent paradoxes. Let us state it this way: the average American figure approaches a kind of perfection of bodily form and proportion; the average is excessively rare.

Ordinarily, when we think of perfection, or the approach to it, we place it at one extreme of a curve of frequency, whose middle range or average is equivalent to mediocrity. Virtuosity, for example, is never at the middle of a curve of frequency. The most skilled musicians, the finest painters, the loftiest intelligences are rare and exceptional, never average for any population. Why, then, should the average bodily proportions strike us as a form of perfection; and if it is average, why is it rare? There are, of course, esthetic and anatomical considerations involved here, but I shall confine myself to a statistical explanation. The extremes of any single

physical character are generally statistically rare, whereas the average is frequent. The middle ranges of stature are most commonly seen, the average weights most often recorded, the mean of a bodily proportion is the most usual.

All these averages are in themselves individually pleasing, and they are common and usual, observed singly. A very fat lady and a very thin one are both rated ordinarily as less attractive than one of more average weight. Obviously, then, if the averages of all traits are brought together in one individual, such a person is bound to agree with the standard not only for one but for all the characters that define bodily proportion. But the combination of so many averages in one person is rare and unusual. One may have an average stature but be far above normal in weight; another may conform to the average for height and weight but possess hips or shoulders that fail to achieve the mean. Thus it comes about that the

▼ DORYPHORUS, THE SPEAR THROWER: a Greek ideal of about 400 B.C. This figure, $7\frac{1}{2}$ heads high, exhibits a massive torso and well proportioned limbs, combined to give an appearance of power rather than agility or speed

Courtesy of the Metropolitan Museum of Art



average physical type is pleasing but also unusual.

Bodily perfection like any other esthetic ideal is admittedly a matter of taste, a subject that may be dismissed with the phrase, "*de gustibus non est disputandum*," or carried into rarefied levels of sensibility. It is, however, interesting to compare Norma and Normman as created by Dr. Dickinson and Mr. Belskie out of the realities of living Americans with the ideal figures conceived by the classic masters according to artistic canons of bodily proportion. The archaic Greeks, bound by the traditions of Crete and Egypt, deliberately carved statues with exaggerated and often unlife-like proportions, and it is not until the fifth century B. C. that we find the classic figure fully developed. The sculptors of this period strove to create a harmonious and ideal body based on the proportions of living men and women but brought to a higher perfection of abstract beauty. It is an idealization rather than a copy of a living model. One of the most celebrated sculptures of



▲ THE AVERAGE young man and woman of the Gay Nineties as portrayed in two figures scientifically constructed by Professor Dudley A. Sargent. Both were shorter than their modern counterparts. The woman also had a narrower waist than her "granddaughter"

▼ THE EARLY GREEK IDEAL in feminine beauty is seen in the statue of Aphrodite of Cyrene, sculptured in the second century B.C. after a fourth century type

Courtesy of the Metropolitan Museum of Art



this period is the Doryphorus by Polykletus (about 440 B.C.) which, because its proportions were regarded as approximating perfection, was known as the Canon. The height of Doryphorus is $7\frac{1}{2}$ heads (measured from the base of the chin to the crown of the head). Compared with it, the average American male is much taller, (though still about $7\frac{1}{2}$ heads high), and much more slender not only in the limbs but also in the torso. Somewhat later Greek sculptors like Lysippus (about 320 B.C.) lengthened their figures to 8 heads, but the solidity of body remains when contrasted with the modern American. The Venus de Milo, also 8 heads high, a proportion that agrees with that of Norma, is, however, much broader in development, with hips that look massive against Norma's relatively slender ones.

Since classic sculpture represented an ideal and not an average, we are warranted only in concluding that our averages of today are deficient judged by classic concepts of ideal beauty. Who can tell how far the contemporaries of Pericles were wanting by the same measures of perfection?

But modern notions of bodily harmony have changed. The world of fashion and photography, for example,

favors an ideal and a canon distinctly its own. The "high fashion girl," whose elongated and elegant grace we see in the pages of the slick magazines and in the advertisements of high priced garments for women, is eagerly sought after as a dress model and much admired by the public. Her broad shoulders, slender hips, and long legs show off clothes to their best advantage and thus help sell the product she displays. Is she a type that suits the prevailing trend of a fashion that might tomorrow leave her demodé, or does fashion follow her contours because she represents an exaggerated but elegant form of a changing bodily conformation in American women?

That the American woman, no less than the American man, has been changing in physique has been frequently asserted and is well known to clothing manufacturers, who have been obliged to make a number of alterations in their sizing formulae to fit the public. Our elders who have commented, sometimes unsympathetically, on the changes to be seen in the younger generations, may refresh their memories of their own intimate appearance of 50 years ago in the illustrations of Professor Dudley A. Sargent's figures of the average col-

COLLEGE MOTHERS —Around 1890	COLLEGE DAUGHTERS —1920
(Compiled from Wellesley, Vassar, Smith, and Mount Holyoke, by Gordon T. Bowles)	

5 ft. 3.6 in.	Height:	5 ft. 4.8 in.
33.5 inches	Sitting height:	34.2 inches
Shoulder width: 14.5 inches		
Bust: 33.6 inches		
24.3 inches	Waist (girth):	25.7 inches
13.0 inches	Hips (width):	11.9 inches
36.4 inches	Hips (girth):	36.8 inches
21.3 inches	Thigh:	
13.1 inches	Calf:	
120.6 pounds	Weight:	124.6 pounds

THE COLLEGE DAUGHTERS of 1920 were taller and heavier than their mothers but had relatively narrower hips

lege man and woman of the gay 90's. These models were constructed from a large series of measurements of Harvard and Radcliffe students and make an illuminating comparison with the "Norma" and "Normman" of 1945. If the Sargent reconstructions are as representative for their day as the Dickinson-Belskie models are for the present generation, there can be no question of the esthetic improvement in the present population. The girl of the 1890's had a constricted waist, the effect no doubt of corsets and the hope of achieving a girth that could be spanned by a man's two hands, if such liberties were thinkable. She seems, moreover, somewhat disproportionate in having legs too heavy for her torso, or, if one prefers, a torso undeveloped for the size of her hips and legs.

We are fortunate in having at our disposal for such a comparison with the past an abundant body of exact evidence that leaves no room for doubt that a marked change has occurred in the physical development of our population. Repeated measurements on the students of various colleges throughout the United States all agree that this generation is considerably and consistently taller than its parents.

One of the most extensive series in time covered is the Harvard study, which embraces a continuous record of around 75 years. Dr. Gordon Bowles, who has analyzed these figures with great skill, has been able to demonstrate a remarkable increase in size and an alteration in proportion in Harvard undergraduates as well as in college women in a number of Eastern schools. To indicate the rapidity and magnitude of the change, I shall cite the average statures of Harvard students by decade of birth. Beginning with 1856-65 and continuing by decades up to 1906-15, the average statures are as follows: 5' 8", 5' 8 $\frac{3}{8}$ ", 5' 9", 5' 9 $\frac{1}{2}$ ", 5' 9 $\frac{1}{5}$ ", and 5' 10". Sons compared with fathers increased 1.38 inches in height, gained 10 pounds, developed broader shoulders and narrower hips. College girls compared with their mothers added 4 pounds to their weight and 1.15 inches to their height. They have expanded around the waist by almost an inch and a half (from 24.2 inches to 25.65 inches) and around the hips by less than one-half inch (from 36.35 to 36.8 inches), although the hips have actually decreased in width by an inch. The daughters also seem better developed in other ways too. They have chests that are an inch greater in circumference and are capable of a greater expansion. Their arms are slightly larger in girth, presumably being more muscular.

This is far from being an isolated phenomenon, confined to the college population and restricted to those born in specially favorable circumstances. Neither is it characteristic only of one stock in our national "melting pot." College records from north, south, east, and west, from endowed, expensive schools and from state universities parallel the trends uncovered in the Harvard sample. Growth studies on children repeated on the same population after the lapse of a generation or more disclose the same marked increases. Mothers who buy for Johnny aged four, suits sized for age 6 or 7, know this without benefit of science. Children are growing at an accelerated pace and reaching within the growth span a greater size. Since all parts of the body do not continue to grow at the same rate but follow a gradient, certain alterations in proportion follow upon this expansion in height.

So far as the evidence is available, this progress, if one may call it that, of the American type affects all our

AVERAGE AMERICAN GIRL—1940	"HIGH FASHION GIRLS"—1945
(Bureau of Home Economics, Dept. of Agriculture)	(John Robert Powers Model Agency)
Age: 20—24 Years	Age: 23.5 Years

5 ft. 3.6 in.	Height:	5 ft. 7.75 in.
	Sitting height:	35.7 inches
Shoulder width: 14.5 inches		
33.9 inches	Bust:	33.6 inches
26.4 inches	Waist (girth):	24.1 inches
	Hips (width):	11.4 inches
37.4 inches	Hips (girth):	34.7 inches
21.6 inches	Thigh:	19.3 inches
13.3 inches	Calf:	12.6 inches
9.2 inches	Ankle:	8.1 inches
123 pounds	Weight:	120.1 pounds

THE AVERAGE GIRL today is stockier than the College Girl of 1920, but her height is likewise increasing. Her bust measurement exceeds the "high fashion" girl's, but she is four inches shorter

population regardless of origin. As long ago as 1912, Professor Franz Boas published his inquiry into the effects of the American environment on the bodily form of recent immigrants. He found that the children born in the United States of European immigrants were appreciably modified from the norms of their parents. My own investigation on the Japanese in Hawaii, although concerned with a different stock, led me, after controlled comparisons with the sedent population in Japan, to conclude that physical type is plastic under changes in environment and capable of significant alterations in size and proportion.

As a result of this increasing stature of the American people, both the new and older stocks, our average now surpasses those of the various European countries from which our population is derived. It should not, however, be assumed that the people of the United States alone are undergoing this expansion in height. In various parts of Europe, in Japan, and in other areas where statistics are available, the same process seems to be affecting mankind. Here in Amer-

ica it is apparently accelerated but not unique.

Even if this trend should appear desirable and we take pride in our rising statures, we should soon reach a point where further increases would become rather alarming. If stature has been increasing steadily for the past 75 or 100 years and our college men already have attained a mean of 5 feet 10 inches, where will it all end? Are we experiencing a transformation into giantism, with averages of 6 feet 6 inches or 7 feet within several hundred years or so? Are we headed for ungainly dinosaurian proportions that will lead to our extinction? Professor Mills, of Cincinnati, says no. His recent analysis of the latest data reveals a slowing down of the process, which presumably means a stabilization or possibly a reversal in the trend.

The precise cause of our increase in size is not completely understood. It has been attributed to a variety of factors, among others to improved nutrition, better care of our young, and advances in public health. But none of them seems entirely satisfactory since some of the tallest men in our army of 1917-18 came from areas that enjoyed none of the advantages in nutrition, medical care, and pub-

HARVARD SONS were ten pounds heavier than their fathers, 1.4 inches taller, and had shoulders 4 10 inch wider

lic health that we often think are typical of all parts of the United States. That nutrition, for example, does influence the growth cannot, on the other hand, be denied. Numerous studies on growth agree that children on better regimens do grow more rapidly and attain greater size than their less fortunate fellows. We are probably confronted here with a complex phenomenon which defies an explanation based on a single variable.

It may well have occurred to the reader by this time to wonder how far the American people are evolving a characteristic American type fundamentally distinct from those of our European contemporaries. Indeed, it was firmly believed at one time that Americans were gradually assuming the aspect of an Indian, on the hypothesis that the same environment that produced our predecessor was transforming us into his simulacrum. Peter Kalm, the Swedish botanist who visited the United States in the middle of the eighteenth century, professed to find "that the French, the English, Germans, Dutch, and other Europeans, who have lived for several years together in distant provinces, near and among Indians, grow so like them, in their behavior and thoughts, that they can only be distinguished by the difference of their colour." But even this surviving mark of distinction was thought by some to be disappearing. The president of Princeton College, Samuel Stanhope Smith, D.D., observed in 1788 that a change had already become manifest in the Anglo-Saxon and other European inhabitants of America, both in complexion and feature, and he further maintained that if the colonists were thrown like the Indian into a state of absolute "savageism" they would soon be marked by the same complexion.

This belief seemed to enjoy a persistent adherence, because as late as the middle of the nineteenth century Dr. Carpenter, writing in an English cyclopedia remarked, "It has not been pointed out, so far as the writer is aware, by any ethnologist, that the conformation of the cranium seems to have undergone a certain amount of alteration, even in the Anglo-Saxon race of the United States which assimilates it, in some degree, to that of the aboriginal inhabitants. Certain it is, that among New Englanders more particularly, a cast of countenance prevails, which usually renders it easy for any one familiar with it,

to point out an individual of that country in the midst of an assemblage of Englishmen. . . . And it is not a little significant, that the well marked change which has thus shown itself in the course of a very few generations, should tend to assimilate the Anglo-Saxon race to the aborigines of the country."

So do errors reverberate down the corridors of time. An echo of this strange doctrine came to my ear not very long ago via a well known professor of English literature who repeated this fantasy with complete conviction. If this were indeed true, then those who, referring to the United States, have urged that we "give it back to the Indians" might have been speaking with more poetic justice than they expected. But any such fanciful notion must be laid aside. The American of today remains a close derivative of the stocks that have settled here, but he has at the same time undergone modifications from his ancestral types. His deviations from European norms are either the results of mixture among the various representatives of Old World types or the consequence of an increased size with the attendant changes in bodily proportion that follow on such a quantitative expansion.

THE SOLDIER of 1918 was shorter and lighter than the Harvard student but had a larger waist. Figures for the soldier of 1945 are not available

HARVARD FATHERS —Around 1890

HARVARD SONS —Around 1920

(Compiled by Gordon T. Bowles)

5 ft. 8.5 in.	Height:	5 ft. 9.9 in.
35.8 inches	Sitting height:	36.3 inches
16.8 inches	Shoulder width:	17.2 inches
34.2 inches	Chest (normal):	35.8 inches
11.6 inches	Upper arm:	12.1 inches
28.7 inches	Waist (girth):	28.9 inches
13.0 inches	Hips (width):	13.0 inches
35.1 inches	Hips (girth):	36.2 inches
20.5 inches	Thigh:	21.2 inches
13.8 inches	Calf:	14.0 inches
140.2 pounds	Weight:	150.3 pounds

U. S. SOLDIERS—1918

(Davenport and Love)

Height:	5 ft. 7.7 in.
Sitting height:	35.6 inches
Shoulder width:	16.5 inches
Chest (normal):	35.0 inches
Waist (girth)	30.7 inches
Hips (width):	11.6 inches
Thigh:	20.8 inches
Calf:	13.4 inches
Weight:	144.7 pounds

We watch Beetles

By LORUS J. MILNE

With the assistance of

MARGERY J. MILNE*

(With illustrations by the authors)

IF you had only two weeks' vacation all year, would you want to spend it watching beetles? Neither did Margery! That the beetles in question would be burying small dead animals, often at night, was no selling point. "Besides," she argued, "watching any kind of beetles, no matter how interesting, is no way to relax after another 50 weeks of war research."

A major campaign is required to convince my wife, especially when she's right. This was to be no exception. But I grew enthusiastic, describing the observations I had made on these beetles many years before, telling how spectacular were their odd habits. "Think of an insect an inch long," I said, "carrying the dead weight of a full-grown mouse or robin, moving it six, ten, fifteen feet in a

*Mrs. Milne is Assistant Professor of Biology at Beaver College, while Dr. Milne does dual duty in war research on visual problems at the University of Pennsylvania and in scientific writing for the Bausch and Lomb Optical Company of Rochester. Before the war he, too, was a biologist. Both of them have doctorate degrees in biology (Radcliffe and Harvard) and have published many scientific reports on their research work.—Ed.

few hours from hard ground to soft, and then burying it, all to provide food for several offspring." Still she was not convinced.

From our bookshelf I pulled down a well-worn field manual of entomology and showed her among its respected pages that the burying behavior of these insects was questioned by experts, believed by some to be wishful thinking and nothing more. We could make a motion picture record of the procedure, to settle once and for all that the beetles did do as I described. Margery began to waver. "It would be a definite scientific accomplishment," I pointed out, "well worth presenting before biological societies." Sold! Margery always falls for a proposed scientific advance. Well, almost always!

Two weeks' vacation can vanish overnight, it seems, unless it is well organized in advance. Each day must be planned to get the most done. To decide on a method, we ought to know as much as possible about the burying beetles, to see what others had written on the subject. Unpleasant jobs like this have always been wifely work, and Margery took it on. Beetle-like, she buried herself in the libraries of the Academy of Natural Sciences and the University of Pennsylvania, digging out the information others before us had gleaned. She even struggled with French and German observations and finally emerged sur-



▲ THE AUTHOR AND HIS WIFE, Lorus and Margery Milne, making photographic records of their findings. The mouse, which was used as bait for the

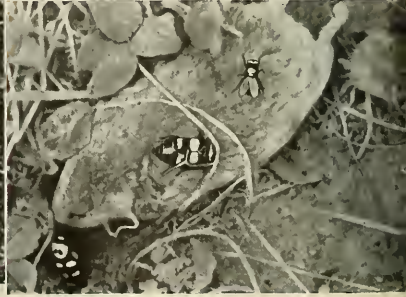
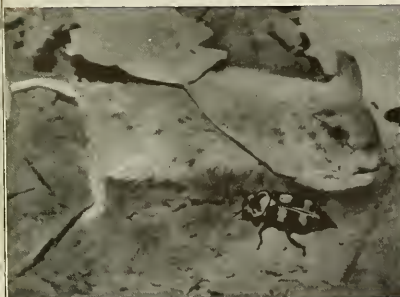
prised and elated over the whole idea.

To improve our chance of getting the photographic record wanted, we wished to find a cottage in northern Ontario as near as possible to the spot where I had seen the beetles at work in former years. We should spend little time in going and coming so as to have most of our two weeks "on location." We had to decide how much Kodachrome movie film we would need, and many other details. But our biggest worry was what to

▼ THE BEETLE THAT CAN MOVE A MOUSE 15 FEET. Among the dead leaves, the mouse appears well camouflaged, but the sexton beetle soon finds it by sense of smell

▼ AFTER MOVING THE CARCASS a short distance, the burying beetle surveys its work from atop the mouse

▼ ONE OF THE SEXTON BEETLES is stretching a clover stalk that hampers movement of the mouse. A moment later, the other beetle pulled the mouse forward a short distance





beetles, may be seen both on the ground and reflected in the mirror, which Mrs. Milne is holding in order to provide additional light for the picture

do if we found a rentable cabin, got to it with cameras and film, and then found that the beetles no longer inhabited the region. After all, it was sixteen years since I had been in that vicinity!

We decided to risk it. We even became resigned to shipping our tenting equipment to the nearest station if no cabin could be had. We had tented happily all over the United States; there was no reason to exclude Canada from our list. Friends spared us this

When two students of insect life take their only vacation to study and record the amazing habits of this tiny beetle, it is indeed a strange occurrence—and what they find is stranger still

difficulty by finding a fine cabin for us quite near the site of previous observations. We obtained our Kodachrome film and selected the last two weeks of July as the time when the beetles (if any) would be at work and when the weather was most likely to be sunny and suitable for color photography.

The day we arrived was beautiful, sunny, and warm, just as planned. I had brought along two mouse traps with which to catch beetle bait. Loading them with peanut butter, we hurried to set them out in likely spots, then stretched our legs a bit, exploring the hilly country near the cottage, admiring the stands of paper birch and evergreens, the great outcroppings of ancient granite, and the rust-colored streams and lakes. Returning from our hike we saw a line of sheep straggling from where we had hidden one trap to a group of the same animals around our second. As we approached we heard a sudden snap, which caused a momentary panic among the sheep. Since the trap made no further menacing gestures, an old ewe proceeded to lick up the rest of the peanut butter. Both traps were cleaned of bait! We chased the sheep over the hill, reloaded our traps, and hid them in new positions where the sheep would be less likely to molest them.

In the evening we climbed over the hill to check our traps, but, nothing

had happened to them. We continued our walk to renew acquaintance with the two neighbors who lived half a mile from the cottage, permanent residents who had been very friendly and helpful years before. Not suspecting our motives they welcomed us with open arms. "Well, Lorus, it's good to see you again! We have spoken of you often and the way you always used to carry a bug net. And so this is your wife! How do you do, Margery . . .!" "Mice! Mercy, you want dead mice! Do you mean you *still* collect bugs?" Horrified, they learned that I had not outgrown such nonsense, in fact had even sold my wife on the idea of photographing the burying beetles. Well! Well! Astonishment is a mild description of their reactions.

The second day dawned clear and warm, and we hurried to inspect our two traps. No mice. To add to our disappointment, one of our neighbors had told of catching 20 mice in her grain bin the week before. She had thrown them into one corner of the dooryard, but no sign of them remained. Did that mean burying beetles were still about?

We *had* to have mice. We should have brought more traps. So to town we went over the long and twisting road. At the general store I bought some traps and then an idea struck me. To the clerk at the meat counter, I said, "I'd like a few pieces of red meat, any kind at all that's fresh, not

▼ TWO YOUNG BURYING BEETLES near the foot of their food supply

▲ THE SEXTON BEETLE pays no attention to the mites on its back or elsewhere on its body. The mites for their part move about freely, keeping the beetle clean by devouring small organic particles that stick to it

▼ TO FREE THE CARCASS for burial, a sexton beetle at midnight chews through a coarse string tied to the mouse's foot



smoked, but each piece must be about three inches long and an inch or so in diameter." Her response was a blank stare, which called for further explanation. "I want about three pieces of meat, each about the size and shape of a mouse." The stolid clerk shuddered at that. I insisted. I wonder if my order still haunts her. She gave me my ersatz beetle bait, but I slunk rather than walked from the store, feeling like a vulture.

On our return to the cottage, Margery checked the traps. I heard her shout, "A mouse! A real MOUSE, very dead!" And back she came with it, trap and all. Quickly we placed it out in front of the cabin where we could watch it while we ate our lunch on the screened porch. By the time lunch was over, a sexton beetle had come to the bait, to be followed shortly by a second. To a duet composed of Margery's amazed comment and the whirr of the movie camera, first the one beetle, then the other, began to shift the mouse and get it underground.

A second mouse, carefully sealed in an envelope as a present from the postmistress, awaited us when we called for mail two days later. More beetles, more movies, more notes! And more mice came to the trapline. Thoughtful neighbors brought a mouse, a shrew, a sparrow, or a dead turkey chick as a calling card. Our fame spread as the bait came in from miles around. For a time we actually had a reserve supply of mice in pint sealers in the ice box. *Those* mice weren't mentioned when we served our callers iced tea and cookies.

Almost everyone becomes interested in an animal if it shows evidence of care for its young. When an insect goes to great trouble to provision and protect its offspring, it is sure to attract attention. The sexton beetles show a very advanced form of parental care in a group of insects where such is not common. In many cases, a small animal may be dead less than three quarters of an hour before a pair of burying beetles have flown to the scene, finding their way by scent. The beetles may bury the carrion where it lies if the ground there is soft and free from roots and stones, or may move it some yards to a suitable site. The body is usually buried to a depth of two to three inches and worked into a ball by the attendant beetles. Feathers or hair, loosened by

the normal process of decomposition, are moved aside. The female beetle lays about fifteen eggs in a little alley excavated to one side of the main chamber.

When the eggs hatch to active little yellow grubs, the parents feed on the carcass and regurgitate partly digested food for the young. After moulting twice, the grubs are very fat and sluggish and soon will be led off through the earth by the parents, away from the remains of the food mass, to pupate and change into adult beetles. There being no need for further feeding or protection, the parents leave at this time.

It is evident that the burying beetles do something to embalm the carcass, but no one knows how they do it. We are aware that destruction of the mass by maggots and similar animals is prevented by the simple process of their being eaten by the parent beetles before any significant losses have been sustained. We do not know how the watchful beetles restrain bacterial action, nor why the tissues turn quickly to a gray paste which lasts for a month or more in this condition while the young and parents feed from its surfaces. This is not the rapid drying out by which the Egyptian mummies have been explained; it is not a mummy but a food supply. It approaches the preserved eggs for which the Chinese have long been famous, but the secret has not yet been disclosed.

The ancient Egyptians knew how to prepare mummies, but they were highly interested in another kind of beetle which worked in pairs, rolling a ball of dung on which their offspring were to feed. This activity led to reverence for the beetle as the "sacred scarab," and when later the Roman legions overran Egypt, the same beetle was adopted as an emblem for their flags. Yet no one seemed to know that when these scarabs have rolled their ball to a suitably soft site, they bury it much as do sexton beetles!

Similarly the sexton beetles were known for many years to transport dead mice and other small carcasses. Their scientific name, *Necrophorus*, refers to carrion carrying and was given to the beetles in the late 1700's. Still few had watched the insects at work, and although they are widespread in the northern hemisphere, their life history was not described in detail until 1933. The burying habits espe-

cially have rarely been observed, and many scientists have doubted that these beetles could possibly show such ingenuity and ability. In part this is due to the preference shown by sexton beetles for nocturnal activity. Flies offer less competition then. However, this can not be the sole explanation of ignorance concerning them, since some of the scientists who have studied these insects in recent years have experienced difficulty in following the beetles prior to the completion of burial. Several report spading up many square yards of soil around the spot where a dead mouse had been set out as bait, all to locate the buried carcass and its attendant beetles.

Sixteen years ago I had realized that a mouse or bird set out as bait could vanish in an hour or so unless tied securely to a stake. In fact, tying the bait with a string did not solve the problem since the beetles can cut a string in a short time. Fine steel wire, however, presented an insuperable obstacle to beetles attempting to carry their trophy to a more suitable burial place. Scientific curiosity might in time have led to this discovery, but spading up large areas of rocky ground for buried bait is wearisome, and I have always suspected that laziness



▲ THE AUTHOR AND HIS WIFE examining a collection of the many different kinds of beetles that were lured to their bait

has mothered more inventions than necessity ever did. Anyway, my earlier interest was in collecting the beetles, and how could this be accomplished more simply than by pulling on a wire to disinter the buried mouse and the pair of insects?

We were anxious to get a motion picture record of beetles cutting a string to free a mouse for burial. After many attempts we decided to tie a coarse string to one hind foot of the mouse, and have the cord extend almost vertically to its attachment point on a near-by stake. A pair of large sexton beetles attempted to bury our bait. Finding that they could not transport the mouse away from the stake, the insects proceeded to loosen the earth immediately below the bait. Soon they had not only broken the soil into small fragments and freed it of roots, but they had produced a cup-shaped cavity over which the mouse dangled on the end of its tether. The cup became larger than the mouse by the thickness of the beetle's body all around and underneath. The insects tried and tried to get the body to fall into their pit. They tugged and they pulled. They rotated it over the cup, first one way, then the other. No luck! The mouse's tail dragged on the cup's rim. Perhaps it was holding the mouse. First one beetle would investigate the tail, then the other, each crawling along the length of the tail from base to tip to see that it was free. It was, but the traffic became so heavy and the mouse so ripe that the skin slipped off the tail like a glove finger. Still the mouse was suspended. One beetle settled on the base of the tail and slowly gnawed it off. Although there was no change in the mouse's position, a beetle now attacked the string.

To get our photographs of the string-chewing, I sat by that mouse with camera trained all afternoon, while the beetles rotated the body over the cup and chewed on the tail. My supper was served beside the camera. Darkness fell and mosquitoes arrived. The string-chewing was finally shot by the light of a flashlamp with the telephoto lens wide open. The colors are good on the Kodachrome record, and the beetle chews magnificently! The patient Job would have made a good insect photographer! My mosquito bites swelled up like his boils.

We had reason to be glad that our tent was in storage and that we were

living in a cabin with a good roof. The first two days were almost the only ones in which it did not rain! Thereafter we did our picture taking in short bursts between showers. We brought in the mice each time to keep them dry and photogenic, then rushed them outside and prayed for beetles at the first hint of sun. One evening we were particularly tired and disgusted with the weather. Instead of putting all our bait away, I tossed one overworked mouse into a butterfly net and, folding the net bag on itself several times, leaned it all against the cottage for the night. In the morning we regretted my haste. Beetles had come to the net, and while the old mouse was still there, so were the beetles, having chewed great holes in the layers of Brussels net to reach the carcass. Only the number of layers of netting kept the many beetles from fighting with each other. Only two had actually reached the body, both large ones. Concern over the sad state of the net kept us from learning how the ingenious beetles would have freed the mouse for orthodox burial. How often have emotions come in the way of scientific observation?

Because of the rain, the insects were most exasperating at times. Fine sun, good mouse, camera ready, photogenic beetles at work, and then they would run off to explore surrounding areas ten to twenty feet away, or would rest for ten minutes with heads among a clump of grass roots. Then as though at a signal, back they would come and all would be fine for photography except that the sky was clouding, a large tree cast a dense shadow on the mouse, the cameraman's assistant had deserted him for some other task, and there were 25 flies, more or less, around the bait!

Three kinds of sexton beetles came to our bait, two of them commonly. One of the two was a large variety, the other not over three-quarters of an inch long and usually much smaller. Size was no guide to sex but it was to disposition. The large type consistently drove away the smaller, and never more than two of the big fellows worked on a single carcass. The smaller kind was more sociable, three often co-operating in transporting a mouse and through the early stages of burying it. Never more than a single pair remained with a mouse, although two pairs of the small type

shared a young turkey. A 30-inch garter snake was buried and attended by two pairs. Apparently the amount of food required by a brood of young determined whether a particular carcass could be shared. The pairs that finally stayed with the carrion were always composed of a male and a female. Sexton beetles arriving at a body that was being moved or buried by a pair were usually driven off at once. Only the large kind was able to dispossess the original "owners."

We tried experiments to test the "ownership" sense. Our friends say they were diabolical. Probably so. We would place a second mouse of similar vintage a foot away from bait on which a pair of beetles were working. During their rest periods, the insects invariably discovered the additional carcass but never did they desert the one found first in favor of the second mouse. They were obviously confused by the extra bait, but examination of it was always followed by a hurried return to the original carcass. We even tried interchanging mice, so that location of the carrion would give no clue. Still there was no swerving in the beetles' loyalty. The first-found bait was IT, and no other could be substituted.

One garter snake innocently gave us a great deal of amusement. A neighbor discovered beetles burying it one evening. She erected a stake to mark the spot and came panting over the hills to tell us about it. It was too late for pictures, but in the morning the sun rose and we hurried down with our equipment. As we set up the cameras, our neighbor spotted us from her house in the distance and came on the run to see the excitement. Her slender niece and a large, well rounded house guest were at her heels. Had our supply of Kodachrome not been dwindling fast, we could have taken a priceless scene of all of these friends down on their tummies, squirming under a high wire fence rather than take time to go around by way of the gate! A few minutes later I was ready to start digging out the snake, and Margery was to operate the movie camera. The scene progressed nicely but two beetles came to the surface and seemed ready to fly away. Without thinking, Margery grasped a beetle in each hand and held them out to our neighbors. "Please hold these while we get the rest of the scene." Now, our friends were very much interested as spectators, but

Continued on page 290



◀ SEASONED TOURISTS exclaim over the unworldly atmosphere produced by the weird Goliaths of the desert

helps to break up steady currents of hot, dry air, further lowering surface evaporation. The shallow root system of the saguaro forages widely for moisture. During the few soaking rains of winter and the sudden, spotty downpours of summer it takes up enormous quantities of water. The wrinkled, fluted exterior of the plant gradually expands like the bellows of an accordion as the spongy tissues fill with water, and the cactus takes on a swollen, bloated appearance. During unusually wet winters, an occasional saguaro may split open from the internal pressure of moisture it has absorbed. The saguaro is an immense vegetable water tank that drinks like a glutton and then guards every drop of moisture.

Although a saguaro may live to be 200 years old, most of them succumb earlier to a bacterial disease to which they become increasingly susceptible after reaching full maturity.

During its adult lifetime, each plant produces and scatters billions of seeds, not one of which may be successful in escaping its numerous enemies and developing into a saguaro plant. The occasional seed that does happen to fall in a protected spot

WHEN President Herbert Hoover in 1933 established Saguaro National Monument, conservationists believed that a unique part of America, the finest of the nation's rare forests of the giant cactus, was preserved for posterity. But conservationists, and every one else, were blissfully unaware of two vital factors: the long-gone pioneers of southern Arizona, and a tiny moth. This peculiar combination has recently risen to threaten the people of the United States, and especially of Arizona, with the possible destruction of their Cactus Forest*.

The huge, leafless, stiff-armed candle-labrum of the desert gave Arizona its State Flower and has become a trade-mark of the entire Southwest, although its range is limited to Old

Mexico, southern Arizona, and extreme southeastern California.

The saguaro (pronounced suh-wah-roh) represents one of Nature's most interesting and highly specialized botanical developments. Reaching a height of over 50 feet, a weight of twelve tons, and a maximum age of about 200 years, the saguaro is truly a vegetable Goliath. And a forest of these spine-sprouting monsters, like the crowded spears of a dragon-tooth army standing silent guard over the hills of Arizona, is a spectacle guaranteed to thrill even the most sophisticated tourist.

Move closer to one of these desert Goliaths and you will begin to see how it is able to raise its fluted stems in defiance of blazing sun and parching wind. Leaves, which permit the escape of much moisture, have been discarded, and tough green skin has taken over their food-making function. The dense growth of spines

A Green Goliath meets its Desert David

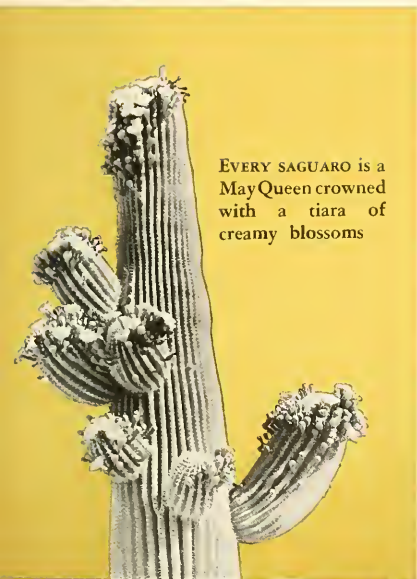
By NATT N. DODGE

ALL PHOTOGRAPHS BY NATIONAL PARK SERVICE

A tiny moth and the long-gone pioneers of southern Arizona threaten the life of the saguaro—State Flower of Arizona and symbol of our Southwest. Is it worth saving?

*A shorter discussion of the threat to the Cactus Forest was published in *NATURAL HISTORY* soon after the Department of Agriculture began its intensive investigations: "Death in the Desert," by Lake S. Gill, in the issue for June, 1942.

where conditions are favorable for germination and manages to avoid destruction beneath the trampling hoofs of grazing cattle or by plant-eating rodents, grows almost imperceptibly during its first two decades. "It is often ten or fifteen years before the seedling saguaro becomes large enough to be noticed," states Dr. Forrest Shreve of the Desert Laboratory in Tucson, Arizona, "and twenty to thirty years before it begins to raise its head above the shrubbery that has sheltered its infancy."



Life begins at thirty

A saguaro 30 years old is about three feet tall and fully protected by an armament of spines against molestation by desert animals. Supported and nourished by a root system like the radiating spokes of a wheel, the young plant begins to put on height and may grow three or four inches each succeeding year.

When eight or ten feet tall, it reaches the first flush of maturity and is ready to blossom. Buds appear in April on the crown of the plant. On older saguaros, buds crowd the tips of all branches as well as that of the main trunk and, as if they had spilled over, may burst out down the side of the stem for several feet. The flowers open at night, exposing their creamy petals around a velvety center of golden anthers. They close during the afternoon of the following day, never to open again. However, only a few of the horde of buds open on any one night, so the plant may remain in flower for several weeks. The crown of blossoms makes the saguaro ruggedly beautiful and spectacular.

The blossoming saguaro is a source of food for swarms of insects that seek the flowers for their sweet nectar and protein-rich pollen. Insects, in turn, attract flycatchers and other insect-eating birds. By July, the flower-

ing period has ended and the first of the saguaro fruits are beginning to ripen. Resembling small cucumbers, they occupy the tips of the trunk and arms where the flowers have withered. When fully mature, they split open, revealing scarlet interiors almost as spectacular as the display made by the creamy blossoms. The pulpy center of each fruit contains a mass of tiny, black seeds. Pulp and seeds are sought by rodents, which miraculously scale the spiny stems of the tall plants or pounce on the windfalls as they reach the ground. Birds consume the sweet pulp and nutritious seeds, and the Pima and Papago Indians migrate from their villages to harvest camps and gather tons of fruit. Seeds, pulp, and juice are separated and prepared for storage. Seeds are ground into rich, oily meal and pressed into cakes; pulp forms the base for jams and preserves; the juice is boiled to the consistency of syrup and provides the Indians with their principal all-year source of sweets. So important was the saguaro in the economy of the Papago Indians before the coming of white men that their calendar was based upon it: the saguaro harvest ushered in the Papago New Year.

Man and beast, bird and rodent, all have been harvesting saguaro fruits since long before Coronado in 1540

▼ CAN ANY STATE boast of a more spectacular and unusual State Flower than Arizona's saguaro blossom?





▲ LIKE A MILLION spears held high, saguaro arms of the Cactus Forest reflect the brilliance of the desert sunshine

first recorded the plant and Castañeda described it as a "giant thistle with fruits that open like a pomegranate." Thus, even before the coming of white men, the saguaro was encountering plenty of difficulty in reproducing itself. The few that survived as tiny plants, usually beneath the friendly shelter of the mesquite, ironwood, or other shrub, still had to run the gauntlet of moisture-hungry rodents. The intricate and delicate balance attained by Nature under settled conditions of long duration gave the saguaro a reasonably secure position in the complex plant and animal community of the Sonoran Desert. But, as with all life in a stabilized community, the introduction of a new factor could easily upset the balance and start a succession of events that would bring tragedy. This is what happened, and the new factor was the white man.

Coronado and his conquistadores passed through what is now southern Arizona in 1540, and Father Kino brought domestic livestock, cereals, and other manifestations of European civilization to the desert in the 1690's. But it was not until 1776 that the village of Tucson was established. As a major station on the famous Butterfield Stage Line to California and a supply base for punitive expeditions against the marauding Apaches, Tucson developed into a thriving outpost of civilization. Woodcutters ranged farther and farther afield, harvesting the mesquite and ironwood that fringed the desert washes to supply

fuel for village fires and fence posts for the settlers. In the foothills of the Tanque Verde Mountains, east of Tucson, limekilns were built, and the immediate vicinity, now the general location of Saguaro National Monument, was denuded of trees as fuel for burning the limestone.

In the 1870's and 1880's, cattle increased to such an extent that there was serious overgrazing of the range around Tucson. Vegetation left by the woodcutters was browsed and trampled. Hillsides were stripped of their protective plant growth, allowing the thin layer of duff and humus to be washed away. Coyotes found veal palatable, and the cattlemen declared unremitting warfare upon them. With the decrease of coyotes, there was a corresponding increase in the population of their natural prey, the ground squirrels, rabbits, kangaroo rats, and other desert rodents. The remaining vegetation on which these rodents fed naturally suffered.

And so, as the years passed and the individual saguaros making up the great Cactus Forest along the base of the Tanque Verdes east of Tucson grew older and more vulnerable, a gradual change was taking place. Few noticed, but no longer were there any young saguaros hidden beneath the occasional tree that still remained. Woodcutters had stripped the area of mesquites and ironwoods, whose low-hanging branches were so essential to the protection of saguaro seedlings. Half-starved cattle wore trails across the hillsides and trampled

new growths into the gravelly soil. Rodents, released from their coyote enemies, multiplied amazingly, ate everything that was moist or green, and gnawed the bark from shrubs and brush. Hardly a single infant saguaro survived. In half a century, Nature's balance had been upset, and reproduction of saguaros in the Cactus Forest east of Tucson had practically ceased.

The warning almost imperceptible

Yet, to the casual observer, all seemed serene and unchanged. The widespread forest of gray-green saguaros lifted fluted arms high into the golden sunshine, and each spring their creamy tiaras of flowers gleamed like the silver crowns of a million queens of the May. More and more people from the East and North learned of the delightful winter climate of southern Arizona and came to Tucson to see, among other attractions, the famous forest of giant cacti. And so, in 1933 Saguaro National Monument was established—a scientific marvel to be protected and preserved for the benefit and enjoyment of the people of the United States.

Both the Federal Government and the University of Arizona were then interested in the Cactus Forest and the many manifestations of desert biology presented there, but it was not until 1938 that the lack of young, small saguaros received attention. A tentative study was started by Carleton and Judith Wilder to determine if reproduction actually was subnormal and if so why. No great importance was attached to the findings. It took a serious outbreak of the bacterial disease to start a series of studies that, although not yet completed, have brought to light the chain of events described here. This disease is the only cause of death among saguaros, so far as is known, except for an occasional wind-thrown individual.

During the summer of 1939, Dr. J. G. Brown of the University of Arizona noticed that many of the older and larger saguaros around Tucson were infected with a type of rot. In Saguaro National Monument, because of the preponderance of mature individuals, the disease reached epidemic proportions. Great sores appeared in the branches and trunks of the desert Mammoths, exuding a black, syrupy fluid that dribbled down

the trunks and formed tarry pools on the ground. The plants literally melted away and died, leaving only their polelike skeletons and big patches of parchment-like skin.

Through exhaustive tests, Dr. Brown and his students determined that the cause of the disease was a bacterium, *Erwinia carnegiana*, and the situation was reported the following year to the United States Department of Agriculture. During 1941 and 1942, the Bureau of Plant Industry, Soils, and Agricultural Engineering sent Dr. Lake S. Gill and Mr. Paul Lightle to set up study plots in the Cactus Forest and to carry out extensive investigations. Remedial measures necessitated the destruction of 335 seriously infected plants.

Continued studies by Dr. Brown of the University and by Drs. Lee M. Hutchins and James L. Mielke of the Bureau have since uncovered a number of pertinent facts. These investigations are still under way and no conclusive statements can be issued until the work has been completed. However, according to a recent unpublished report by Dr. Mielke, some of the findings are so strongly supported by accumulated evidence that the following statements seem to be well established.

Apparently this disease, or necrosis, has for centuries been the principal cause of death of saguaros. It is generally fatal only to mature plants.

Younger plants become infected, but the lesions callous over and the plants usually recover, except for an occasional individual.

The bacterium causing the disease is carried within the intestine of the larvae of a small, night-flying moth, *Cactobrosis fernaldialis*, the David to which the saguaro plays Goliath. The larvae live only in fresh, pulpy saguaro tissue and gnaw tunnels indiscriminately through the flesh upon which they feed. It is along these tunnels that the bacterial infection makes its appearance. The rot has not yet been found in association with any injury of the saguaros other than the tunnels made by the moth larvae, except in the case of one lightning-struck plant.

There are some interesting sidelights. For example, two or more species of drone flies breed in the rot pockets in the decaying saguaro pulp. Woodpeckers, particularly the Gila woodpecker and the Gilded Flicker feed on the larvae of the drone flies. Probing in search of them, the birds open the rot pockets and clear out some of the decayed material. Apparently about 50% of the lesions thus opened, even in old plants, callous over and heal. Thus the woodpeckers become an important aid to saguaros in effecting self-recovery.

Taking a lesson from the woodpecker, technicians of the Bureau of Plant Industry, by opening and draining rot lesions, found they were able to save many infected saguaros. However, since the infection starts along the larvae tunnels deep within the tissues of the plant, the disease frequently destroys so much tissue before there is visible evidence that control measures are impractical. It has not been found possible by any means yet developed to prevent the death of a certain proportion of infected plants each year. So, like an army surrounded by the enemy and

without hope of reinforcements, it appears to be just a matter of time until the famous Cactus Forest of Saguaro National Monument will gradually go down under the persistent efforts of the bacterium and its moth-larvae carrier.

Can extinction be prevented?

The pioneer woodcutters, their cattle, and the coyote hunters of old Tucson, with the help of the larvae of this moth, seem to have set the stage for the destruction of the Cactus Forest. But is it not still possible for us to step in on the side of Mother Nature and counteract the damage that was unwittingly started by the pioneers back in the 1880's? Can we not fence out the cattle, poison the rodents, encourage the ironwoods and mesquites to re-establish themselves, and in so doing restore conditions favorable to a new generation of saguaros? It may not be reasonable to expect the cowmen owning or leasing large blocks of land in the Cactus Forest portion of Saguaro National Monument to remove their cattle and turn over their range to cactus and coyotes. But many will say that it is sad indeed if a great country like ours, in which the expenditure of a billion dollars scarcely makes a newspaper item, cannot buy out these private lands, which have such relatively trifling economic worth. The unfortunate cattle, probably dozens or hundreds, certainly not thousands,

Continued on page 290



◀ THIS SAGUARO is seriously infected with the disease and is literally melting away. Note the big lesion on the trunk just above and between the branches. Moisture stored in the great plant flows from the open sore in sticky, tarlike rivulets

➤ ONLY THE SKELETON bleaching in the desert sun: a desert giant that recently became a victim of the disease



Deep in the jungle's forbidding wilderness, these magnificent creatures enact a drama of enchanting beauty. Centuries of search have revealed their secrets, and now the finest existing collection enables the American Museum to offer the public a spectacular new exhibit

Birds of

By ERNST MAYR

Curator of the Whitney-Rothschild Collections,
American Museum of Natural History

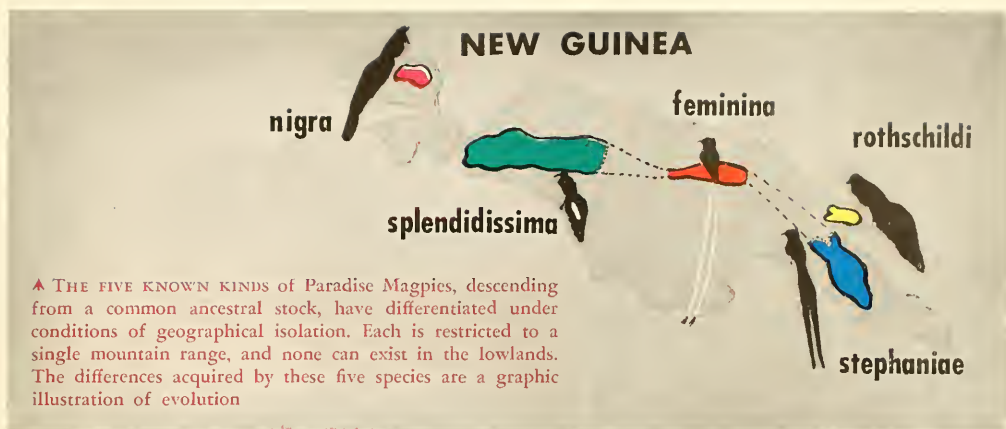
A.M.N.H. photo

▲ GREATER SICKLE-BILL (*Epimachus fastosus*). In its display the male resembles a long-tailed giant butterfly. Although restricted to the mountain forest above 5000 feet in western and central New Guinea, this bird was already known to the eighteenth century naturalists through skins collected by the natives

THE birds of paradise richly deserve the epithet "the most beautiful birds in the world." Theirs are not only exquisite colors, such as oranges, greens, blues, and reds of many shades, combined in harmonious patterns; what gives them their real distinction is their plumes. The many shapes into which Nature has been able to mold their feathers are a constant source of amazement. There are the true plumes of the genus *Paradisaea*, which surpass the feathers of egrets in soft daintiness. Others have the prismatic sparkle of highly polished metal, their reflections changing with the angle of the light to pass through the whole spectrum of the rainbow. The Superb Bird of Paradise has a velvet cape of softness and dignity to make every well-dressed lady envious. The most astonishing feathers of all are the plumes of the King of Saxony's Bird of Paradise. This bird is no larger than a small thrush, but it produces on either side of its head a thin "feather" a foot and a half long,

whose simple wirelike shaft is be decked on one side with two-score little horny plates like silvery-blue flags.

So extraordinary is the plumage of these birds, which are found nowhere outside the New Guinea area, that some were known to Oriental traders and seafarers centuries before the actual discovery of their native home. As a result, some fantastic ideas grew up about the birds. The first skins to reach Europe were brought by El Cano who, after the death of Magellan, took over the command of the first circumnavigation of the globe. At the small Moluccan Island of Tidore, the Rajah of Batjan presented him with several bird of paradise skins, which reached Spain on September 6, 1522. These skins had been prepared by New Guinea natives in the customary way by taking out the body, cutting off the legs, and drying the skin over a fire. The curious legless skins with the beautiful long plumes led to some amusing stories. Girolamo Cardano, for ex-



Paradise

ample, wrote in 1551: "The 'Birds of the Gods' come from the Moluccas where they are picked up dead on land or in the sea. They are never seen alive. Since they lack feet, they are obliged to fly continuously and

live therefore in the highest sky far above the range of human vision . . . the back of the male is hollowed out and the female lays her eggs into this cavity and incubates them while the male continues flying . . . they require no other food or drink than dew from Heaven." The name Bird of Paradise was given them in the belief that Paradise was their true home.

At this time their plumes were already in use as customary ornaments by the Janizaries of the court of the Sultan of Turkey, as reported by

Belon (1546-1549). The first (and very inadequate) illustration of a bird of paradise was published by the Swiss naturalist Gesner in 1555. All these early reports seem to refer to the Greater Bird of Paradise (*Paradisaea apoda*). In 1605, Charles L'Ecluse was already able to give a short but accurate description of three

▼ EMPEROR WILLIAM'S BIRD OF PARADISE (*Paradisaea guilielmi*). At the climax of its courtship display, the male hangs upside down

A.M.N.H. Kodachrome



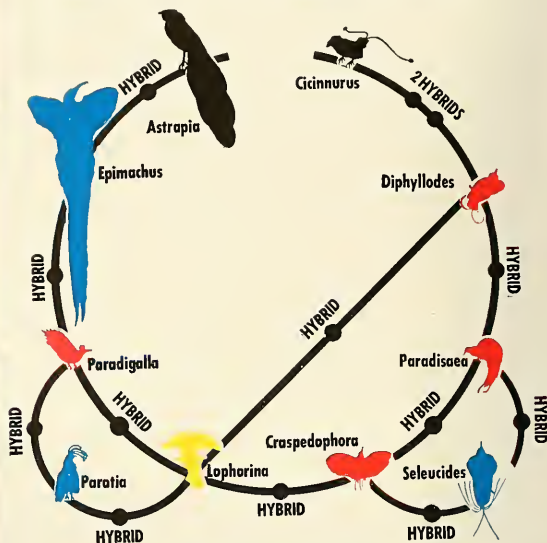


▲ SWAMPY LOWLAND FORESTS, particularly with sago palms, are the favorite haunt of the Twelve-wired Bird of Paradise. When exposed to the sun, the delicate orange of the plumes bleaches to white. The female is plain: brown and black above, barred buff and brown below

A.M.N.H.
photos

► A NEW MUSEUM EXHIBIT OF "RIFLE BIRDS," as the black birds of paradise, with velvety and iridescent colors, are sometimes called. As if to make up for the simplicity of their black dress, these birds have developed some of the most bizarre ornamental plumes known among birds

▼ TEN of the 20 genera of birds of paradise are known to cross and produce hybrids, as shown by this diagram. Two of these (in black) cross with species of only one other genus. Three of them (in blue) cross with two. Four of them (red) cross with three. The Superb Bird of Paradise (yellow) is known to produce hybrids with four other genera. (The colors are represented arbitrarily)



▼ BIRD OF PARADISE eggs are mostly orange streaked with brown. Those of six different species are reproduced here in actual size. At lower left is the Twelve-wired Bird of Paradise. Right upper and center are the Australian Rifle Bird and the Paradise Magpie respectively. The other three are Plume Birds. (Actual size.)

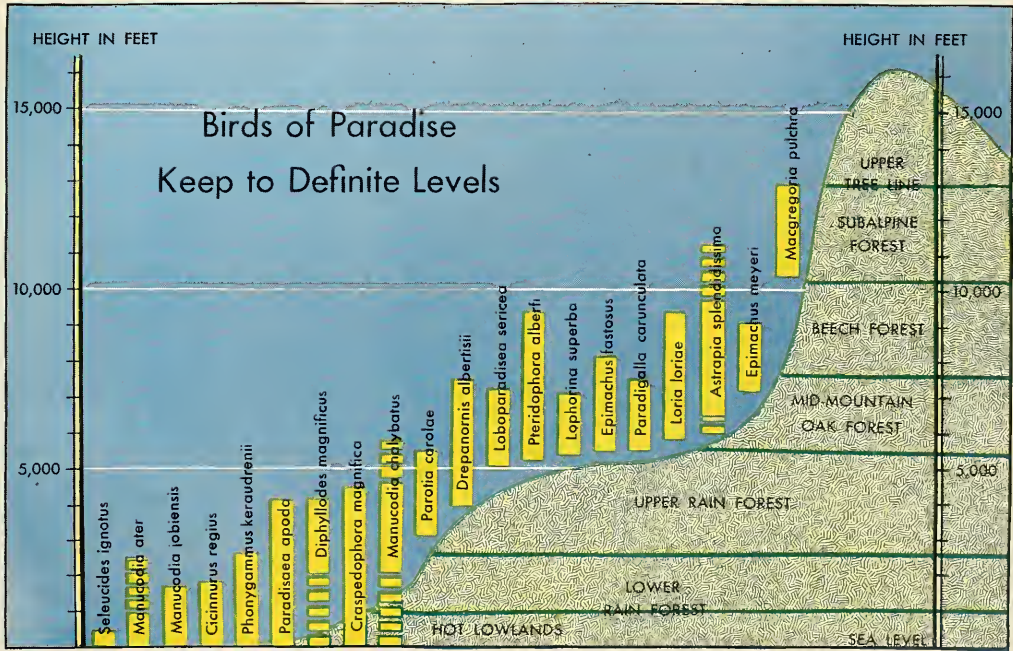
After Ernst Haeckel, in Novitates Zoologicae



A.M.N.H. Kodachrome

▲ THE LESSER BIRD OF PARADISE (*Paradisaea minor*) was one of the most important "plumed birds" of the feather trade. Countless thousands were killed annually early in this century to adorn ladies' hats. Groups of males have "dancing parties" in a favorite tree where they display their plumage in an effort to win the favor of visiting females

▼ BIRDS OF PARADISE are restricted to definite elevations like all animals. The chart below shows the ranges of 20 species in relation to the zones of vegetation on the slope of the Snow Mountains in South New Guinea





A.M.N.H. Kodachrome

▲ THE BLUE BIRD OF PARADISE (*Paradisaea rudolphi*) is named in honor of the ill-fated Archduke Rudolph of Austria. It is found

only in the mountains of southeast New Guinea. In its upside-down display it spreads its delicate blue plumes fanlike

species, but François Valentyn (1726) was the first to describe in detail the plumage, habits, and distribution of six species. Since then, the exploration for birds of paradise has made rapid progress. A new species was discovered in the interior of New Guinea as recently as 1938.

The thrill of the search for birds of paradise was conveyed by the celebrated naturalist Alfred Russel Wallace, writing from Aru almost one hundred years ago: "The first two or three days of our stay here were very wet, and I obtained but few insects or birds, but at length, when I was beginning to despair, my boy Baderoon returned one day with a specimen which repaid me for months of delay and expectation. It was a small bird, a little less than a thrush. The greater part of its plumage was of an intense cinnabar red with a gloss as of spun glass. On the head the feathers became short and velvety and shaded into rich orange. Beneath, from the breast downwards, was pure white, with the softness and gloss of silk, and across the breast a band of deep metallic green separated this

color from the red of the throat. Above each eye was a round spot of the same metallic green; the bill was yellow, and the feet and legs were of a fine cobalt blue. . . . Springing from each side of the breast, and ordinarily lying concealed under the wing, were little tufts of grayish feathers about two inches long and each terminated by a broad band of intense emerald green. These plumes can be raised at the will of the bird and spread out into a pair of elegant fans when the wings are elevated. But this is not the only ornament. The middle feathers of the tail are in the form of slender wires about five inches long, which diverge in a beautiful double curve. About half an inch of the end of this wire is webbed on the outer side only and colored of a fine metallic green and, being curled spirally inward, form a pair of elegant glittering buttons, hanging five inches below the body and the same distance apart. These two ornaments, the breast fans and the spirally tipped tail wires, are altogether unique, not occurring on any other species of the 8000 different

birds that are known to exist upon the earth. . . . My transports of admiration and delight quite amused my Aru hosts who saw nothing more in the "Burong rajah" than we do in the robin or the goldfinch.

"Thus one of my objects in coming to the Far East was accomplished. I had obtained a specimen of the King Bird of Paradise (*Paradisaea* [*Cicinnurus*] *regia*), which has been described by Linnaeus from skins preserved in a mutilated state by the natives. . . . The emotions excited in the mind of a naturalist, who has long desired to see the actual thing which he has hitherto known only by description, drawings, or badly-preserved external covering—especially when that thing is of surpassing rarity and beauty—require the poetic faculty fully to express them. The remote island in which I found myself situated, in an almost unvisited sea, far from the tracks of merchant fleets and navies; the wild, luxurious tropical forest, which stretched far away on every side; the rude, uncultured savages that gathered round me—all had their influence in deter-

mining the emotions with which I gazed upon this "thing of beauty." I thought of the long ages of the past, during which the successive generations of this little creature had run their course—year by year being born and living and dying amid these dark and gloomy woods, with no intelligent eye to gaze upon their loveliness; to all appearance such a wanton waste of beauty. Such ideas excite a feeling of melancholy. It seems sad that on the one hand such exquisite creatures should live out their lives and exhibit their charms only in these wild, inhospitable regions, doomed for ages yet to come to hopeless barbarism; while on the other hand should civilized man ever reach these distant lands and bring moral, intellectual, and physical light into the recesses of these virgin forests, we may be sure that he will soon disturb the nicely-balanced relations of organic and inorganic nature as to cause the disappearance and finally

the extinction of these very beings whose wonderful structure and beauty he alone is fitted to appreciate and enjoy. This consideration must surely tell us that all living things are *not* made for man. Many of them have no relation to him. The cycle of their existence has gone on independently of his and is disturbed or broken by every advance in man's intellectual development; and their happiness and enjoyments, their loves and hates, their struggles for existence, their vigorous life and early death, would seem to be immediately related to their own well-being and perpetuation alone, limited only by the equal well-being and perpetuation of the numberless other organisms with which each is more or less intimately connected."

The writer is often asked by would-be young explorers what chances there are for the discovery of new birds of paradise. Crystal gazing is not my profession, and the only an-

swer I can give to such a question is based on an estimate of probabilities. Since 1910, only one good species of bird of paradise has been discovered, and even that is a geographical representative of three other mountain species that had long been known. I would judge, therefore, that the chances are exceedingly slight. However, it is a virtual certainty that unknown *races* will be discovered in the unexplored mountains in the interior of New Guinea. As late as 1929, I discovered a new race of the little Golden Silky Bird of Paradise (*Loboparadisea*) in the Herzog Mountains, near Lae of recent battle fame, a species previously known only from the Snow Mountains of Netherlands New Guinea.

The most striking discovery of recent years was the male of the Ribbon-tailed Paradise-Magpie in 1938, of which the inconspicuous-looking female had been known already for 25 years. This magnificent bird has two extremely long silky-white central tail feathers with black tips. The rest of the plumage is black and dark green, the glossy parts sparkling in all the colors of the spectrum. It is not surprising that this bird has escaped discovery so long, because its range lies in the most inaccessible part of central New Guinea, in the mountains between the headwaters of the Fly and Sepik Rivers. While most or all of the species are known, so little is known about their habits and life history that any student is sure to make his share of discoveries. There are at least ten species whose habits are still completely unknown.

Elusive birds of paradise

One reason why Lord Rothschild asked me, in 1927, to go to New Guinea was to search for the so-called "rare birds of paradise." This term has a special meaning. In the days when the plume trade was flourishing, tens of thousands of bird of paradise skins went every year through the hands of the great plume dealers in the Indies, Paris, Amsterdam, and London. These dealers, among whom the Dutchman Duivenbode and the French dealer Mantou were best known, discovered each year in their shipments from New Guinea a few skins that did not seem to belong to any known species. Lord Rothschild and other collectors were willing to pay fabulous prices for



A.M.N.H. photo

▲ THE SUPERB BIRD OF PARADISE (*Loborina superba*) has two sets of plumes. One is a breast shield of a glossy green; the other is a cape of velvety black feathers which can be raised over the head. The inside of the mouth is brilliant yellow and is displayed prominently against the background of the raised black cape

these specimens, which they subsequently described as new species. In later years, it was discovered that some of these skins had come by devious channels from inaccessible mountains in remote parts of New Guinea. More than a dozen of these species, however, defied all the efforts of even the most resourceful hunters. Lord Rothschild did not give up hope, however, and when he sent me to New Guinea it was in the expectation that the home of these rare species would eventually be discovered. I was to make a thorough survey of a number of isolated mountain ranges in that region.

I had a most successful expedition in every way except with respect to Lord Rothschild's pet project. I did not rediscover a single one of the rare birds of paradise. My failure to do so, however, was indirectly responsible for the eventual solution of the puzzle. It set Professor Stresemann of the University of Berlin on the track of these birds, and by a careful study of the museum specimens he came to the conclusion that all the fifteen rare birds of paradise, whose homes could not be discovered, were actually hybrids of well-known species. This conclusion is now universally accepted.

Frequency of crossing

The question has often been asked why hybrids are so common among birds of paradise. But are they really common? If one or two such hybrids were culled out of an annual crop of 30,000 to 50,000 plumes, it would mean that only one out of 20,000 birds is a hybrid. This is certainly not a very high ratio. Even so, there is reason to believe that it is higher than among most other birds. The reason is obvious as soon as we recall the breeding habits of these birds. The nestling female bird never sees her father, and her younger brothers as well as her mother are of a simple coloration, totally unlike that of the adult male. The mature female is attracted to the display ground when she is ready for mating and leaves the male soon after. It is only to be expected that she will accept a mate of another species oftener than will females of species in which the members of a pair live together for days, weeks, or months before the actual start of reproduction.

The American Museum's collection of birds of paradise was very

meager until about twenty years ago. Dr. Leonard C. Sanford, generous trustee of the Museum, who has done so much to build the Bird Department, was fully aware of this deficiency. In 1928, he sent Rollo H. Beck to northeast New Guinea and the writer to Dutch New Guinea to fill some of the gaps, and in 1929 they were followed by the Whitney South Sea Expedition, sponsored by Harry Payne Whitney, which concentrated on British Papua.

The result of these efforts was the finest collection of birds of paradise to be found in America but, alas, still a very poor second to the famous collection in the private museum of Lord Rothschild in England. This collection, resulting from 40 years of concentrated effort, contained nearly every known kind of bird of paradise, including about seventeen that were for the first time described by Lord Rothschild himself. Furthermore, this collection was of inestimable scientific value, because it contained large numbers of young, female and male birds in various stages of molt, giving a complete picture of variation and evolution in this wonderful group.

It seemed utterly beyond our fondest hope that the American Museum should ever come into possession of such a magnificent collection. It was therefore an overwhelming surprise when in 1932 Lord Rothschild offered his entire collection for sale and Mrs. Harry Payne Whitney seized the opportunity to donate it to the American Museum. It gives this institution by far the finest representation of birds of paradise existing in the world. It has since been augmented through the explorations of Richard Archbold and his associates.

Although primarily a research collection, the Museum has long felt that visitors would appreciate a public exhibit of birds of paradise, presenting the latest information on the remarkable displays of these birds. Through the interest and generosity of Colonel C. V. Whitney, it has been possible to carry out plans for such an exhibit, originally conceived by Dr. Sanford. Most of the illustrations on the accompanying pages are based on photographs of these new exhibits in Whitney Memorial Hall at the American Museum of Natural History.

Birds of paradise are believed to be resplendent relatives of the crow family. Indeed, the most primitive birds of paradise, the four species of manu-

codes, look very much like small crows, except that the plumage has a more pronounced purplish or bluish sheen. Males and females in this group are colored alike, although the males are slightly larger. Most persons would hardly believe that these plain birds are birds of paradise. Yet they are connected with the more bizarre types by an unbroken series of intermediate forms.

Recent students recognize 39 species and 59 subspecies of birds of paradise, grouped in twenty genera. The ornithologists of the nineteenth century had the habit of naming newly discovered birds of paradise for the crowned heads of Europe, to honor them and perhaps to please them sufficiently for a raise in the annual appropriation for their respective museums. This custom displeased the French ornithologist Charles Louis Bonaparte, nephew of Napoleon. When he finally had a chance to name a newly discovered bird, he called it "A Republican Bird of Paradise" with the following amusing explanation:

"Since I for my person have not the slightest regard for the sovereignty of all the princes in the world, I have adorned the most exquisite bird of paradise with the name of the Republic: that Republic which would be Paradise, if it had not been turned into Hell by evil tricks and through the ambition of so-called Republicans unworthy of the name they claimed for themselves. . . . However, even though a paradisaean Republic does not exist, at least there is now a *Paradisea respública* (a Republican Bird of Paradise)."

Unfortunately there are no good English names for about eleven of the groups in which the known 39 species may be divided. The brightly colored ones are sometimes referred to as "plume birds," and the black ones with metallic feathers as "rifle birds," but this classification of convenience oversimplifies matters. A diagram reproduced on page 274 shows the family tree of the birds of paradise and divides them into a few convenient groups.

No less bizarre than the plumes of the birds of paradise are their courtship habits. To be sure, there are a few species that live a very conventional and proper family life. It is more than a coincidence that these same species lack the extraordinary plumes and color. The manucodes

are black with a greenish blue or purple gloss. Both mates co-operate in the building of the nest and in raising the young. If these birds behave like their close relatives, the crows, it will be found that the female alone incubates the eggs. No observations on this point are yet available. The males, however, have one very extraordinary feature: their trachea, or windpipe, is more than twice the normal length and is coiled up in a big loop on top of the breast bone.

Recent observations by Dr. Rand indicate that in Macgregor's Bird of Paradise the male also participates in the raising of the young. In all other species, so far as we know, the female is alone and completely responsible for the cares of nest building, incubation, and feeding the young. The males devote their entire existence to feeding and courtship. No wonder they have enough surplus energy to develop their famous plumes as well as to engage in all sorts of odd performances.

It is by no means easy to observe birds of paradise in the wild. Their complicated display poses, therefore, have first been described chiefly from zoological garden specimens. Captivity does not seem to interfere with the normal course of their behavior. It seems that a bird in a cage will go

through the same motions he would in nature. What the captive specimens do not tell, however, is whether the courtship is solitary or communal.

On the basis of my own observation, I would say that the display of most of these birds is solitary. Exceptions are the true plume birds (*Paradisaea*) and perhaps the flag birds (*Parotia*). Dr. Rand has added to this category Macgregor's Bird of Paradise, whose males engage in communal courtship chases.

Special "dance floors"

The flag birds, which are limited to the unbroken mountain forests, clear a piece of ground as their "dance floor." There must be a number of low horizontal twigs on which the birds strut. Coming on one of these clearings in the forest, I could always tell whether it belonged to a *Parotia* by the presence of these horizontal branches. There is another bird of paradise that lives in much the same surroundings and prepares little clearings on the forest floor. It is the Magnificent Bird of Paradise. However, most of its perches are vertical—numerous small saplings, at least partly stripped of their foliage. The male performs its curious display while climbing up



A.M.N.H. photos



▲ THE PARADISE MAGPIE (*Astrapia atra*) leads a solitary life in the mountain forest. It does not indulge in spectacular displays

◀ THE LONG-TAILED FLAGBIRD (*Parotia uabuesi*) is restricted to the Huon Peninsula. The Flagbirds are also sometimes called the Six-wired Birds of Paradise



▲ WALLACE'S STANDARD-WING (*Semioptera wallacei*) lives in the Northern Moluccas. Most of the plumage is pale brown, but the triangular breast shield is brilliant green. The ribbonlike plumes, or "standards," are raised in the display

▼ THE PLUMES of the King-of-Saxony's Bird of Paradise (*Pteridophora alberti*) are considered the most peculiar feathers to be found in the bird kingdom. This is a rare bird of the mountain forest in central New Guinea





▲ THE KING BIRD OF PARADISE (*Cicinnurus regius*) is also called Money-bird because of the coinlike tips on the long wirelike plumes. This is a common bird of the lowland forest

▼ THIS MALE of the Magnificent Bird of Paradise displays in an almost upsidedown posture to a female perched above him on the same sapling. Note the raised ruff and the wirelike plumes

A.M.N.H. photos



▼ THE RANGE of the bird of paradise family. Each group of dots indicates how many kinds of birds of paradise might be found in a cross-section as shown at the foot of page 265

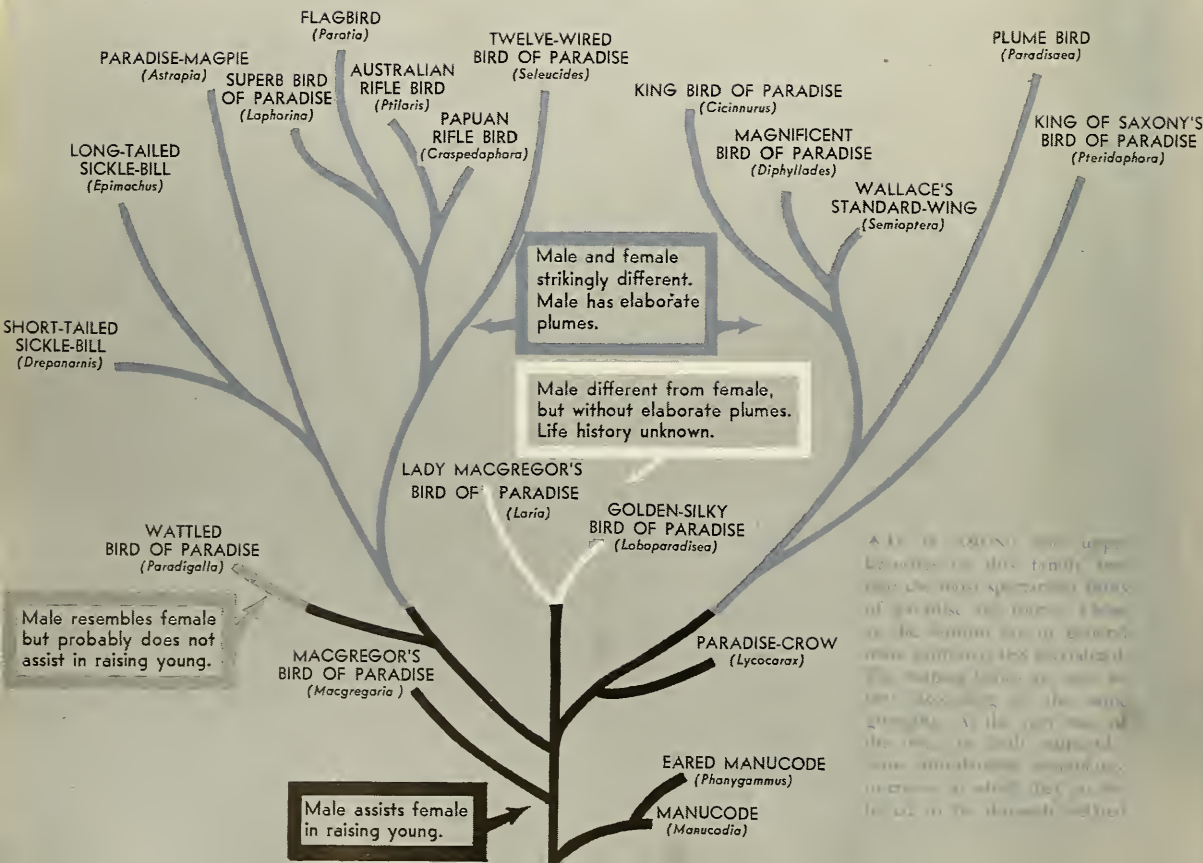


and down these vertical perches. A single male owns each of these display grounds and guards it jealously against any intruder of the same sex, as described by Dr. Rand in *NATURAL HISTORY* for March, 1940.

These seem to be the only birds of paradise that have regular display grounds. All the others may well have a favored tree or even a perch, but it looks like any other in the forest.

Their future

With heavy fighting going on in New Guinea and with hundreds of thousands of troops stationed along its shores, one may ask whether or not the existence of these birds is threatened. Some apprehension is not unjustified in view of the restricted ranges of the various species. Still, I feel that no danger exists at present and that the birds of paradise will continue to survive and even to flourish, provided no additional danger develops. Two factors, more than anything else, are likely to cause ex-



tion, as shown by the history of birds in New Zealand and Hawaii. One is the destruction of habitat, the other the introduction of alien species. These latter act either as predators, as competitors, or as carriers of diseases and parasites. In view of the vastness of New Guinea forests, the efforts of conservation should be directed principally against voluntary or accidental introduction of alien species.

That even heavy hunting in an undisturbed habitat does not necessarily lead to extinction is well illustrated by the history of the plume trade, which began, at least in a small way, fully 500 years ago. As more and more white people settled in the East Indies, the demand for plumes rose. Finally, enough of them were imported to Europe to attract the attention of fashion designers. The plumes were featured on ladies' hats, and fabulous prices were paid for them. Wallace describes how the natives of Aru hunted the birds around the middle of the last century: "They shoot the birds with a bow and arrow, the arrow having a conical wooden cap to the end as large as a tea cup, so as to kill the bird by the violence of the blow without making any wound or shedding any blood. The trees frequented are very lofty; it is therefore necessary to erect a small leafy covering or hut among the branches, to which the hunter mounts before daylight in the morning and remains the whole day, and whenever a bird alights they are almost sure of securing it."

Beginning about 1880, the hunting of birds of paradise developed into a prosperous trade and reached a peak about 1910. Malay and Arab plume hunters penetrated far into the unexplored regions of Dutch New Guinea and along the coast. Whole towns subsisted on the plume trade. Hollandia was a town of 700 in 1923. In addition to the Malay hunters and their Papuan companions, there were Chinese, Arab, and Dutch traders. The prohibition of hunting in 1924 brought about a slump, and when I visited the region in 1928, Hollandia was a regular ghost town of only 30 or 40 people, like some of the famous mining settlements in the West.

➤ A PAIR of Magnificent Birds of Paradise in courtship. The male is in the full glory of his display, with his velvety shield glistening like burnished metal and his yellow cape thrown forward

Drawing by B. F. Chapman



The hunting of the plume birds was a strictly seasonal affair. Though male birds of paradise do not have a regular eclipse plumage like certain ducks and passerine birds, they have to go through an annual molt like all birds. Naturally, the plumes are in best condition shortly after this molt. The Malays knew by experience when that date was reached and fixed on it the opening of the season. Hundreds of small expeditions then left the coast to settle in some village in the interior, which served as the base of operations. From here every

morning, Papuan hunters went to the neighboring forest to hunt for males in full plumage.

After several months, when all the trade goods had been exhausted and all the adult males in the neighborhood collected, the little expedition made its way back to the coast. Here great celebrating took place, and I am told that between gambling and drinking many of the Malays lost all their hard-won gains within a period of a few weeks.

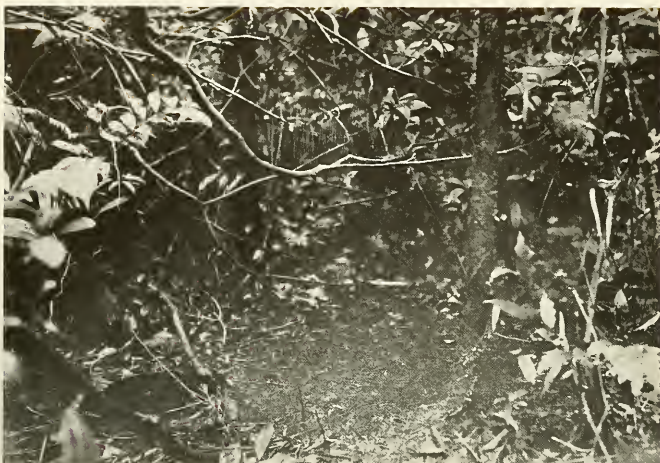
In former German New Guinea and in the Australian part of New

Guinea, the hunting was usually in the hands of the white residents. The hard-struggling colonists found in this trade a means of support while waiting for their plantations to mature. Most of the plantations in eastern New Guinea grew coconuts, which do not begin to yield profits until they are about 8 or 10 years old. Meanwhile, the plantation labor had to be paid, and in the absence of any other income, the birds of paradise were a lifesaver to many of the colonists. In a few weeks they could collect enough birds to pay for all the expenses for the rest of the year.

The number of skins exported annually from New Guinea was appalling. In 1913, for example, no less than 30,000 birds of paradise appear to have been offered for sale in London auctions. In the years before the last war, around 10,000 birds were exported annually from German New Guinea alone. In a single shipment in 1912, a British firm received 28,300 skins. Some figures indicate that as many as 80,000 were exported from Dutch New Guinea in a single year.

Conservationists throughout the world feared that birds of paradise were definitely threatened, even though the hunters spared the females and immature males and did not hunt out of season. Finally, the season on birds of paradise was closed completely. Since 1924, no birds of paradise have been collected legally, and even the illegal hunting has been negligible. When I visited Hollandia in 1928, I was surprised to discover that birds of paradise were displaying right in the outskirts of the town. There were numerous display trees within a few miles. Obviously, the birds had made a wonderful recovery within only four years. The mountain species, of course, had never been under pressure. If they are scarce in collections, it is either because their habitat is very remote, as in the case of King Albert's Bird of Paradise, or because they are very rare even in nature.

So much for the birds in their natural home. Words can never fully portray their beauty. And for this reason, New York is fortunate in having this new exhibit, in which are displayed a number of outstanding specimens from the world's finest collection, along with related information. It is hoped that many persons will see it.



Ernst Mayr photos

CERTAIN birds of paradise prepare "dancing grounds," in which the male displays his iridescent plumage in an elaborate courtship ceremony. (Above) Nicely spaced horizontal

branches characterize the dance floor of the Flagbird. (Below) Vertical branches are required by the Magnificent Bird of Paradise on which to perform





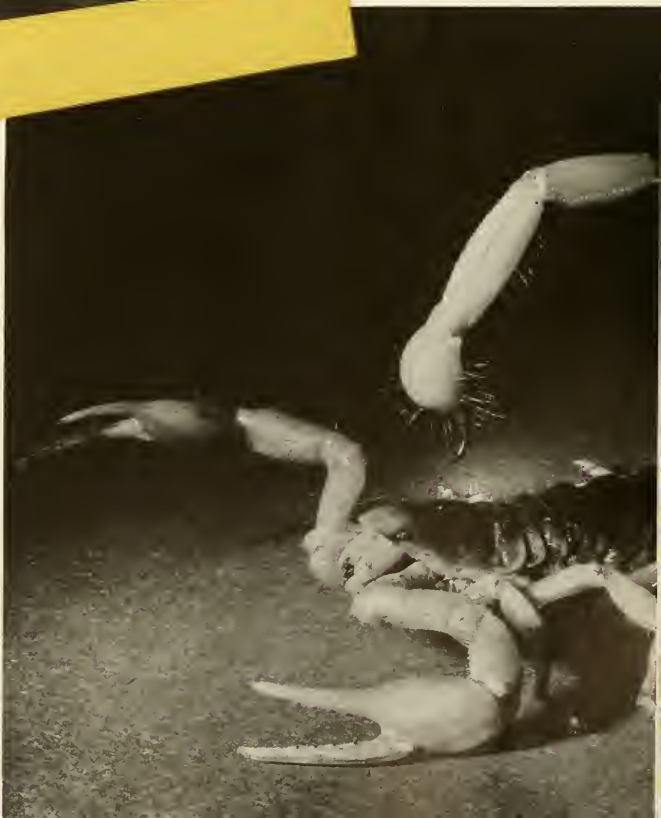
◀ OUR COMMONEST native preying mantis, *Stagmomantis carolina*, is smaller than the Chinese mantid and occurs over a much larger part of the country. Its habits are the same, however, and its front legs are perfectly modified for catching and holding prey. The rows of spines on the front tibiae of the Carolina mantid are shorter and less numerous than in the imported species

By RICHARD L.
CASSELL

A Gallery of INSECT PORTRAITS

► ONE OF OUR LARGEST SCORPIONS (*Hadrurus arizonensis* Ewing), in defensive posture. Curled over the back is the long "tail," with the sting at the end ever in readiness to deal death to its victims. Although lethal to insects and other invertebrate prey, the venom of this species has little effect on man, the pain being comparable to a bee sting. In deserts of the Southwest it burrows into sand or hides under stones during daytime

A GALLERY OF INSECT PORTRAITS





"The Sphinx is drowsy,
Her wings are furred."

—Emerson

◀ SO RESTS this hawk moth, one to be seen at dawn or dusk of a summer's day visiting flowers, almost anywhere across the continent from southern Canada to the Gulf States. The "Striped Morning Sphinx" is a beautiful creature with white-striped forewings and broad pink bands on the hindwings. The caterpillars feed on purslane, dock, and many other plants. Its scientific name is *Celerio lineata* (Fabricius)

► PORTRAIT OF A TARANTULA. Although they are the largest and most notorious of all our spiders, the shaggy tarantulas (*Aphonopelma* sp.) are extremely docile creatures. Their shining claws give the appearance of intense ferocity, but their venom has a very feeble effect on man. During the day, they hide in burrows that are made comfortable with their spun silk. At night, they wander boldly about and are often seen crossing the highways in our southwestern states



► BEE FLIES love the sun, are found during the hottest part of the day, and are most abundant during the hottest months of the year. Almost all of them visit flowers, from which they obtain nectar. *Anastoechus nitidulus*, because of its long proboscis, is able to reach the deeply seated nectar cups of the wild geranium and other plants. It is found not only in North America but also in Europe and Asia



▼ PORTRAIT OF A JUMPING SPIDER. With stout bodies, often decked with colored scales, silky hairs, and miscellaneous finery, the jumping spiders swiftly pursue and leap upon their prey. Keeness of vision is an attribute of all these vagrant day hunters. The large

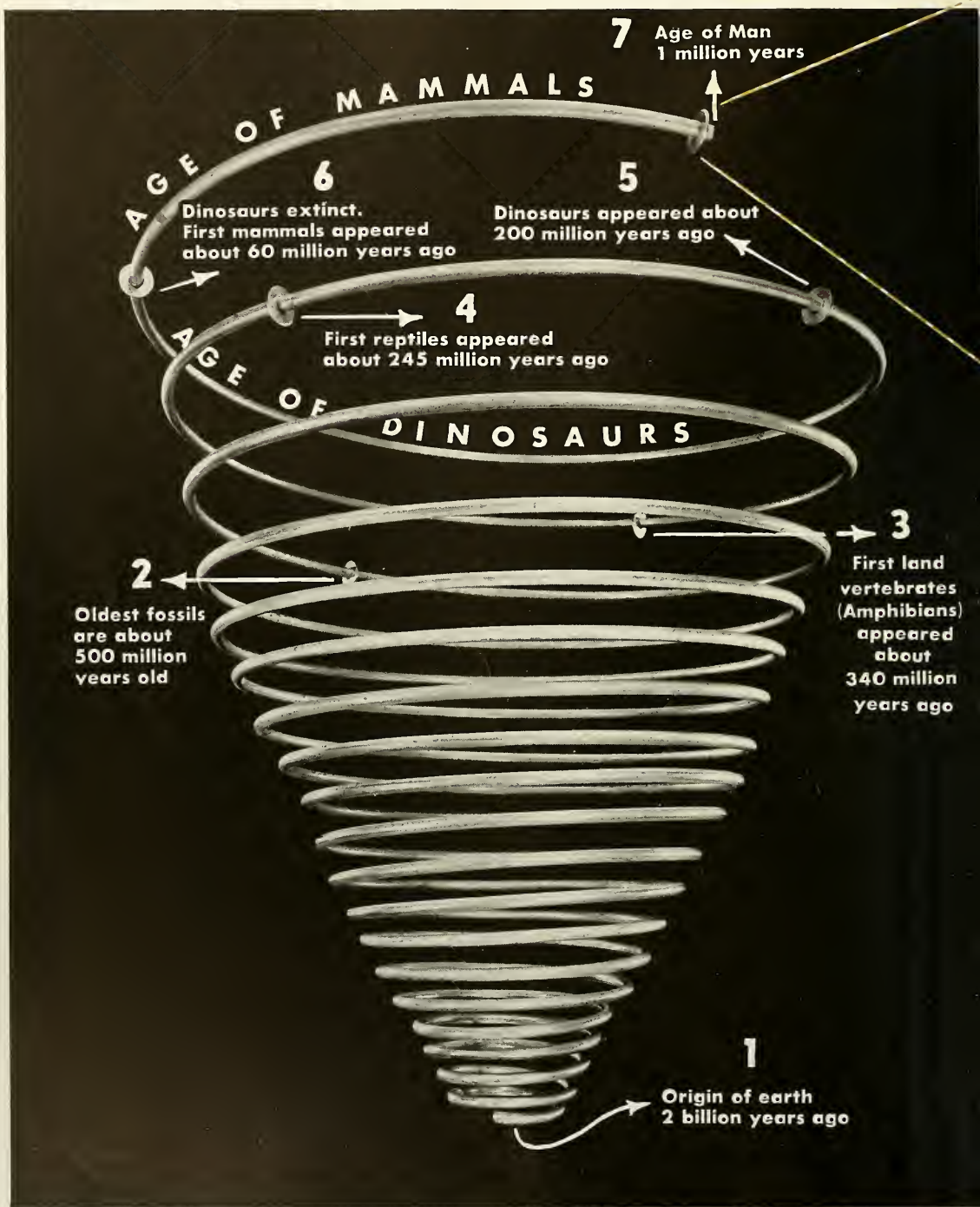
bright eyes of the female below (*Phidippus* sp.) might well be trained in watchful attention on the male of her species, who with resplendent body and gleaming chelicerae, wigwags and beckons to her in his characteristic love dance



IMPORTANT THOUGH IT IS from the human point of view, our written history is too short to show on this

spiral. The tip has been enlarged about 25 times, at right. This section representing man's one million years

then becomes about 3 inches long. The last 1/50 inch of this represents the entire period of recorded history.





If 3 inches = Age of Man
(1 million years)

1/50 inch = entire period
of recorded history
(5000 B.C. to present)

A.M.N.H. photo

Drawing by Museum
Illustrators Corps

A CALENDAR OF LIFE

Man is said to rule the earth, but others have ruled it before him. The most careful scientific estimates show that life has existed on earth for more than 70,000 times as long as man's recorded history

By EDWIN H. COLBERT
*Curator of Fossil Reptiles, Amphibians,
and Fishes,
American Museum of Natural History*

WE are living in the Age of Man, the period in which man rules the earth. For better or for worse we have attained some degree of supremacy over all other forms of life. No longer is our existence threatened by large animals, as was the case with some of our not very distant forebears. No longer are we so seriously threatened by the less spectacular but much more deadly microscopic parasites, as were our an-

cestors of a few hundred years ago.

It is readily understandable that, having achieved this supremacy, we are apt to think of ourselves as the culmination of evolutionary history. And from our present-day standpoint this may be true. Yet there is another way of looking at it. Let us forget our natural bias as human beings and regard the question from an objective viewpoint.

Man has lived on earth for perhaps a half-million to a million years, which seems a long time. Of that great period, man has written only the last 7000 years of it into his record. Before the period of recorded history, man was a primitive savage, wrestling his living from the soil and from the chase, ever surrounded by large beasts

that challenged his right to the fields and forests.

Many years ago, in the dim past of earth history, lived the dinosaurs. These animals arose, evolved, and became extinct at ages so far distant from us that we can hardly stretch the imagination sufficiently to comprehend the immense passage of time that separates them from us. Since they are gone from the face of the earth, we are inclined to regard them as "failures" in the long history of life. Were they really failures?

Arising some 200 million years ago, the dinosaurs lived through a period of about 140 million years and were the dominant animals on land during all that time. Thus, for a stretch of time at least 140 times as long as the entire history of man, and more than twice as long as all the time that has passed since their day, the ancient dinosaurs lived and fought and died—the lords of creation. Who are we to say that they were not successful?

Certainly the span of dinosaurian history through a considerable portion of geologic time was tremendous as compared with the entire span of human history and prehistory. Indeed, to men generally accustomed to thinking in terms of human history, or per-

◀ This unusual presentation will appear as part of *The Dinosaur Book*, soon to be published by the American Museum of Natural History

haps in fractions of human history, the whole subject of geologic time is staggering in its import, for its immensity is so great that the human mind can grasp it only with considerable difficulty. It is almost as if one were to try to understand infinity.

The earth is about two billion years old. This is not a mere guess but is the result of careful, cumulative studies by many investigators working over a long period of years and along various lines of evidence. Of particular use are the investigations of radioactive materials in rocks of ancient age. Largely by the study of the slow disintegration of radium and uranium into lead have we extended our conception of geologic time to its present tremendous limits.

Of the two billion years of earth history, only about one-fourth of it, or 500 million years, contains useful records of plant and animal life. In other words, 500 million years ago life on the earth reached the stage where the remains of plants and animals were of sufficient density and complexity to be preserved in the form of fossils.

The 500 million years of life history, as revealed by the fossil record, have been divided into three great eras, each marked by characteristic developments in the evolution of plants and animals. The first of the

millions of years when lowly creatures without backbones were the only animal life. Then the fishes appeared and were the most important animals for more than 100 million years. Still there were no backboneed animals on *land*. Approximately 300 million years ago the first amphibians crawled up out of the water, and for some 50 million years the world witnessed the Age of Amphibians. This was the period during which the first land vertebrates were evolving as descendants from their fish cousins.

The first reptiles, the earliest backboneed animals that did not have to live in water during any part of their life, appeared before the end of the Age of Amphibians, but it was not until about 225 million years ago, that the reptiles became well established and the Age of Reptiles began. During the last 140 million years of the Age of Reptiles the dinosaurs were supreme.

While the Mesozoic Era (200 to 60 million years ago) was primarily the Age of Dinosaurs, there were, of course, other types of animals living at the time. Fishes and aquatic reptiles inhabited the water, flying reptiles and primitive birds were to be seen in the air, and (toward the end) small archaic, warm-blooded mammals lived on land. But these animals, important as some of them might be

petitors that had developed around them. During this era the evolutionary race was won by brains and speed, rather than by mere bulk, so that the mammals became increasingly varied and perfected. They inhabited almost every nook and cranny on the surface of the land, and some of them even reinvaded the water. This was the period during which the greatest perfections in vertebrate evolution were attained.

The culmination of the Cenozoic era was marked by the appearance of man. The last of the dinosaurs had long since passed from the scene, almost 60 million years previously. Man, even in his most primitive manifestations, was a relatively late product of evolutionary history. Physically, this new type of mammal was not even as well-developed or organized as hundreds of other types of mammals that had evolved before, or were evolving. But he was characterized by one trait by which he surpassed all the other mammals, even his close primate cousin. This was in the very great enlargement and perfection of his brain. Man became by far the most intelligent of all the mammals. This is a fact of the utmost importance in evolutionary history.

By reason of his intellect man was able to help himself evolve. He was able to resort to stratagems far beyond the capacity of other mammals, to invent implements that would increase his effective power, to use fire and to co-operate in a way that other mammals could not co-operate. Therefore, the development of man progressed at an increasingly rapid rate; he became a social animal, and cultures evolved. From then on, through the development of civilizations, man has increased and spread his dominance over the face of the earth.

Telescoping geologic time into a brief summary like this and returning to the Age of Man, we see that the span of our written history is infinitesimal in comparison with the periods into which life on the whole is divided. The days of ancient Egypt seem vague and distant to us, yet compared to the entire history of man on earth, they are as but yesterday. Man first appeared about one million years ago. The 7000 years of history are an insignificant portion. If the entire history of the earth were one day, man's recorded history would be less than one-third of a second. Two billion years are a long time.

Cenozoic and Recent Era	The Age of Mammals	Began 60 million years ago
Mesozoic Era	The Age of Dinosaurs	Ended 60 million years ago Began 200 million years ago
Paleozoic Era	The Age of Early Life	Ended 200 million years ago Began 500 million years ago
Proterozoic Eras	The Ages with no fossil history	Ended 500 million years ago Began 2 billion years ago
Archaeozoic		

eras is the Paleozoic, the time of ancient life on the earth; the second is the Mesozoic or the middle period of life history; the third and last is the Cenozoic, or what might be called the "modern" section of life history.

Perhaps the relationships of the great eras of life history may be made clearer if expressed in the form of the simple table above.

The fossil record shows that during the early part of the Paleozoic Era there was a long period of many

in view of the subsequent history of animal life, played relatively insignificant roles in the great drama of earth history. The real actors on the stage of Mesozoic times were the dinosaurs.

Then came the Cenozoic Era, the Age of Mammals, the period during which the furry, warm-blooded animals evolved and became supreme. The dinosaurs disappeared, seemingly unable to cope with new environmental conditions and with new com-

TICKS

AND

HUMAN

WELFARE

By C. H. CURRAN

*Associate Curator,
Department of Insects and Spiders,
American Museum of Natural History*

From unwise conservation policies to a child stricken with Rocky Mountain spotted fever is not so great a distance as you might imagine

NOT long after the first white settlers moved into the territory that is now the State of Montana some of them were smitten by a strange disease. In addition to all the symptoms of severe fever, the victims developed red spots on the wrists and ankles, and these quickly spread to all parts of the body. Even before the appearance of the rash and fever, there was usually a period of a few days when the victim suffered from loss of appetite and was clearly "not himself."

Parts of Montana, particularly the Bitter Root Valley, became notorious as "spotted fever country." But the disease was not wholly confined to Montana, though it was and still is most severe there. It extended over most of the Rocky Mountain area from Canada into northern Mexico and caused the death of from 1% to 70% of its victims, depending largely on season and locality. Because a great many kinds of fever are accompanied by red spots or rash, this type of fever came to be distinguished as Rocky Mountain spotted fever.

Today, the disease occurs in almost all the states of the Union, but there is no way of telling whether it always has or whether it has been spread by

people returning from the Rocky Mountain region. Had we known as much 40 years ago as we do now, this might have been determined. But the disease was often diagnosed as typhus or any of several other fevers, and it was not until 1902 that it was proved to be carried by ticks.

During the past few years we have heard so much about insects and the diseases they carry that it seems that we must have known about these carriers for centuries. Yet we have known definitely of the role of insects and their relatives in the spread of some of our most deadly diseases for less than 50 years. And even less than 30 years ago many people scoffed at the idea that mosquitoes and ticks could kill people by injecting into their bodies a "poison" that caused fever. This is not surprising, because during the first two decades of the present century there were thousands of outstanding medical authorities who "pooh-poohed" the idea and held up to scorn the discoveries of the young scientists who were actually making medical history.

Rocky Mountain spotted fever was one of the diseases that was early proved to be carried by an insect relative—a tick. Ticks are most closely

related to spiders, and they are generally included with them, because all but the newly hatched ones have four pairs of legs. Ticks carry Rocky Mountain spotted fever as well as a number of other diseases in North America. This was clearly demonstrated as early as 1902, but it was almost ten years before the fact was generally accepted. As a result, much valuable time was lost in studying the disease and its prevention. Indeed, even today few people know very much about it, and the great majority of our medical men have not come in contact with it. Tomorrow things are certain to be different because the many thousands of doctors who have gained experience in the war zones will be on the lookout for insect-borne diseases.

In North America, Rocky Mountain spotted fever is the most widely known of the tick-borne diseases of man. It is curious that in the West the majority of victims are men, while in the East, women most frequently contract the disease. It is easy to understand why men should be the most frequently attacked in the West, because in an agricultural pursuit they spend much time in the fields, but there seems to be no explanation why

women should contract it more in the East.

The disease is transmitted by at least seven different kinds of ticks, including the spotted-fever tick (*Dermacentor andersoni*), Pacific Coast tick (*Dermacentor occidentalis*), the eastern dog tick (*Dermacentor variabilis*), and the brown dog tick (*Rhipicephalus sanguineus*). Only a few months ago it was demonstrated that *Amblyomma americanum* might prove to be as important as the other four kinds.

Fortunately, there are several factors that tend to prevent Rocky Mountain spotted fever from developing into a great plague. One of these is the amazing difference in its severity in different parts of the country and at different seasons (1% to 70% fatal). In the spring of the year, just after the ticks have come out of hibernation, one may contract the disease and become immune without even knowing it. But when the weather gets hot, or if the tick has fed during the sunny but cool spring days, the symptoms are usually quite apparent and death may result. Late June and July are the most dangerous months. When the weather gets really hot, the ticks find a suitable place in which to spend the "dog days" and stay there until the following spring.

Then, too, it is only the adult ticks that bite human beings, and only a very few of the seed ticks that hatch from the 2000 or 3000 eggs laid by a mother tick develop to the adult stage. Of all ticks in various stages less than 5% are generally capable of transmitting the disease, even in the worst disease areas.

Unfortunately, there is also a darker side to the picture. The female tick can transmit the disease to its offspring. The disease is carried through the eggs to the seed ticks and thus to the mature, man-biting adults. Only a small percentage of the offspring are infected with the disease, but these undoubtedly play an important part in keeping it going among rodents. Also, the common rabbit tick, which transmits the disease among rodents but does not bite man, helps keep it going among rats, mice, rabbits, and so on. Unfortunately, also, the apple cart may be upset by one of the dog ticks.

The brown dog tick has usually been considered to be a creature of warm or tropical lands. It is no longer that in the United States. The cus-

tom of families to spend the winter in some of the warm southern states has brought a new threat to northern areas. It is believed that the brown dog tick cannot stand our northern winters and that, even though it may be spread to rodents during the summer, it will die off when frosts set in. But it really doesn't have to worry about our winters because it can do quite well in our houses or in dog kennels. On the other hand, we do not have to worry about the seed ticks or nymphs biting us; only the adults will do that.

In the past we have associated ticks with rural areas, and our urban areas have been relatively free from them. The brown dog tick has changed this. Perhaps we should change its name. Possibly we should call it the "city tick," because it is the only tick that occurs more than incidentally in the large urban centers of our country. It is undoubtedly a potential menace to our health and to the well-being of our dogs and cats, but up to the present it has not caused any outbreaks of disease. Uninfected ticks are harmless. But if an urban outbreak should occur, the brown dog tick may play an important part in the spread of the disease. This is not likely to happen unless we are very careless and do nothing about getting rid of it.

The spread of the disease among mice, squirrels, rabbits, and other rodents is through the seed tick and young larval stages. If a tick infects one of the animals, other young ticks, feeding upon the animal can contract the disease and transmit it either to another animal or to man. The number of rodents suffering from the disease is relatively large in some areas, but the number of ticks able to transmit the disease to man is rather small, usually not more than one per cent. Thus it will be seen that the number of cases in any section will be determined partly by the abundance of ticks. The great increase in the number of ticks in some parts of the United States during the past 20 years may account for cases of the disease where it was not previously known.

Tularemia is less well known than Rocky Mountain spotted fever, and the death rate is lower, being about five per cent in man. It is, however, highly fatal in rodents, and it is probable that this disease is responsible for the periodic plagues that destroy large parts of the rabbit population. It is spread among rodents by a number of

biting insects—fleas, lice, flies, and ticks, of which rabbit ticks are especially instrumental. This disease is transmitted to man by ticks but may also be contracted directly from diseased animals.

Most cases of the disease in man occur as a result of handling rabbits that have been shot. The disease enters the human body through the slightest abrasion and may possibly do so through healthy skin. Apparently, all rodents are subject to the disease, as well as foxes, coyotes, sheep, dogs, and many other small animals and birds, such as pheasants, prairie chicken, quail, etc. Bites of diseased animals transmit the disease, and it may also be contracted through handling their skins.

Tularemia is widespread in the United States and Canada, but as a rule the percentage of infected animals is very small. It is only when the disease approaches epidemic proportions among rodents that it may become a serious menace to man. Protection may be obtained by wearing rubber gloves when handling wild rabbits, other game, and vermin that have been killed. The pelts may be sterilized by soaking in a strong solution of mercuric chloride. The flesh of animals suffering from the disease is edible if it is thoroughly cooked, but the disease can be contracted from improperly cooked food.

Tick-borne relapsing fever is a disease of world-wide distribution in areas where the ticks classified as *Ornithodoros* occur. These ticks occur in the United States from Texas to Kansas and westward to California. In the latter State the disease occurs only at elevations of 5000 feet or more. As with the other diseases, it is a disease of rodents. It may be carried to man either by *Ornithodoros* ticks or by contact with diseased animals, in the same way that *tularemia* may be contracted. In areas where the ticks exist the same precautions as outlined above should be taken when handling dead rodents. The fever is usually severe, lasting from two to four days, with gradually lessening attacks occurring at varying intervals. A friend of the author who contracted the disease in California as a result of blood from a squirrel getting on his hands had attacks of the disease for many months, the attacks gradually decreasing in intensity and the time between them becoming successively longer. About 59 per cent of those

suffering from the disease succumb to it.

The strangest and most inexplicable disease carried by ticks is one that is known as tick paralysis. No one knows just what causes the disease, which affects man and some range animals. Children are especially susceptible to tick paralysis, which may result in death in two to five days, but the cure is simple and effective. Ticks attach themselves chiefly to the upper part of the body. In most cases of tick fever the ticks have been found attached to the nape of the neck, from one to five being present. Apparently they must remain attached for at least two days before symptoms of paralysis develop. The treatment consists merely of the removal of the ticks. When this is done, recovery is rapid and the patient usually is fully recovered in two or three days, although in severe cases a week or two may be necessary before the victim can resume normal activities. This disease is caused chiefly by the Rocky Mountain spotted fever tick and therefore occurs only where this tick is found—in the area near the Rocky Mountains in this country and in British Columbia, where the number of cases is surprisingly large. The fact that there are dozens of cases each year demonstrates the gentleness with which ticks are able to attach themselves to human beings and to feed without the slightest knowledge on the part of the victim that his or her blood is being drawn off by a dangerous, disease-spreading parasite. (During the past year at least two cases have been reported in the East: the eastern dog tick would be the cause.)

Most of the ticks that carry disease to man in North America lay 2000 or 3000 eggs. Many years ago, when I knew little about them, I received a fully fed specimen of the Rocky Mountain spotted fever tick for identification. It was in a match box, and after naming it I left it on my desk. A day or two later I discovered that it had deposited what I estimated must be at least 2000 eggs. The mass was many times greater than the size of the engorged tick, and the tick had shrunk to the normal leathery form that sits on leaves and reaches for you as you pass by. Also it had died. I thought it would take some time for the eggs to hatch, but a few days later tiny seed ticks were crawling all over the place. Perhaps some of them found mice upon which to feed, but most likely they all died of starva-

tion within two or three weeks.

The increase of ticks in recent years can be attributed to man's ignorance or selfishness. For example, a man might know that hawks destroy large numbers of field mice and rabbits, both of which destroy a goodly percentage of his crops each year. But just because certain kinds of hawks will grab an occasional chicken, every hawk that is seen is killed if possible. The chicken is worth a few cents, or at most a dollar. The hawk, by killing off rodents might well save the farmer many dollars in crop loss. It might do much more than that, too; it might save the life of the farmer's son or daughter by destroying rodents infected with tick-borne diseases.

The increase in the number of ticks is due to practices started many years ago. These practices are not only the result of individual action. They are mainly the result of the acts of organized society—the State and County governments. One of the chief causes was the payment of bounties for the destruction of wolves and coyotes. There is no doubt that both these animals caused severe losses to ranchers in many instances, and we cannot condemn the logic that led to their extermination in many areas. But we cannot escape the fact that the result has been an enormous increase in the numbers of rodents. At the same time that we were killing off the four-legged predators, including foxes, we were also killing off as many hawks and owls as we could. Then too, in many parts of the country there have been (and still are) organized snake hunts, in which all kinds of good and bad snakes are killed. It just happens that the poisonous snakes are among the most beneficial ones.

It should be apparent that by killing off these animals we have rather badly upset the balance of Nature. As a result, rodents have increased enormously, and great rodent-poisoning campaigns have been carried out, at great cost. It is natural that we should have done what we did, because few of us realized what the effect of killing off a few predatory animals might be. It is not the few that one individual kills; it is the cumulative effect of what everyone kills that adds up to the serious total. In this case it has added up to a great increase in the number of rodents and a disproportionate increase in the number of ticks. When rodents were less numerous than they are now, the seed ticks had a lot of trouble finding

something upon which to get a full meal, and almost all died. But with more rodents running around, the ticks have a much better chance of surviving. Several hundred seed ticks or nymphs may be feeding on a single mouse, rat, squirrel, grouse, rabbit, or woodchuck. This had always been the case, but when these animals were less abundant the ticks were much less numerous too, and the danger of their spreading disease to man was much less than now.

The wily fox seems to be reappearing in places where he has not occurred for many years. He loves mice, ground squirrels, and rabbits (which we are not allowed to kill, except in limited periods). If the fox should become more abundant, there will be fewer hosts for ticks, and even if we are called upon to pay with an occasional chicken, we should not object too strongly. That chicken may save the life of a member of our family—it will be a cheap price to pay.

From this brief summary of ticks and human disease one might possibly come to the conclusion that it is very dangerous to go into the country where ticks may be found in fairly large numbers, but this is far from true. When we examine all available data and analyze it, we find that human deaths as a result of tick bites constitute only a very minute percentage in the vital statistics of our country. Up to the present time ticks have been relatively unimportant in their relationship to human diseases, and we might reasonably expect them to remain so, were it not for the fact that these creatures have been increasing to an alarming degree in recent times. We do not believe that this increase will cause any such epidemics as occurred in the days of the "Black Death" in England and the rest of Europe. We do know that all the potentialities of such a plague exist in the large numbers of diseased rodents and ticks in America.

To offset this danger a large number of scientists are at present watching developments with an eagle eye. And they are working with good hope that methods of destroying the carriers of the threatening diseases will keep one jump ahead of human epidemics. Progress has been made, and greater progress, perhaps certain cure, may come as a result of the unbelievable amount of research being conducted in connection with the war effort.

Hermits don't always live alone

By ARTHUR CARPENTER and WALDO H. LOGAN

IF you visit lonely Mona Island toward the end of August, as we did on two occasions, you will see the Hermit Crabs [*Coenobita diogenes* (Latreille)] hold their strange convention. It happens on almost exactly the same day each year.

Mona Island lies halfway between Puerto Rico and Santo Domingo and is a tableland of limestone and coral that has been lifted bodily out of the sea. The crabs occupy nooks and crevices in the rocks on the top, amid a wild growth of thorn bush, brush, and Spanish bayonet. Sheer cliffs 80 to 200 feet high, which can be scaled only with difficulty, guard their stronghold. After the habit of hermit crabs everywhere, each one lives in a discarded sea shell and never moves about without it. These empty whelk shells range in size from your thumb to your fist.

This is what we saw. Almost with one accord on the proper night, the crabs made their way to the edge of the cliff and commenced to climb down. Many fell, and not a few were killed. But the great majority struggled down to one sizeable beach, a three-acre triangle of sand. Within 48 hours, the great horde had congregated.

During the heat of the day, they gathered in cooler spots to form heaps, some of which reached a height of four feet. Wheelbarrow loads of them, even boatloads, could be found in a single pile. In a forenoon you could gather enough hermit crabs to fill a moderate-size house. They climbed up on small trees until the branches bent to the ground.

At sunset they scattered over the beach. Then came the startling event. The jamboree began, and it was as

though the grandfather of all hermit crabs had called through his megaphone: "Change shells with the lady on your right." The hermit crabs came out of their portable houses and began to exchange them. It was moving day, dance marathon, and bargain basement rolled into one. A good many were soon looking the worse for wear; but the brawl went on. The night sea was still, yet you heard a scuffling, clicking, and rattling as loud as gentle surf on a shingled beach. It was the frenzied antics of tens of thousands of little people of the sand, playing "musical chairs."

Less than a week after the start,

▼ ROUGH, ROCKY SHORES rise steeply to the flat top of Mona Island. The hermit crabs use one of the few beaches. Mona was a favorite hide-out of pirates. Captain Kidd himself visited it



▲ THIS TORCHLIGHT SCENE was taken on the beach the first night of the "convention." The second night the crabs were so thick you could not walk without kicking them aside

► THIS SPECIES OF HERMIT CRAB differs from all others in being "left-handed," that is, the left pincer claw is better developed, instead of the right. The empty shells they apparently prefer to occupy are those of *Lirona pica* (Gmelin)



Photo by Waldo H. Logan



Photo by Waldo H. Logan

▲ DURING THE HEAT OF THE DAY, they gathered in cooler places to form great heaps. The exchanging of shells occurred almost entirely at night

the sun rose on an empty beach. The hermit crabs had all gone back into seclusion on top of their fortress rock—all except a few who had found the "trip to town" too strenuous.

The primary purpose of their mi-

gration to the beach, according to James E. Benedict, is for breeding. Other hermit crabs do not congregate in this manner, and the majority of species are never found very far from the water.

Photo by Arthur Carpenter



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ON the side of a post in a weedy fence-row along a cornfield, the grasshopper clung head end up, his inch-long, brownish-green body blending closely with the weathered wood of his perch. From this high vantage point, except for his immediate front, he could see all around. If danger threatened, he could hop or fly away, or as was his more usual custom, he could either slide quickly around the post in timber-squirrel fashion, or drop suddenly to the weed-thicket beneath. He always accompanied this last trick by an additional one—a quick, sidewise scurrying from his point of landing. Only against those expert hunters, the domestic turkeys, was this last trick ineffective, for these birds had learned to strike a grasshopper at the instant of its fall.

All around him were dozens of his kind, some of them his brothers and sisters. All were alike as shelled peas, and all, save for an occasional waving of their feelers or mouthparts, sat quietly as he was sitting, their bodies held in inconspicuous fashion parallel with the post. Also, like him, each pictured its surroundings through huge lidless, immovable eyes, and each held its long hind legs in a great inverted V ready for instant action. But he paid them no attention, and they, none to him, for, except when mating, it is the way of a grasshopper to look only after himself. Besides, it was mid-day, a sort of rest period. Each and all were chockful of tender corn leaves, and being thus temporarily sated, were using the post both as a lookout and a shelter against the blazing July sun.

Nothing, of course, of what has been said was passing through the grasshopper's brain as he clung there in the shade of the post. Not that he didn't have a brain. He had a rather big one, in fact, as insect brains go, a brain that received stimuli from sense organs such as his eyes and "feelers" (which were really smellers), and which directed the proper movements of his body in response to these. Strangely enough, however, his brain seemed to have little or no control of his muscles by way of co-ordination, for when, as sometimes happened, one of his kind had its head bitten off, the headless creature could still walk, jump, or fly for a time. Moreover, if men were right in their knowledge of him, his brain, like that of Burns's mouse, gave him no power to look behind or forward

by way of memory or contemplation. Hence, he couldn't think about danger until it presented itself, or recall, for example, that half-an-hour before he had narrowly missed being gobbled up by a sparrow-hawk. Of course he could not know that frosts were only two or three months ahead, frosts that would destroy both his food and himself.

Yet, for all that, there were to be found in his tiny body (and a score of his kind would be required to weigh an ounce) all the organs and machinery necessary for him to function as a perfect animal. Like the birds and snakes and frogs and skunks that preyed upon him, he, too, had eyes, hearing organs, taste-buds, and a sense of smell and touch. He, too, could breathe and digest food and add new substance to his body; could circulate blood, fly, walk, hop or swim, and bring others like himself into the world.

Which is not to say that he was constructed upon the same body plan as that of the backboneed animals, or that his internal workings were carried on after their fashion. For Mother Nature has a way of arriving at the same end by many different means. According to her plan for the construction of all insects—some 600,000 different kinds of them—she had used no bones in the building of him, but, instead, had fashioned his skeleton from a hornlike substance. Stranger still, she had placed that skeleton on the outside of him. It was as if his body had been poured into this jointed armorlike covering, his muscles all being fastened to its inner side.

Nor had lungs been used in his make-up. True, as he sat there against the post, his body wall rose and fell in a regular breathing rhythm, but no air entered his body through a nose and from thence to lungs as he breathed. It rushed instead, through tiny holes which pierced his armor at the sides, holes connecting with tubes that branched to carry air to every cell and tissue. Hence, although a food distributor and a carrier of wastes, his blood had little or nothing to do with the carrying of oxygen. Neither was it red nor confined in blood-vessels. It seeped slowly through open body-spaces into every corner of him, some of it being constantly sucked into his heart to be sent at every beat on its slow way through his body. Also, as if to add to his peculiarities,

A Grasshopper

To become a full-grown hopper—a rare accomplishment in the world of his kind

his "ears" were placed just above his hind legs, hind legs so long and powerful that only a few creatures in the world could equal him as a jumper.

Such was the grasshopper as he clung there to the post. But, full-grown, fully functioning, energy-transforming machine that he now was, he had been thus for only a few days. For he had been hatched from an egg barely three months before, that egg having been deposited by his mother during the preceding fall in the soil of this very fence-row only a few rods from where he now sat. By the use of four sharp blades at the rear of her body, she had drilled a half-inch-deep hole into the sandy soil and had placed therein some 50 or 60 tiny, banana-shaped eggs all glued together. But laying her eggs in a suitable spot—and the fence-row, because of the unlikelihood of its being ploughed up, was such a spot—was his mother's sole contribution to the welfare of her family. For she died shortly after without seeing or perhaps ever knowing what came from them.

As a matter of fact, the soil around them being still warmed by the September sun, each egg began to transform into a grasshopper. And though this process may have been retarded with the onset of winter, the advance of spring found them well on the way to hatching. One morning in May, along with the rest of the brood, the grasshopper kicked himself free from the egg shell and scrambled upward through the sand to take his first look at the world.

hopper sets forth

By ROY L. ABBOTT

Professor of Biology, Iowa State Teachers College

Men call young grasshoppers "nymphs." But tiny, pale and wingless fellow though he was, with a huge head and a baggy skin or skeleton, both seemingly far too large for him, it was easy to see that he was a grasshopper. No absurd, wormlike infancy stage for him as was the case with his remote relatives, the flies, the moths, and the beetles.

But in spite of his size, in a few hours after emerging he and the rest crawled up the stem of a cockle-burr and began to feed. By evening the cockle-burr leaves had a shot-hole appearance, the holes being cut by the busy jaws of the nymphs.

Also, in a few days, the young grasshopper's body appeared less wrinkled. It was as if he had grown enough to fill up his over-large skeleton, just as a boy may "grow into" his brother's old suit.

In fact, as a result of his enormous appetite, his skeleton soon fitted him so tightly that something had to be done about it if he were to get any larger. For the young grasshopper—as is the case with all insects—on account of his unstretchable covering, could not grow up by gradual, barely perceptible degrees like a child. So as his skeleton became uncomfortably tight, he left off eating, crawled under some low leaves and remained very quiet. The molting-period had come, the first of several such events which must take place before he could become a full-grown grasshopper.

As the moment for casting his outer coat approached, he closed his breathing pores and began gulping air. This air, filling his digestive tract, raised

the pressure within him. Increased by his vigorous wriggling, the pressure soon became too great for his old coat to withstand. It parted suddenly along his back in a wide rent, and after more wriggling, he finally crawled out of it, renewed, so to speak, both without and within, for incredibly enough, his cast-off outer coat carried with it the linings from his mouth and intestine and airtubes.

After thus ridding himself of his old suit, the grasshopper appeared larger than before, but very pale and weak, for his new skeleton was still soft. But it would harden quickly, and if he were to gain any advantage from the shedding process he must stretch his new garment while there was yet time. Hence, guided by that inborn instinct which told him what to do next, he continued to take in air and stretch himself to such an extent that it would have been impossible to have fitted himself back into his old coat. And so as the result of all this, he found himself once more with an over-size skeleton into which he would again fit himself by a period of active feeding and growth.

Four times more in succeeding weeks he went through this same weird process. From each of these seeming new-births, he came forth with a bit larger body and a head more in proportion to the rest of him. And now with the last molt past, having attained full growth and functional wings, he sat on the post sleek and trim, not so voraciously hungry as he had been as a nymph, but wide awake and ready to play his role in the grasshopper world.

In arriving at physical maturity, the grasshopper had accomplished a rather rare thing in the world of his kind. Thousands of mature hoppers were near him there in the field, of course, but for each one like himself, 50 or more had died on the way. Of those who had hatched with him, for example, only two or three had matured. Half of them, perhaps, had been eaten by birds. Several had died from fungus growths picked up by their near-naked bodies while molting. Several had hopped blindly into a garden spider's web to be promptly bitten and swathed into silken mummies. Some had been seized and carried off to be sucked dry by robber flies. A shrew had made a meal of several; and a night-prowling skunk had picked off a dozen as they slept along the ragweed stems.

Even as he sat there on the post in seeming security, danger lurked overhead, for a tachinid fly was hovering near. It required only a second for that fly to dart downward and touch one of the hoppers, and that touch, when made, was the touch of death. For it left a tiny egg poked between the joints of its victim's body. And that egg would hatch, bore into the flesh, eating as it went, leaving a trail of ruin and eventual death in its wake.

But as was said at the outset, the grasshopper knew nothing of all this, neither what had gone before nor what was to come, his brain being geared to meet only the stimuli of the immediate present. For the moment at least, those stimuli were to his liking. It was warm and dry there on the post; his belly was full of food, and he was unaware of any danger. When night came he would sleep with a crowd of his fellows along the vertical stems of near-by weed-stalks. Each morning (for the next month or so) he would awaken to a replica of the preceding day's doings—a feeding and a resting and a keeping out of harm's way.

But to this daily round he would soon add another activity. For with his last molt, sexual maturity had come, and with it, the first sensing of a new urge, the need for a mate.

As a result it would come about that when the frost of October arrived and he and his mate were dead, 50 or 60 fertile eggs—the product of him and his mate—would lie well hidden in the fence-row waiting the coming of another spring.

WE WATCH BEETLES

Continued from page 259

none of them had ever held a beetle. Nevertheless the urgency was obvious and each one took a vigorously squirming specimen. Determined not to let the insects escape yet not to crush them by too firm a hold, waves of mixed emotions chased over our friends' flushed faces to record every wriggle of the captive beetles.

We wanted to see later stages in the beetles' life cycle, but the end of our short vacation from war research kept us from staying to watch for beetle young. Why not take a pair home with us? We filled an enamel-ware pan with earth to a depth of perhaps four inches, and placed two dead mice on top. Very obligingly the sexton beetles came flying to our bait and buried them where they lay. Covered by a screen, the dish and all its contents traveled 500 miles to Philadelphia while the self-buried parents tended the incubating eggs. Weeks later we dug them up and were able to add to our movie record some close-ups of sexton beetle grubs, fat and yellow, ready to transform into adults.

It's fun to watch beetles! But it surely is hard on our friends!

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A GREEN GOLIATH MEETS ITS DESERT DAVID

Continued from page 263

might be better off elsewhere. Larger numbers of coyotes might favor the cactus area, but they are not necessary. Grazing is the chief adverse factor.

At the same time, we must remember that even if measures such as these could be carried out, the healing hand of Nature works so slowly in the desert that it would be at least 50 years by the most optimistic estimate before pre-Gadsden conditions could be restored and reproduction of saguaros again established in the Cactus Forest. It would take another 50 years for those seedlings to attain stature remotely comparable with that of the present patriarchs.

Surely the saguaro is worth saving. This gray-green Goliath, this majestic vegetable water tank of the desert, is a veritable trade-mark of the Southwest. If it is a sufficient tourist attraction to stir business men of southern Arizona with the desire to retain it, there should be hope for its survival.

Thousands of acres of saguaro-dotted desert in southern Arizona have been turned under by the plows of cotton and alfalfa farmers and citrus growers. Other thousands of acres of desert have been subjected to grazing, coyote hunting, woodcutting, and all the activities of civilization that have brought about conditions

reducing or entirely preventing saguaro reproduction. However, there still remain a few spectacular stands of saguaros that are more favorably located and are still perpetuating themselves. Plants of all ages are about equally represented in these spots. It is still possible to save one or more of these normal stands if proper protection to perpetuate natural conditions is assured now; now, before woodcutters, cattle, and coyote hunters can lay the foundation for 50 or 100 years hence when the disease will build up to another epidemic among mature saguaros unable to reproduce.

One spectacular stand of saguaros is that of Tucson Mountain Park. Another but less extensive stand is within the boundaries of Organ Pipe Cactus National Monument, south of the mining town of Ajo; and there are others. Mining interests a few years ago exerted pressures that opened Organ Pipe Cactus National Monument to prospecting, and prospectors must cut firewood, and, in some instances, timbers for bracing and shoring. Most of them graze pack stock and shoot coyotes on sight. Where miners have had their chance and found nothing, it would seem fair now to take measures to protect the scenic and educational attractions. If strict regulations could be enforced now and henceforth, the most important conditions favoring normal reproduction would be preserved. But there is strong opposition to the enforcement of the very regulations so essential to the preservation of the saguaros.

Lessons learned from the extinction of the passenger pigeon and heath hen came too late to save those interesting manifestations of primitive America. Classic principles of wildlife conservation engraved upon our understanding by the cougar-deer experience of the Kaibab Forest of Northern Arizona were acted upon in time, and only the healing scars remain to remind us of that near-tragedy.

Will the spectacular groves of these desert Goliaths one day be found only in museum dioramas and in photographs, where future generations will get only a meager impression of the splendor that "His Majesty, the Saguaro," once imparted to the desert? Or will the unsightly skeletons gradually take the background and remain only as reminders of another triumph in conservation?

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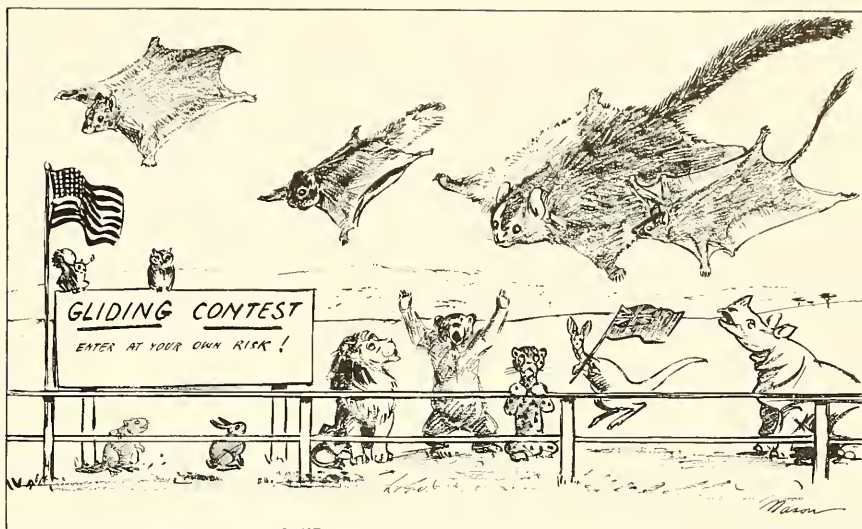
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GLIDER CONTEST



By JOHN ERIC HILL
Drawing by
G. FREDERICK MASON

ALTHOUGH bats are the only mammals that can actually fly, members of four different mammal families have become living gliders, making use of the same forces as man-made gliding machines do. The force of gravity causes an unsupported body to fall, but if this body has sufficient flat surface to take advantage of air resistance, it may be carried a long distance before landing. All of us as children have folded paper to make small gliders; and natural gliders include the autumn leaves, elm seeds, and many other similar objects.

Even the common mammals that live in trees can make use of air resistance when they fall or jump from heights. I once followed a large squirrel to the top of a pine tree, some 75 feet high, trying to take a close-up photograph of it. When I approached within four feet, it jumped clear of the tree. As it fell through the air, the squirrel spread out as flat as it could, with legs and tail extended. Although it landed with a thud on the hard, sun-baked ground, it recovered its breath in a moment and ran up another tree.

The mammalian gliders have improved on this, developing broad skin-folds, which, stretched between the fore and hind limbs, present a plane surface to the air and enable these

animals to glide from tree to tree with little loss in altitude. First among the gliders in its degree of adaptation is the cobego, colugo, or flying lemur of the Malay region and the Philippines. It is about the size of a cat, with a somewhat doglike face and long, slender limbs. The limbs support a wide, thin membrane that begins on the neck, includes the fingers and toes, and extends to the tip of the tail. The cobego would need only long fingers and powerful breast muscles to graduate from gliding to flying, but although it can control its direction, it depends entirely on air-resistance for support and on gravity for the necessary motive force. Students of flight in birds and bats believe that gliding was a stage in the development of true flight.

Flying squirrels, properly so called, are the best known of the mammal gliders, though not the most efficient. The two species in the eastern United States are soft-furred, grayish brown animals that frequent our woodlands and are active during the hours of darkness. They are related to the tree squirrels, with typical rodent teeth and skull. In eastern Europe and widely distributed in Asia are other species of the same family. Those found in the Indian and Malay regions are especially varied. Some are giants of their tribe, brightly colored flying squirrels more than a yard in length. The gliding membranes of these large forms are especially wide, hampering their movements on the

ground or in trees but allowing them to sail through the air for some 80 yards.

Flying squirrels can turn almost at right angles from their course in mid-air and can control the angle and consequently the speed of their glide. At the end of a glide, the animal checks its speed by swinging upward and lands head-up on the tree, its goal.

The African scaled-tails look like and are often called flying squirrels. They are rodents but belong to a family of their own, far removed from the squirrel family. At the base of the tail, on its underside, are the large overlapping scales from which these rodents derive their name. The gliding membrane in these animals is supported by a stiff rod of cartilage attached to the elbow, while in the flying squirrels there is a similar strut arising from the wrist.

In Australia, New Guinea, and near-by islands, there are gliding marsupials, distant cousins of the kangaroos and koalas. Locally they, too, are called "flying squirrels," but they are phalangers, greatly different from rodents internally though similar in appearance. Like other marsupials, they have pouches in which the young are carried on these flights. One species is large, a yard long including the long tail, while another is a pigmy, hardly larger than a mouse.

Thus, four unrelated tree climbers have developed the same means of escaping from enemies; they sometimes seem to glide just for the fun of it.

LETTERS

Continued from page 241

spot I landed at was within a few miles of 1° 15' South, 133° 28' East. The mountain that was visible must have been Togwormeri, and the landing strip (where you'll find your pygmies) lies on a course of 239° from Manokwari.

We flew down the coast until we hit a me to turn south and fly until we saw small grassy plain, then the guide told what we were looking for. The flight wasn't too bad, but not knowing the terrain any too well and being afraid of running into the side of a mountain, I 'buzzed' all the way. The little Valiant just purred along, and I was enjoying myself by staying as close to the tree tops as I possibly could, first, because of the Japanese and second, to see how the native guide would take it. He turned blue at first but got accustomed to it after a while.

My altimeter slowly began climbing. We had been in the air about one and three-quarters hours, and if we didn't find the place soon I would have to turn back. I checked the gas and decided about ten more minutes was all I could give to the search. The terrain of the country here was different from anything else I had seen in New Guinea. It reminded me very much of the Feather River country up in California: tall trees well spaced, beautiful grassy plains, and mountains towering on all sides. I estimated them to be somewhere around 10,000 feet. Then at last we came to a smooth plain and saw natives hopping up and down, wav-

ing cloths and things. I dropped down to within ten feet of the ground and, sure enough, there were white men among them. I turned the ship around and landed, trying my darndest to keep from killing half the natives, who ran out and began petting the plane even before it stopped rolling.

The natives were pygmies all right. The tallest was about four feet eight, and he looked like a giant among the rest. The average height, I judged, was about three feet eight. The most notable thing about them was their superb physique. They were all normal; not a deformity in man or child, nor any sores or skin diseases such as I had seen among the natives along the coast. They were also much lighter in skin color. *Their hair was black but it was not kinky; it looked soft and silky*, reminding me of Chinese hair, although it was much finer. Both sexes wore it hacked off short, and some wore a head covering made from the colored silks used in parachutes for dropping supplies. Generally the features were clean cut, the nose somewhat aquiline in shape, mouth wide with thin lips, teeth very white and well shaped, ears small and set close to the head. The shape of the skull did not strike me as unusual, but the women did strike me as being very nice looking. Others earlier must have noticed that, for there were a few half-white children running around in the crowd.

The pygmies appeared a happy, intelligent lot, and evidence of the latter was seen in the workmanship on the orna-

ments they wore. Everyone wore bracelets and necklaces of some metal that looked like gold, set with green stones something like emeralds. And they were well worked. (I ought to know; I was with a manufacturing jeweler before I went in the service, and my specialty was working with pearls.) Some of the women, in addition to a white bone three or four inches long thrust through an incision in the ear lobe, wore solid gold earrings! If it wasn't gold, it looked enough like it to fool me.

For weapons the men carried a sort of dart or spear about four feet long. It tapered to a point at both ends and was thick through the center and weighted with something heavy. The knack of throwing it was not easily acquired, as I found out later. You grasp the weapon by the weighted center and throw it as you would a stone. It is supposed to revolve once and then fly straight to the target. I didn't think it could be done until they showed me . . . and the natives' accuracy with such a cumbersome weapon was remarkable.

The women wore the usual cloth around the waist, and the men were covered with a loincloth of rough weave; but two chiefs to whom I was introduced were draped in the uniforms of Japanese colonels! The blouses fitted all right, the sleeves fine, but the pants were much too large and long and made their flat feet sticking out below look twice as big and flat as the others'. The chiefs were very polite and affable, but I noticed that they kept staring at my mouth, and whenever I spoke or laughed the rest of the natives just stood and looked at my face. There must have been 400 pygmies in the crowd, and not one of them so much as breathed hard! During those moments, the vast silence in that valley was incredible. I must admit I began to feel a bit uncomfortable and finally asked one of the Dutch why the natives looked at my mouth so intently. He asked the chiefs, and they told him it was the gold in my mouth, my gold inlay! Very much relieved, I invited them up for a formal inspection, opening my mouth wide so they could get a good look, but the chiefs shooed the rest back. They evidently wanted to be the source of information after I left. Yes indeed, the two agreed, that was the thing all right! Gold in the teeth. No doubt they began cramming in gold inlays and pushing out teeth as soon as they could get to their supply—which makes one wonder where their supply of gold does come from.

I didn't see any huts or shelters anywhere near. One of the white men told me that because of the proximity of the Japanese, the natives' houses were well hidden in the woods. And I can believe it. Since then I've flown many times over this same area, purposely swinging off course on the way home from a strike, and I could never even locate the field again. I've also flown at treetop level trying to spot the pygmies' village but could see nothing but trees, grass, and mountain streams. I could only conclude the jungle had once more claimed its own.

LT. S. BOCCHIERI.

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LETTERS

SIRS:

Your article on Eagles by William H. Carr interested me very much. For about 25 years it was my good fortune to live on the shores of two Montana lakes, where there were large numbers of eagles, both the "Bald" and the Golden.

I have frequently seen a Bald Eagle attack the immense flocks of Mud Hens [American Coots] that gathered on Flat-head Lake. The eagle's technique was interesting. The mud hen can make only a very shallow dive. It can stay under water about two seconds before coming up for air. The eagle would concentrate on only one bird in the flock, and when the eagle swooped for it, the mud hen would dive and the rest would scatter. The eagle would go past his victim possibly 50 feet, then turn and come back to where the mud hen had made its quick dive. The mud hen would again dive, and the eagle would again return. Eventually the eagle's swoop would synchronize with the mud hen's emergence, and the eagle would fly to a near-by tree and eat the mud hen at his leisure. I have seen this repeated dozens of time.

Kalispell, Montana WEBB R. BALLORD.

SIRS:

I recently witnessed a most unusual phenomenon. On the night of April 12, Wyoming was visited, about dusk, by a sudden violent storm. There was very little wind, but there was dense fog and the snow flakes were so large and thick that it was impossible to see more than two feet away.

When my car stalled five miles from the ranch, I proceeded on foot, holding to the barbed wire fence. Suddenly I saw a faint light and found, to my amazement, that it was a small sputtering light a few inches above a tall fence post. It gave off the crackling sound of electric sparks, but no heat. As I followed the fence, at about one mile per hour, I observed the light above occasional posts for about three miles. At times the "fire" played along the edge of the visor of my cap, and when I tried to brush it off, it was transferred to my glove. I found I could start a light above any of the posts by twiddling my fingers over it. I later learned that another man had seen the lights above some tall pine trees. No doubt the light was a form of static electricity, was it not?

Our whole family has enjoyed NATURAL HISTORY Magazine for a number of years. We especially liked the articles about Indian relics and fossils, which we collect from our hill pastures.

ANGUS M. BARTON.
Wheatland, Wyoming

The following comments are offered by Mr. Hugh S. Rice of the Hayden Planetarium:

This interesting phenomenon of atmospheric electricity is called *St. Elmo's fire*. Occasionally it is seen emanating from points on masts of ships, and less commonly from corn-

ers and points on high buildings and other sharp-pointed structures. Seemingly, pointed objects have the quality of attracting or repelling electricity.

Mr. Barton is correct in assuming that St. Elmo's fire is a type of static electricity. With its faint bluish color it affords a startling appearance. Actually, the fire is an electric discharge allied to lightning. It betrays a high "potential gradient" at the time. That is, the rate of change in the electrical pressure between the charged portion of the atmosphere and the ground, with respect to the distance between the two regions concerned, is abnormally high. The fire is one kind of "brush discharge"—as is witnessed when an electrostatic generator is running in a darkened place. In Mr. Barton's example a heavy charge of static electricity was "induced" on the wire fence (acting as conductor), the high potential gradient being set up by the passing of electrified clouds and air-masses. The crackling sound is also characteristic of St. Elmo's fire.

The appalling disaster of the dirigible *Hindenburg* is supposed to have

been caused by St. Elmo's fire igniting some escaping hydrogen gas.

SIRS:

I read the article about the American ideal in the June issue of NATURAL HISTORY and it brought to my mind a subject which has been of interest to my family—the subject of beards. Why is it that White people grow beards, Yellow people grow wisps, and Indians of the United States did not have any? It would be very nice if you could find an answer for us.

JOANNE LEWIS.

Waverly, Pennsylvania

The ability of men to cultivate beards varies considerably among the diverse races of mankind, as Miss Lewis has noted. One of the most hirsute of human stocks is the white race, although they are rivaled if not surpassed in this by such people as the Ainu and the Australian aborigines. At the other extreme stand the Negroes and various Mongoloid people, whose beards appear relatively late and are so sparse that the expedient of plucking out the hairs instead of shaving them off is feasible and widely practiced among them. The

Continued on page 340

ST. ELMO'S FIRE

From an old print



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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President

ALBERT E. PARR, Director

VOLUME LIV—No. 7

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SEPTEMBER, 1945

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YOUR NEW BOOKS

MAMMALS OF THE PACIFIC • CINCHONA CAREERS IN SCIENCE • RELATIVITY

THE MEANING OF RELATIVITY

----- by Albert Einstein

Princeton University Press, \$2.00
135 pages

THE first edition of this book consisted of the text of Professor Einstein's Stafford Little Lectures, delivered in May, 1921, at Princeton University. For this second edition, Professor Einstein has added an appendix, of about 25 pages, discussing certain advances in the theory of relativity since 1921. In this supplementary chapter, among other things, the author discusses the confirmation afforded by Hubble's experimental evidence of the expansion of the stellar system, based on the red shift.

When one opens this little book, he is reminded of Jeans's remark, that the only conception of the universe that can now be framed is a mathematical conception, and that after we have it, only a mathematician can understand it.

Brilliant minds have attempted to make clear the theory of relativity, ranging from our popular writers, E. E. Slosson and Garrett P. Serviss, to our leading mathematicians, physicists, and astronomers. In this professional group we have Arthur S. Eddington, Oliver Lodge, Bertrand Russell, Frank Dyson, J. J. Thomson, J. S. Ames, Henry Norris Russell, Max Planck, H. A. Lorentz, W. de Sitter, and many others. But many students will wish to follow the reasoning in the words of the author of the theory, now considered "one of the highest achievements of human thought" since Newton's day.

CLYDE FISHER.

CINCHONA IN JAVA—

The story of quinine.

----- by Norman Taylor

Greenberg, \$2.50
96 pages, 16 illustrated pages

THIS interesting little book does not claim to present the results of original research on quinine. It is, as its subtitle indicates, merely the story of the drug which, during the three centuries of its use, has saved more lives than any other medicine. We of the northern states scarcely realize the importance of malaria, but it is still rife in parts of our land, and Taylor says it costs us half a billion dollars per year.

Quinine comes from Cinchona trees, of which several species have been used. For more than two centuries medicine depended for its supply of quinine entirely on bark gathered from wild trees in the

Andes. Cultivation of the trees began as early as 1865, and the Dutch have grown it with especial success in Java.

Mr. Taylor is a graphic writer and unfolds his story in a convincing manner. He tells us of the dreadful importance of malaria and of the startling discovery by Laveran, Ross, and Grassi of the microscopic plasmodium which causes the disease. He tells us of the discovery and early history of quinine, of its increasing importance to the white race as colonization of the tropics proceeded, of the efforts to grow Cinchona trees on plantations, and of the gradual increase in the yield of quinine through application of modern methods of plant breeding. In short, he has brought together in ninety-six pages as complete a story of quinine as the layman will wish, while his bibliography will serve as a guide to further and deeper reading.

H. A. GLEASON.

SCIENCE IN THE UNIVERSITY

By Members of the Faculties of the
University of California

University of California Press, \$3.75
332 pages, 7 plates

THIS volume, among others thus specially designated, was published in commemoration of the 75th anniversary of the founding of the University of California, and it should be of particular interest to all who have ever studied at this great western institution of learning. Included in the book are nineteen chapters or essays on as many branches of science.

The first chapter is a classical treatment of the progress of the fundamental science of Astronomy, entitled "Driving Back the Dark," by Dr. Robert Grant Aitken, Director Emeritus of the Lick Observatory. This chapter alone would justify the book. "Trees and History," by the paleobotanist, Dr. Ralph W. Chaney, who was on the 3rd Asiatic Expedition headed by Roy Chapman Andrews, is an interesting story of the pre-history of California. Here the reader is reminded that fossil trees represent the thermometers and rain-gauges of the past; that the prints of leaves and seeds in sediments now turned to stone, and petrified logs buried in the gravels of ancient streams, constitute the documents from which much of the pre-history may be read.

Besides these there are chapters on Cosmic Rays, Molecular Forces and Solubility, Organic Chemistry, Meteorology, the California Current, the Evolution of a Sierran Landscape, a Modern Conception of Living Material, the Theory of the

Gene, Longevity in Organisms, the Trend of Bird Life from the Fossils through the Present, Plant Nutrition, Physiology, Psychology, Oceanography, and finally a closing chapter entitled "Life, Morals and Huxley's 'Evolution and Ethics'."

It is evident that the topics treated are all scientific, and they were written for the general public. While some are excellent pieces of popular writing, others are only semi-popular, and a few are necessarily rather technical. Altogether the book is a worthy volume commemorating the progress of a great University during three-quarters of a century.

CLYDE FISHER.

MAMMALS OF THE PACIFIC WORLD

----- by T. D. Carter, J. E. Hill
and G. H. H. Tate

The Macmillan Company, \$3.00
227 pages, 69 illustrations

AMONG the few things that can be marked in black ink in the crimson ledger of war are heightened interest in distant parts of the world and increased knowledge of them. Pacific islands that were not even names to us a year ago are now being seen by thousands of American soldiers and are becoming familiar to the rest of us through letters and publications. Strange native tribes and unfamiliar animals and plants live on these islands. The interest that these awaken is reflected in a constant and growing flow of inquiries received by museum curators from service men, their families, and the public in general. To answer this interest with authentic, comprehensible, and readily available information, the American Committee for International Wild Life Protection has sponsored a series of seven books on the Pacific World, each of which is being issued in a paper-bound edition for the armed forces and in a library edition for the public.

This region produces some extravagantly queer and exotic mammals, such as the platypus, the bandicoot, the cuscus, the koala, the wombat, the gibbon, the tarsier, the linsang, the mouse deer, and the babirusa, to mention only a few. The book provides excellent information for service men and for those who followed their painful adventures from afar. Many of the Pacific islands have no undomesticated land mammals except the ubiquitous mouse and rat, introduced by man, but some, such as Sumatra and Japan have exuberantly varied mammalian faunas, and the many outlandish mammals of Australia are also included. The three

authors, who are all on the Staff of the American Museum, have collaborated to make this book a masterpiece of organization and conciseness.

Beyond the appearance and habits of the animals, the book discusses the basic principles of mammalian history, migration, and distribution. There is a glossary (somewhat too brief) and a check-list of the mammals of each island or island-group.

This book is recommended without reservations, both for its immediate utility and for its permanent value. G. G. S.

SCIENCE TODAY AND TOMORROW

----- by Waldemar Kaempffert,
Second Series

The Viking Press, \$2.75
279 pages

IT is evident that no survey of science can be final. The object of this book is to bring up to date the progress of science as outlined in the essays of the first series published only six years ago. Some of the first series is already out of date, and has been omitted. In fact, more than half of the second series is new, and among other advances recorded here is the influence of the war, always a profound impetus to science and invention. The author reminds us that Leonardo offered his services to the Duke of Milan primarily as a military engineer, and that Galileo was a professor of military science.

In this volume we have 24 chapters on as many different phases of present-day

science, including the prospects for tomorrow, written in a popular, imaginative style. The subjects of the essays include "Science, Technology, and War," which might have been titled "The Evolution of Warfare"; "The Chemical Revolt Against Nature," in which is related the story of the sulfa drugs, the discovery of penicillin, etc.; "After Coal—What?"; "Life in the Solar System"; "Birth and Death of the Moon"; "Can the Laboratory Create Life?"; "Electronics"; and "Through Science to World Unity."

These stories are dramatically told in non-technical language for the layman by the Science and Engineering Editor of the New York Times. Mr. Kaempffert was for eighteen years editor of the *Scientific American*, and editor of *Popular Science* for five years. He was the first director of the Museum of Science and Industry in Chicago, founded by Julius Rosenwald. His background and experience, together with his literary gift, have qualified him to prepare a fascinating book on science brought up to date.

CLYDE FISHER.

THE ELEMENTS RAGE

----- by Frank W. Lane

London: Country Life, Limited
to shillings, 6 pence,
188 pages, 46 illustrations

THIS is an entertaining work concerned solely with the violent manifestations of nature, their origins, and something of their effects. Hurricanes, tornadoes, waterspouts, hail, snow, lightning,

meteors, earthquakes, and volcanoes contribute to the subject matter, and all are discussed in wholly non-technical and entertaining language. Each chapter has been checked for accuracy by at least one expert, and the author has indicated in footnotes those places where the experts have failed to agree or have felt that the statement given was not sufficiently inclusive. A terminal bibliography (including several references to articles in this magazine) adds to the value of the book for the serious reader.

There is much miscellaneous and interesting information to be found within these pages. Did you know, for example, that the Empire State Building was struck by lightning 63 times in 3 years, and during one storm, 15 times in 15 minutes? Or that the largest single hailstone of which there is authentic record, which fell at Potter, Nebraska, in 1928, was 17 inches in circumference and weighed a pound and one half? When cut open it was of layered construction, proving it to be one stone—not an aggregate of stones. Larger stones are believed to have fallen. One collected at Heidgraben in Germany in 1925 measured 9.8 x 5.5 x 4.7 inches and must have weighed 3 or 4 pounds, but it may have been an aggregate of several stones frozen together. These are but samples of the unusual information brought together here and supplemented by some remarkably fine illustrations.

It is a pleasure to recommend this book to those who are interested in pleasant and instructive reading on natural phenomena.

H. E. VOKES.

Continued on page 336

"BOOKS THAT LIVE"

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The Pacific World



Edited by FAIRFIELD OSBORN
Introduction by William Beebe

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WAR CASU

◀ A FEMALE LAYSAN "FINCH" detaching and eating portions of the root of the "Beach Magnolia" (*Scaevola frutescens*) on Eastern Island, Midway



Photo by T. M. Blackman

By THOMAS M. BLACKMAN

THE news that Midway's only three land birds have recently been exterminated came as a shock to bird students in Hawaii, and application has been made to the Naval authorities for information regarding this event.

The official report, published in an article by Mr. George C. Munro in *The Elepaio*, Journal of the Honolulu Audubon Society, leaves no room for doubt. Due to the admittance of rats to both islands of Midway, the Laysan rail (*Porzanula palmeri*) and the Laysan "finch" (*Telespiza cantans*) have completely vanished. And the third species, a large and flourishing colony of imported canaries (*Serinus canarius canarius*), two of which were last seen in the vicinity of the Cable Station on October 20, 1944, has apparently also been exterminated.

Although none of these birds was indigenous to Midway, their loss is a serious one to the bird life of the Hawaiian Islands. The flourishing colonies of the Laysan rail and the Laysan "finch" at Midway contained the only representatives of these species in the world, with the possible exception of a smaller number of the "finch" still believed to exist on Laysan.

Laysan Island, the original home of these two birds, lies 360 nautical miles closer to Honolulu than Midway, in the northwestern Hawaiian chain. It was long famous as the chief breeding place of the albatross that bears its name and of enormous num-

bers of various other ocean birds. From the year 1890 until 1904, the island was exploited commercially for the collection of guano for use as fertilizer. Shortly before the latter date, rabbits were imported and liberated by a resident on the island, and they increased so rapidly that in a very few years the entire vegetation of Laysan was on the verge of disappearing. The rabbits were dying of starvation, and the four species of small land birds, found exclusively on this small island, were faced with extinction owing to failure of the food supply.

Fortunately, two of these small land birds, the Laysan rail and the Laysan "finch," had been introduced on Midway and were becoming established. The rail was completely exterminated on Laysan, and the Laysan "finch" decreased until only a few survived there. The other two land birds of Laysan vanished from the face of the earth. One, a somber-colored little songster known as the "miller-bird," succumbed because it could not find the moths upon which it depended for food. The other, a small honey-eater, perished through lack of shelter and food.

In February, 1909, President Theodore Roosevelt issued an executive order creating the Hawaiian Bird Reservation. This sanctuary for bird life included all the islands of the northwestern Hawaiian chain with the exception of Midway. And with Midway under the jurisdiction of the United States Navy, its birds were receiving, up to the beginning of the

The only three land birds inhabiting Midway Islands have been exterminated

present war, very similar protection to that accorded on the other islands. Therefore, a feeling of greater security for the bird life of these islands had existed.

The loss of so interesting a species as the Laysan rail is a matter of deep regret to all who take an interest in birds. Moreover, it can easily be the forerunner of other misfortunes yet to be discovered, resulting from strenuous conditions during war activities.

Throughout the winter of 1939-1940 and the ensuing spring, the writer had numerous opportunities to observe the habits of the Laysan rail and the Laysan "finch" at Midway, where both were very numerous over almost the entire area of both islands.

The Laysan rail, although only about six inches in length and quite flightless, gave one the impression of being the quickest thing to be seen on two legs. Its cry was heard at all hours of the night, leaving one to suppose it was just as active then as during the daytime, when it might regularly be seen searching beneath the vegetation on almost any part of the two islands, with the exception of bare patches of sand near the shore lines.

The Laysan rail was chiefly an insect eater, and it rendered good service by its untiring attacks on the flies that were such an annoyance to residents at Midway, especially during the summer months. It was adept at catching them when they settled on the dead birds that are always in evidence among crowded bird colonies. Running up quickly, it often succeeded in catching a fly before it could escape. The rail then usually ran quickly away to devour the fly a few feet distant before returning. By

ALTIES among the BIRDS

that time, other flies had generally settled, and the procedure was repeated. Should no fly then be present, or if the rail should miss catching a fly, it often walked around the dead bird to examine the opposite side and then proceeded to pick at it. Most of the dead birds had holes torn in their soft underparts, and rails were occasionally seen to examine these places for fly-maggots. On one occasion, a rail was seen to detach two or three feathers from a dead petrel's neck and release them.

In their foraging excursions, these rails were frequently seen to enter the burrows of petrels and shearwaters. Sometimes they would reappear almost immediately, but at other times they remained below ground for two or three minutes. I am unable to say whether the rails ate the petrel's eggs on these underground excursions, but they were observed to eat the contents of eggs that were found broken on the ground. It seems likely that insects of some kind were found within the burrows.

The Laysan "finch" was credited with doing much injury to various cultivated plants on Midway, but during my observations it obviously rendered good service in destroying

great quantities of the troublesome, sharply spined seed cases of the creeping plant *Tribulus cistoides*. It picked these up from the ground and cracked them with its strong bill to extract the seeds, which apparently formed its main food supply. It also ate the white berries of the "Beach Magnolia" (*Scaevola frutescens*), and on one occasion was seen to remove and eat portions from the root.

This bird has a pleasant though not very powerful song. Like the Laysan rail, it eats any eggs it finds, if they are not too hard to break.

In early February, when the Bonin Island petrels (*Pterodroma hypoleuca*), so abundant on Midway, were laying their eggs, a number of the eggs were seen scattered on the ground each morning. There was much speculation among the residents to account for this. On February 5, fourteen such eggs were counted within a few minutes, and 150 were seen on a half-mile walk the same day. In the early mornings, most of these eggs were unbroken; but as the day advanced, it was difficult to find an unbroken one, or even any of the contents in the shells. The shells all bore what appeared to be the marks of a bird's bill. There were, of course, no

rats at that time on either of the islands of Midway. Though I never saw either a rail or a "finch" break into one of these eggs, I twice saw a rail eating from one of the broken eggs, and on one occasion a "finch" was doing it. I heard of other instances of the "finch" eating eggs.

I was inclined to attribute the number of petrel's eggs on the surface of the ground to the accidental destruction of their nests by men walking on loose coral sand. It was not at all uncommon for one's foot to sink to a depth of a foot or more several times in the course of a short walk off the track. And each time one permitted this to happen, it probably left a bird entombed in its burrow or unable to enter it on its return. Birds in the latter predicament probably sometimes laid their eggs unprotected on the ground.

All of these things illustrate the disturbances that result from alterations of natural conditions. As an example of the disastrous effects produced on Laysan, it is on record that in 1923 only four species of plants remained out of 26 that had previously existed on the island. This was when the Tanager Expedition, sponsored jointly by the U. S. Biological Survey, the Navy Department, and the Bishop Museum of Honolulu, visited Laysan. One of its objects was the extermination of the remaining rabbits, and this is believed to have been achieved. Efforts have since been made to re-establish the vegetation of the island.

Bird lovers throughout the world are actively interested in preserving species that are threatened with extinction, but localities like these illustrate that it is not enough simply to protect the birds themselves. Care must be taken against the introduction of new enemies and against any threat to the food supply. Otherwise, unexpected dangers are apt to arise when it is too late to prevent serious damage. A better public understanding of these delicate relations in the world of nature is most important to the cause of conservation. Only with a broader knowledge of these basic principles can we expect wise legislation and intelligent participation by individuals.

▼ A LAYSAN RAIL catching flies. Advancing slowly until it is within a few inches of the dead petrel, the rail quickly runs up and often succeeds in catching the fly before it can escape

Copyright photo by T. M. Blackman



Arizona's Ancient Irrigation

By EMIL W. HAURY
Director, Arizona State Museum

Before Columbus came, America's Master Farmers had evolved an elaborate civilization, had accomplished amazing feats of engineering, had become highly skilled in the arts—and then had vanished

MANY persons, picturing the Early American Indian as the most elementary sort of agriculturist, are surprised that the so-called Hohokam people developed an elaborate irrigation system in the desert of southern Arizona before Columbus discovered America and as a result thrived by agriculture beyond the wildest dreams of their contemporary neighbors. Modern engineers, with their mechanical monsters for moving earth, would not be daunted by the task of duplicating their system. But no such aids were available to the Hohokam, not even domesticated beasts of burden. The construction of the canals was wholly by hand, from their planning to the back-breaking job of digging and repairing them.

If we begin to calculate the amount of earth moved, loosened with stones and sticks, and packed out on human backs, the figures become incomprehensibly large. Yet the evidence of the superhuman effort is there, clear and unmistakable. For output of labor on a single cultural feature, the Hohokam had no peers among the native Americans north of Mexico. The accomplishment earns for them, hands down, the title of America's Master Farmers.

In the Salt River Valley alone, canals, traceable in recent times, go an aggregate length of about 150 miles. They often attain a width of 30 feet, and depths of as much as ten feet have been measured. In a few places, they were literally hewn through stony formations.

Whether the Hohokam people invented canal irrigation or whether they borrowed the idea from others is academic. We do know that, by

A.D. 700 or soon after, this type of farming was well established among them and that it increased in size and complexity to reach its greatest magnitude roughly between A.D. 1200 and 1400. It represented a major adjustment to inhospitable environmental conditions and paid rich dividends in security and leisure time for the people. Populous villages arose, and their occupants lifted the level of tribal attainment from mere existence to rich living.

What information we have about these people is the direct result of the archeologist's insatiable curiosity. No one knows what name they had for themselves. The placid Pima Indians, who today live among, and, in some cases in, the village sites founded by these earlier folk, recognized the ruins as the homes of the ancient ones—"those who have vanished," or the "Hohokam." This label, the archeologists have been quick to borrow.

For many years the Hohokam were regarded only as a regionally specialized branch of the Pueblo Dwellers, whose well-known cliff homes and large communal villages are scattered far and wide through northern Arizona, northwestern New Mexico, and the southern parts of Utah and Colorado. But, as more and more was learned about them, it became clear that the mode of life, architecture, treatment of the dead, and arts and crafts were too different to be included in the Pueblo pattern of culture. The early excavators, like Cushing and Fewkes, while they did not recognize the Hohokam as an entity separate from the Pueblo inhabitants of the fourteenth century, nevertheless made specific contribu-

tions by gathering a large body of facts. It remained for the personnel of such institutions as Gila Pueblo at Globe, the Los Angeles Museum, Pueblo Grande Laboratory at Phoenix, and the Arizona State Museum at Tucson to piece together the main cultural story of the Hohokam and fill in many of the details.

These canals also tell us something about Hohokam leadership. A project of this magnitude must have required not only a well organized system of directing labor battalions—but an integration of the efforts of numerous settlements that were to profit by the network of ditches. Authority here netted a strictly utilitarian and secular accomplishment as distinguished from the great religious edifices, equally consuming in labor, demanded by the theocratic civilizations of the Aztec and Maya.

When archeologists work with the tangible vestiges of a bygone people, representing their history over generations of time, it is inevitable that differences in these products should become apparent. The house types may vary in form and earthenware vessels may show marked alterations in shape, design, and color. Cultural items may appear suddenly and others may die out. Change, to a greater or lesser degree, is inherent among all peoples. It is this very fact that permits the archeologist to arrange the history of a group like the Hohokam in chronological sequence. This has been done most effectively for the Hohokam by leaning on the principle of stratigraphy. When the architecture and other relics of one generation lie buried beneath those of another, it is known that they are older. Applying this principle, painstaking

Builders

▼ A VIEW of the desert landscape that America's Master Farmers made to flower between about the time of Christ and A.D. 1400

Photograph by Tad Nichols



▼ A TRENCH dug at right angles through an irrigation ditch at Snaketown. The Indian stands on the floor of the oldest of three superimposed canals dating from the Colonial Period (about A.D. 600-900). Silt subsequently filled this canal, and it was later re-excavated to form the second irrigation artery. The Indian's left hand rests on the latest of the canals, which was in use during the Classic Period, perhaps around the fourteenth century, as revealed by pottery fragments found on the floor

Gila Pueblo photo



► RELICS left by the people at different levels of occupation at the same site reveal four stages in their history. This photograph of a Hohokam trash mound in process of dissection shows the archaeologist's method. Each rectangular block of trash was excavated as a unit and screened. Materials showing human workmanship thus sifted out were carefully analyzed. About 175,000 pottery fragments were taken from this one mound at Snaketown

Gila Pueblo photo

study of deep trash deposits at Snake-town by the Gila Pueblo Museum has given us a picture of the Hohokam over a long period.

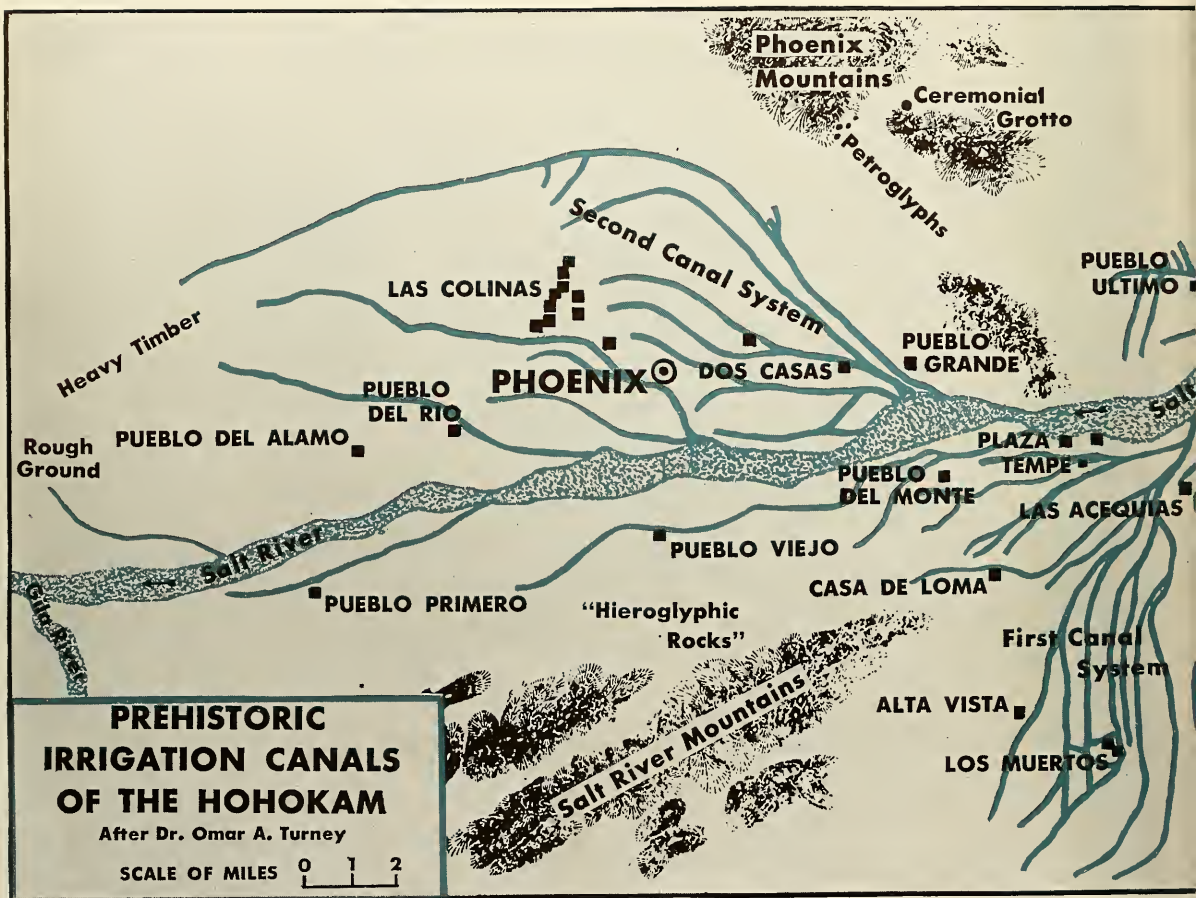
For how long? you ask. Here is where the principle of stratigraphy breaks down, because it does not offer the key to the local historical sequence in relation to the Christian calendar. This must be arrived at by other means.

North and east of the Hohokam domain, in the realm of the Basket-maker and Pueblo Indians, we now

have an exact measuring stick in the tree-ring method of dating. This has revealed the ages of such spectacular ruins as Pueblo Bonito in New Mexico, the cliff houses of Mesa Verde in Colorado, and Betatakin and Kiet-siel in northern Arizona. The system was developed by Dr. A. E. Douglass, an astronomer at the University of Arizona. It cannot be applied directly to Hohokam remains, because the arid environment there did not provide the right kind of trees. But there is a way out of the dilemma. The

Hohokam established contact with their northern Pueblo neighbors and exchanged goods with them. Pottery was the most significant item, because the various types of Pueblo pottery have been dated by the tree-ring method and therefore serve as useful time markers when found at various levels in the Hohokam region. Conversely, distinctive Hohokam pieces occur in Pueblo ruins, so that the archeologist has a two-way check on his efforts to correlate the development of the Hohokam with the known chronology of the Pueblos. In this way, periodic divisions have been assigned to the Hohokam. It must be remembered, however, that

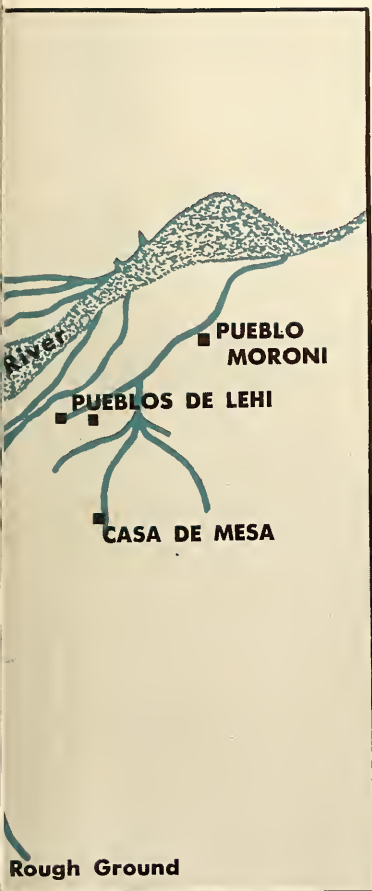
▼ WITH ONLY the most elementary tools of stone and wood, these people constructed an irrigation system totaling 150 miles of canals in the Salt River Valley alone



► POTTERY permits the closest dating of the Hohokam culture, because it can be compared with the styles of neighboring regions where accurate dating has been possible. Measurement of tree rings in ancient timbers enables the scientist to establish a precise time scale based on known fluctuations in rainfall. Neighbors of the Hohokam people used such timbers in building; therefore the Hohokam, who traded with them, can be fairly accurately fitted into the same chronology. The jar at left is known to belong to the Colonial Period (A.D. 600 to 900), that on the right to the Classic Period (A.D. 1200 to 1400)



Arizona State Museum photo



actual dates, particularly the early ones, are assigned only tentatively.

The formative stage of the Hohokam, beginning perhaps about the time of Christ and lasting to A.D. 500 or 600, has been called the Pioneer Period. During this time, the people were developing a new economy and in that sense were pioneering, even if they may not have recently arrived as immigrants. This economy was based on native American plants, notably corn, which had been domesticated somewhere to the

south and came to them by the normal process of diffusion. No proof has been found to support the idea that irrigation was practiced at this early time, but I believe it may safely be assumed that a start had been made.

Strangely enough, the partially sunken houses of the Pioneer Period were very large, as much as 35 feet square, and were unmatched in size by any of the later domestic structures. According to some authorities these were occupied communally. The engineering skill required to build

▼ THIS RED-ON-BUFF PLATE with a boldly but poorly drawn figure of an animal, dates from the Sedentary Period (A.D. 900 to 1200)



Arizona State Museum photo



Gila Pueblo photo

▲ **DIFFERENT ARCHITECTURAL HORIZONS.** The square house dates from the Pioneer Period, when the people built their biggest houses. After it fell into disuse, another house was built on the debris, as shown by the raised section

these homes was far beyond any first faltering attempts at house building, and in this we may have an argument that Hohokam history began long before our present information would indicate. In the lesser arts and crafts, the accomplishments were not so marked. Well-made though simple pottery, strictly functional stone tools, a limited number of personal ornaments of shell, and clay figurines about exhaust the list of goods that have survived. The figurines are reminiscent of those found on the Mexican plateau, and the ideology that impelled their making, whether a cult or not, probably reached the Hohokam along with corn from Mex-

ico, about the beginning of the Christian Era.

Efforts to determine the physical appearance of the Hohokam people have been frustrated largely by their custom of cremating the dead, which leaves almost nothing for the archeologist in the way of anatomical detail. No other North American group adhered more consistently to this custom. It was already practiced in the Pioneer Period and continued to be the fashion for perhaps a millenium and a half.

Including the Pioneer Period, a total of four stages are recognized as follows, with approximate dates:

Pioneer Period, A.D. 1 to 600

Colonial Period, A.D. 600 to 900

Sedentary Period, A.D. 900 to 1200

Classic Period, A.D. 1200 to 1400.

During each period there were characteristic achievements. New elements were added, some old ones were lost, and those that survived were constantly modified. The greatest technical and artistic advances came in the late Colonial and Sedentary Periods. Space permits us here only to touch on a few of the highlights.

Except for the size of the earlier houses, the Hohokam never distinguished themselves in domestic architecture. They were content throughout their long history to erect a flimsy brush and earth-covered structure over a floor sunken below the desert level—a shallow form of pit house. The shape of the floor varied from time to time from squarish to rectangular to oval, and there were necessary modifications in the type of roof. An architectural sequence has been established, but this makes a poor showing when compared with the multi-storied masonry houses of the Pueblos.

The most prepossessing architectural products of the Hohokam—architectural at least in a sense—were the ball courts or game arenas. During the Colonial and early Sedentary Periods these were large, unroofed, oval areas, as much as 200 feet in length, or two-thirds as long as a football field. The floors were sunken well below ground level and flanked by high earth-banked sides. We think that these courts were used for games similar to those played in the more elaborate and professional ball courts of the higher civilizations of Mexico and Central America. In fact, rather specific analogies have led to the speculation that the Hohokam courts were inspired by the older ones in Mexico. By the Classic Period, the ball court had been much reduced in size and, whatever games may have been played there, appear to have lost popular support.

In Mexico and Central America, there is abundant documentary proof that balls made of native rubber were employed in the games long before the arrival of the first Europeans. Of the thousands of rubber balls demanded annually by the Aztecs as tribute from subjugated tribes, not one has survived to the present. Paradoxically, however, one has been found in a Hohokam ruin in Arizona, preserved because it was buried

▼ **ROUNDED corners and oval entrance make this house typical of the Sedentary Period (A.D. 900 to 1200)**

Gila Pueblo photo





Gila Pueblo photo

▲ **BALL COURTS** were a conspicuous feature of Hohokam social life during the Colonial and Sedentary Periods (A.D. 600 to 1200). In the Classic Period their size and importance had become much reduced. This one, at Snaketown, measured 175 feet long. Stone markers were set in the floor near each end of it

➤ **A RUBBER BALL**, used in all probability in the playing courts, centuries before the white man had ever heard of rubber. It was still resilient beneath its oxidized surface and was made of native American rubber, unvulcanized and unrefined. Found in a jar near Toltec, Arizona (Sedentary Period)



Arizona State Museum photo

in an earthen jar. The age of this ball, judged on the basis of associated material, is the Sedentary Period, or perhaps around A.D. 1100. A chemist's analysis states that the rubber, still resilient beneath the oxidized surface, was of native American origin, unvulcanized and unrefined. No one can say that this ball (or others like it) was used by the Hohokam in the ball courts, but I am inclined to believe that the occurrence of these two features together was more than mere accident.

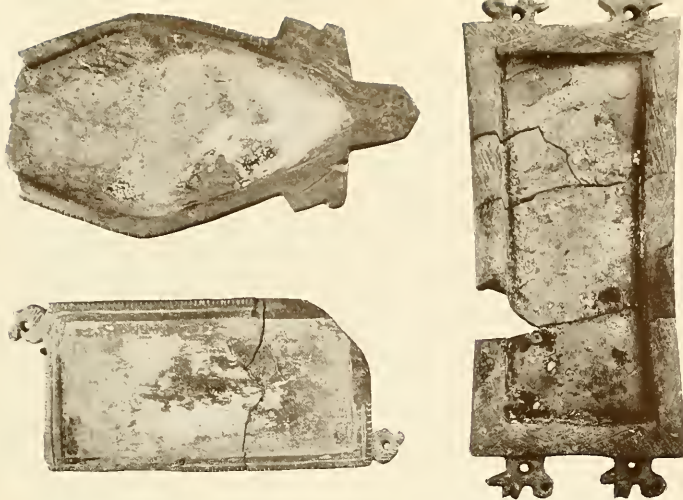
As among most stay-at-home farming people, pottery was an important feature of the Hohokam household. It ran the full range from plain and often very large cooking and storage vessels to eccentrically shaped containers, possibly of ritual import. The standard decoration was painted in red-brown on a light buff background, which, together with design

and vessel shape, readily distinguishes Hohokam pottery from that of other southwestern groups. The Hohokam potter was no precision artist when it came to painting design, yet a certain admiration is evoked by the complicated geometric layouts and particularly by the animation achieved in small life forms by a few extemporaneous strokes of the brush.

Stylistic change in form and design affected Hohokam pottery just as it does tableware in our own culture. This has led to the recognition of a series of nine phases of the potter's art, extending over an estimated 1200 to 1500 years. The ceramic histories of native American people has seldom been traced over so long a period as here.

In sculpturing and carving, the Hohokam made notable strides, though they were still far behind such people as the Toltec and the Maya.

All their work was on a small scale and generally in soft materials. Cup-like stone vessels, whose use has not been determined, show carved geometric motifs or high relief figures of desert reptiles and occasionally people. Also characteristic are birds and animals in the full round with a receptacle in the back in simple and not too realistic execution. Rectangular palettes of slate with raised incised borders are an inevitable accompaniment of Hohokam ruins. These usually come to light with the cremated ashes of the dead, and the conjecture that they had some ritual meaning may not be far from wrong. Traces of pigments suggest actual use of paint palettes, doubtless for decorating the body. Curiously, many of them reveal incrustations of lead compounds and even metallic lead. The heat generated by the pyral fire, through which these objects passed,



Los Angeles County Museum photo

▲ SLATE PALETTES are found frequently in Hohokam cremations. Sometimes they have marginal decorations of birds and snakes and occasionally of desert reptiles. All of these had passed through crematory fires. The heat had sometimes reduced the incrustations of lead compounds, which were possibly used as pigments, to a metallic state. The people, however, appear to have been completely unconscious of their metallurgic feat. (Colonial Period)

was great enough to reduce the mineral to a metallic state. But the Hohokam appear to have been completely unconscious of their metallurgic feat, as the use of lead was never exploited.

Any account of the Hohokam would be incomplete without due acknowledgment of their fondness for ornaments made of sea shells and of the high skill developed by their craftsmen in making them. Most of this material, in a raw state, was imported from the Gulf of California by human freight-carriers over the desert of northwestern Mexico and southwestern Arizona. Both univalve and bivalve shells, representing several scores of species, were used. The natural shape was exploited for finery of distinctive types. Smaller univalves could easily be changed to beads by grinding off the spires. Larger ones, as the *Conus*, were readily transformed into spangles, and

the nearly circular shell of the *Glycymeris* was ideal for bracelets and rings. But where the shellwork assumed its truly distinctive quality was in the carving of pendants in effigy of desert creatures, as the rattlesnake, lizard, frog, and bird, and also in the carving in relief of snakes and birds on bracelets and rings. In the latter a favorite motif was two birds, back to back, each engaged in swallowing a snake, the bodies of which intertwined to form the band of the ornament. Mosaic shell overlay was also known, but productions of this sort have survived only in the most fragmentary form.

The fame of Hohokam shell carving traveled far and wide, even during their own time, for objects undoubtedly made by these people reached the distant tribes in the southwest. Indeed, archeologists have strongly suspected that the Hoho-

kam, being near the source of supply, were mainly instrumental in dispersing shell over this area.

Shell artistry reached its peak among them when some creative or observant soul invented a method for etching shell. This took place perhaps in the eleventh or twelfth century. We do not know, of course, just what the process was, but the same results have been achieved in laboratory experiments by using only the materials available to the Hohokam. The chemistry of the process is simple, as the nearly pure calcium of the shell is readily attacked by acids. In the test a corrosive was eventually derived by fermenting the juice extracted from the fruit of the giant cactus, making a weak acetic acid. The next step was to cover portions of the shell with an acid-resisting material, pitch. The unprotected parts were thus subject to chemical action when the piece was immersed in the acid. A 72-hour treatment duplicated the effect achieved by the Hohokam, detail for detail. An accompanying figure shows one such piece, with geometric pattern, further strengthened by additions of green and red paint. It epitomizes this unique form of art, unmatched anywhere in the world up to this time, so far as I have been able to learn. The earliest record of etching in Europe is on armor dating from the mid-fifteenth century. Perhaps because the technique was difficult to control, shell etching was short-lived, as the abundant shell remains from Classic Period sites retain no trace of it.

That the Hohokam were in contact with the high civilizations far to the south in Mexico is attested by a number of objects that have been unearthed in early southern Arizona villages. Indeed, it seems altogether probable that much of the stimulus for their cultural advances came, directly or by circuitous routes, from that source. This began originally with the northward spread of corn about the beginning of the Christian Era, and it may also be reasoned that the art of making pottery and figurines from clay arrived at the same time. From then on, the Hohokam placed their special stamp on such accessions. The small human figures of clay were present in all periods, although they lessened appreciably in numbers by the Classic Period, and stylistic changes are traceable just as

▼ A SLATE PALETTE with simple incised border. (Sedentary Period)



Arizona State Museum photograph



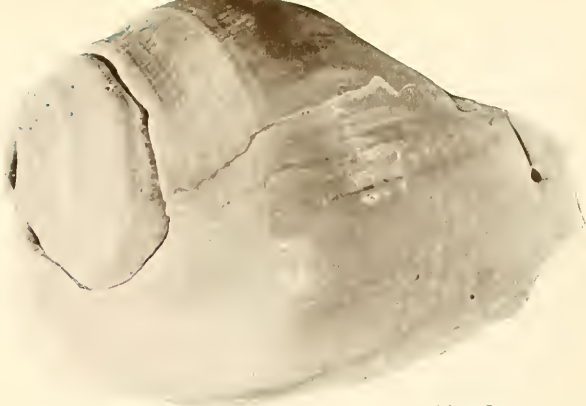
Arizona State Museum photo

▲ **ETCHING** before Europe knew the art: a large shell (*Cardium elatum*), the inner surface of which is decorated with a design eaten away by acid. The pattern is further accentuated by additions of red and green paint. The effect has been duplicated today by use of vegetable juices known to the ancient people. The earliest etching in Europe is from the fifteenth century. This example, found near Tucson, dates from the period between A.D. 900 and 1200

► **SHELL PENDANTS** carved in varying degrees of realism. A lively industry in shell ornaments of this sort distinguished the Hohokam culture and made its influence felt far beyond the boundaries of the tribe. Most of the shells were brought from the Gulf of California by human freight carriers

▼ **BRACELETS** were the commonest shell jewelry. The thin fragile type (*above*) was, in general, earlier than the heavy standard form (*below*)

Arizona State Museum photo



Arizona State Museum photo

▲ A LARGE CONCH SHELL trumpet used by the Desert Hohokam of the Classic Period



Arizona State Museum photo

▼ **TWO BIRDS** back to back and each swallowing a snake, formed a favorite motif, as illustrated here by a carved shell ring

Los Angeles County Museum photo



▼ THIS HEAD of a mountain sheep was carved in a leg bone of a deer by a River Hohokam of the Colonial Period. The piece is about two inches long. (Grewe Site)

Los Angeles County Museum photo



Arizona State Museum photo

▲ A SMALL STONE VESSEL with snakes in high relief: a product of the River Hohokam people of the Colonial Period

they are in Mexico. The ball court is another clue to southern contacts, going back perhaps as early as A.D. 600 to 800.

Some objects are unmistakably direct importations, brought north by traders or traded from group to group and acquired from neighbors. I am thinking particularly of the mosaic plaques or mirrors, and copper bells. The plaques consist of stone discs, one face of which is covered with an expertly fitted mosaic of thin iron pyrite sheets. The other face is decorated with heavy-bodied pigments in a technique resembling, but not duplicating, cloisonné. Examples found in Arizona, though heavily damaged by crematory fires, are indistinguishable from those recovered in Yucatan and as far south as Guatemala. It is improbable that anything as intricate and complex as these mirrors should have been thought out independently by the Hohokam.

Bells of cast copper, resembling the familiar sleigh bell, are the only

metal objects of consequence that reached the southwestern United States prior to Spanish times. These came to the Hohokam and their Pueblo neighbors to the northeast possibly as early as 1100 but mostly a century or two later. Here again the case for importation seems clear. Nothing yet found indicates metallurgical knowledge among the southwestern Indians before the Spanish Conquest, and exactly similar bells are found in great number in such places as the State of Michoacan in Mexico.

Trade goods from Mexico, such as we have been mentioning, may in time even permit a correlation of Hohokam and Mexican chronologies.

The term "Classic Period" is perhaps misleading, since the summit of Hohokam progress had been passed and the culture was going into decline. But a significant event characterizes the period—the arrival of a new people, the Saladoans, a branch of the Pueblo folk. This immigration

▼ PART OF A HERD of clay animals found by Frank Hamilton Cushing in the Salt River Valley in 1887. Their resemblance to the guanaco of South America caused Cushing to call the ruin "Los Guanacos;" but the creatures are probably deer. Average length, 5 inches



Peabody Museum, Harvard University, photo

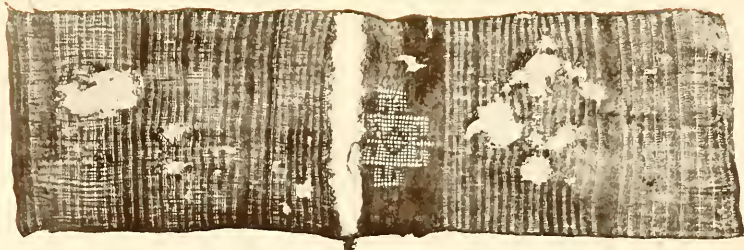
took place, according to the best judgments, about 1300. A host of features, previously foreign to the Hohokam, were introduced. Among them were thick-walled adobe buildings with many rooms and several stories, the custom of burying the dead instead of cremating them, and pottery decorated in red and black.

It would appear that this meeting of two distinct groups in the Gila and Salt River Valleys was an amiable one. Particularly along the Gila, the indications are that these groups lived on friendly terms in the same villages and shared the responsibilities of keeping the irrigation system functioning and the crops coming in. This situation prevailed for several generations when, for reasons that are not yet clear, the Salado contingent moved away. In round numbers this took place about 1400.

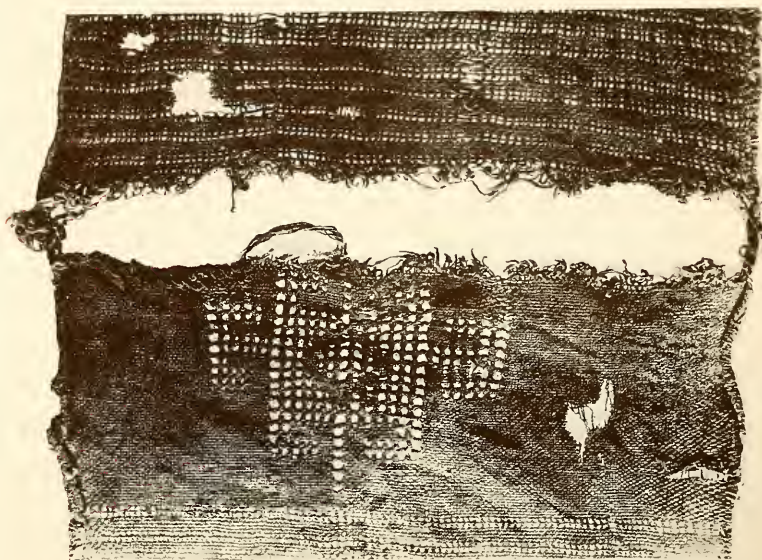
The preceding comments all refer to the remains of the Hohokam found along the rich valleys of the Gila and Salt Rivers. It was here that the culture rose to its greatest height and the members of the social body extended their greatest efforts for the common good in the construction of irrigation systems. These were the River People. But not all of the Hohokam lived in such fortunate surroundings. To the South, in what is now the Papago Indian Reservation, lived their kinsmen, the Desert People. Among them, scarcity of surface water meant that tillage was restricted to a few favorable spots, and natural plants, like the saguaro cactus, were much more important. Nevertheless, supreme efforts were sometimes made to catch run-off waters after sharp seasonal rains in the hills and direct them by hand-dug ditches to the fields far away. One of these, identified first from the air, is ten miles long and was apparently used in the fourteenth century.

The rigors of environment were felt here in other ways, too. There were few if any large towns, because the food resources would not support them. And the arts and crafts were esthetically only a faint echo of those of the more fortunate River People.

The history of the Desert People, as traced by the Arizona State Museum, begins likewise roughly at the time of Christ. Their record adds a good bit that we would not otherwise know about the Hohokam, for the Desert People left their remains in at least one locality where extreme dryness preserved many articles that



TWO VIEWS of a cotton poncho for a child, belonging to the Desert Hohokam. From the eleventh or twelfth century



Arizona State Museum photo

▼ THE SO-CALLED SALADO PEOPLE, who entered the domain of the Hohokam around A.D. 1300, used pottery of this type, in red, black, and white. They apparently were friendly visitors and for a few generations shared with the River Hohokam the responsibilities of keeping the irrigation system in order

Peabody Museum, Harvard University, photo





Arizona State Museum photo

▲ VENTANA CAVE, once occupied by the so-called Desert Hohokam, yielded valuable new evidence regarding more perishable objects. Protected from moisture and the elements in a way that was not possible in the damper sites of the River people, textiles, baskets, and robes of rabbit fur were preserved here. Skeletal remains also were found, giving evidence of the physical appearance of the Hohokam people

▼ THICK-WALLED ADOBE BUILDINGS were an innovation brought in by the Salado people, as seen here in the ruins of Casa Grande, about 40 miles southeast of Phoenix. But for reasons that are not clear, they moved away after several generations. And the Hohokam culture itself, with its elaborate system of irrigation, became inactive about 1400

Photo by George A. Grand; courtesy, National Park Service



would normally have perished in the exposed village sites of the River People. Handsome cotton textiles, baskets, robes of rabbit fur, sandals, and a host of other things have thus been preserved. They were certainly known to the River People, too, but were almost completely erased by their crematory fires or by the elements.

After about A.D. 1000, the Desert People appear to have changed their burial custom from burning to earth burial. Some 40 burials from this valuable site, Ventana Cave, give us for the first time some notion as to how these people looked. We can characterize them simply as of medium structure, with skulls that do not seem to differ greatly from those of the Papago Indians, who have been known in this same area since Father Eusebio Kino discovered them in 1698. Indeed, this is strong reason to believe that the Desert People of a thousand years ago are still with us, in the shape of this enterprising modern tribe.

The mummies of Ventana Cave tell us more: how the people dressed and how they wore their ornaments. In colder weather, they wore a blanket of rabbit fur or woven cotton, but otherwise a breech clout sufficed in this sun-baked area. The fashion in personal decoration is illustrated well by an adult male who wore disc-shaped shell pendants hanging from his ears and a wooden cylindrical plug skewered through his nasal septum.

What may be called an early American version of the Maginot

Continued on page 335

YOUNG HERONS

By RONALD K. MONRO

From Three Lions



The following pictures trace the adventures of some young gray herons as they leave their nest in Australia. They have lived high in a gum tree overlooking a swamp in South Gippsland, Victoria

▲ FOUR OF A KIND: the heron quadruplets on their flimsy nest of sticks in the fork of a gum tree. When danger approached, they all "froze" into various attitudes and stayed perfectly still until the intruders had gone



◀ PENSIVE. A young white-faced heron quietly sits and awaits more food to be brought by its graceful parents. Note the baby down still adhering to its new feathers on the head and breast

1

▼ TRIAL FLIGHT. Long before they could fly, the baby herons spread along the limbs of their nursery tree and flapped their wings vigorously, going through all the motions of flight



2

▼ TAKE-OFF. First flight of a young heron caught by the magic eye of the high-speed



4

▼ FLIGHT. At the completion of the wing beat, the feet are drawn up into the body, the head is folded onto the breast, and the wing feathers almost touch at the tips



5

▼ REINFORCEMENTS. A young heron sees a frog hop beneath some rushes. One of the others comes down and helps to hunt for it



camera. Here the young bird spreads wide its wings and springs from its perch



3 ▼ AIRBORNE. Once in the air, the bird beats its wings down with a powerful sweep and gathers up its lanky legs beneath its streamlined body as it starts to fold its graceful neck onto its breast



6 ► ESCAPE action has been successfully taken by the frog and although the two young herons hunt diligently, they can find no trace of their hoped-for meal





DRYING. A wet tail and no frog was the reward of the inexperienced hunters



◀ SLEEP. After an exciting day, the young heron was ready to enjoy a good sleep

► TUCKING ITS HEAD over its wing and under the back feathers, the bird draws one leg into its breast feathers and sleeps soundly. During the night it changes legs from time to time. Tendons working automatically ensure that the grip is maintained during sleep



"BAT RADAR"



By JOHN ERIC HILL
Drawing by
G. FREDERICK MASON

IN the postwar world, pilots of commercial airplanes will have radio instruments that will determine accurately the position of obstacles and their distances from the plane, as well as the altitude of flight and the physical conformation of the surface of the earth below. These radio detection devices, or radar instruments, function as well in fog and bad weather as they do in clear weather.

The public has been given enough information on radar to understand the general principles involved: Radio impulses are beamed out into space, and when any solid object is encountered, an "echo" rebounds. This echo is received by a detector which indicates the direction from which it comes and the time required for its return. Since radio impulses travel with the speed of light, approximately 327 yards per microsecond (a millionth of a second), it is possible to compute accurately the distance the beam has traveled, half of which is the distance of the object.

Bats, the only mammals that can truly fly, use a similar method for avoiding obstacles in their darting flight. Instead of radio impulses, they

emit a series of intense cries, pitched too high to be heard by the human ear, and they are guided by the echoes that their sensitive ears are tuned to hear. For generations, the ability of bats to make their way through the inky darkness of winding caves puzzled naturalists. More than 150 years ago an Italian scientist blinded bats and found they could fly as skillfully as ever. While their sight is far keener than usually believed ("blind as a bat" is one of our false proverbial sayings), these experiments proved that they did not depend on their eyes. Some years later an investigator found that if the ears were plugged, the flying skill of a bat was greatly impaired. This discovery was forgotten for many years, and naturalists almost without exception accepted an untried theory that special senses in the skin of the wings were responsible for the ability of bats to fly without hitting things.

In recent years,* however, bats and their flight were studied anew. A number of experiments showed that they had extremely keen hearing, especially for high-pitched sounds. With sensitive recording devices it was discovered that bats give forth a series of strong sounds, pitched far

above the limit of our hearing—45,000 to 50,000 vibrations per second, as compared with our limit of about 20,000.

A soundproof room was divided by a hanging screen of metal wires, set about a foot apart. Bats were temporarily blinded and then made to fly through the wire barrier. Blind bats were as successful as normal bats in this test, confirming the old experiments. But when the bats were gagged so they could not make their sound, or when their ears were plugged so they could not hear it, they had great difficulties. They would not fly without much urging, and when they were forced to fly they went slowly, as if uncertain of themselves, bumping into the wires and even the walls again and again, unable to adjust to the unusual situation.

Blind persons make a similar use of echoes to avoid obstacles. The tapping of a blind man's cane along the sidewalk and the resulting echoes have been widely used for generations as a guide when sight could no longer serve. Studies of the problems of "echolocation," as this method has been called, are now in progress, and improvements in technique may be expected which will add greatly to the well-being of sightless persons.

*Griffin and Galambos, *Journ. Exper. Zool.*, LXXXVI (1941), 481-506; *Sci. Monthly*, LVI (1943), 155-162.

▼ THE "CANDLE OF GOD" blooms luxuriantly in the late spring. The creamy-white blossoms stand out brilliantly against a dark sky, as the late afternoon sun sends its last beams of light over the desert

Candle of



GOD

By
CATHERINE AND
DICK FREEMAN

Out on the desert wastes, this tall and stately plant plays a curious game of existence with a tiny moth—and neither could survive without the other

IT is late spring in the chaparral of Southern California when the "Candelaba de Dios," or Candle of God, as the early Californians called it, thrusts its way rapidly upward like a giant asparagus from a "bristling hemisphere of hostile bayonets."

The first warmth of early summer has begun to bring out an aromatic fragrance from the growth in every dry arroyo and mountainside. In rapid succession one after another of these giant stems shoots skyward until finally the desert vistas are transformed into a beautiful flower garden extending oftentimes as far as the eye can reach.

At the rate of nearly a foot a day the stems push their way up to a height of some eight to fifteen feet,

depending on favorable conditions. For two or more years the fiercely bayoneted plant has been living in its dry habitat preparing for its magic-like rise into ravishing beauty. No ugly duckling ever becomes a swan as rapidly as this beautiful plant.

The creamy, waxen flowers of the *Yucca Whipplei* hang in dense profusion, from hundreds to even thousands of blossoms on a single stalk. As one passes among the "forest" of stems, their heavy fragrance fills the air and is as alluring to man as to insects.

The plant owes its name to Lieut. A. W. Whipple, leader of a surveying expedition sent to the Pacific coast in 1853-54. Dr. J. M. Bigelow, botanist on this expedition, was the first to collect specimens, and Dr. John Tor-

rey, when classifying them later named the plant for Lieut. Whipple. The Navahos, according to research by Charles Francis Saunders, called the plant *yabi-tsa-si*, which literally means "yucca of the gods." The Spanish Californians had two names for it, *quiot*, probably from the Aztec name *quiotl* for the flowering shoot of the maguey plant, and "Candelaba de Dios" or Candle of God, a most poetic and delightful name.

The plant ranges from the edge of the Mojave Desert south through the San Diego country into Lower California in Mexico, extending from low elevations to around 5000 feet in altitude.

It was used by both Indians and early Californians for food, the young tender flower stalk being boiled,

▼ AFTER living for two or three years without flowering, the yucca plant's leafy rosette suddenly sends forth a tender young shoot

▼ THE YOUNG SHOOT grows rapidly, sometimes as much as a foot in 24 hours. Now it is taking on the shape and appearance of a large stalk of asparagus. Its colors are truly exquisite, ranging from a light green to a bluish-purple and rose





▲ THE YOUNG FLOWER STALK is now several days old and six or seven feet in height. The tip is about ready to break out in little clusters of buds



✦ A CLOSE-UP of the stalk as it begins to open out. Little branchlets loaded with buds appear at the base of each bract

▼ THE beautiful yucca blossoms photographed at their most luxuriant stage



▼ AN INTERESTING VIEW of the yucca flower, magnified to show the detail and texture of a delicately modeled blossom





▲ NOW THE YOUNG BRANCHLETS have grown out from the stalk six to twelve inches, and the buds have blossomed forth into the beautiful creamy-white flowers. At the top, the stalk is still shooting skyward, and the buds have not as yet opened



▲ THIS PLANT is by far the most beautiful yucca the writers have ever seen. Apparently the stalk was damaged or affected in some way so that the branchlets grew horizontally outward two to three feet instead of the usual eight to twelve inches, making a veritable tree. The trouble, however, seems to have become quite suddenly repaired, for the upper part of the yucca grew as all yuccas are supposed to grow



▲ HERE IS SHOWN the root system of the yucca as exposed by nature along the bank of a sandy wash. The roots are seen to go straight down as deeply as possible in their diligent search for water, instead of spreading out as many plants do

▼ USUALLY BY LATE JULY or early August the flowers have faded and green pods have taken their places. These pods average from one to two inches in length, varying with the locality. As the ovary or pod develops, it lifts itself into an upright position on its stem

► BY FALL the pods have dried, become brittle, and started to lose their seeds. The stalk now rattles in the breeze, no longer the beautiful exotic plant it once was. Now and then a pod will suddenly pop open and scatter its seeds on the ground around the base of the plant



roasted, or baked. A favorite method was roasting in a pit. The pit was excavated, filled with dry wood, and burned. When the fire had burned down to ashes and cooled a little, the stalks, cut to proper lengths, were put in the ashes and left to cook until cold. This was called *quite tatemada* by the early Spanish Californians. Sometimes the stalks were roasted like potatoes in outdoor ovens. The Indians used to boil and eat even the flowers, while the seeds were ground to use as porridge.

From the fiber of the plants the Indians also made nets, ropes, and saddle blankets. The leaves were soaked in water, then pounded until the fleshy pulp was largely removed. The fibers were then combed and twisted into strands for weaving.

The roots in their turn were very useful, as they contain enough saponin to make a soapy mixture for washing clothes. Perhaps they don't yield the very frothy consistency that we like



▲ THE TINY MOTH without which there would be no "Candelaba de Dios," and whose life, in turn, would end without this plant

in our washing tubs, but the Indians didn't have our soap.

Recently the light wood of the dry yucca stalk has been used in making small model airplanes such as are used in the classroom. Sheets cut from the pulpy stalks have also been used to protect young trees from rodents and sunburn. Pincushions and many other novelties have been made from the stalk; and in all probability had not

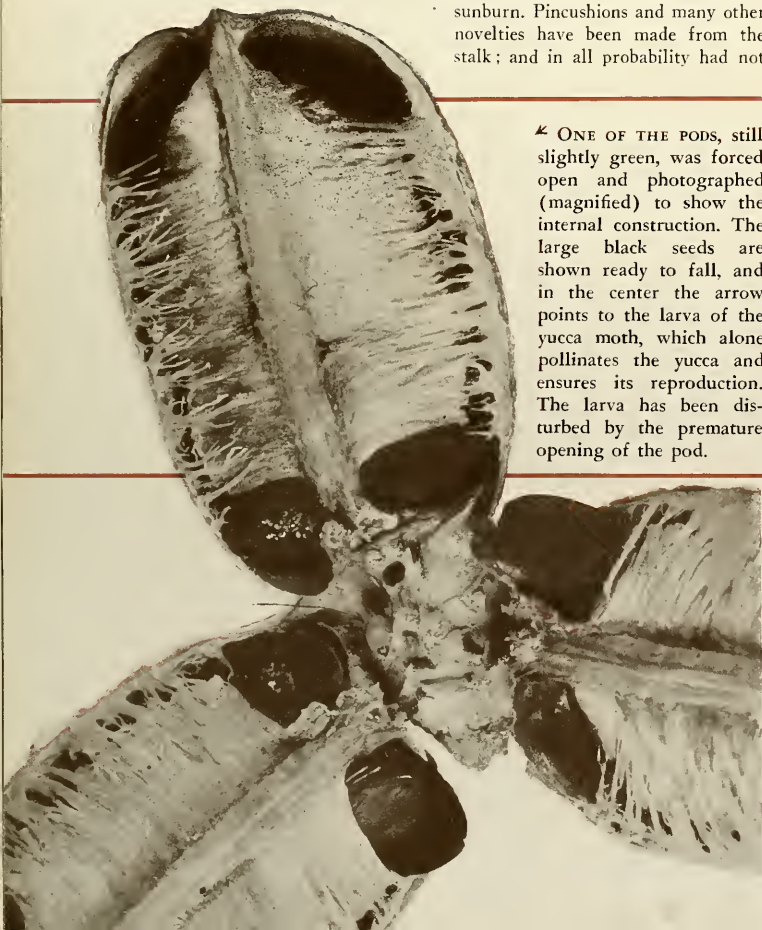
laws put a fine on the destruction of the yucca, its numerous uses would ultimately have spelled its extinction.

The unusual way in which the plant is pollinated by the moth *Pro-nuba yuccasella* has brought much attention to the yucca, and justly, for it is a fine example of plant and insect interdependence. Owing to the construction of the yucca flower and the fact that the pollen is too glutinous to be borne by the wind, fertilization without the aid of this insect can take place only by the merest accident. So if it were not for the moth there would be no yuccas. On the other hand, if it were not for the yucca there would be no moths; for this particular moth, which fertilizes only the Candelaba de Dios and perhaps other closely related yuccas, lays her eggs nowhere else.

After collecting the pollen from numbers of anthers, she forces her ovipositor into the swollen seed-bearing base of the pistil, known as the ovary, and lays several eggs. After this operation, she ascends the pistil and deposits the small mass of pollen where it can fertilize the ovules. It was originally thought that the moth was attracted by nectar and was bent on taking sustenance; but she actually takes no food during her entire life. Therefore, the only end achieved by this action is the fertilization of the plant and the production of a seed pod on which her offspring will be able to feed. One wonders what either the plant or the insect did before it had the other.

As the young larvae eat only a few of the seeds many are left to carry on the life cycle of the yucca, so the strange co-operation of plant and insect goes on to the joy of all of us.

✦ ONE OF THE PODS, still slightly green, was forced open and photographed (magnified) to show the internal construction. The large black seeds are shown ready to fall, and in the center the arrow points to the larva of the yucca moth, which alone pollinates the yucca and ensures its reproduction. The larva has been disturbed by the premature opening of the pod.



► ABOUT THE TIME the pods are hardening and ready to expel their seeds, the full-grown larva bores its way out, leaving the hole visible in this picture. It then drops to the earth, probably by means of a silken thread. There it bores into the earth several inches and spins a tough silken cocoon mixed with soil. This operation probably occurs at night. It will be ready to emerge as a full-grown moth in the spring, when the flowers of the yucca are blooming again



▼ AFTER THE FLOWERING STALK has cast off its share of seeds, it becomes dry and brittle, so that it can readily be broken off. The once erect hemisphere of bristles turns its spines backwards toward the earth, and the last chapter in the life cycle of the lovely yucca has been told



King Crab — mode

By EDWIN WAY TEALE

ON that late May day of fog, I was walking alone across a wide sea-meadow. The woods behind me, the level moor on all sides, the slate-blue line of the bay ahead—all these, minute by minute, had grown more indistinct. At first, like faint breathing on a mirror, mist from the sea had silvered the distant landscape.

Then, pearly gray streamers of thicker vapor drifted in, succeeded, in turn, by heavy, rolling fog that flooded in noiseless breakers across the moor. The horizon drew swiftly closer. The visible land contracted to a disk with a rapidly diminishing radius. Soon, I could see no farther than a score of feet in any direction. I seemed confined in a circular room—a room with indistinct and silvery walls and a floor of wiry grass and salty *Salicornia*.

It was a chamber that, like some nebulous snail shell, moved when I moved and halted when I came to a stop. It progressed with me as I felt my way down the path. This strange pilgrimage, this advance through a world half air and half water, was well-suited to the even stranger pilgrimage I had come to this lonely moor to witness.

Moving through the mist, cut off from the rest of the world and surrounded by vegetation that appeared low and primitive, I had the feeling of being carried back to an infinitely remote time. The present had receded, not suddenly, but as if I had slipped gradually backward through millions of years. It was at the edge of the sea, and on a shore saturated with the moisture of vapors, that land life, in forms now long outworn, first gained an initial foothold. On the solitary stretch of mist-enshrouded moor, I seemed infinitely closer to this dateless beginning of things.

Groping my way forward, I saw darker lumps of gray evolve into



▲ A KING CRAB on the dry ocean beach. Although these so-called horseshoe crabs are underwater dwellers and breathe through gills, they are able to endure a day or more on land without water

bushes. I followed their wavering ranks and came to the edge of the bay. Above the tide-line, sea weed, carried ashore by storms, clung in a windrow to the stiff moor grass. Bleached by the sun, it wound sinuously away into the fog like the sloughed skin of some gigantic serpent. Below, edging up the slope of the shore, the tide was nearing its flood. On the narrowing strip of mud and sand, between the farthest grass-clumps and the edge of the water, a

lacework of tracks recorded the activity of the shore birds.

The world's first writing was formed of tracks, and the world's first mud tablets were formed at the edge of the ocean. The earliest characters set down in this track-written record of events were produced hundreds and millions of years ago by some long-vanished form of life.

The creatures I had come to this remote spot to see were contemporaries of some of the earliest experi-

an creature of the past

mental creatures that first appeared in that disputed realm between the tides, just as they are contemporaries of all the varied life of the present. They were descendants of the trilobites and have survived virtually unchanged through ages and eras and epochs of geologic time. For 300 million years, they have formed an unbroken thread, linking the past and the present. While whole seacoasts have lifted above the water or sunk beneath it, these ancient creatures—the king crabs, or horseshoe crabs—have continued to endure.

In form and habits they have stood still, while hundreds of millions of years have had their way with countless other forms of evolving life. The king crab reached its heyday before birds or mammals appeared on earth. The same lithographic stones of Bavaria that yielded the remains of the earliest known bird, *Archaeopteryx*, also contained perfectly preserved bodies of *Limulus*, the king crab, alike in every respect to those we see today.

Every year, when spring is well advanced along our eastern shore, these living fossils come home from the sea. They make an annual pilgrimage, a mating migration, to deposit their

While countless other forms of life have changed their ways, this curious, plodding creature has remained virtually the same throughout 300 million years of evolutionary history

eggs in the shallows. This journey has had its counterpart during all the years since Paleozoic times. On the edge of the fog-enshrouded bay, that late May afternoon, I witnessed once again, a re-enactment of this world's oldest love story.

As in the Biblical tale of Noah's ark, the animals each spring walk two by two. The mating impulse runs through the wild and stirs even these low-pulsed, armored creatures of the shallow ocean bottom, bringing them up to the verge of the tide-line. Even within the confines of my fog-formed horizons, I could see three of these dark, flat-bodied creatures, nearly a foot across and having roughly the outlines of a horseshoe, moving about in the shallow water. Their backs, wet and shining, pushed above the surface from time to time. They suggested black washbasins, inverted and moving under their own power.

Close to the upper limits of the tide, the females were working. They were pushing this way and that in the

wet sand. They were scooping out depressions an inch or so in depth. In these shallow holes, the eggs—round and greenish-hued—would be deposited. A thousand or more pour into a single depression to be fertilized by the milt of the male.

No mating like that which takes place among higher animals, occurs in the world of the king crabs. Sometimes, a male will appear, attached to the female—in fact, there are instances of a whole chain of males, like the tail of a ponderous kite, being pulled along by the larger female. But in such instances, the males are being borne along to the spot where their milt will be needed to fertilize the spawn.

After the male, or several males, have spread the fertilizing fluid in the water, the work of the king crabs is over. They move on to repeat the performance farther down the beach, leaving the waves and the receding waters to cover the eggs with a layer of sand. One female king crab will deposit as many as 10,000 eggs in the course of its spawning season. And all down the Atlantic coast, from the Maine headlands to the hot sand flats of Mexico, during May, June, and July each year, other females are depositing their contributions to the astronomical total. And that total, today, is but a small fraction of the total a century ago. Less than 90 years have passed since one English naturalist estimated that on certain sections of the coast there were sometimes as many as one million king crabs visible on a single mile of ocean beach.

Usually, it is during the hours of darkness that these sea-creatures come up the slope of the ocean bottom to the tide-line. But on a number of occasions I have observed them at work in broad daylight.

Each of the shapes I saw moving in the shallows before me had started life at least four years before on such a beach as this. The egg from which

▼ A KING CRAB progressing across a sandy beach leaves a ribbon of tracks such as is shown here. Because of its long, pointed tail, it is also known as a swordtail





▲ THE SKIN shed by a young King crab at molting time. The creature gives the impression of "creeping from its own mouth." The skin splits along the curved forward edge of the shell and the soft, molting individual pulls itself from the "outside skeleton," which it is discarding



it had come had been warmed by the sun's rays at low tide and bathed by the sea water at high. It had lain there for a period of from three to ten weeks, according to how cool or how hot the weather was. As the days passed, the sphere, less than one-twelfth of an inch in diameter, grew transparent. The little passenger within became visible, curled up in the manner of a pill bug. When it crept forth, on some July or August day, it had no spine-tail projecting to the rear. This would come after molting began. At first, its appearance suggested the long-vanished trilobite. Hence, the name for the baby king crabs: "trilobite larvae."

The minute creatures that hatch in this way are the fortunate few. Of the thousands of eggs laid by the female, vast numbers are destroyed before they reach the hatching stage. Storms uncover the nests. Many of the tiny spheres roll about on the bottom of the shallows. Others are carried by the waves up on the dry beach. Fish get some; birds get some; even people, in some places, consider the eggs of the king crab a delicacy. The fate of the eggs is various, and only a small percentage produce the crabs of a new generation.

Sometimes, even as they are laid, they are devoured by their enemies. I remember reading a report in *Science*, in the early 1930's, of a great commotion noticed near the mouth of the Caloosahatchee River, on the Gulf Coast of Florida. Across

the shallow waters of a sandy flat, king crabs were laying their eggs. Catfish, by the thousand, had been attracted to the feast. According to the correspondent, Louise Merrimon Perry, a noted shell collector of Sanibel, Florida, each female and male king crab were surrounded by a rosette of shouldering catfish, each fish almost standing on its head, with its tail, partly out of the water, lashing the surface into foam. Even as the eggs were laid, the catfish gobbled them up. In spite of the confusion around them, the king crabs continued their fruitless depositing of the eggs.

Although unable to survive the ravages of such foes, these green-tinted spheres can endure adverse weather conditions and surprising hardships. In one instance, king crab eggs were left forgotten in a jar in a laboratory for 50 weeks. When they were restored to natural conditions, they hatched and produced larvae. Packed in seaweed, king crab eggs have made the journey from America to England and have arrived in good condition. The vitality of the eggs, which are left deserted to the mercies of fate on the sandy beach, is an important factor in the continuance of the species.

On its emergence, the "trilobite larva" usually creeps down the slope of the shore, away from the dry sand. Scientists have tested king crabs at various stages of their development and have found that they possess an acute sense of gravity. Cover their eyes so

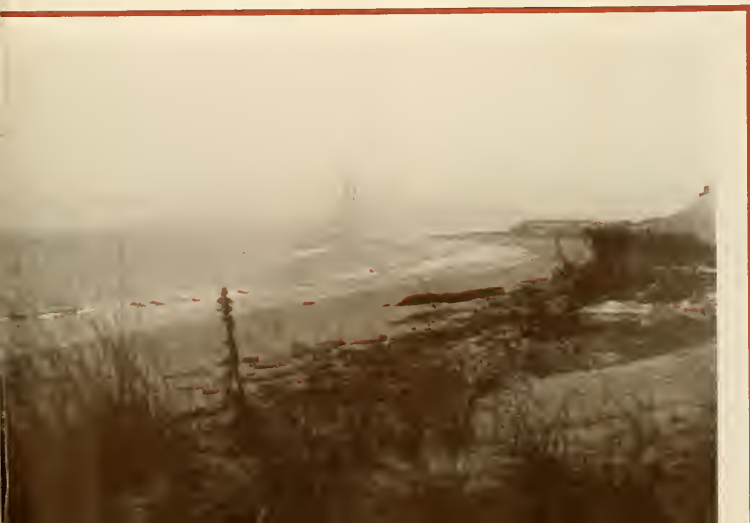
they can see nothing and they will head directly down the beach for the ocean. If, however, you prepare an artificial incline that slopes away from the water, they will just as readily head downhill toward dry land. It is the slope and not the call of the sea that guides them on their journey.

As a rule, the young king crabs remain close to shore during their first summer. One striking exception to this rule was observed by Alexander Agassiz. He found young king crab larvae swimming at the surface of the sea fully three miles off Buzzard's Bay. But, normally, the larvae are encountered in tide-pools along the rocky northern coast and among the flooded grasses of shallow arms of the sea. Not far from the spot where, in the fog, I watched the adult crabs at work, I once found half a dozen pale-yellow discarded skins of immature king crabs within the area of a square yard. They were of several sizes and represented different molts. During the first summer of its life, the young king crab molts several times. On its first birthday, it is hardly more than an inch in length. Some individuals keep on growing for eight years or more. A king crab is sexually mature at four years. When it has attained its full size, it may be a foot across and more than two feet long, counting its slender lancelike tail.

This tail has given rise to one of the many common names by which the king crab is known: swordtail. Its general shape explains the familiar designations of horseshoe crab and horsefoot crab. And pioneers, who sometimes used its empty shell for a basin, called it the pan crab. Scientists the world around refer to our Atlantic coast species as *Limulus polyphemus*. And at the risk of adding to the confusion resulting from so many different names, it might be pointed out that the king crab is not a crab at all. It is an arachnid, a relative of the spiders, mites, and scorpions.

In performing each of its many molts, the creature seems to "creep out of its own mouth." The shell of chitin—the same material that forms the outer skeleton of the grasshopper, the beetle, and the butterfly—splits along the curving front edge of the sheath. The upper and lower plates separate. Just as a dragonfly appears from its nymphal skin, soft and defenseless, so the crab emerges from its shell. The chitin of the new shell soon hardens, however. It may range in color from sage-green to pure black.

▼ ALONG LONELY SEASHORES, King crabs come in large number to deposit their eggs in the shallows



Observed in the water, a king crab almost always appears completely black.

As the tide reached its flood and slowly edged back down the slope before me, on that late spring day, there was movement and then long pauses among these creatures that had come in from the sea. One female finished her work and, in moving in a wide turn, pushed, in her near-sighted way, close to the upper verge of the waters. Reaching down, I gripped her long spine tail and lifted her dripping body out of the water. Tipping her on her back, I deposited her upside down on the beach. In this position, I had a chance to examine her closely. The inspection suggested that the creature was something turned out in

mass production. It looked as though it had come from one of the stamping machines of a Detroit automobile factory. Its armor, surrounding its surprisingly small, vulnerable inner body, protects it completely from almost all of its enemies. It moves along like a tank on the ocean bottom. Only the devil rays and the swordfish appear to devour king crabs as part of their regular diet. Sometimes, a king crab gets one foot caught in a closing clam shell. Otherwise, it is so well protected from its foes that it is almost invulnerable.

Even far-famed Yankee ingenuity has been unable to find much use for the king crab. Virtually the only commercial employment of these animals is in the making of fertilizer. I re-

member seeing great numbers stacked within wire enclosures on the coast of Cape May, New Jersey. This reeking pile was being made ready for grinding into fertilizer. Occasionally, the sea creatures have been fed to pigs and chickens to fatten them. Some New Jersey poultrymen believe the meat of the king crab will make hens lay. Others maintain that the diet gives the fowls a strong and unpleasant taste when they are cooked. Thus, the slight value of the king crab to man, as well as its armored form, has protected it from destruction.

With her numerous legs clawing the air impotently, the female I had placed on the sand tried to right herself. The spine tail dug into the beach. It twisted her body from side to side. This lever-action would eventually turn her over right-side-up after many attempts. Until this was accomplished, the normally hidden parts of the creature's body were visible. The vital parts consist only of essentials. A heart, a brain, a digestive system—this is virtually all the inner body contains. Breathing is accomplished by means of "book gills"—a series of from 150 to 200 plates that are hinged like the leaves of a book and are located beneath the rear section of the shell. Through each of the hollow leaves blood flows, carrying oxygen to the life stream of the king crab. Appropriately enough, considering the ancient lineage of this venerable creature, this vital stream is formed of blue blood.

The book gills have a double purpose. Like the dragonfly nymph, which obtains oxygen and at the same time propels itself forward by drawing water into the alimentary canal and then ejecting it forcibly, the king crab uses the plates of its gills to drive itself through the water. When it makes one of its infrequent jumps off the bottom and propels itself through the water, the moving paddlewheel of the leaves of the book gills provides the motive power. Such bursts of activity usually occur at night when the creatures are feeding on the floor of the shallow sea bottom.

Most of this feeding by the adults is carried on in water with a depth of between 12 and 36 feet. Few venture into deeper water. Small marine worms form the staple item on their bill of fare. Like rooting pigs, they burrow in the mud, pushing the curved forward edge of their shells

▼ A PREHISTORIC TRILOBITE, the ancient creature that appeared as early as 500 million years ago. The King crab is one of the closest links we have with these extinct inhabitants of the earth





▲ THE EYE of a King crab, like the eye of an insect, is a compound organ made up of many small lenses. The spine above the eye points backward

into the soft ooze by means of their clawing feet. For long periods, their hunger satisfied, they will lie buried to the eyes in the ocean-bottom mud. It is probable that this pushing of their bodies through the dirt scours the shells as a knife is polished by repeatedly thrusting it into sand. At one time, scientists suggested that king crabs produce some unknown secretion which prevented barnacles and other sea creatures from adhering to them. That king crabs are not immune to the work of barnacles is revealed by a shell I once saw after it had been brought up from the sea bottom on the coast of Florida. Twenty or more barnacles were attached to its back. This particular creature may have been ill or less active than the normal king crab.


To the student of animal evolution, the notched rear portion of the king crab's shell is of much interest. It indicates that in the far distant past this part of the creature's body was formed of a number of segments,

just as were the bodies of the extinct trilobites. Like all animals, individuals among the king crabs have peculiarities and variations of their own. One day, on a visit to the National Museum, in Washington, D. C., I was shown a curious king crab shell. It possessed a double tail which formed an elongated letter V. Another individual characteristic is the ability of king crabs to endure removal from water. Some can live for surprising periods and almost all of them can stand being stranded on dry land away from their normal source of oxygen for a day or more.

As soon as the female I had lifted from the water succeeded in prying herself on one edge and then over into an upright position, she started scrambling down the fog-enshrouded slope toward the receding tide. A

moment later, the waters swallowed her up. Behind, among the bird-tracks, she had left a ribbon, a foot wide and filigreed with many-footed tracks. This marking on the wet sand was familiar to the earth long before the first wedge-print of a sea bird made its initial appearance. The disturbed female was going back to deeper water. The other workers continued unmoved in their labors.

But, they, too, would—in the course of time—return to the sea from which they had come. Groping my way back through the fog—along the edge of the inlet and down the familiar path—I left them behind me, enveloped in the mist. That hour on the lonely beach had been one of those memorable events—an hour lived in a world of fossils returned to life.



From these curious little starlike impressions found in Montana, scientists reconstructed a strange story of under-sea life more than 60 millions years ago

IN solving a mystery the modern detective usually has a *corpus delicti* and other evidence that is comparatively fresh. The fossil hunter, however, often has to work with far fewer clues, because the events that he is trying to reconstruct happened so long ago that the entire environment was different and the participants unlike any living on earth today. The interpretation of the evidence and the elucidation of all the circumstances then becomes fascinating. Such is the story of the star impressions.

The Valley of the Yellowstone River in Montana is bordered by high yellow sandstone cliffs from which the river took its name. Paralleling it to the north is the Mussel-shell River, and from a tributary of the latter stream Mr. A. E. Perry of Winnett, Montana, several years ago sent a block of stone to the American Museum on which an eight-pointed star impression was deeply incised. The star had sharp sides, and where the rays approached one another they terminated in a central, unmarked disc. There were small piles of sandy matrix at the end of each groove.

This track, the size of a silver dollar, puzzled every scientist who examined it. Many explanations were offered as to its origins, but none were

satisfactory. If it were a "footprint," what sort of creature could have made it?

Footprints are sometimes classed only as circumstantial evidence, but they have shed light on a good many

▲ THE CREATURE that made these dollar-size, eight-pointed impressions always left eight of them in a row. The additional "stars" on these slabs were parts of other series destroyed during excavation

mysteries. So I was determined to visit the locality and make a careful study of the tracks in position.

Mr. Perry, who sent the first specimen, had moved from Winnett, and a local collector who was sent to the

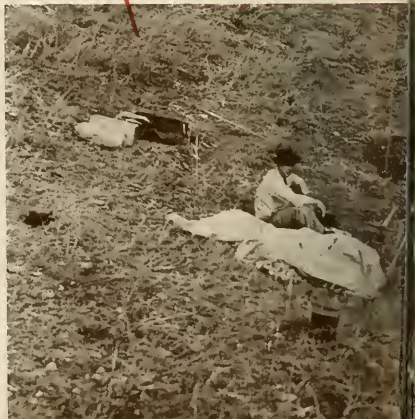
The Mystery of the 8 pointed STARS

By BARNUM BROWN*
Curator Emeritus of Fossil Reptiles,
The American Museum of Natural History

A.M.N.H. photos

* DR. BARNUM BROWN is one of the most celebrated dinosaur hunters in the world. He is therefore generally on the lookout for larger creatures than the ones which left these curious star-shaped tracks. But anything that presents a riddle in the realm of prehistoric life is apt to capture his curiosity, and his explorations have taken him to many parts of North and

South America, including the southernmost sections, where he was once shipwrecked, as well as to India, Abyssinia, and the Mediterranean region. He has been with the American Museum for 48 years. Much of his exploring has been by airplane, and he is planning to make another expedition as soon as helicopters are available.—Ed.





locality failed to find the rock layers where the specimen had been found.

Later, in 1932, Mr. George F. Shea of Billings, Montana, reported star impressions on a farm eighteen miles south of Billings. That fall we drove to the spot. The highest rocks of this area are of Eagle (Cretaceous) Age and were laid down some 60 million years ago. Below the sandstone cap are older dark gray shales and thin layers of hard, flinty sandstone. Fifteen miles south of Billings you find these hard layers cut by tributary streams and exposed as ledged terraces, which break off in blocks of irregular size. Above, on the hillsides, the streams head in farmlands, coursing over beds of the hard siltstones.

In this locality we uncovered eight of the curious impressions in a line in a depression in a field. Snow and lack of time permitted us only to make a photograph of them, but this served to stimulate interest and in-

creased our desire to learn what made the impressions.

Eight years later a single perfect specimen was sent to the Museum by Mr. Oscar T. Lewis from a locality fifteen miles south of Billings, and in 1941 Dr. W. G. Pierce of the United States Geological Survey photographed several impressions from a point northeast of Cody, Wyoming. Some of these showed feathery grooves running sideways into the deeper cuts. The story was now becoming intensely interesting.

All of the impressions appeared to come from rocks of Upper Cretaceous Age, specifically from what is known as the Mowry Formation, which means that they were some 60-odd million years old.

Opportunity to revisit the Billings locality came in December of 1942 while we were on a dinosaur hunting

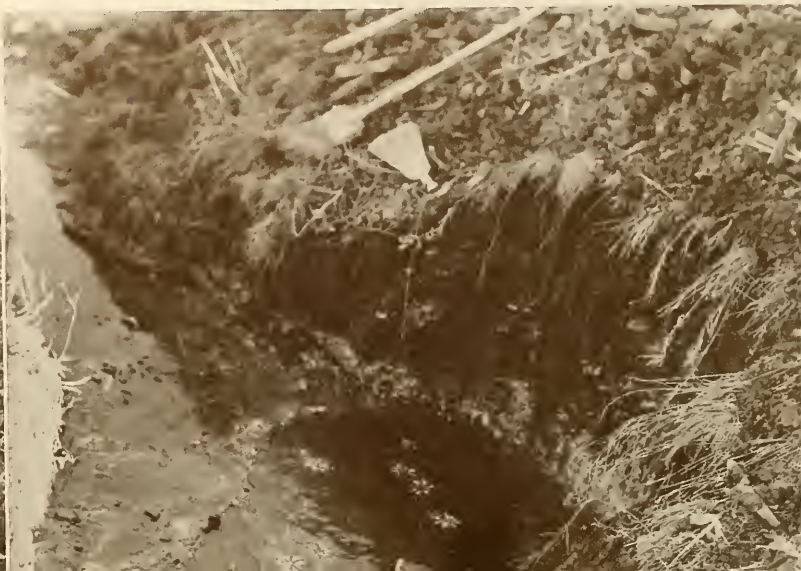
expedition. In company with Mr. George F. Shea and Al Stolz (now Private Stolz), the writer proceeded to the track exposures to excavate and study them in position.

Snow, running water, and frost made work difficult, but we uncovered several series of impressions and collected two complete sets. In doing so, we discovered several pertinent facts. The impressions, when they were complete, always included eight tracks forming a relatively straight line with variations in spacing as shown in the photographs. And they were invariably covered by a layer of white kaolin or bentonitic clay from one to seven inches thick, beyond which on the same layer of rock there were no tracks.

Many fish bones, fish scales, and an ammonite shell were found embedded in hard rock—evidence that

▼ BELOW THE freshly cut bank, the left-hand slab has been trimmed and is ready to receive a plaster cast. The white clay visible at the foot of the bank covered the tracks as a layer of volcanic dust, and was apparently necessary for their preservation. Where it disappears, so do the tracks

▼ THE TWO SLABS of tracks were taken from this spot on the Ira Hartley farm in Montana. The rocks are more than 60 million years old. George F. Shea of Billings, Montana, who reported the tracks in 1932, is standing near the right-hand row of tracks. Seated opposite the left-hand one is Al Stolz





▲ FROM EICHSTÄDT, BAVARIA, comes this clue as to the nature of the animal that made the prints in Montana. It is a fossilized squid of the Jurassic period, *Plesiotenthis prisca*. Note the similar imprint of its tentacles

the rocks had been formed under a sea. But we found none of the creatures that could have made the star impressions.

We collected samples of the clay which, when analyzed, proved to be of volcanic origin. This clay, which must have drifted into the sea as dust, had apparently been necessary for the preservation of the tracks. Many tracks were probably made on the soft sea bottom, but if they were not filled rapidly by the overlying clay, they were presumably soon obliterated. We can assume, therefore, that the creatures were quite numerous.

When the blocks were prepared for study, it was found that some showed slight feathery scratches on the edges of the impressions, as in the example found near Cody, Wyoming. In most of the tracks there were small piles of sediment on the inner end of each deep cut. Some of the impressions measured in the field were larger than others, but in each series all impressions were of the same size and evidently were made at intervals by the same creature.

Now, in early marine rocks of the Jurassic Period in Western United States and Canada, cigar-shaped fossils known as *Belemnites* are found

in countless numbers. Each fossil represents a part, called the guard, of the internal skeleton of a squidlike animal. None of the softer body parts have been found preserved in America. This hard part is closely associated with the ink sac that enables a squid to cloud the surrounding water and escape its enemies. In some places *Belemnites* cover hillsides and fill depressions thicker than raisins in a cake. About 350 species of *Belemnites* are known throughout the world, ranging from the Lower Jurassic to the uppermost Cretaceous, and they are important as index fossils.

In some kinds of living squids, the hard part corresponding to the *Belemnite* is the familiar cuttlebone fed to canaries, while its tentacles or arms are provided with disclike suckers. The tentacles of ancient Jurassic squids were provided with lateral rows of horny hooks, as shown in a specimen preserved in the Peabody Museum of Yale University. These hooks would account for the lateral scratches bordering the deep cuts made by each tentacle, assuming that the Late Cretaceous squids were similarly modified.

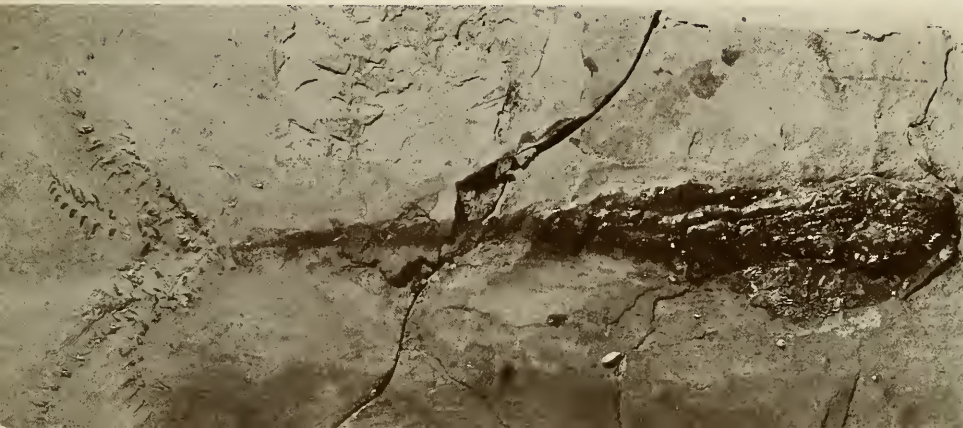
Further to substantiate the case, there is in the American Museum

collection a fossil squid from the Jurassic lithographic stone at Eichstadt, Bavaria, in which there is a clear imprint of eight tentacles lying in exactly the same relative position as are the radii of the fossil impressions in question. Moreover, the tentacles are almost the same size as would be required of those that made the fossil markings. Thus there is fairly conclusive evidence that squids were the makers of the impressions.

But we must still account for the regularity and number of imprints in each series, for living squids usually swim in a horizontal position. This leads us to the egg-laying habits of living squids.

In observations on the female squid *Loligo pealii*, G. A. Drew notes, "Toward the end of the period during which the string of eggs is held, the animal shows an increasing tendency to turn the body into a nearly perpendicular position to bring and keep the tips of the arms in contact with the bottom. . . . With the arms held rigid and the tail fin moving rapidly, she goes bounding along on the tips of her arms, dorsal side foremost with a movement somewhat similar to the bounces that may be obtained by pushing a lead pencil, held by one extremity and slightly inclined from the perpendicular, over a table. This action is generally repeated several times."

Each female lays many strings of eggs during the season (June to September), and Drew calculated it took two minutes for each placement of eggs. These observations were made on specimens kept in aquariums at the Marine Biological Laboratory at Woods Hole, Massachusetts; therefore the recorded movements were not influenced by tides. It is reasonable to suppose the habits of ancient squids were similar to those now living, and the position of the



◀ HOOKLIKE CLAWS are seen on the tentacles of this squid from Lower Jurassic times, reproduced at about $\frac{3}{4}$ actual size. They offer an explanation of the feathery scratches found on the edges of some of the eight-pointed stars from Wyoming. (*Geotenthis bollensis*, from Lyme Regis, England)

Courtesy of the Peabody Museum of Yale University

animal just described would seem to be identical with the posture the ancient squid would have assumed at the time the impressions were made.

Why were there always eight impressions in each row? Ten complete series were uncovered during our work, and there were never more and never fewer than eight if the area of the rock was large enough to show the complete series. In each case, the individual impressions were distributed in the manner shown in the photographs. The series were lying in different directions, sometimes parallel, but we could not uncover enough area to establish any general relationship to a possible shore line. Nevertheless, I am of the opinion that wave action was in part responsible for the way in which the tracks were distributed.

Close examination shows that where the rays of the stars were pressed into the mud the impression is not always symmetrical. Sometimes one side of the groove is more acutely incised than the other, and in some cases it even overhangs the bottom of the groove itself, as it would if considerable pressure had been exerted on one side by motion of the water. Wave action has been detected as deep as 600 feet below the surface, so there is no reason to suppose the egg-laying was restricted to shallow shores. Since these seas were inland bodies of water, tides would probably not have been perceptible.

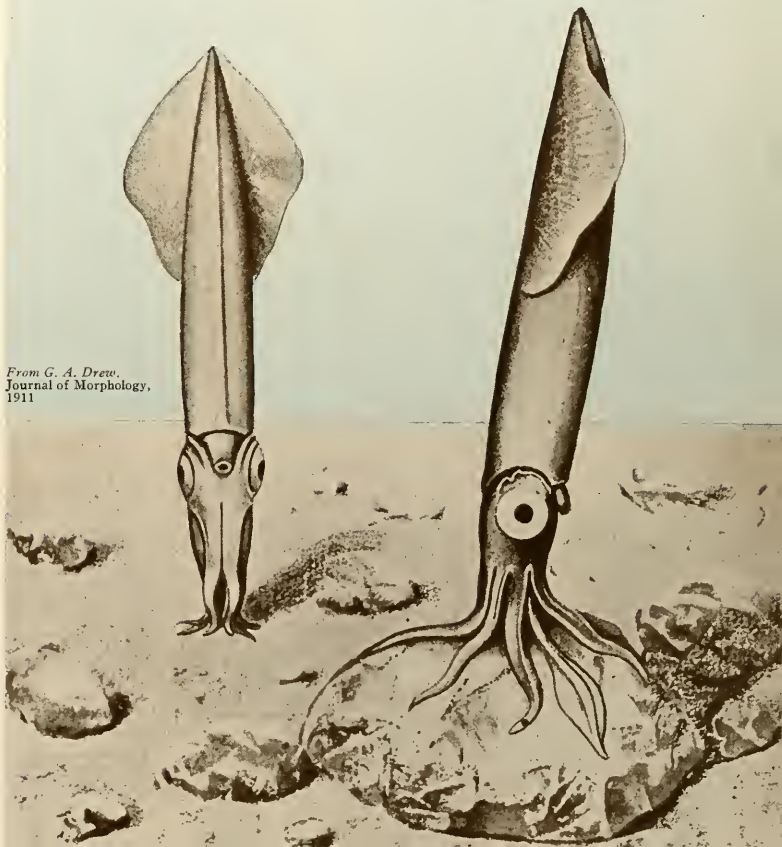
To visualize these tracks in the making we picture myriads of Mrs. Squids bouncing along the bottom of a shallow turbulent inland sea, interested in depositing eggs. Mrs. Squid reaches the bottom and holds to the spot selected, busy with her own affairs. As water pressure tends to shift her position, her eight tentacles cling to the soft bottom, holding on and cutting in as her body is being lifted clear. After about two minutes she again touches bottom, and the process is repeated eight times in all.

The position of the impressions in series of eight could be related to the disturbance of the surrounding water induced by the cycles of movement between crest and valley of waves above. But the most satisfactory explanation of the number eight is that Mrs. Squid's supply of eggs, for the time being, was exhausted at the end of the eighth stance.



▲ **ALTHOUGH THE REMAINS** of squidlike animals have not been found in direct association with the tracks in Montana, these belemnites have been preserved in countless numbers a few hundred miles away in the Black Hills. Each belemnite represents a part of the internal skeleton of a squidlike animal

▼ **LIVING SQUIDS** (*Loligo pealii*) have been observed laying their eggs in this position. They assume a nearly perpendicular position and cling to the bottom with their tentacles, depositing their eggs in intervals of about two minutes. Presumably the Cretaceous squids of Montana had laid all their eggs at the end of eight stances



From G. A. Drew,
Journal of Morphology,
1911



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Insects in the House

THE FALL WEBWORM

By C. H. CURRAN

*Associate Curator, Department of Insects and
 Spiders, American Museum of Natural History*

IT is not often that an insect enemy of trees or cultivated crops is also classified as a household nuisance, but there are times when such insects do invade houses in large numbers and become extremely annoying. At this season there is one that causes many persons to write to their local scientific authorities for help in exterminating it from their homes. This is the Fall Webworm (*Hyphantria cunea*),



which attacks forest and shade trees. The caterpillars are the chief cause of worry in the home. The moths also enter houses in large numbers, being attracted to light.

There are two generations of Webworms each year, one in June and July, which is usually small, and one in August and September which may be very large. When the caterpillars mature they wander about in search of a suitable place in which to build a cocoon, and unless a building is tightly screened, they may crawl in and distribute themselves over the walls and ceilings. Also, their food supply may run out when they become so numerous as to completely defoliate a tree, and in that case the caterpillars go in search of other food. When this happens, the partly grown caterpillars become a particularly serious problem.



Control is rather simple, however, since the creatures can be destroyed by spraying the trees with an arsenical poison. Since the caterpillars are gregarious and live in unsightly "tents" on the branches, they may be destroyed by cutting off the parts on which they occur and burning them. This should be done while they are still young. If it is done during the development of the first brood, the size of the second brood can be greatly reduced.



TREES — WE LIVE WITH THEM

Photographic Tips

By **THANE L. BIERWERT**

*Acting Chief, Division of Photography,
The American Museum of Natural History*

WHEREVER a man lives, a tree grows. At the oasis in the desert, near the homestead on the prairie, along the village lane, and on the sidewalks of New York, wherever we find a habitation, except in the far north, trees are part of the landscape.

We shall develop a better appreciation of the part that trees play in making pictures more interesting if we know our trees and their characteristics. To develop that appreciation we might give ourselves a useful, year-round problem. Make a series of pictures suitable for lecture purposes or for the album that will show all aspects of neighborhood trees, both from aesthetic and educational viewpoints.

A foundation of tree knowledge is necessary before we can set out with camera and equipment. Arm yourself with a book with which to identify the various kinds common to the locality.

Select trees that are typical of the species. An elm covered with a "beard" of suckers is not a healthy tree. One found growing in a woods will not have developed the usual wide-spreading crown of foliage; it will be too narrow and "leggy." Buds, leaves, flowers, and fruit can be photographed on young trees. But it is the mature tree that has a truly representative silhouette and bark structure.

The trunk and bark are easier to photograph in autumn, after the leaves have fallen, when sunlight can strike the base of the tree. The beech and the gray birch will require glancing illumination in order to give contrast to their smooth bark. The rough texture of hickory, or maple

will photograph best on a hazy, slightly cloudy day, when diffused light will fill in the otherwise black shadows. Trees that have unusually interesting bark, like the unkempt shagbark hickory or the mottled sycamore, will provide particularly striking close-ups to enliven your series. Since the bark of trees varies widely in texture, we should have some method of showing relative size. By photographing comparable views from the same distance, we can make slides or prints that will show in true proportion the differences in bark structure. Among these sets, the pictorialist will discover numerous pattern pictures for decorative purposes.

Good silhouettes of trees, whether in foliage or with naked boughs, should be made on clear days to give sparkle to the print or slide. The selected tree will be sharply outlined if it stands clear of its surroundings and against a contrasting background, which can be out of focus if far enough away. We may find that photographic conditions are ideal for a particular tree only during a certain time in the day. The subject will be lighted best when the sun is about 45° to either side of the camera, giving a pleasing roundness to the tree. Before exposing a negative or transparency, make this visual test to determine whether the tree will stand out in the photograph. Close one eye and stare at the center of the picture, slowly closing and opening your other eye, repeatedly. In a few seconds, you will see only blended tones that will have some of the quality of the finished picture. If the subject appears satisfactory, make the exposure.



▲ THE GNARLED TRUNK of the Rocky Mountain cedar is best photographed in diffused light. Its fibrous bark was used for rope by the Indians

Photographs by the author

▼ SHARP SUNLIGHT helps to bring out the shallow fissures that give the variegated sycamore its scaly appearance



▼ SYCAMORES average 60 to 120 feet in height and are easy to recognize even after their leaves have fallen



Spring is the season to record the foliage. Then the leaves have not yet become insect-eaten; they are a pale, bright green and will photograph more as we see them. By mid-summer, many of the growths, especially on the evergreens, have become so dark in color that it is nearly impossible to capture detail in the negative.

Usually the branches are so high that we will need to pull the leaves down to tripod level to see their upper surfaces. Fish out of the gadget bag a piece of string and a tent peg. Drive the peg into the ground and tie the branch to it. This is much better than having someone hold the branch in position while we compose and focus, for if our assistant has an itch or if a bee buzzes by, we may lose branch, focus, and temper. The picture should show the form and structure of the leaves, and how they are joined to the branch. These are important for distinguishing similar species in a family. It may be necessary to thin out a few other branch ends in order to allow light to fall fully on the selected leaves and to get rid of distracting elements. A large shadow from a densely foliated branch becomes an excellent background because it will not be broken up with small patches of sunlight. In the picture, a patch of sunlight appears as a brilliant out-of-focus area that is exceedingly distracting. Well-composed photographs of leaves are difficult to make. Success depends principally upon the selection of as small an area of the branch as will show the characteristics of the tree.

The film to which you have become accustomed is the one to use. With orthochromatic you will sometimes want a green, yellow, or polarizing filter. If you use panchromatic, which is better for most subjects, a red filter as well will be useful. The choice and use of a filter will depend upon the kind of day and the subject. A yellow (or red) filter will darken a blue sky. We can also separate a tree from a clear blue sky by using a polar-screen, with the handle pointed directly at the sun. Leaf surfaces that are veiled over with sky reflections can have the color and texture brought out by using the polaroid filter. The proper angle of polarization can be determined by viewing the subject through the filter and rotating it until the reflections are subdued, but not extinguished. Some highlights should be retained to give a natural glistening. A green filter will lighten the tone of the leaves. Thus when the tree blends into a dark background, a green filter will sometimes lighten the subject and bring it into more prominence. Generally, we find that the darker the background, the lighter the filter required to brighten the tree.

Close-ups are rendered in good detail without the addition of colored filters. And if the tones of the tree and leaves are well separated from the sky and other trees, we are safe in not using a filter.

Some of us will wish to bring home some leaves, flowers, buds, winged seeds, acorns, or chestnuts for indoor photography. For this sort of work, the major problem is to create naturalness in the set-up.



▲ SO ATTRACTIVE an ornamental tree as the blue spruce deserves to have its cool, silvery-blue needles photographed early in the season

During the first few days of photographing trees, you will probably wish that you had a couple of lumberjack friends to clear away underbrush and to remove intervening boughs, or at least that you had the foresight to bring along your own ax. To record those "perfect specimens," no program of deforestation is really necessary. Move around a bit; another angle may provide just the view you want. When in doubt, make the exposure. Next year you may find a better tree.

The person who intends to make a complete series of educational pictures of the 30 most characteristic trees of his locality, should include photographs of

each tree in silhouette, both in foliage and as a skeleton, and close-up views of the bole, bark, buds, flowers, leaves, and fruit. If the series has been made with any degree of uniformity, it may be worth while to inform some of the book publishers, because they are clamoring for good illustrations. There may be a pot of gold waiting for someone who is willing to make a rainbow of God's trees.

We have such a tendency to accept trees as a part of our environment that we seldom think of interpreting them for others. After we have come to know them individually and as species, we can show our friends how better to enjoy them as the strongest part of our landscape.

▼ OUTLINED against a somber sky, this oddly shaped Rocky Mountain cedar is a fascinating subject for any cameraman specializing in trees



ARIZONA'S ANCIENT IRRIGATION BUILDERS

Continued from page 310

Line has aroused interesting conjecture regarding the Desert Hohokam. More than a score of hill forts are known through the length and breadth of Papagueria. The summits of isolated volcanic hills, preferably protected by cliffs, were the favorite strongholds. Defensive walls of rough-laid stones, sometimes as many as seven in a series, barred ascent up the more accessible slopes, and on the crests of the hills within the fortified area are found clearings and terraces for homes. Usually near by in favorable terrain will be found a village site that was occupied except when danger threatened.

What was this danger? We are not sure, but there are some clues. The potsherds found in the refuse of these defensive sites are, with few exceptions, of the same order. This means that at a given period the threat of a hostile group was uniformly felt by all of the Desert People. This pottery occurs also as trade ware in the River Hohokam ruins when the red-on-buff of the Classic Period was produced, and both can be linked with Pueblo pottery of the fourteenth century as dated by the tree-ring method. Thus, the fortified hills can be assigned to the fourteenth century.

The next question is, what people were stirring about at this time to alert the Desert Hohokam? Here again, there is a plausible answer. Beginning about 1300, the Pueblo or Salado people of east-central Arizona extended their frontiers far to the south and west. Casa Grande National Monument and a host of other ruins are proof of the presence of these people among the River People. But so far, the domain of the Desert Hohokam has revealed almost no trace of these aliens. The time of the Salado thrust and the age of the hill forts roughly agree. It would be difficult to explain this without a cause-and-effect relationship. So, until proof to the contrary is forthcoming, we can cling to the idea that the Saladoans heeded the "No Trespassing" signs of the Desert Hohokam and remained for a time among the more friendly River People.

At about 1400, the archeological record of the Hohokam comes to an end. It has revealed the story of a people who rose from a simple agricultural state, up through illustrious

achievements in husbandry, in the arts, and inferentially in the political and social phases of life, only to descend to a state of almost complete cultural eclipse. I say "almost" because I believe that further records of the Hohokam will eventually relate them to living people who still occupy the territory. The present gap in our knowledge may well stem from the archeologists' preoccupation with the larger and more productive ruins. Further research may also shed light on the origin of these agriculturists and reveal whether their roots penetrated to the simple hunters and food gatherers known to have been in southern Arizona before the Christian Era. At present, this seems more likely than the supposition that they came as immigrants, bringing with them those elements of culture that a thousand or so years later emerged as the rich precipitate here described.

The archeologist is also continually seeking to establish with greater clarity the process by which scattered farming communities came together to form populous urban centers, located among the canal networks and hemmed in by the fields from which the food staples were drawn. The rich assortment of textiles, carved stone, pottery, shells, stone, and perishable goods were the logical consequences of the agricultural accomplishment, coupled with some outside stimulation from tribes in Mexico. But after this great surge of cultural energy and only a few centuries after the Hohokam had reached their peak, symptoms of degeneration began to appear in their culture. The dissolution seems to have been rapid. Where a

score of towns can be listed as thriving during the fourteenth century, not one can be certainly identified as having survived into the fifteenth and sixteenth centuries. Drought? Pestilence? Oppression? Internal strife? Exhaustion of the soil, or failure of the canal system? No one yet has a satisfactory answer. It is paradoxical, perhaps, that the earlier history of the Hohokam is better known to us than the latest phases of the culture, which were much nearer in point of time to the twentieth century.

The foregoing is not said with the intention of creating a mystery out of the problem of what happened to the Hohokam. There are a few persons, I among them, who concede the possibility that the modern Pima and Papago Indians of Arizona are the survivors of the Hohokam. This conclusion is based partly on logic and partly on the fact that there is a continuum of the mode of life and of many cultural elements from the pre-Spanish to the modern inhabitants. Before such a view can be flatly accepted, the present gap in our knowledge from 1400 to 1700 must be bridged. I have no doubt that future work in this direction will be richly rewarded.

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Continued from page 297

HUNTING, FISHING AND CAMPING

----- by L. A. Anderson

The Macmillan Company, New York,
\$1.95, 214 pages, 20 plates

MODERN writers on outdoor sports usually assume that the reader has at least a basic training in hunting and fishing. Mr. Anderson takes nothing for granted. While not boring the reader with numerous details that can best be learned by experience, he gives the fundamental requirements necessary for a successful sportsman. These facts are presented in such a way that they are not only interesting reading but automatically fix themselves in the reader's memory. Mr. Anderson, who lives right in the Northwoods and spends every bird hunting and deer hunting season at his camp in northern Wisconsin, has gleaned his knowledge firsthand from practical experience.

In the first part of the book the reader will find practical information on how to shoot moving game and birds on the wing. This section includes a special chapter on deer hunting and discussions on the use of the rifle. There are also special chapters on grouse and duck hunting, and the kind of clothing to wear on a hunting trip.

The second section concerns fishing and begins with the relative merits of live bait and artificial bait. In subsequent chapters Mr. Anderson discusses fishing tackle, casting, and some useful tips on fishing. There is a special chapter on trout fishing and one on how to catch other game fish.

The third and last section of the book covers camping and preparation for the field trip. Here, the essential equipment

for an enjoyable trip in the great outdoors is given, the kind of food to take with you and how to cook it. Every fisherman and hunter will agree that insufficient attention paid to these details may utterly spoil a vacation. Finally, after a brief chapter on the art of canoeing, Mr. Anderson gives timely advice on fellowship of the trail. He says: "Camping leads to good fellowship. It brings out the best in man, and the worst. Conditions are hardly ever perfect, but the man who makes the best of things is the one who will always come back for more. . . . Rain or storm does not deter this man. He can see the humor in a rainstorm, wind, snow, or hail. He takes them all in his stride."

GEORGE G. GOODWIN.

CAREERS IN SCIENCE

----- by Philip Pollack

E. P. Dutton & Co., Inc., \$2.75
222 pages, 56 illustrations

CAREERS in Science is written primarily to serve as a guide for young people planning their life's work. The book sets forth the advantages and disadvantages connected with careers in more than 70 specific occupations and should be very helpful to individuals faced with making such an important decision. Moreover, *Careers in Science* is extremely interesting reading for any one, because it gives the highlights of science in a very entertaining and instructive fashion.

The field covered by the book includes chemistry, physics, biology, and geology. In addition there are chapters on "New Worlds and Careers" created by science, "A Woman's Place Is in the Laboratory," and "Futurama." A supplement contains two important articles on "The Outlook for the Physicist and Prospective Physicist in Industry," and "How Can We Develop Inventors?" There is a good bibliography at the end of the volume.

This is a tremendous field to be covered in a single volume, but the treatment is successful to the extent that it outlines the possibilities in each category, and the reader can decide which one of the fascinating avenues he may wish to travel. But selecting a career is not like picking the best item out of a catalogue. The individual must weigh carefully such factors as aptitude, capacity for learning the field in

question, and ultimate personal satisfaction with the work. Such matters as salary and prestige should really be secondary, although the author, in each case, gives information on these points as well. But the really important questions the candidate for a career in science must ask himself are these: "Do I like it deeply enough? Do I have what it takes?"

The book is generously sprinkled with incidents, famous names, and outstanding achievements in science. Not only are these examples of how other people reacted full of human interest, but to a certain extent they bring the reader abreast of the times.

H. E. ANTHONY.

BEHOLD OUR GREEN MANSIONS

----- by Richard H. D. Boerker

The University of North Carolina Press,
\$4.00, 313 pages, 167 illustrations

THE author of this book on forestry served with the U. S. Forest Service from 1910 to 1917, and for a time he was forester for the New York City Parks—in fact his primary life-time interest has been in this subject. He is the author of an excellent book on our National Forests and two on forest ecology.

The present volume is a comprehensive one covering every phase of the subject from wood as a critical war material to recreational forestry—always from the standpoint of human welfare. There are eighteen appealing chapters, including a modern definition of conservation; the relation of forests to wildlife, water supply, holding the soil, and flood control; lumber and its by-products; the forest as a live-stock range; forestry and agriculture; insect enemies; tree diseases; and fire, the destroyer.

A phase of forestry that interests the city dweller as well as the rural population is that of recreation, and during the past quarter of a century travel for recreation in this country has increased amazingly. In response to this growth, there are now more than 3800 picnic and campground areas, over 70,000 miles of streams suitable for fishing, and over 150,000 miles of riding and hiking trails in our National Forests.

There is a wealth of dependable information in this book, arranged logically and presented in an interesting and convincing manner. The reader will be surprised and pleased to find more than 150 very fine photographic illustrations, the majority of them full-page. In future printings of the book, it is hoped that there will be a list of these illustrations following the table of contents, or that they will be included in the index. The selection of the photographs is to be fur-

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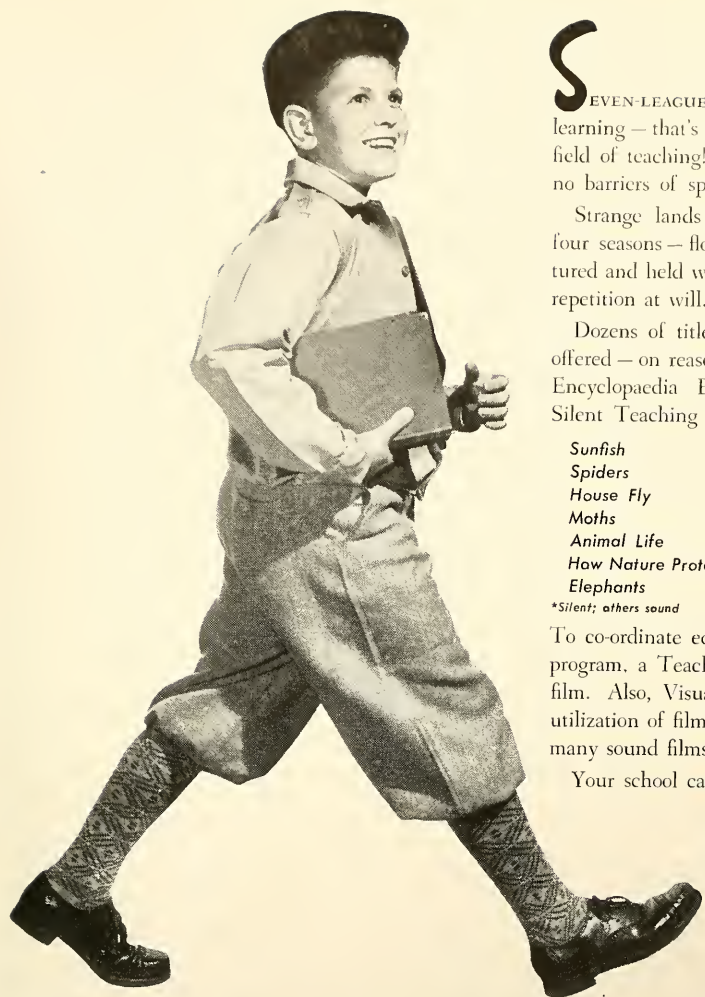
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our armed forces serving in the Pacific with the nature and character of the people they are likely to encounter, it is equally well suited to introduce the civilian reader to the people that form the background against which the fighting has been taking place. For, once the problems of the war are over, these people will remain, and a proper understanding of who and what they are and the difficulties that beset them will help enormously in restoring them to a well integrated life.

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HARRY L. SHAPIRO.

THE ORIGINS AND HISTORY OF THE MAYAS, PART I

----- by M. Wells Jakeman

Research Publishing Company, \$3.00

THIS is the first part of a proposed three-volume work intended as a general reconstruction of Maya history. It is an attempt to re-evaluate and synthesize our knowledge of the Maya and to integrate the results of such separate lines of research as archaeology, physical anthropology, and the studies of the hieroglyphics and documentary sources. The author is interested primarily in the historical accounts of the sixteenth century and believes that there is information in them that can be considered to apply to the whole range of Maya history as discovered by the archaeologist. These historical accounts are thought to be more accurate than has usually been supposed, and much of the book is concerned with their critical examination.

Dr. Jakeman's book is not a popular account of Maya history to be read as an introduction to the subject, although it does contain sections of general information belonging properly in such a book. With these, however, are certain chapters of a highly technical nature which could not be of interest to the general reader.

This is primarily a work for the specialist in Maya studies and, as such, we cannot adequately judge its merit before

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it is published in entirety. From what we do have, however, it is our opinion that Dr. Jakeman has in some ways approached the general field of Maya studies with a little less caution and care than would appear desirable.

G. F. EKHMOLM.

OUR HERITAGE OF WILD NATURE

by A. G. Tansley

Cambridge University Press, \$2.50
74 pages, 26 photographs

THOUGH this is an excellent book, it is not one that will fill the wants of most American readers. It is written for residents of the British Islands having a real appreciation of nature in its aesthetic or scientific aspects or both. It is a strong plea for efforts to preserve the natural and beautiful features of the British landscape and its native birds, animals, and plants, with which the necessities of so many years of war have played such havoc, especially through the destruction of the forests and breaking up and exploitation of the large estates that used to serve as effective nature reservations.

The book gives interesting facts and pictures of areas that still retain more or less of their natural character. It is, however, written with a full appreciation of the difficulties that increasing economic pressure and indifference on the part of a large section of the public place in the way of preserving such areas.

Its author does not appear to be too hopeful of much being accomplished along that line, but tells what is being done by government and private agencies and organizations, and points out other things that may and should be attempted.

Our American conservation problems are, of course, not just the same, and fortunately have not reached the desperate stage that they have on the British Islands. Yet nature destruction is now going on far more rapidly here than in Great Britain, and the sooner we are willing to look ahead and face the facts

the way this book does, the better it will be. Too many of us who think ourselves to be conservationists ignore the fact that "conservation" all by itself is merely an abstraction with no real existence unless applied to saving particular things.

WILLARD G. VAN NAME.

WEEDS OF LAWN AND GARDEN

by John M. Fogg, Jr.

University of Pennsylvania, Press, \$2.50
215 pages

THE Professor of Botany in the University of Pennsylvania has prepared an authentic handbook on weeds for eastern temperate North America, written for those who have lawns, gardens, or even flower-beds—not a textbook for students of botany, but a popular treatment for the layman. In the introduction, the author discusses: What Is a Weed? Why Some Plants are Weeds, The Dispersal of Weeds, The Geographic Origin of Weeds, The Extermination of Weeds, Chemical Controls, and Weeds as Soil Indicators.

The main part of the book is made up of descriptions of weeds accompanied by excellent line-drawings which are a great aid in identification. Of the 242 weeds treated in the book, it is interesting to note that more than half are of European or Eurasian origin; about one-third are native to North America; approximately 8 per cent come from eastern Asia or India; a little more than 5 per cent are indigenous to the tropical or subtropical portions of America; and less than 1 per cent are derived from Africa. The book has a glossary, a well-selected bibliography, and an index.

CLYDE FISHER.

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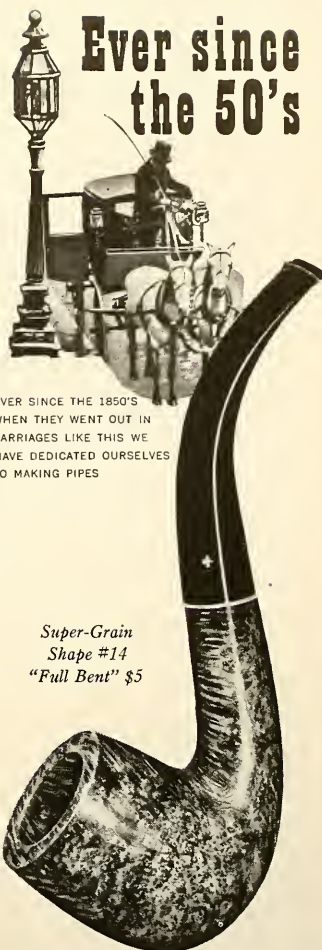
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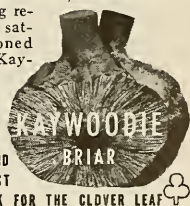
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LETTERS

Continued from page 293

full D. H. Lawrence beard covering almost the entire face except for the eyes and nose is never seen among full-blooded Negroes or Mongoloid people. At least the few long wispy hairs carefully preserved on the faces of some elderly Chinese fall far short of even the minimum requirements of a youthful white aspirant to such an adornment.

As far as I know, there is no direct environmental explanation of this diversity in racial hairiness. All that we can say is that genetic differences exist among the races of mankind in this character, some being endowed with a tendency to greater hairiness than others. That the differences are of immediate genetic origin seems indisputable when we observe that even within the white race or within any sub-division of it, individuals show a marked variation in their hairiness. Thus many white men show a sparseness of beard and others a much heavier growth. Often certain families tend to exhibit pronounced differences in this respect. Moreover, the areas of the face on which hair will grow often form distinctly different patterns that are probably hereditary in origin.

HARRY L. SHAPIRO,

Curator of Anthropology,
American Museum of Natural History

New York, N. Y.

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COUGAR



Photograph from Herbert C. Lanks

SIRS:

In your June, 1945, issue of *NATURAL HISTORY* Magazine there is a series of photographs whose title, "A Gallery of Insect Portraits," is not in accordance with the animals pictured. . . . The scorpion, tarantula, and jumping spider are not insects, but are in the class Arachnida. . . .

Forest Hills, N. Y.

ALICE HASSARD.

SIRS:

In the March, 1945, issue under the title "Nature Through the Camera's Eye," it says in smaller type, "Three Insects and Their Prey." Two of the three "insects" referred to are spiders, not insects. . . . Again in June, 1945, we find "A Gallery of Insect Portraits," among which are a scorpion, a tarantula, and a jumping spider. . . .

PAUL GRISWOLD HOWES,
Curator, The Bruce Museum,
Greenwich, Conn.

In the strict scientific sense, these objections are valid. Even in a title, where it is difficult to mention everything in a few words, it would be more precise to use the term "arthropods" instead of "insects," though it might frighten some readers more than the creatures themselves. However, anyone who finds it difficult or awkward to refrain from using the word "insects" whenever there are any spiders around may be comforted to know that leading dictionaries both in this country and England permit one to speak of spiders and certain others of these creatures as insects.—Ed.

SIRS:

In Dr. Wissler's excellent article, "The Domestication of Animals" in *NATURAL HISTORY* for May, I note that, following the usual assumptions, the domestication of elephants is assigned one point of origin, in southeastern Asia.

These usual assumptions are that elephants were first tamed in India some time between the Aryan invasion (circa

1500 B.C.) and the invasion by Alexander the Great in 327 B.C.

There is a line in the famous Babylonian epic known as the *Gilgamesh* which, if the Leonard translation is correct, implies that elephants may have been domesticated earlier, in Iraq. When the hero Gilgamesh is denouncing the goddess Ishtar, he says:

"Keep thy gifts to thyself! . . .

Thou art like a back-door

Which keeps not the storm out,

Like a palace which slayeth the heroes,

Like an elephant who shakes off his carpet. . . ."

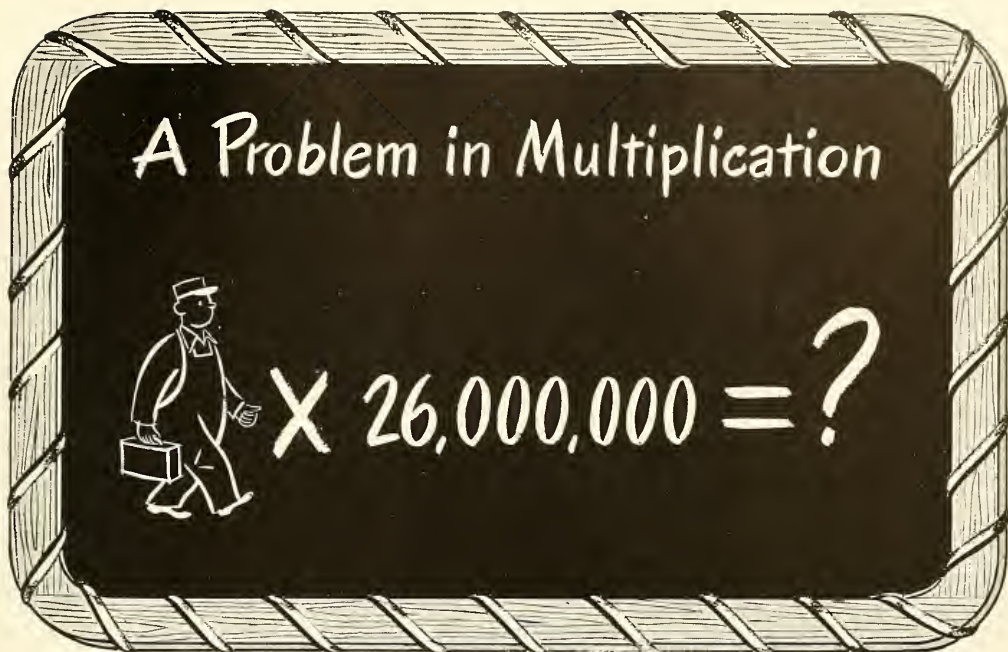
Elephants don't make their own carpets, so this refers to a domesticated elephant. The most complete extant version of *Gilgamesh* is from the seventh century B.C., but the materials of which it is composed are supposed to go back to 2000 B.C. or earlier. And back before Hammurabi's time [about 1900 B.C.] there had been wild Asiatic elephants in Iraq.

Now, was this reference to elephants inserted into the *Gilgamesh* in Ashurbanipal's time [seventh century B.C.], by an Assyrian anthropologist who had heard about the elephants of India? It seems unlikely, because if elephants were unfamiliar to most Assyrians, they would hardly be mentioned so casually. To one who had never heard of elephants, such a line would be unintelligible by itself.

The alternative is that the line was part of one of the original stories or poems from which *Gilgamesh* was compiled, composed back in Sumerian times. If this is so, did the Sumerians learn the art of elephant-taming from the people of the pre-Aryan Indus Valley culture, with whom they are believed to have had commercial relations; or vice versa; or did the Sumerians and Indians domesticate elephants independently?

LT. COMDR. L. SPRAGUE DE CAMP,
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The reference to "an elephant who shakes off his carpet" certainly suggests a familiarity with domesticated elephants in southwestern Asia. But whether the text is old enough to indicate priority over India may be questioned. A monograph entitled "Some Aspects of the Asiatic Elephant in Zoology and Ethnology," has been written by P. E. P. Deraniyagala, Acting Director of the Colombo Museum. In this he states that the earliest association of *Elephas maximus* with man in historic times dates from the days of Mohenjo Daro, and he puts this as early as 4000 B.C. At that time the animal is said to have probably been used both as a beast of burden and as food. It is admitted in Burmese and Singhalese literature that elephant management was first developed into a science in India and thence spread to other countries. But further archaeological evidence will be necessary before the exact sequence of events can be established.—Ed.



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LETTERS

SIRS:

How can I pay due tribute to your cover picture for September? It is a sort of sublimation of the very aim of the magazine itself, and it needs no title. It is, in Biblical phrase, "altogether lovely." Noah himself, as he watched from the ark, could have had no fairer picture. The blue, the white dove, and the green olive leaflets make a combination superlative for simple beauty and for the symbolism of the new day. The deluge is over. . . .

PAUL G. HUSTON.

Jacksonville, Florida

SIRS:

This morning's mail brought your great magazine, and the cover is so beautiful and breath-taking, that I felt I must write to thank you for it. I hope its full meaning may pierce the cinders of the bomb—that stopped the war.

I share my copy with ten in this house, and then it goes to South Dakota to nearly seventy Indian children. They will love its beauty.

KATE LEAH COTHARIN.

Milton, Massachusetts

SIRS:

Congratulations on your beautiful and dramatic cover for September. Your covers are always most attractive and interesting, but this one is the climax.

AGATHA LAUGHLIN.

El Cajon, California

SIRS:

I want to tell you how very much I have enjoyed both your very interesting article on Birds of Paradise in the June NATURAL HISTORY and the beautiful exhibit of them in the Museum. They certainly make a gorgeous display. I have seen it three times now, and each time I enjoy it more. The birds' coloring is lovely, unbelievably so.

Thank you so much for both.

LEIZABETH N. KENNEDY.

Tuckahoe, N. Y.

SIRS:

Among the many interesting things in your magazine, the article "A Toad Is Like This" by Roy L. Abbott in the March number held my attention, partly because, as a boy in New England, I always found the toads interesting and partly because the introduced Tropical American Toad is so common here in Hawaii.

In his article Mr. Abbott states that the toad never eats anything that is not moving. This is not true, I am sure, of the Tropical American Toad (*Bufo marinus*). These quickly gather where any flesh is left. I have often found them in the cat's dish cleaning out remnants left by the cat and also eating and dragging away parts of rats left by the cat. Even while the cat is eating, the toads will gather and come directly toward the flesh as if

attracted by odor. Thus these toads, which have become very numerous since their introduction in 1931, seem to be useful not only in getting rid of untold numbers of insects, centipedes, and other small animals but in acting as scavengers as well.

CHARLES S. PUTNAM.

Hilo, Hawaii.

* * *

The following comments are offered by Charles M. Bogert, Chairman and Curator, Department of Reptiles and Amphibians, American Museum of Natural History:

It is not impossible, of course, that some toads have evolved other means of selecting their food or prey, but, by and large, all the tailless amphibians in the adult stage rely upon visual cues in selecting their food. Aquatic salamanders, and possibly tadpoles, may utilize taste, and when animals live in the water there is, of course, no obvious difference between taste and smell. The end-organs for both are commonly placed in the same category as "chemo-receptors."

I am not aware that anyone has demonstrated the presence of a sense of smell in toads. All observations reported indicate that toads detect only moving objects as prey. Studies have been made on the food habits of the Neotropical toad in Puerto Rico, where the creature was also introduced to aid in controlling beetles that were destructive to the sugar cane. The results of this survey indicated that a high percentage of their prey consisted of beetles and their larvae, although other insects were found. We examined the stomach contents of a few specimens taken in southern Sonora and found a preponderance of beetles, although ants, moths, and a few other insects were represented. Also, we found a few grains of corn in a few specimens. We did not interpret this, however, as evidence that the toads had purposely eaten the corn. Rather we assumed that the corn had been picked up accidentally because ants or beetles were eating it and the toads had picked up the corn along with the moving insect.

I do not doubt for a minute, therefore, that the same species of toad in Hawaii has been found cleaning out remnants of food left by the cat. But it is a fair assumption that the food had first attracted insects, probably flies, ants, or beetles, and that the toad was in turn attracted by the moving insects. Similarly, a large toad might easily attempt to catch an insect crawling on portions of a rat and accidentally ingest part of the carrion. I would rather expect the toad to continue swallowing the meat, since I doubt whether it would distinguish between carrion and insect once the adhesive tongue had been thrust out to carry in the morsel that was moving. I am not prepared to vouch for the fact that a toad will pick up buckshot rolled in front of it, but I'd fully expect a toad

Continued on page 344



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VOLUME LIV—No. 8

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OCTOBER, 1945

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WINDBLOWN JEFFREY PINE

*"Is it as clearly in our living shown
By slant and twist which way the wind hath blown"*

▲ THIS PICTURESQUE TREE grows on top of Sentinel Dome, 8117 feet above sea level in Yosemite National Park. The photograph was taken by John Henry Coon, who suggests the appropriate lines quoted above from Adelaide Crapsey's poem. Aside from the low shrub in the foreground, the gnarled pine is the only thing growing on top of Sentinel Dome

LETTERS

Continued from page 341

to pick up shot the size of a BB without much difficulty, provided it was moving when seen. Neither would I have been surprised if we had found toads in Sonora that had engulfed Mexican jumping beans; had we collected our toads at the right season of the year I wager we'd have found the peripatetic beans in their stomachs.

Mr. Putnam's observations are interesting, and I am sure that he will forgive me if I suggest that they were possibly incomplete. Unless the toads in Hawaii are a remarkable strain, they must rely upon visual cues. In fact, an amusing story related by Mr. Perviss, who serves frequently as night watchman in the power plant at the Archbold Biological Station in Florida, suggests that a toad may not even be aware of his failures. One evening a stream of the large wood ants (*Camponotus floridanus*) that enter a variety of habitats in Florida, were moving across a wire in the powerhouse in such a manner that their shadows fell plainly on the floor. A toad wandered in at this juncture and spent all of ten minutes, according to Mr. Perviss, "picking up shadows."

It may be added that *Bufo marinus* is one toad of vast economic importance. Not only have they been introduced in Hawaii but in numerous places throughout the tropics, particularly the East and

West Indies—virtually every place, in fact, where sugar cane is grown. Largest of all true toads (*Bufo*), the Neotropical species attains a length of over eight inches, exclusive of the legs. Studies on other species indicate that during the active season of the year a toad may completely fill the stomach four times within 24 hours. According to some estimates an individual toad may consume enough insects to save the farmer four or five dollars worth of produce every year. The insectivorous habits of birds have long been appreciated, but except for cane growers, few people have given the toad sufficient credit.



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VAN ALLEN LYMAN.

Balboa, Panama Canal

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During these times when we should try to know and understand our neighbors better, NATURAL HISTORY Magazine is doing a splendid job in giving us a true picture of what other people in distant lands are like.

LADISLAUS C. TURNA.

Clinton, New York

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JUNIOR the CHIMP

SIRS:

The chimpanzee shown in these photographs was raised from infancy on a bottle, and he readily feeds a pair of black bear cubs in the same way at Benson's Wild Animal Farm at Nashua, New Hampshire. He also frequently enjoys a romp with them. When one of them gets a little too rough and scratches him, he handles it like a man with a hot potato, shifting it rapidly from one hand to the other.

"Junior" also likes the dog shown with him in one of the photographs. They frequently play together but have to be watched, for they both get excited as the frolic progresses. The dog will nip at Junior's hands, and the chimp will then look for a stick or stone as a weapon. If he can't find anything better, he will throw dirt at the dog. One day he picked up a whip that had been carelessly left on the ground and gave the dog quite an expert clip. As far as the dog was concerned, that ended all play sessions for some time. But Junior's real favorite is the raccoon. He will hold and fondle it as a woman does a child, and allow it to crawl up his back and onto his head. Far from resenting it, Junior will aid the raccoon in these gymnastics. Incidentally, the same raccoon likes human beings but fights all other raccoons when placed in a cage with them.

Junior seems to like his keeper, although he has bitten him during his training period. The chimpanzee seems to be quite indifferent to other men and even has an intense dislike for women and children. His brother, incidentally, is quite vicious, illustrating how much difference in personality there is among similar animals.

LAURENCE LOWRY.

Malden, Massachusetts



▲ JUNIOR has his hands full feeding two hungry black bear cubs at the same time

Photos by Laurence Lowry

JUNIOR and his pet raccoon, Sharkey, are good friends. Sharkey prefers the chimp to others of his own kind

THE CHIMPANZEE likes the dog when he is well-behaved, but throws dirt at him when he becomes too frisky





Photo by William J. Evans

The Kinkajou

SIRS:

I think you will agree that a kinkajou's yawn is a thing of wonder and a joy to behold.

Junie, our pet kinkajou, seems to derive great satisfaction from his yawns and consequently begins each period of activity with a half-dozen of the jaw-splitting, tongue-stretching exercises. How he accommodates that stretch of tongue is something we have never been quite able to figure out. Fully extended, Junie's tongue is nearly twice as long as his round head and short, pointed muzzle.

Picture, if you can, the fuzzy brown teddy bear of your childhood, alive and equipped with a long prehensile tail, and you have a remarkably accurate picture of the kinkajou. Owing to their tropical origin (they are natives of Central America and northern South America), kinkajous do not thrive too well in colder climates.

When we first saw Junie in 1942, he was a fuzzy little cinnamon-colored ball in the Mexican town of Tamazunchale. For the first few nights that we had him he cried lonesomely—real shrieks that rose in ear-splitting cadence. He was worse than any baby—that is why we named him Junior, later shortened to Junie.

Junie has lived with us ever since, and supplying him with bananas during war times has been neither easy nor inexpensive. Fortunately, tramp banana boats have arrived in Tampa, Florida, fairly regularly, and our home is within the Tampa trade area.

Junie is our second kinkajou. His predecessor was a female, misnamed Stinker. Actually, kinkajous have virtually no odor. Stinker was nearly grown when we

got her and was accustomed to standing up for her rights against a young spider monkey. Junie has never had to stand up for his rights to anybody, although sometimes he shows a marked disapproval of strangers, and he has the dental equipment to enforce his opinions if necessary. We had heard that kinkajous became less tame as they grew older, and that two years was the age when they stopped being friendly. Junie has passed that line and is tamer than ever, if such could be possible.

Kinkajous are nocturnal. They spend the day sleeping in compact balls with all the edges tucked in. When evening comes, they become active and remain that way until morning. Their bare-palmed paws are almost as useful as a monkey's hands, and may be employed equally well for climbing and for grasping.

Junie prefers to dine while lying on his back, balancing his food on the sole of one hind foot and holding it in place with both forepaws. Junie eats many things besides bananas—carrots, potatoes, papayas, oranges, string beans, apples, and bread. His tribe is supposed to be omnivorous, but he has spurned the few pieces of meat we have offered him and does not seem too keen about eggs.

Little seems to have been written about kinkajous. We have learned some things by watching our two, but there are other things we should like to know:

(1) Why are they equipped with the long tongue that makes yawning such a satisfying event? (2) Kinkajous make their homes in trees, but how many kinkajou babies are in a litter, and in what season of the year are they born? (3) Is

there anything unusual about the animal's digestive system? Junie's digestive processes are remarkably rapid. (4) And what are kinkajou habits in the wild?

EDNA H. EVANS.

Lakeland, Fla.

In answer to these questions, the following information is given by George G. Goodwin of the American Museum's Department of Mammals:

It is usually some outstanding characteristic that focuses attention on a particular species of animal and thereby brings out many interesting facts about the creature. The extraordinary long tongue is not the only strange peculiarity about the kinkajou. His long prehensile tail serves not only as a fifth hand used for grasping and holding onto the branches of trees, like that of the South American monkeys, but is actually used to reach for things beyond the range of his hands and feet. Thus, fruit may be picked and carried to his mouth clasped in the prehensile tip of this remarkable tail.

Once in his native surroundings, the treetops, nothing can shake him down—not even a tornado can break the stranglehold of his four feet and his tail. Strangely enough this meek and mild creature really belongs in the Order of Carnivorous Mammals, but somewhere back in geological time his ancestors gave up the practice of slaughtering and turned to fruit for a livelihood.

The long tongue of the kinkajou is a special adaptation for the frugivorous diet. With it he can clean out the pulp of any fruit in a far more efficient manner than we can with a spoon. Some of the fruit-eating bats also have long, extendable tongues. Fruit, as we all know, is readily digested and passes quickly through the digestive tract.

The kinkajou is one of the gentlest and friendliest of all wild creatures. It shows little resentment when captured and soon becomes docile and easy to handle. Its token of affection is to wrap its tail securely around your neck, and the animal is extremely annoyed if any liberties are taken with this sensitive appendage.

The kinkajou spends its life in treetops and uses a hollow tree as a den in which to pass the daylight hours. Small parties or family groups attracted by ripening fruit will re-visit the same trees night after night while the crop lasts. They often retrieve fallen fruit from the ground and are somewhat quarrelsome over choice fruit, uttering squeaking noises, coupled more rarely with short barks.

Like most animals that live in tropical countries, the kinkajou does not have a fixed breeding season. A pair in the Milwaukee Zoo had two young in the latter part of September—apparently the only young ever born in captivity. Although the kinkajou reaches maturity in less than two years, this pair lived as mates under ideal conditions for nine years before the female gave birth to twins. As for the average span of life, a nine-year-old kinkajou should be well past his prime, but an old patriarch in the London Zoo lived nineteen years and at that grand old age was still in good health.

YOUR NEW BOOKS

HUDSON HIGHLANDS • HAWAIIAN INSECTS
PLANT GROWTH • CULTURE CHANGE

PLANT GROWTH

----- by L. Edwin Yocum

Jaques Cattell Press, \$3.00
203 pages, 25 figures, 16 plates

THIS useful book answers many of the questions that enter the minds of those amateur horticulturalists who refuse to accept blindly the dictatorial planting directions on seed packets, or whose interests extend beyond the mere production of a fine display of flowers, to the growth functions of plants and their relationships to their environments.

Professor Yocum, though he has necessarily culled much of his material from standard treatises, shows that he has kept constantly abreast of recent botanical research by the character of the collateral literature cited at the end of each chapter. Few of the matters discussed can be caviled at: Certainly the present scientific attitude toward the new insecticide DDT is much more cautious and reserved than is suggested by the mildly enthusiastic comments in the book (page 101). The much popularized thesis advanced by the author of *Plowman's Folly* remains discreetly undiscussed. One reads merely that "plowing and cultivation keep the soil loose . . ." (page 158), and "Hoeing and cultivating soil . . . appears to have no merit in a direct way, but . . . increases . . . absorption of rainfall, . . . aeration of the soil, destroys weeds, and probably increases the bacterial action in the soil." The moldboard plow, condemned by Mr. Faulkner, is not even mentioned.

Among the many items brought out in the book that attract notice, mention might be made of the continuity of life in moss and fern plants, their ability to continue developing and growing at one end while the old hind end dies and decays, making some of them possibly older than the oldest living trees (page 66). There is also a historical picture of the background of Gregor Mendel, the Austrian monk who discovered and partly interpreted the fundamental laws of inheritance. The chapters on hormones, weeds, rest periods of plants, and special considerations of plant growth (Chapter 24) make especially interesting reading.

Some of the line illustrations are the excellent work of Miss Antoinette K. Ketner; others are taken "by permission" from other works. The flatness of some of the half tones may be due to the quality of the paper. There is a glossary and an index.

G. H. H. TATE.

THE DYNAMICS OF CULTURE CHANGE

---- by Bronislaw Malinowski

Yale University Press, \$2.50

PROFESSOR MALINOWSKI, whose death in 1943 removed from anthropological ranks one of the most trenchant of thinkers, is widely known for a series of books based upon his field work in the Trobriand Islands. Many non-anthropological readers have read and enjoyed his *Argonauts of the Western Pacific*, *The Sexual Life of Savages*, and *Coral Gardens and Their Magic*.

In this posthumous volume, Miss Phyllis M. Kaberry, a former student of Malinowski's, has arranged from his notes and from his various published articles a coherent résumé of his characteristic ideas and opinions on the problem of culture change in the modern world. The text is based on the African scene, but its lessons extend far beyond that continent. The first part of the book, drawing heavily on Malinowski's published articles, presents a vigorous exposition of his views on the nature of culture contact, on the dynamic trends that arise from it, and on the proper methods of studying the phenomena. He shows little respect for the traditional approach—an attitude not unexpected in this protagonist of functionalism in anthropology—and urges the study of cultural phenomena as they exist without reference to the dubious reconstructions of dead and almost forgotten antecedents.

The second half of the book discusses the application of his suggested methods of study to specific problems such as diet, land tenure, warfare, and witchcraft. No one can help being impressed by Malinowski's vigorous argument and by his profound belief in the practicality of anthropological technique in solving the tangled and complicated consequences of intercultural relationships. Now more than ever we stand in need of such efforts as this to arrive at a workable means of assessing and guiding the results of the increasing interdependence of nations, races, and cultures. Miss Kaberry has rendered Malinowski and the general reader a great service in making her teacher's researches and thinking available in this cogent and accessible form.

HARRY L. SHAPIRO.

Continued on page 387

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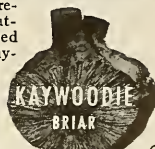
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THE COVER THIS MONTH

In describing the blossom of the Franklinia tree, we have the privilege of quoting portions of John Kieran's column, "One Small Voice," through the courtesy of The New York Sun:

"Fenley Hunter is the explorer who discovered the Nahanni Falls—about twice as high as Niagara Falls—away up in northwestern Canada, but that isn't why the Astronomer and I went out to trample over his lawn at Garden City, Long Island.

"It was a tree blooming on the Hunter lawn that was the lure for us. . . . Mr. Hunter showed us an old cannon that he had hidden in the shrubbery and trained along the line of approach to the tree. It was a short, squat, muzzle-loading antique atrocity that the explorer had picked up from a collection of old iron in Bruges, Belgium. . . . Mr. Hunter said he could stuff it with black powder and bolts and nuts and nails and paper wadding and set it off with a flaming torch if necessary.



DR. CLYDE FISHER, JOHN KIERAN, and FENLEY HUNTER examine the thriving Franklinia tree in Mr. Hunter's garden on Long Island

"If I do, probably it will kill everybody in the neighborhood, beginning with me," said the owner with an air of bland satisfaction.

"The truth about the tree that was in bloom on the Hunter lawn is one of those mysteries of botany in this country. Two

centuries ago the greatest botanist in the Colonies was John Bartram, and after him came his son William, who, just after the Revolution, traveled all over the Carolinas and Georgia and Florida on foot and horseback. . . . In 1791 William Bartram . . . described a flowering tree that he had found growing in a certain place in Georgia near the Altamaha River. He wrote in part:

"This very curious tree was first taken notice of ten or twelve years ago, at this place, when I attended my father (John Bartram) on a botanical excursion. . . . We never saw it grow in any other place, nor have I ever seen it growing wild in all my travels . . . which must be allowed a very singular and unaccountable circumstance; at this place there are two or three acres of ground where it grows plentifully."

Thus the famous Franklinia tree was discovered in 1765; and no one has seen it growing wild since 1790. William Bartram named it *Franklinia alatomaha* in honor of Benjamin Franklin. (Alatomaha is the old spelling of Altamaha.) Fortunately Bartram brought five or six slips back in his saddlebag and planted them in the famous Bartram gardens in Philadelphia. Descendants of those trees are still flourishing in nurseries and private gardens, like that of Fenley Hunter. On Long Island the Franklinia blooms in September, and flowers continue to unfold until frosty weather arrives.

The Astronomer mentioned above is Dr. Clyde Fisher, and we are indebted to him for the color photograph of the blossom.*—Ed.

* The "lost" Franklinia was discussed as one of America's rarest trees in the June 1940 issue of NATURAL HISTORY.

AN EXPEDITION TO AFRICA

In opening a new program of exploration and research with the cessation of war, the American Museum of Natural History makes known the plans for its first large-scale expedition abroad since 1941.

Mr. Arthur Vernay, Trustee of the Museum, who has sponsored numerous expeditions to remote parts of the world in the past 25 years, will lead the expedition in Nyasaland, South Africa, next April.

In discussing the undertaking, Mr. Vernay pointed out that, "During the war the Museum, like every other scientific institution of its kind, turned over to the forces and agencies prosecuting the war its vast store of knowledge and experience gained through expeditions in every part of the world. Thousands of photographs of obscure islands and coastlines; recordings of ocean depths and currents; climatic conditions; detailed maps on rivers and mountains, and information concerning native peoples, as well as on wildlife and living conditions were all put to the uses of our armed forces. With the beginning of peace we are going forward to help increase that knowledge through new expeditions and research.

Objectives of the Vernay-Nyasaland Expeditions are intensive collections of the mammal and plant life of the region. A district of particular interest is Mount Mlanje, in the wild and mountainous country south of Lake Nyasa. Southern Nyasaland is one of the few remaining parts of Africa offering pioneer opportunities in science. It is believed that valuable information on the relationships of the animals, plants, and climate will be disclosed by the collections and subsequent laboratory study.

Mr. Vernay will be accompanied by Dr. Harold E. Anthony, Chairman and Curator of the Department of Mammals; Mr. Leonard Brass, botanist; and Captain Guy Shortridge, Director of the Kaffrarian Museum of King William's Town, South Africa.

Mr. Brass is an experienced botanist who accompanied the Richard Archibold Expeditions to New Guinea, which in 1939 discovered the hidden "Shangri-La" Valley recently featured in the news. The material he collects will go to the New York Botanical Garden, which is co-operating in the project. Trained natives will assist the expedition in hunting and preparing the material.

The expedition will be in the field for five months, working during the dry season, from May to October of 1946.

Man and the Atom

As the explosions of the first atomic bombs recede into time and the rubble of destruction settles on the scarred landscape, the issues raised by man's use of atomic energy become clearer. The exultation, the joy, and the relief in our minds that we had at last the power and ability to destroy our enemy completely, should he refuse to cease the struggle, are replaced by a profound concern about a future exposed to the uses of atomic energy.

Now that we have it, what are we going to do with it? This question, of course, involves more than the temporary measure of keeping its secrets safe within our own councils, for it is clear that we cannot hope to remain the sole guardian of the scientific knowledge that has made the atomic bomb possible. The basic principles are common property, and it is only a matter of time before other nations will have learned the final steps that we have already mastered. Under such circumstances, it is useless to urge that the knowledge of the means of harnessing atomic energy be obliterated in order to protect ourselves or our successors from their own folly, even if we had the moral right to deny the vast possibilities for good that are inherent in such knowledge.

The consequences, moreover, of attempting to destroy the knowledge of atomic energy, and therefore to declare it by mutual agreement to be a *terra prohibita*, would eventually result in blocking the advance of physics along other and more innocent fronts. Science cannot progress, leaving behind it unknown areas set aside and marked dangerous. Mankind is too comfortably installed on a *de luxe* express named "Science." There are no stops.

It is perhaps salutary, as we contemplate the future, to view this discovery in the perspective of human development. In a very real sense the history of man is the story of an expanding use of energy outside the human organism. The discovery of atomic energy represents only the latest achievement in acquiring sources of energy and thereby devising means of harvesting natural re-

sources for our material and even spiritual welfare. Beginning with the use of fire, man has gradually and with quickening tempo tapped one source of energy after another. With each of these achievements, he has laid open vast areas for good as well as acquired the means of destruction. Fire itself, used by man for perhaps 500,000 years, still requires vigilance and control. Is it conceivable that men should abandon these present powers because of their latent evil? Should we give up our automobiles because they are used recklessly and unwisely by some, our radios because they are possible means of spreading pernicious propaganda, our airplanes because they may carry bombs? Who can predict what alleviations of human misery atomic energy may bring? And although we recognize the dangers, are these benefits to be rejected for fear of its misuse?

There are those who advocate that mankind should first learn moral restraint and social responsibility before being entrusted with undue power. But who shall judge when man will have reached that point in his development, and how may he achieve such virtues in the absence of the responsibilities that force him to acquire them? Moreover, it may be said that man has never been completely ready socially or morally for each new source of power that he has acquired. The apelike beings who first discovered the beneficent uses of fire were no better organized to control it than we who today have within our grasp the vastly greater quotient of energy locked in the atom.

Since, however, atomic energy is here and is likely to stay, it is the solemn obligation of scientists, particularly those concerned with human affairs, and of all men of vision, to work for a political and social organization of mankind that will, by making war impossible, permit us to employ our powers without disaster.

H. L. SHAPIRO,

Chairman and Curator,

Department of Anthropology,

The American Museum of Natural History.

Inside the ATOM

By WILLY LEY

The word the Greeks had for it meant "indivisible." Twenty centuries were necessary to show that the atom is divisible and that its energy is great enough to revolutionize peace as well as war

NOTHING in the whole history of human thought has ever received as wrong a name as the atom. Both the idea of its existence and its name originated in the world of Classic Greek philosophy. The word that is the root for our word "atom" is the Greek *atomos*, which means "indivisible." Even the man on the street now knows that nothing divides more spectacularly than the atom.

The weapon that helped to blast Japan out of the war with two enormous blows depends upon the explosion of these "indivisible" particles, which contain the most incredible amounts of energy.

Like all ideas, the concept of the atom as the ultimate particle of matter grew from small and simple be-

ginnings. The best way to understand what has been done during the last four years under extreme secrecy in American laboratories is to trace the growth of that idea. The "father" of the atom was a Greek natural philosopher, Democritus the Abderite, who was born in Abdera in Thrace in about 460 B.C. That he followed, in part, the teachings of one Leucippus who lived about half a century earlier should not detract from his glory.

Students at the time of Democritus were groping for an explanation of the basic differences between various substances. Democritus argued that all substances must consist of a number of fundamental pieces. Thus the idea arose that water was composed of particles that were very round and smooth (as we would say, like

small polished steel balls) and therefore easy to part, while the atoms of iron were rough and therefore difficult to part. Atoms of acid were supposed to be covered with little hooks which made them sharp and grasping.

These particles differed in shape and arrangement and possibly in magnitude and weight. Also they were capable of movement. But their chief peculiarity was that they were indivisible. Each was so small that it could not be reduced further; hence the word "atom."

All this sounded reasonable enough, and the idea of indivisible atoms retained its validity with but little change until half a century ago. People assumed that there had to be an





A.M.N.H. photographs

URANIUM ORE takes its own photograph without any illumination, by action of invisible rays. Yet only an infinitesimal quantity of pure metallic uranium could be extracted from this specimen of ore. The same piece is photographed in ordinary light at left

irreducible particle, and atoms filled the bill.

It should be remembered that Democritus' atoms were purely philosophical and not supported by any experimental evidence. They were as much the product of belief as of reasoning; therefore, nobody was obliged to accept their existence. Aristotle had no use for them, and while his biting criticism failed to kill the idea of atoms once and for all, the atomists did not rise to a dominant position in natural philosophy and remained but *one* philosophical school among many.

Throughout the Middle Ages the idea remained static. The alchemists did not like "unchangeable" atoms,

because their goal was the transmutation of metals, particularly the making of gold from baser elements. Some alchemists, to be sure, had idealistic goals such as the *aurum potabile*, or "drinkable gold," which was to cure all ills. But most of them were content to try for solid gold, stating euphemistically that they were looking for the Cure for the Great Illness of Poverty.

They had their own theories to go by. Chalk, for example, was thought to be the same as sulphur, except that chalk lacked "yellowness" and "combustibility." If you could impart "yellowness" and "combustibility" to chalk, you would have sulphur. Likewise, silver was the same as gold

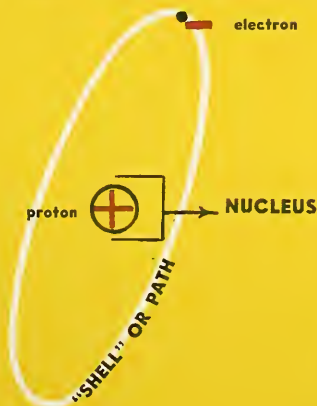
except for "yellowness" and "heaviness." Mercury, or quicksilver, only needed "solidity" to become silver, and this might be accomplished if you forced the "basilisk" (not the same as the "king of serpents" of medieval zoology, but a demonic concept) in the mercury, to part from it. If in addition, you could impart "yellowness," say from sulphur, you would have gold.

In the course of time, theories of alchemy disappeared to make room for other ideas which, although wrong in themselves, were much more effective because they led to more systematic experimentation.

Around the year 1800 the time was evidently ripe for the revival of the atoms of old. This was done by an English chemist, John Dalton, whose ideas had been directed into atomistic channels, curiously enough, through the avenue of weather observations. Seeing rain fall and disappear again,

WHAT IS AN ATOM?

1 A HYDROGEN ATOM has one proton (a positively charged particle) as a central mass, or nucleus. This is balanced by one electron (negatively charged) moving around it

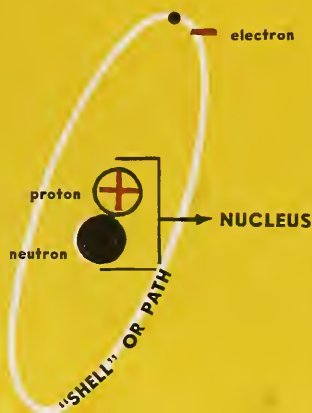


2 It takes 1840 electrons to equal the weight of one proton



The whole atom is so small that it is far beyond the range of the electron microscope

3 BESIDES ELECTRONS and protons there are also neutrons, particles that are neutral in the electric sense but have weight. If there is a neutron in the hydrogen nucleus, we have "heavy hydrogen," which forms "heavy water"



Dalton could think of no other explanation than that both water and air consisted of tiny separate particles; otherwise the evaporating water could not enter the air. Observations in the chemical laboratory helped this idea along. Hydrogen and oxygen combined to form water always in a given and rigid weight ratio, no matter how it was done.

After enough facts of this kind had been amassed, Dalton was able in 1808 to write the following:

"These observations have led to the conclusion which seems universally adopted, that all bodies of sensible magnitude, whether liquid or solid, are constituted of a vast number of extremely small particles, or atoms of matter, bound together by a force of attraction, which is more or less powerful according to circumstances. . . . Chemical analysis and synthesis go no farther than to the separation of particles one from another, and to their reunion. No new creation or destruction of matter is within the reach of chemical agency. We might as well attempt to introduce a new planet into the solar system, or to annihilate one already in existence, as to create or destroy a particle of hydrogen. All the changes we can introduce consist in separating particles that are in a state of cohesion or combination, and joining those that were previously at a distance."

Dalton's words became the basis of chemical thought for a full century, and still hold true for chemistry proper. He said, in brief, that all chemical elements consist of minute particles that cannot be subdivided further—in other words, atoms. These atoms could form an enormous number of combinations with one another. The smallest possible particle that represented such a combination then received a new name, molecule (meaning "small bundle") and the customary classroom explanation sounded like this: By mechanical means, as for example through evaporation, you can divide and subdivide a droplet of water until you arrive at a very small quantity, the water molecule, that can no longer be subdivided and still be water. If you take that molecule apart, you no longer have water but only the elements composing it—in this case, two atoms of hydrogen and one of oxygen.

It rapidly became clear that the atoms of the elements were not all of the same weight. The atom of hydrogen had to be lighter (and presumably

KINDS OF ATOMS

smaller) than that of carbon. The carbon atom, in turn, was lighter than the oxygen atom, and the oxygen atom lighter than that of silver. The weight of the atom did not, however, determine the weight of the substance. The atom of gold, for instance, is lighter than the atom of lead, though gold itself is heavier than an equal volume of lead. The atoms of gold happen to be more closely packed.

The relative atomic weight of hydrogen was arbitrarily called "1," and the carbon atom was found to be about 12, that of oxygen almost precisely 16, silver about 108, gold about 197, and lead about 207. These weights were only approximate, but the differences were small. And the English chemist Prout, as early as 1815, ventured the guess that these small differences might be merely mistakes and that all the elements were probably just combinations of various numbers of hydrogen atoms.

This sounded intriguing, especially since it recalled another guess of the alchemists, namely that there was a primary substance, a *prima materia*, of which all other substances were composed. But Prout's idea could not be proved, because the small "mistakes" were stubborn and persistent. Sometimes the figures underwent slight changes when improved methods were used, but they never became the even figures that Prout's guess demanded.

Later in the century, however, a different type of progress was made along similar lines. Two chemists set out, independently and at about the same time, to arrange the known elements in a logical order according to their atomic weights. They finally succeeded in doing this by leaving a few holes in their tabulations, holes which they hoped and predicted would be filled later by the discovery of additional elements. That was in 1869, and the names of the two men were Lothar Meyer and Dmitri Ivanovich Mendelyev. Both came to about the same conclusions, but Mendelyev's name became attached to this Periodic System of the Elements, mainly because he had made several very good predictions about the then unknown elements. One after another, the holes in the table were rapidly filled in, but one of the newcomers was so unusual that it looked for a moment as though the whole Periodic System would have to be thrown out on its account.

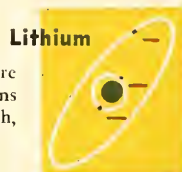
That newcomer was radium. The

THE ELEMENTS, such as gold, silver, oxygen, etc., have long been considered the basic substances that cannot be separated into different substances, only combined with each other to form compounds

Each element is made up of its characteristic atoms, which differ in the number and distribution of their electrically charged particles



THE HELIUM ATOM is almost as simple as the hydrogen atom. But it has two positive protons in the nucleus and two electrons to balance them. Its greater weight, however, shows that the nucleus has also two neutrons



LITHIUM has three protons in the nucleus (here shown simply as a solid body). The three electrons that balance them cannot all get on the inner path, or "shell." One of them is farther out



Beryllium

BERYLLIUM has two electrons on the inner path or "shell" and two on the outer one. To balance these four electrons, there must be four protons in the nucleus. The beryllium atom is therefore heavier than that of lithium and helium



BORON has five electrons on the two paths or "shells." These "shells" can accommodate a total of ten, and when they do, the atom is said to be "satisfied." The boron atom is not "satisfied" and therefore will readily combine with other elements



Carbon

CARBON has a total of six electrons (negative particles) in the two shells. They are balanced, of course, by six protons (positive) in the nucleus



Nitrogen

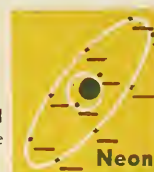


Oxygen



Fluorine

NITROGEN, oxygen, and fluorine have seven, eight, and nine electrons respectively. The same number of protons balance them in each case



NEON has all ten electrons that can be accommodated on the first two paths or "shells." It is therefore "satisfied" and is a chemically inert element

name itself, derived from the Latin *radius* ("ray"), described its main peculiarity. It was then found that other substances also gave off radiant energy. One of these was uranium, atomically the heaviest of all known elements and therefore number 92 in the table. It was named uranium in 1789, the year of its discovery, because the planet Uranus had become known some eight years earlier and Klaproth, the discoverer of uranium, meant to honor the astronomical discovery by transferring the name of the new planet to his new element.

A new science sprang into being at the beginning of the present century, the science of radioactive substances. John Dalton had not been able to explain evaporation without assuming that all matter consisted of tiny particles. Radioactivity now compelled its investigators to assume that the very heavy atoms at the upper end of the periodic table emitted still

smaller particles. It seemed that these very large atoms,—those of radium, actinium, uranium, etc.,—had grown too large to hold together very well. They decayed and in decaying gave off radiation, which is energy in the form of particles smaller than an atom, subatomic particles.

Sir William Ramsay, one of the investigators of the new mystery, could not refrain from writing a poem, which he titled "The Death Knell of the Atom":

*... So the atoms in turn, we now
clearly discern
Fly to bits with the utmost facility;
They wend on their way, and, in
splitting, display
An absolute lack of stability.*

Electrical research tied in with these discoveries of the instability of the heavy atoms. Physicists had arrived at the conclusion that electricity was discontinuous, that it had to con-

sist of particles of some kind. A flow of electricity was not like the steady beam from a searchlight, but rather like the stream of bullets from a machine gun. The smallest particles were called electrons, from the word the Greeks had for amber, the substance which when rubbed would pick up bits of paper.

These negatively charged particles (electrons) turned out to be one of the building stones of the atoms. It was a logical sequel that there must be particles having an opposite or positive electric charge, but although their manifestations had been discovered as early as 1886, they were not named until 1920. They were called protons, and it can be remembered that they are positive because both words begin with "p." It was found that these protons, while carrying a positive charge of the same amount as an electron, were much more massive. The best figure at pres-

URANIUM 238

URANIUM is a monster among atoms. It has a total of 92 electrons, distributed on seven "shells." In addition to an equal number of protons in the nucleus, it has 146 neutrons. 92 protons plus 146 neutrons equals 238 atomic units; therefore this atom is called Uranium-238.

Uranium also comes in a different form, called Uranium-235. This atom has only 143 neutrons instead of 146

THERE ARE 92
ELECTRONS DISTRIBUTED
IN THE SEVEN SHELLS

$$\begin{array}{r} 92 \text{ PROTONS} \\ + 146 \text{ NEUTRONS} \\ \hline = 238 \end{array}$$

ent says that one proton has the mass of 1840 electrons.

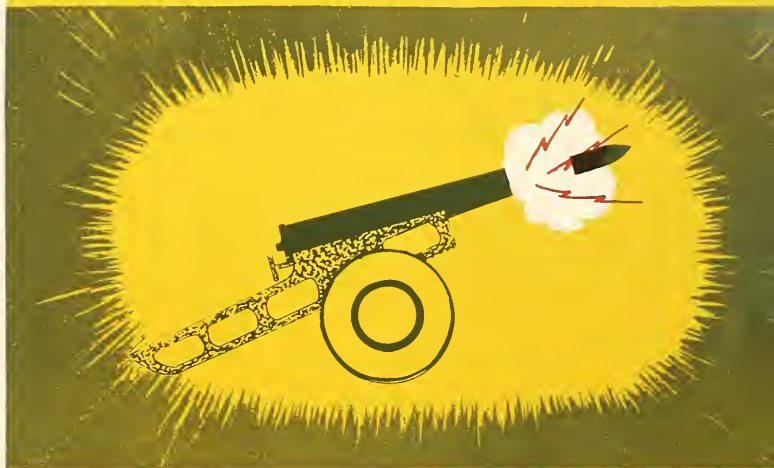
It was about that time that Niels Bohr evolved his famous theory of atomic structure. While there have been other attempts to describe the atom, Bohr's has best stood the test of time, and it is the only one that is easy to visualize. According to his theory, an atom can be compared to the solar system, in which the various planets move in curved paths around the sun. In the center is the main mass, the nucleus or heart of the atom, carrying one or more positive electric charges. Around the nucleus whirl planet electrons, as many as are required to counter-balance the positive charge of the nucleus. We might say that the atom is a positively charged mass surrounded by a veil of negative electricity.

Now the mass of one proton is just about the same as the mass of a hydrogen atom. Therefore it was reasoned that a hydrogen atom consisted of one proton in the nucleus, circled by a single tiny electron.

Hydrogen is element number 1 in the atomic table, with a weight of 1.008. Element number 2 is helium, with a weight of 4.003. But the nucleus of this atom, also called alpha particle, carries only two positive charges electrically balancing its two electrons. This would add up to only little over half the known atomic weight of the helium atom. Apparently there had to be a mass in the nucleus without any electric charge. It was at this point that a suggestion made by Lord Rutherford of Nelson in 1920 proved useful. Rutherford had suggested the existence of a sub-atomic particle called a neutron—in other words, a particle that was neutral in the electrical sense. It was said to have the same or about the same mass as a proton, but without any charge. The nucleus of helium, consequently, was understood to consist of two protons and two neutrons, with two electrons moving around it in a single orbit.

Element number 3, lithium, has an atomic weight of about 7; hence its nucleus contains three protons and four neutrons, with three relatively weightless electrons circling round it. Two of these electrons were the same in position and arrangement as those of helium, but the third electron moved in another orbit farther out. That second orbit, or "shell" as it is known technically, can take up to eight electrons; then it is full, or

THE BEHAVIOR of radio-active elements suggested how the atom might be smashed. A radio-active atom can be compared to a cannon. The bullet is the so-called alpha particle (or helium nucleus). The smoke is the beta "radiation." And the flash is the gamma radiation

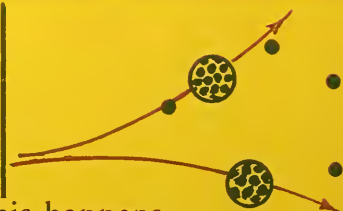


If a slow-moving neutron is shot at a Uranium-235 atom,



this happens:

THE ATOM breaks apart and forms two atoms (usually barium and krypton), releasing enormous energy and sending out four neutrons

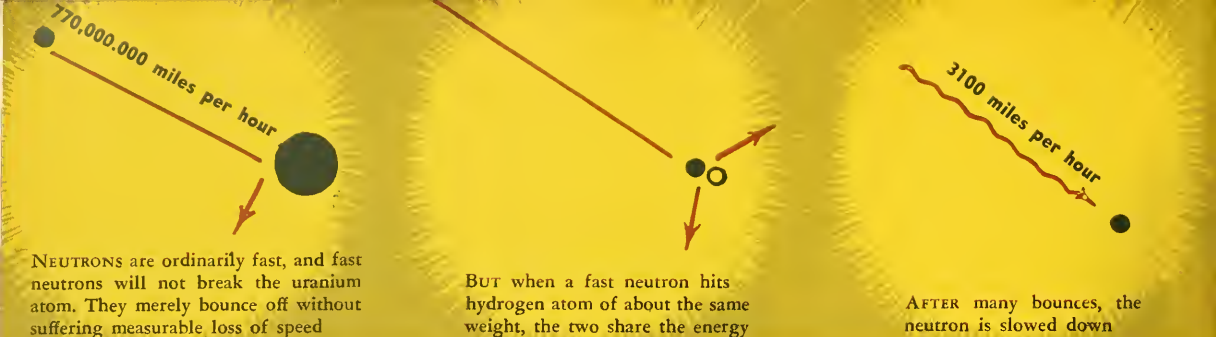


THE ENERGY released is 200 million electron volts



COMPARED with only 14 million
from normal radio-active elements





NEUTRONS are ordinarily fast, and fast neutrons will not break the uranium atom. They merely bounce off without suffering measurable loss of speed

BUT when a fast neutron hits hydrogen atom of about the same weight, the two share the energy

AFTER many bounces, the neutron is slowed down

"satisfied." This is the case with neon (element number 10), in which ten electrons balance a nucleus containing ten protons and ten neutrons, to give an atomic weight of about 20.

Element number 11, sodium, had one more electron still farther out, in a third shell. If the outer shell in any instance is full or satisfied, we have an element that shows no inclination to form any compounds, for instance helium, neon, and with more shells, argon, krypton, and xenon. But if the outer shell is not full, chemical activity results. Sodium atoms have one electron in the third shell, chlorine atoms have seven. These two elements combine very readily. But all these chemical combinations take place in the outer shells; they do not touch the nuclei. Hence atoms go into chemical compounds and out of them again without experiencing any change. If you want to change the atom itself, you have to attack the nucleus.

The attack on the nucleus, popularly called "atom smashing," became the big problem. Obviously, the only way in which one could attack the very small nucleus was to shoot at it with still smaller particles. The behavior of the radioactive elements themselves suggested what might be done. When a radioactive atom convulsed, it shot out an alpha particle (or helium nucleus) accompanied by two types of radiation, called beta and gamma rays. The beta "rays" were streams of electrons. The gamma rays were true radiation, comparable to the very hardest variety of X-rays.

To help us visualize this occurrence, there is a beautiful comparison. The emission of an alpha particle corresponds exactly to the firing of a gun. The heavy alpha particle is like the bullet. The beta "radiation" is the smoke, less substantial and lighter. And the burst of gamma radiation

is the flash, impressive but non-material. The same gun, needless to say, was fired back at the atom in the effort to break it.

All the machinery that received newspaper publicity from time to time—the van de Graaff generator and finally the cyclotron—were only atomic cannon. They were machines designed to fire subatomic particles, especially alpha particles, protons and deuterons, into atoms. Physicists learned a great deal while inventing, constructing, and using this machinery. The dreams of the alchemists were realized to some extent: some elements were actually changed into others. Atoms were hit and chipped; but the military significance of these experiments was not too impressive. Most of the time, the damage was only comparable to a hole put through the funnel of an enemy steamer. Only very rarely was an atom really broken up. Especially obstinate in the face of the bombardment were the heavy atoms, which one could assume might ultimately be the most satisfactory targets.

Then, in 1939 and 1940, the great problem was solved, at least in one particular case, the case that led in a straight line to the atomic bomb. The Italian physicist Enrico Fermi, later of Columbia University in New York, working with uranium, made an observation that could not even be explained at first. For a short time Fermi thought that he had discovered a new element. Other researchers took up the trail, and in view of the political events then brewing, the situation became critical, for they were German scientists—Drs. Hahn, Strassmann, and Lise Meitner. Dr. Meitner left Germany and aided the scientists of the United Nations.

They found that what had happened was an absolute novelty. A uranium atom had not simply had pieces chipped off by a subatomic

bullet: it had exploded like a torpedoed ship! The nucleus had broken into two pieces of approximately the same mass, sending out streams of energy on an unprecedented scale. Physical science even lacked a term for this performance and had to borrow the word "fission" (a cleaving, or breaking up into parts) from the biologists.

It was the first time that one of the really heavy atoms had yielded, and it had yielded not so much to brute force as to persuasion. Not a fast-moving alpha particle but a slow-moving neutron caused the fission of the uranium atom. But not every uranium atom responded.

It had already been learned that the established elements sometimes masqueraded in slightly different costumes. The so-called "heavy water" that was recently discovered is "heavy" because its hydrogen atom is one of these variant forms. Likewise, in addition to the usual helium 4, there is helium 3, with only one neutron instead of two; and there is lithium 6 as well as lithium 7. Chemically there is no difference, but the atoms have different weights. These variant forms of an element are called isotopes.

In the case of uranium, there were U-234, 235, 236, 237, and 238, the last being the most common type. U-236 and U-237 are not stable; U-234 is very rare; but U-235 is comparatively abundant, one out of every 140 uranium atoms being of this type. And U-235, with 143 neutrons instead of 146, goes into fission as soon as a slow neutron wanders in.

The explosion or collapse (either term applies, depending upon the point of view) is restricted to that one atom. The atom gives off four additional neutrons in the process of breaking up, but these are fast neutrons and therefore do not touch the nuclei of other atoms. It seems that

a fast neutron, when it runs into a heavy atom of any kind, mostly just bounces off without apparent loss in speed.

The two problems that arose as soon as these facts were known were: (a) how can one extract U-235 in large quantities from the customary mixture of U-238 and U-235, and (b) how can one slow down those four neutrons that are released so that they will in turn cause other

atoms to explode and produce what is called a chain reaction.

The problem of separating U-235 from regular uranium (U-238 plus U-235) was extremely tedious, as can be imagined from the size of the factories that had to be built to make the atomic bomb. There existed, in 1940, an instrument called the mass-spectrograph. It operated somewhat on the principle of a cream separator, the slightly heavier U-238 being

separated from the lighter U-235 by means of a magnetic field which affected them differently. But one single mass-spectrograph would have to be kept running 24 hours a day for about 12 million years to sort one pound of U-235 atoms from the necessary amount of purified metallic uranium.

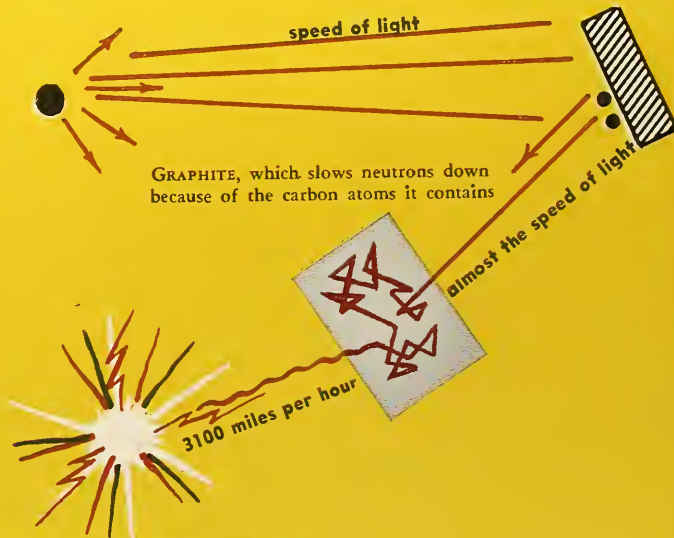
One way would have been to put 12 million machines to work and get a pound of U-235 in one year. To obtain a yearly production of 400



It can now enter the uranium nucleus without racing through, and the uranium gives off four more neutrons which, however, are all fast

THE FIRST experimental "trigger" for U-235 then looked like this

BERYLLIUM, which when hit by the rays, gives off fast neutrons



U-235, HIT BY SLOW NEUTRONS, EXPLODES

pounds, the amount the Hiroshima bomb may have contained, would require 4800 million machines.

Another possibility (and this was purely hypothetical in 1940) was to do something with U-238 to *convert* it, in some manner, into some other material. Irradiation of uranium with neutrons produced a new uranium isotope, U-239, which does not exist in Nature. This decays into a new substance, called neptunium because the planet Neptune is *beyond* Uranus in the solar system. This substance was not stable. It changed into still another new substance called, for similar reasons, plutonium.

Plutonium, it seems rather certain, is stable to a certain extent and fissionable like U-235. But a difference is hinted at in a cautious report prepared by Prof. Smyth of Princeton University at the request of the War Department. Apparently plutonium fissionizes like U-235 when its mass is small, but once the mass approaches what has been called the "critical size,"

it will go into atomic explosion. This characteristic suggested an application that could be used in military operations. If enough plutonium to produce an atomic explosion could be kept in separate pieces, so that each piece were well below the "critical mass," and then could be brought together rapidly, the whole would explode with tremendous violence.

Part of the answer to the second problem—how to produce a chain reaction—is no secret. A fast neutron will bounce off a heavy atom without measurable loss of speed. But if it runs into a light atom, like a hydrogen or carbon atom, which has little more mass than the neutron itself, the bounce is mutual, and the two bodies share the original speed of the neutron. This means that a neutron which has been bounced around in a dense swarm of light atoms for a time will have slowed down enough to set off additional uranium atoms. In practical terms it means that the U-235 should be surrounded by a

compound rich in hydrogen atoms, such as paraffin or simply water, or one rich in carbon atoms, such as graphite.

That should create a more or less fuel-like slow reaction, very useful for peaceful purposes, but not suitable for bombs. The method of setting off all the atoms at once remains one of the most closely guarded military secrets.

The bombs which helped to end the War prove that atomic energy can now be used at will. So far, we have only been able to explode the atoms of the rarer isotopes of uranium and its heavier derivatives. In appearance U-235 is a silvery metal, slightly softer than soft steel and about as heavy as gold. Gold has a specific gravity of 19.3, while that of uranium is 18.7. But having found the key to one element's nucleus, we'll probably find the keys to others' too. And the peacetime possibilities of atomic energy are even more boundless than its destructive power in war.



ONE POUND
of U-235 equals



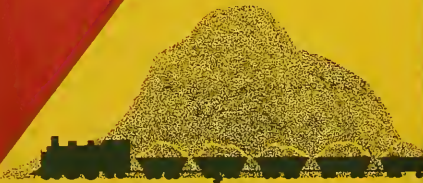
20 1-ton bombs of T.N.T.



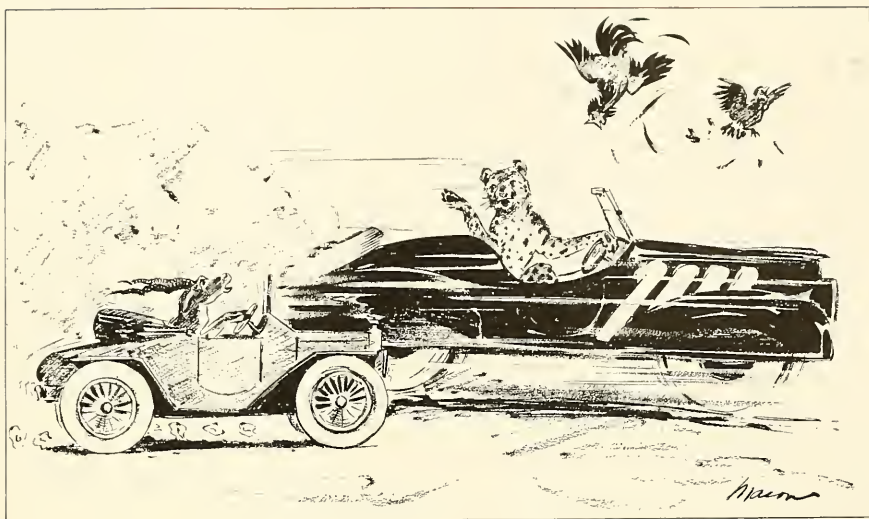
IN FUEL VALUE,
one pound of U-235



equals 5 million
pounds of coal



SPEEDY ANIMALS



By JOHN ERIC HILL

Drawing by

JOHN FREDERICK MASON

MANY animals owe their existence to their fleetness of foot. Grass eating creatures must flee from their carnivorous enemies, and the flesh-eaters often must run down their prey.

The speediest mammal is the cheetah. It has been known to run at a rate of 70 miles an hour for short distances. This strange, long-limbed cat commonly overtakes the swift black buck, one of the fastest of the antelope tribe, even with handicaps of as much as 200 yards. The other large cats—leopard, lion, and tiger—are also fast sprinters, but they cannot sustain the pace for long. Even the cheetah slows up considerably after about a quarter of a mile.

After the cheetah, the larger gazelles are runners-up. Dr. Roy Chapman Andrews once chased a herd of Mongolian goitered gazelles in front of his car while the speedometer registered 60 miles per hour. The American prong buck is almost or quite as fast as the gazelles, as clocked by automobile speedometers. Even in a race of 27 miles, prong bucks have been reported to average a speed of

36 miles an hour. Deer are not so speedy; they go through the woods at about 30 miles an hour but cannot keep this up for long.

Race horses rarely run the mile much faster than a speed of 35 m.p.h., but Man O' War once ran at 43 m.p.h for a quarter mile.

The cheetah and antelopes that exceed the horse in speed do not weigh nearly so much, and it is only fair to take the size of the racer into account. It is more extraordinary that a horse and rider can go a mile in about 1½ minutes than that a 100-pound gazelle can run a mile in a minute, because the energy required is much greater. Almost as fast as the race horse are the Asiatic wild asses, also timed by Dr. Andrews, which are reported to run at 40 m.p.h.

The fastest greyhound cannot quite keep up with the best horse, in spite of the great advantage of light weight. Their record rate is 36 m.p.h. This is as good as or better than the speed of any of the wild dogs. Probably the fastest of these is the African hunting dog, which runs down the swift antelopes of the veld. Coyotes, which have a reputation throughout their range for speed, rarely reach a rate faster than 30 m.p.h.; and although greater speeds are reported for foxes, the records are doubtful.

Running ability depends upon many factors: the length of limb-bones, the development of levers and pulleys in the limbs, the strength and contractability of muscles, and the nervous impulses that control the actions of the muscles. The champions and contenders for place are all built for speed, being long-limbed, slender and muscular. But some animals whose limbs are not proportioned for speed are nevertheless able to charge with surprising quickness. It is astonishing to see how rapidly some large, clumsy-looking animals can travel. A rhinoceros has been reported to chase an automobile at 35 m.p.h down a slight incline; and the wart hog, though short-legged and heavy-bodied, is able to run at 30 m.p.h. The African elephant has been timed with a stop watch at 24 m.p.h. for 120 yards, and it weighs four tons or more. The gangling giraffe gallops at some 32 m.p.h., and a charging bison has been reported to go at the same speed.

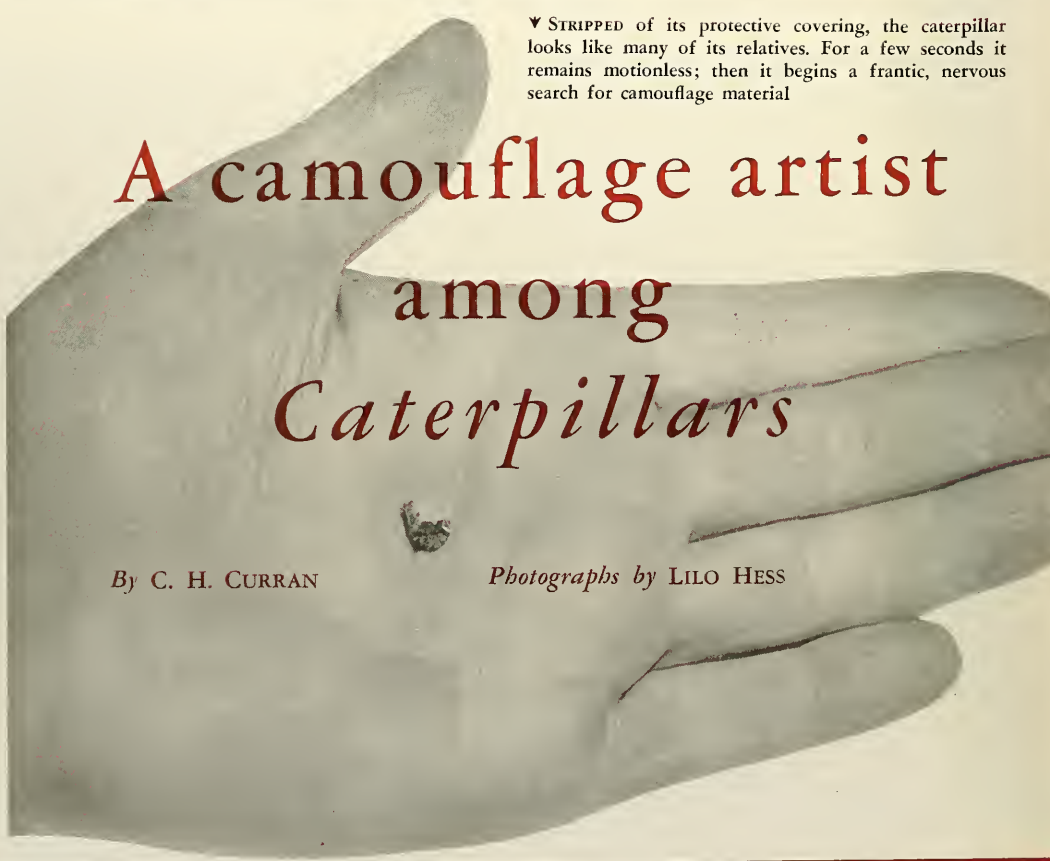
Human racers do not come out so well. The world record for the eighth mile (starting from rest) is a little over 22 m.p.h. But the sloth and the slow loris (a lemur) are really slow pokes. A sloth hurries at about a half mile per hour, while the natives say that a loris is likely to starve to death going from one food tree to another.

LONG before man began the study of camouflage as a protective measure, many insects had become masters of the art. Among the most proficient of these is *Synchlora aerata*, one of the measuring worms belonging to the family Geometridae.

This is a very common insect, but it is seldom seen in the caterpillar stage because of its habit of concealing its body beneath a shield of leaf fragments.

When it becomes a moth, however, it attracts much attention because, though small, it is beautifully colored in delicate green, with faint white lines crossing the wings. It may fly into view as you walk through the fields in the daytime and is frequently attracted to light at night.

▼ STRIPPED of its protective covering, the caterpillar looks like many of its relatives. For a few seconds it remains motionless; then it begins a frantic, nervous search for camouflage material



A camouflage artist among *Caterpillars*

By C. H. CURRAN

Photographs by LILO HESS



▲ WHEN THE CATERPILLAR becomes a pale green moth, it constructs no camouflage. Though small, the insect is then far from inconspicuous. Here it is shown on a marigold plant

a AS SOON AS the caterpillar finds a leaf of parsley, it begins to bite off leaf fragments and attach them to the spines and tubercles on its body by means of fibers of white silk. It begins this career of deception shortly after birth

b THE CATERPILLAR camouflages the hind part of the body first, alternating irregularly from one side to the other. It can twist its body at an unbelievably sharp angle, and thus is able to cover all but the narrow front end

C IN LESS THAN HALF AN HOUR, it has completed its task. It rests for a moment on the stem before crawling to the leaves, where it blends perfectly with their fringed edges



WHEN the caterpillar has completed its camouflage, it may feed on near-by leaves or seek a position among them, where it can sleep with little danger of discovery. Carrying its own concealment, it does not attempt, like most other caterpillars, to hide. Instead, it takes up a position in full view on the edge of a leaf or stem. So well does it fit into its surroundings that, even when one knows it is on the plant, it can be located only after a very careful search. It feeds upon a variety of plants, but perhaps the best place to find it is upon the Black-eyed Susan and common daisy. There it can frequently be observed feeding upon the petals, under a camouflage composed of pieces of them.

The caterpillar's readiness to change its food plant may provide amusement for the collector. Since the effectiveness of its camouflage depends upon the way it blends with a particular plant, the caterpillar can be induced to change its coat quite frequently. It will discard a bright yellow costume made from the Black-eyed Susan for a green one of parsley leaves, or an ensemble of some other color, if the food offered proves suitable. The change usually begins within an hour and may be completed within another half-hour. First the caterpillar bites the silken threads that hold its outmoded camouflage in place and drops them to the ground. Then, piece by piece, it attaches its new coat in position. Portions that in time become discolored or dried are replaced every day or two; otherwise they would not match the surroundings.

▼ WHEN IT IS FULL-GROWN the caterpillar makes a flimsy cocoon by fastening its camouflage to a stem. In this cocoon it changes to a pupa, which works its way out shortly before the moth is ready to emerge





b



c

▼ THE MOTH, with wings expanding from small saclike pads, clings to the pupal case. Liquid is pumped into the wings, and they quickly lengthen and broaden

✧ AFTER THE WINGS have reached full size, the moth must rest for several hours while they harden. The scales on the wings and body are fully colored. At this time the moth is quite helpless; but when dusk comes, it will fly away in search of nectar. This it obtains from a wide variety of plants, but daisies are a favorite source





THE WATERS BENEATH

Things are not always the way they appear to be on the surface
—and water is no exception. The location and conservation
of subsurface water is vital to the economy of innumerable
American homes, farms, and ranches

By WILLIAM H. CARR

A NUMBER of automobiles lined up waiting, bumper to bumper, on either side of a raging torrent that swept straight out of the gray-green desert. One of the cars had even been overturned some distance from the road. So suddenly had the rushing water descended that the vehicle had been literally washed into the desert before the driver could avoid the surging currents. Five minutes before, this spot on a main Arizona highway had been as dry as the neighboring wilderness of heat-bitten cactus that stretched to the

horizon and beyond. Now it was a raging flood. And yet, among the delayed and irritated travelers, it is probable that few, if any, were aware of the less spectacular but profoundly more serious danger of which the waters were a dramatic but incidental manifestation—a danger not to automobiles but to human welfare.

No dam had burst, and no underground river had suddenly risen to enjoy a rampage. It was a flash flood. In this arid country of Santa Cruz, such floods come whenever torrential rains deluge the desert and surrounding mountains. Owing to the ground's poor powers of absorption, the water,

with nothing to restrain it, simply rolls off as quickly as it falls. Tiny rivulets find larger streams, and soon, in some aged wash or arroyo, there is a full-fledged river coursing its way to the dry plains below. To the passing motorist, these sudden and unpredictable floods are a nuisance, and the destruction they cause is often considerable; but to the permanent resident, they are a feature of a land that is beset with a vastly greater problem—not of too much water but of too little.

In a land of wells and windmills, where all usable water must be pumped from unseen reservoirs far

◀ **ARID ARIZONA:** a land of scorching deserts, occasional downpours, and irrigated farmlands. Rainfall originating in rugged uplands like the Superstition Mountains, viewed here between two stately cacti, pours downward and recharges the underground reservoirs. Almost all water for field and home comes from wells

beneath the ground, nothing is of greater concern than the quantity of accessible ground water. If the level of this water falls below the reach of the deepest wells, the only available source of supply is lost. Such a land is this great Valley of Santa Cruz, which drains an area approximately as large as New Hampshire. Its ground-water level is dropping—slowly, almost imperceptibly, but surely. And it will continue to drop, so long as it is depleted faster than it can replenish itself. Samuel F. Turner, ground-water expert in charge of investigations in this area by the Ground-Water Division of the Geological Survey, reports that in 1944 more than 200 major wells were under observation, in which some 806 measurements of water level were made. He states that during the six years this office has been in operation the level of water in subterranean

▼ **FLASH FLOOD COMING!** Before many minutes have passed, various tributaries may add their supply to swell the tide and the entire landscape shown here may be under water. The rapidity of the run-off robs the land of much valuable well water



Photo by Reginald Russell

▲ **IT IS THE SUDDENNESS** of desert downpours that causes accidents like this. Dry riverbeds become raging torrents, bridges are washed out, and treacherous areas of quicksand develop. The waters not long before completely covered this car and were flowing at a rate of about 30 miles an hour

Photos by U. S. Geological Survey unless otherwise credited



storage basins has dropped from 10 to 20 feet in certain regions. In 1944 the pumpage of water in Arizona's Santa Cruz Valley alone was three and one-half times greater than the estimated safe annual yield and double that of 1940.

To a certain extent, this dropping of ground-water levels has been reported from other sections of the United States, including large areas of California, Ohio, Louisiana, and Georgia, and parts of Texas and Florida, especially in the vicinity of Miami and the Everglades. These conditions, while not regarded as immediately alarming, have nevertheless caused much concern. Turner states that the decline in his area is constant and that some remedy must be found to prevent overuse by both commercial and domestic exploiters who have continued to drill wells in increasing depths and numbers as the years go by. The principal usage involves huge quantities of water brought up from deep within the ground and employed in the artificial irrigation of thousands of acres of cultivated land where the farmers are almost entirely dependent upon



▲ WATERS RISE so quickly that highways are often overrun, forcing motorists to wait for the waters to recede. In the center of this flood a bus is stalled behind a passenger car

ground water for the success of their growing operations.

In the early days of European exploration, there was a great deal more water in the Santa Cruz Valley than there is today. When the Pioneer Missionary, Father Kino, commenced the establishment of religious institutions in this same "Rio de Santa Cruz" region in 1691, he stated that water lay on the surface of the ground in sufficient quantity to be entirely adequate for the Indian population, in striking contrast to the drought conditions of today. Where powder-dry desert now prevails, tall grasses, high enough to reach the head of a horseman, once flourished in rich profusion on the soil-covered bottom lands. Now there are wells more than 800 feet deep. The introduction of electric pumps and the resultant day and night pumping of water have helped to draw off the invisible supply at an unprecedented rate. Beaver, once reported abundant in certain streams, would now perish for lack of water. In fact, the disappearance of water from the surface of the land has actually changed the character of the valley as a whole. Where the river once flowed steadily, there now exists only a dry bed throughout the greater part of the year.

The story of the replenishment of water in subsurface as well as surface regions is, in effect, the basic story of life in the entire mountainous-desert area. Winter snows and summer cloudbursts are the backlog of any refilling of the ground-water reservoir, but by no means all of the

precipitation reaches the underground storage chambers. Evaporation under the hot sun, transpiration through the leaves of plants, and other factors prevent a large percentage from ever percolating downward to raise the so-called water table below. Consequently, replacement cannot hope to keep pace with excessive usage, and the result is that the entire area may one day become a wind-driven, sandy desert similar, in many respects, to that of the Dust Bowl.

The comment, "thirsty desert," has frequently been made, apparently to indicate that the dry sands and gravels eagerly absorb each drop of moisture as it falls. Nothing, however, could be further from the truth in the Santa Cruz Valley. Quite to the contrary, the desert surface is seemingly impervious in many sections, though of course not in all. The author and a companion once laboriously dug a hole about the size of a ten-gallon pail in the floor of the desert near Tucson, using pickaxe and shovel. The hole was then filled to the brim with water, and we sat down to observe patiently how the "thirsty desert" drank its fill. To our surprise, it required three hours for the water to disappear, and one observer facetiously remarked that the blazing sun seemed to take more through evaporation than did the earth through absorption! Indeed, it seemed as if the level would never drop, whereas if the water had been poured on ground covered with humus, it would have disappeared very quickly.

So it is that much of the water deposited by heavy cloudbursts, unable easily to permeate the desert floor in this region, simply runs off in sudden and destructive flash floods. Turner has discovered that some streams build up clay or siltlike bottoms that are practically impervious to water; it is as though one had covered the land with a thin layer of cement. The surface material dries and cracks under the sun, and when the next flood comes roaring along, it rushes over the ground, with practically no water seeping through. Of course, a prolonged scouring by water may remove the silt and create a permeable surface once again.

When one considers that the water table is at least 50 feet beneath the surface and in some places as much as 300, one realizes how long it may take individual droplets of water to find their tortuous way through minute interstices in the hard surface to the concentrations of water far below. Often the journey is fraught with difficulties that would seem insurmountable, but as long as solid rock does not block the passage, the water that is not otherwise lost somehow contrives to find its way there, particularly through the sand and gravel beds of streams.

A popular misconception is that ground water lies in enormous underground lakes. This is rarely the case. In reality, concentrations of ground water are invisible "rivers," flowing in the same general direction as the slope of the ground and moving often imperceptibly. It has been stated that bodies of underground water may move as slowly as a foot a month or less, depending upon the porosity of the material through which they must pass. Deep and shallow wells alike reach down to tap the water stored in small spaces in rocks, gravels, and other formations. When one digs a well, in almost any area, underground water is seldom encountered directly. It infiltrates or seeps into the opening that has been made and is then pumped off. However, when the level of the water table eventually drops below the bottom of the well, it becomes necessary to excavate to a greater depth, and knowing how slow the process of replenishment is, one pauses to wonder what will eventually happen when the table drops too far in the years to come.

This is the question that is becoming increasingly serious every year in the Santa Cruz Valley. It is true

that water is seldom appreciated while the wells are still full, but it is hoped that conservation steps may be taken before they go completely dry. A natural resource as essential as water should certainly be protected at all costs. The building of many small dams in tributary washes or gulches is by no means the solution to the problem of encouraging water to "stay put." While this might benefit

► **IRRIGATION CANAL.** Millions of gallons of water, pumped from far beneath the surface, are the "lifeblood" of farms and ranches in Arizona. Snow-capped mountains like those in the background replenish the wells that feed irrigation ditches like this one. If the water is pumped faster than it is replenished, dust-bowl conditions can blight the land

► **IN FLOOD:** a desert gulch normally dry. Many a farmer and rancher wishes that more of this water would sink through the well-nigh impervious ground, for all their wells depend upon it. Time-worn channels like this one are dangerous to cross because of quicksand

▼ **MUCH OF THE WATER** that does not flow off evaporates into the desert air, so impervious is the ground





▲ HERE the water from the Santa Cruz River flooded areas of agricultural land. When it evaporated, the silt it had deposited coated the ground with a hard surface that further impeded seepage to the underground reservoirs

certain upstream areas, it could easily deprive communities farther downstream of what little they had before.

The Ground-Water Division of the Geological Survey does its best to inform the public concerning the condition of the water supply, but warnings and up-to-date information only too often fall upon deaf ears. Turner keeps the newspapers supplied with information at their request and issues frequent bulletins. In one instance, he visited a region to hear a speaker discuss county water supply problems, only to find himself called upon. He discovered that the local paper had published an article that day minimizing the seriousness of the ground-water situation, and he did his best to present an adequate picture of the true conditions. The newspaper editor was present and, realizing that a falling water table was of far greater consequence to his community than he had thought, afterwards wrote an editorial retracting the statements of the previous day.

Desert flora, such as cacti and the palo verde and mesquite trees, can

survive by storing away small quantities of transitory water near the surface. But many other plants in the region, such as tamarisk and cottonwood trees, are dependent upon the deeper ground water for survival and must tap it with their root systems. These roots often extend downward for many yards and are known to grow longer as the water level retreats. If the water table is lowered too far, however, many of these trees and other plants are unable to carry on. Various birds and animals, lacking the food and shelter of these plants, then also perish. Although many of the huge cottonwood trees that line watercourses or former watercourses in Santa Cruz Valley often appear to live without visible means of support when surface water is nonexistent, they are nevertheless dependent upon the unseen sources that lie far beneath the surface. This fact should be recognized by ranchers who frequently wonder why the trees die but fail to take into consideration deep wells near-by that are constantly being drained through pumping.

It is obvious that the geologic formation of subsurface material will govern, to a large extent, the amount of ground water to be found in a given area. If the spaces between the rocks are large, there will naturally be greater room for water. The underground storage basins, which receive the water that seeps through from above, vary from huge caverns of limestone to imperceptible spaces, actually so small that a microscope is needed to see them. In some regions the water can flow readily from one area to another, while in others underlying formations of solid rock produce isolated pockets of water. It is well known that sedimentary deposits, containing gravel and rounded or angular rocks of varying size, are particularly favorable for storage, because of the relative ease with which the water can percolate through them.

So concerned is our Federal Government with the entire story of underground water, regardless of its source, that the Department of the Interior, through the Ground-Water Division of the Geological Survey, maintains staffs of experts in 38 states and Hawaii. These overworked staffs are charged with many respon-

sibilities, including, among other things, the estimation of available quantities of water, their sources, fluctuations, and directions of movement, and many other equally important projects, all of which are of inestimable value in the ultimate conservation of ground-water resources. Their work, particularly in determining the location and amount of the hidden supply, is appreciated by many of our states, which often contribute an amount of money equal to that supplied by the Federal Government to enable field stations to operate. Often the technicians issue statistics upon which is based corrective legislation to govern the use of water.

A typical field office of the Ground-Water Division is the one located in Tucson, Arizona, which is entrusted with obtaining information about the presence and availability of water in that climatically diversified region of desert and mountain. Here is situated the great Valley of Santa Cruz, where climatic conditions range from arid at an elevation of 1000 feet to humid at 9000 feet, and where the

Continued on page 387



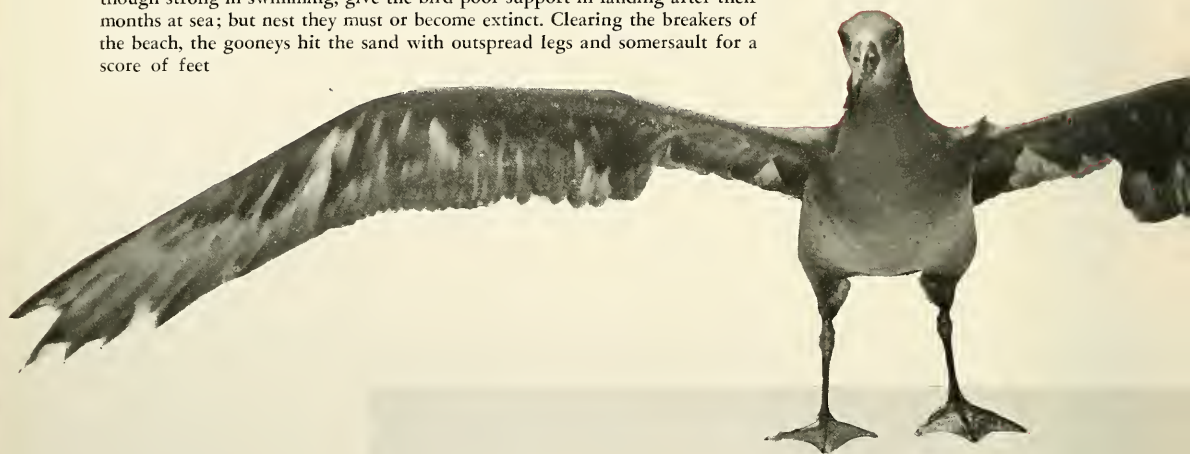
▲ SAND STORM blowing in from the desert. Lack of sufficient vegetation favors storms of this type, which benefit neither man nor beast and sometimes cause considerable damage

▼ STORM CLOUDS over Arizona's Tanque Verde Mountains. These summer storms, often torrential in character, provide the principle recharge for ground water supplies. It is for man to guard carefully the level of his wells, for historical records indicate that there was once much more water in the region



The BLACK

➤ MANY OF THESE TREMENDOUS BIRDS with 7-foot wing spread have not seen land for many weeks when they glide in to nest on islands northwest of Hawaii. Some have been as far north as the Aleutians, others have spent their time off the coast of Lower California, or within sight of Japan. Their legs, though strong in swimming, give the bird poor support in landing after their months at sea; but nest they must or become extinct. Clearing the breakers of the beach, the gooneys hit the sand with outspread legs and somersault for a score of feet



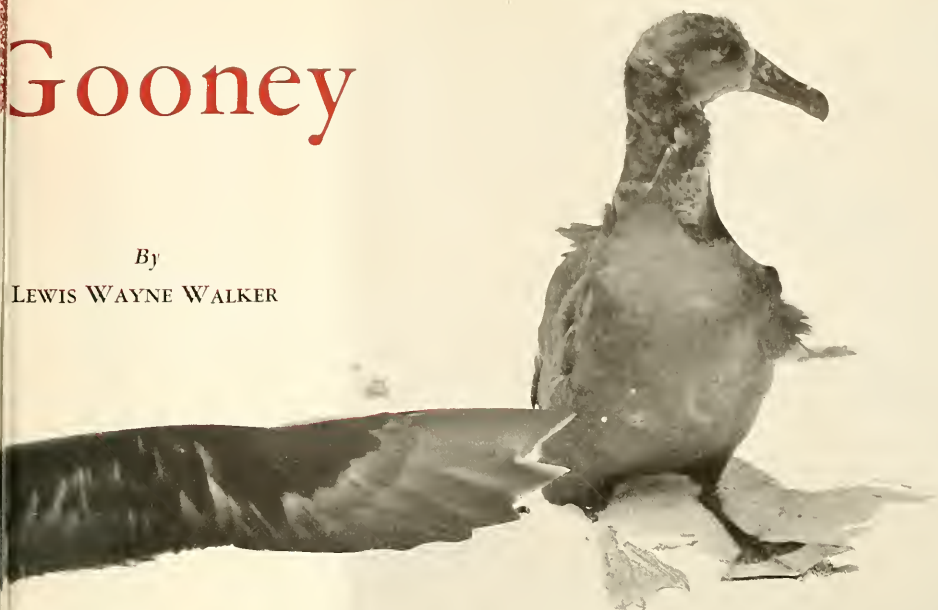
➤ A COLONY of black-footed gooneys, or albatross, with a few Laysans. In selecting a nesting site, one bird of a pair will carefully scoop out a hollow in the sand and, with actions that would put many a real estate agent to shame, attempt to convince its mate that this is the "spot of spots." The other bird may have found a location that is "just as good." Condescendingly each walks over and views the other's choice. Morning will find a five-inch egg in one of these holes, and this will be the final determining factor



Gooney

By

LEWIS WAYNE WALKER



► A YOUNG BLACK GOONEY which has never been to sea. Yet when it goes, it will return unerringly to the islands where it was born

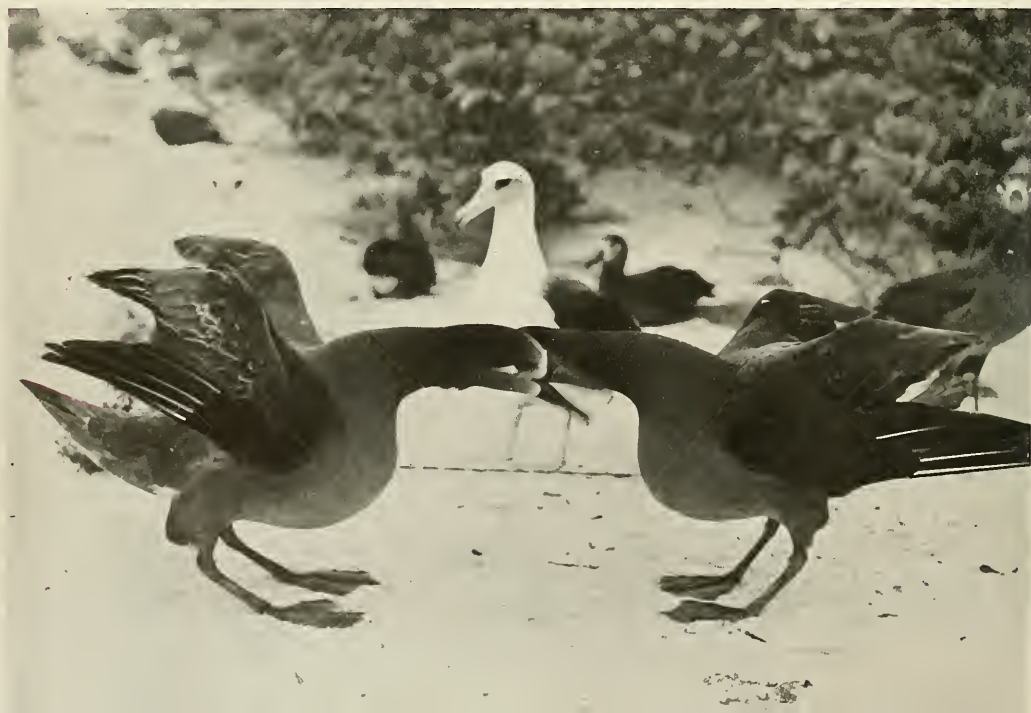


► AN ADULT GOONEY: the bird that has entertained thousands of our servicemen on remote islands of the Pacific. They remain on land for about nine months of the year, beginning in November



"SHALL WE DANCE?" Black gooneys, like the famed Laysan albatross, have an entertaining dance routine. Here two of the birds address each other with dignity. But since the black gooneys lack the pleasant disposition of their

white cousins, a slight misstep on the part of either partner may convert formality into chaos, and viciously snapping bills will end the act, as shown below



MEET JOE GOONEY

CLOWN

OF THE ISLAND CIRCUIT

By EDWIN D. NEFF

IF you know a serviceman in the Pacific—afloat or ashore—it's a hundred-to-one he's been writing you about his new friends, the gooney birds.

Gooney birds were press-agented long ago by Samuel Taylor Coleridge in "The Rime of the Ancient Mariner," as the albatross. Today these wonderful birds are making amateur ornithologists out of half a million Americans who are seeing them for the first time. Most of these youths and their commanding officers had never given a half-hour's thought to any bird before.

When the gooney appears behind a ship to wait for food, seamen, petty officers, ensigns, and even four-stripers give quiet little lectures to newcomers to the Pacific, and on the nesting islands, even the mighty seabees hop down from their roaring bulldozers to rescue infant gooneys in their path. There is a tacit understanding on gooney-inhabited islands that anyone "unduly molesting" the birds has earned a stiff sock in the jaw—for gooneys have laid enough golden laughs to be worth their weight in comic strips. The name "gooney" itself comes from "gony," meaning a dunce or simpleton.

Nonchalant, poker-faced, and wholly lovable, gooney birds walk with a hay-foot, straw-foot waddle that is better than anything Charlie Chaplin ever did before a camera, and their attempts to land on a calm day are reminiscent of burlesque's immortal "sliding" Billie Watson at his best.

Ornithologists recognize nineteen species and subspecies of albatrosses and have found them throughout most of the oceans, except the North Atlantic. Yet, no matter what role has been assigned to these birds by science, it is G. I. Joe who has discovered that the gooney bird is one-third comic, one-third "straight man," and one-third human.

The gooney's talent for clowning comes into play the instant he lands. He is just not built for shore duty. His scrawny legs are set far aft and wide apart, while his weight, like a hefty dowager's, is forward. His feet are big and webbed, protruding like the shoes of a circus clown; and when he walks he bumps and bounces worse than a flat-wheeled ox-cart.

Yet when he stands still, or sits on the nest, the gooney is as handsome as a square-rigger, his big, snowy chest billowing like a mainsail in a 40-knot wind. He is of about the same general architecture as a goose, but his yellow beak is longer and it is tipped with a hooked point. His eyes are shiny black, and in the case of the Laysan albatross, the feathers beneath them are shaded a delicate gray. The stately Wandering albatross is believed to have a greater wingspread than any other bird—11½ feet—but 6 or 7 feet is about the average for the Laysan albatross and the black-footed gooney. When you approach one of these birds, he will bow politely, then back away. Except for a few incidents some years ago, when Japanese feather hunters slaughtered the albatross on one of the Hawaiian nesting islands, the birds have been unmolested for thousands of years, and are nervous, rather than afraid, in the presence of people. Move a few feet away, and they forget you.

Despite their awkwardness ashore, the gooneys spend only a little better than three months a year at sea. There

is evidence that they fly heroic distances; banded birds have been discovered 6000 miles away from their starting point. They depend upon the sea for both food and drink. When mating time arrives in late October or early November, the males return to the nesting islands following some little-understood instinct, and a few weeks later their girl-friends flutter in.

On the nesting islands, now occupied by servicemen, the returning gooneys are as welcome as a U.S.O. show. Uniforms gather on the beaches, and there is a laugh for every landing. The size of an albatross's wings doesn't permit them to move with the lightning flutter of a small bird's in landing. The gooney does best against a strong wind. When he tries to land in a calm, he comes in too fast, hits the beach with a sickening plop, and skids along the sand on his chest. Then he staggers to his feet, looks around as if to say, "Who pushed me," and waddles off self-consciously. No matter how many years of landings are allotted to a bird, he can never fully master the calm landing. When the wind is strong, he will float down as gracefully as a paratrooper, landing almost on his toes. But a dead calm is disastrous.

Take-offs too are a problem when there is no wind. Gooneys never perch on rooftops, trees, or telephone wires. Like airplanes, they need a fast take-off against the wind. On some of the gooney islands, Uncle Sam has built magnificent runways, which the gooney birds use freely. Yet even on a runway, the gooney's technique is nothing for a pilot to emulate. He holds his wings slightly aloft, umbrella-fashion, and when he starts to run, his webbed feet pound the runway like the brogans of a Keystone cop. He sprints up to about 20 miles per hour and takes off. Once in the air the burlesque ends, and the gooney becomes as graceful and elegant as a ballerina.

Long known but seldom seen until now, these curious birds are winning the affection of thousands of G.I.'s in the Pacific and are providing as much amusement as half a dozen comedy acts put together

One of his favorite maneuvers is to slip down an airstream to within a few feet of the earth, then bank suddenly, lowering one wing tip to a fraction of an inch from disaster. Somehow, they never miss. Any human pilot who tried it—and lived—would be grounded for life.

Pilots feel a natural friendliness for gooney birds. Seeing them for the first time, they stand around laughing and pointing like kids on a Sunday School picnic at the zoo. Usually the spectators are satisfied with a free show, and wander off after a few painful attempts to pet the birds or pick them up. But sometimes a departing airman will try to kidnap a gooney. The gooney's hooked beak is as swift and accurate as a striking snake. Struggling birds have been rescued literally from the cockpit by their friends—and it's just as well, for gooneys never have been known to survive captivity.

Besides their comic gait and fouled-up landings, the gooneys have a number of tricks that endear them to servicemen. Easily the most spectacular is their dance. Since both males and females look alike, it is impossible to tell whether this weird performance is a love dance or just a game. Probably the latter, since the dancing goes on after the mating period. The invitation to the dance is a gracious bow, combined with clacking of beaks. The bowing soon becomes frantic, involving the whole body, which rises and dips like the prow of a canoe. Suddenly one of the birds breaks off this rhythmic bobbing and ducks its bill beneath a quickly raised wing. From time to time the dancing birds snap their beaks toward the sky and give out a long, calflike "mo-o-o-o-o-o-o." *Vis-a-vis* again, they shake their heads with a fury that ought to addle their brains.

The whole ceremony is punctuated with shrieks and screams, alternated with the sharp, castanet sounds of the powerful beaks. This beak is about six inches long, solidly built and well-muscled. It can snap with the speed of a terrier's jaws and clamp down like a bulldog. At sea, the beak snares the food, which consists largely of squids; and it is a useful weapon at all times.

G. I. Joe discovers this when the gooneys are nesting. Both male and female alternate at this duty, sitting three- or four-day watches for nine weeks. Off the nest the bird is wary of human advances, but when he—or she

—is covering an egg, the bird will not budge, except to rise, from time to time, to look down and under at the egg, and to "chirp" reassuringly to the infant within. Anyone trying to move a gooney from the nest is asking for a fight. The bird arches its neck like a coiling snake, its eyes bright and fearless. It knows the sensitive parts of the human anatomy, and will show only mild interest in a heavily-shod foot. But a bare hand, however tenderly advanced, brings a swift and painful jab. The hooked point always draws blood. But it cannot tear off a finger, as newcomers to the nesting islands are sometimes told.

Yet even on the nest some gooneys can be tamed. The nest is haphazardly built of sand scooped up a beakful at a time and distributed more or less evenly around the egg. Sometimes leaves, ribbons, or bits of trash are added. Often one of a pair of nesting birds will take pride in repairing the nest, while the other, doubtless the male, is archly indifferent. Most birds will accept human assistance, and a few are even grateful. On one island, a half-dozen birds built their nests on the leeward side of the Navy Post Office. Came a heavy rain, and the sand washed away, leaving the birds to shiver in little puddles of water. One of the mail clerks, touched by their plight, brought dry sand in a wheelbarrow and built magnificent new nests. The birds were plainly grateful and seldom snapped at their benefactor. They even seemed more temperate toward strangers.

On the other hand, one gooney, who established herself at the door of the officers' club, became deeply cynical toward men. Both junior and senior officers startled her at night with rollicking affection. Following a New Year's party, they forced her into a jeep, and on a sharp turn the outraged bird was thrown out, bumping her nose on the concrete. After that, the mere sight of braid would infuriate her—though she refused to move herself or nest.

Sometimes there is tragedy. Planes and trucks inevitably collide with some of the birds, and telephone wires are new to their experience. First aid is rarely of any use. Although the birds know a score of love calls and ecstatic shrillings for their dance, there seems to be no cry for pain. A bird with a shattered wing makes no protest. Like all wild things, it waits for death alone—silent and unafraid.



BEFORE the present Pacific war, the dance of the white gooney, or Laysan albatross, was known to the general public solely through motion pictures taken by a few explorers. Now, however, thousands of servicemen have seen the birds.

Many of these islands were not discovered until about the middle of the last century. Some early navigators were drawn to their shores by the abundance of bird life on the surrounding ocean. Others found the islands unintentionally at night when their ships crashed against treacherous reefs. For many years, Laysan was the only island of the chain stretching northwestward from the Hawaiians to be utilized commercially. This island had an accumulation of guano, many feet thick, and packing of this fertilizer was carried on until the early 1900's.

The bird life of the island was protected by the guano workers, and although the eggs were used for food, the birds fared well until their pro-

HITE Gooney



By LEWIS WAYNE WALKER

The introduction of rabbits upset the balance of nature on Laysan Island—this together with the coming of feather poachers nearly exterminated the gooneys. Conservation steps taken in 1923 have enabled the birds to hold their own

◀ THE DANCE of the white-footed gooney, or Laysan albatross. The elaborate routine seems to have no sexual significance. Sometimes three or four birds engage in it, and sometimes a gooney will start the dance if a person holds his arm in a position resembling the neck and head of a bird

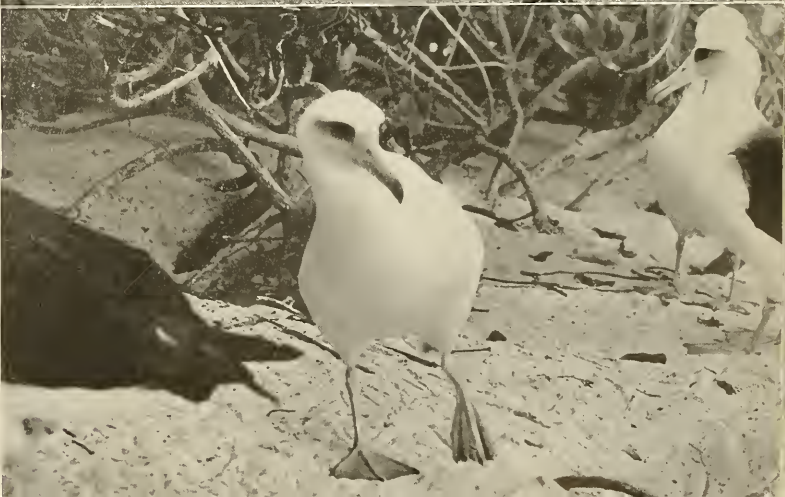
▼ A SOCIABLE GROUP, less held down with the responsibilities of parenthood than a few weeks before. Below: The gooney walk

tectors departed. Rabbits, left by the guano workers, then increased by proverbial leaps and bounds and rapidly depleted the island's limited vegetation. Sand, no longer held in place, shifted back and forth with the wind and covered eggs as rapidly as they were laid. As though to hasten the desolation, feather poachers landed and set up camp. With short clubs they killed thousands of trusting birds that had never known a land enemy.

In 1923 a group of scientists landed and, to halt the deterioration, completely eradicated the rabbits, which had by then reached a point of starvation. Seeds of grasses were sown and cuttings of suitable sand-binding foliage were planted, to make the island once more a livable haven for its original bird owners.

Two years ago I flew over this dot in the broad Pacific in the company of the botanist of the 1923 expedition. Where once there had been the white glare of shifting, powdered coral, there now came up to us the

THE WHITE GOONEY





green tinge of vegetation. The labor of 20 years ago had been productive. Birds by the thousand were skimming over the grove and gathering their aquatic food from the turquoise shallows surrounding the island.

Hundreds of miles farther on we glided down and were surrounded with birds. Some single birds were incubating eggs; others were shading newly hatched young in depressions in the sand. The gooneys were apparently holding their own, and with wise conservation they will continue to do so. I was glad to have a camera with me with which to take these photographs.

◀ THE AWKWARD AGE: one of the young birds shedding its down

▼ A LAYSAN albatross sheltering its chick





King of the Bears

By BEN EAST

IN more than twenty years of hunting wildlife with a camera, in the woodlands and along the waters of America from the Great Lakes to the Aleutian Islands, I have encountered a great many interesting bird and animal personalities. But of them all, the most outstanding is the giant brown bear of Alaska, king of his clan and overlord of the flesh-eating animals left on earth today.

The brownie is generally accepted as the world's biggest bear and biggest land carnivore. Whether he can actually claim that distinction is open to some debate, however. More than one arctic explorer believes that the great white bear of the ice fields outranks him in both weight and length.

Authentic weight records for either animal are not too common, considering how many have fallen to the guns

of sportsmen, collectors, and travelers in the last century and a half.

Not many big bears are killed under circumstances that make accurate weighing possible. The top recorded weight for the brownie seems to be 1656 pounds (cited by Seton from Ward's *Records of Big Game*). The same authority lists a 1600-pound polar bear killed in Hudson Strait more than a hundred years ago as the largest of that species ever put on scales. Stefansson likewise accepts 1600 pounds as the maximum weight for a white bear, but adds the personal belief that it is probably the largest of all bears.

Many guides and experienced hunters in Alaska believe the brown bear actually grows as large as 1800 pounds. Whether that opinion has a reasonable foundation or is only wild

*BEN EAST is well known to the readers of *NATURAL HISTORY Magazine* through his articles on conservation and the North. In 1931 he directed and accompanied as photographer the first winter flight to Isle Royale in Lake Superior, now a National Park. He was the photographer on a trip made to James Bay and Hudson Bay in 1937 for the University of Michigan and the Cranbrook Institute

of Science. In 1941, as photographer and collaborator of the U. S. Fish and Wildlife Service, he cruised through the Aleutians to make natural-color motion pictures of the Alaskan sea-otter. In the same year he filmed the complete story of the Pribilof Island fur seal herd. He is the Outdoor Editor of the *Grand Rapids (Michigan) Press* and has contributed to numerous popular magazines.—Ed.

guesswork is not easy to say. By the same token, men who have taken really big polar bears insist that the animals would have gone to 1700 or 1800 pounds if weighed in one chunk before being bled. Whether they are right, again, is hard to decide.

I can offer only this much firsthand evidence: Our party killed a white bear on Grey Goose Island at the north end of James Bay in 1937 that measured 10 feet, 6 inches from tip to tip and 52 inches in girth around the neck before skinning. We could only guess at his weight, but Jack Palmquist, skipper of the trading schooner "Venture" on which we traveled that summer, believed he was not lighter than 1700 pounds. Probably that estimate was high. All the same, the green pelt, with feet and skull skinned out and every ounce of fat scraped away by Cree Indian women, weighed 125 pounds on the scales at the Hudson's Bay Company's post at Fort George two days later.

It is interesting to compare the measurements of that bear with those given by Seton for the Alaskan brownie. He lists a bear taken on the Alaska Peninsula in 1918 by Robert H. Rockwell of the Brooklyn Museum as 10 feet, 6 inches long with neck girth of 41 inches skinned, and adds "This is very near a record in size." Obviously our polar bear was as big if not bigger.

Whether the king of the arctic ice or the king of the Alaskan rock slides reaches greater size is of no major importance. Both are magnificent bears, by a wide margin the greatest big-game animals the western hemisphere has to offer and ranking well up among the dangerous game of the world.

To me it seems that the Alaskan brownie has a trifle the more colorful personality of the two, but maybe that's only because I've had a little more to do with him and know him better. Likely the ice bear would on further acquaintance prove every bit as whimsical and unpredictable and hair-raising.

The white bear—Nanook to the Eskimos, and Wabesco to the Hudson Bay Crees—is a bear of the sea, the brown a bear of the land. And I must admit I have met the two of them only on land, where Wabesco was out of his element. Were I to know him in the arctic ice or along the open leads where ice and sea meet, it is likely I would revise my estimate of his character completely.

One of the most unforgettable summers I ever had was spent in the brown bear country on Kodiak and Afognak Islands and along the bleak and barren Alaska Peninsula, just before the war.

We didn't have much luck that June and July along the salmon streams of Afognak, or in the devil's-club and salmonberry thickets of Kodiak. We found plenty of bear signs; we followed bear trails along the creeks that were worn as deep and smooth as sheep paths, and we



blundered into bear beds in the tall rye grass without knowing they were there. But luck and weather turned against us time after time, and we moved on to the Peninsula finally without making one good contact.

There we found more brownies in one day than I had expected to see in the entire summer. Our record was fifteen between noon and dusk, an even dozen of them within camera range.

The rock slides, the high walled canyons, and snow patches just below the permanent snow fields of a 6000-foot mountain out there on the Alaska Peninsula make up a desolate and almost lifeless landscape. Yet it is in that landscape, high on the windswept slopes where neither grass nor creeping shrubs are able to defy the endless cold and bitter storms, that the great king bear makes his home.

The brownie has magnificent, breath-taking scenery in his front yard. Brown hills streaked with snow drop away on all sides from his lofty retreat. Farther down, near the sea, he can look out over rolling green meadows laced with the silver threads of tiny, snow-fed creeks. Here and there belts of darker green mark alder thickets beside the larger streams. And in the farther distance lies the steel-gray sea. He is seldom out of sight of it. He is the ruler of a vast, high domain, remote and forbidding. He owns the roof of the world and in its windy canyons and on its cinder-paved plateaus man is a puny intruder, uneasy and out of place.

Of all the bears we met in that empty, giant land, I remember best five that we spotted all at the same time one afternoon, while we were following the rim of a rock slide that

fell 500 feet, steeper than the pitch of an average roof, down into a sunless canyon where a wild creek of ice water from the snow fields brawled and roared.

I was with Frank Beals, an Alaskan game warden, and Jack Benson, a wildlife agent of the game commission from Kodiak. Beals and I were toting cameras. Benson had the rifle—and the ability to use it if the need arose.

We stopped at the rim of the slide to look out over the lower end of the canyon where it spilled into a meadow a couple of miles away. We could trace the silver line of the creek all the way to the place where it lost itself in the alders of the meadow. And along its banks, half a mile from us, we saw something move, something which at that distance didn't look much bigger than an overgrown brown marmot.

Benson laid his glasses on it and let out a low grunt of surprise. "Bears," he said sharply. "Four of 'em!"

I put the motion picture camera down and had a look with my own glasses. The brown object we had seen was a big sow, a rich cinnamon in color. She was following the creek upstream at a steady walk, apparently on the lookout for stray salmon. Tagging after her, romping on her heels, were three cubs. They looked almost black, but even at that distance I could make out the pale, cream-yellow collars that are the hallmark of the young brownie. We guessed their weight at 30 to 40 pounds apiece. We watched them for a couple of minutes. They were a lively trio if ever I saw one, full of mischief and devilment.

Beals took a step nearer the rim of the slide for a better look. He happened to glance straight down the slope and there, 500 feet below him, was the fifth bear. It was lying down on a little mossy bench almost at the lip of the canyon, and we assumed it to be a solitary boar. It was big and much darker than the distant female and we guessed its weight at better than 1000 pounds. We found no reason to revise the guess on closer acquaintance.

By that time Benson had the stalk all planned in his mind. "We'll go down to the drop-off of the canyon," he said. "That will bring us 40 or 50 feet above the creek. The wind is drawing upstream with the bears. That sow and her three cubs will work right under us if we're careful.

I'll put you where you can pitch pebbles down on her back."

I was dubious. "What about Old Lonesome down there?" I demanded.

"We'll have to dodge him," Benson admitted.

It seemed improbable to me that we could descend the rock slide without alarming all of the bears. The slope was steep enough to make the climb actually dangerous, and inevitably we would loosen a hundred small avalanches on the way down. But Benson and Beals discounted that. No noise we might make, they argued, would reach the bears above the roar of the stream in the canyon.

We started, hitching and sliding, and at each step boulders rolled loose under us and clattered down, jarring others into motion as they went. We could see them bounce over the lip of the canyon far below us in a steady, noisy stream.

We covered 400 feet in 15 or 20 minutes. It would have taken the better part of an hour to climb back up again. At that point Benson called a halt while he did enough scouting to relocate the bears. It wouldn't do, he remarked, to get between the sow and the boar and thus have a brownie on either side of us in such a place. One of the first rules of brown bear hunting, especially when you're carrying a movie camera and looking for no trouble, is not to surprise the bear. The very first is never to let the bear surprise you.

Benson edged up to the top of a low ridge that shut off our view of the creek. He looked over and cringed back all in one motion. It was plain he had made contact at close range. Beals and I clambered across to him, and when I came into the clear on the crest of the ridge I was standing less than 100 feet from the biggest bear I saw that summer.

He had left his bed down by the canyon and started to feed up the steep mountainside, following a shallow, mossy ravine. He had his back turned to us but there was something surlly and evil-tempered in the way he stood and in his lumbering, deliberate movements.

Benson and Beals went down flat on their faces to make sure the way was clear for the camera. I braced the tripod among the rocks and spun the lens into focus. The initial whine of the shutter reached the bear and whipped him around. There was nothing clumsy in the way he moved now.

He saw one man and only one,

crouched on the ridge 30 yards from him, and decided instantly he didn't have to tolerate trespass of that kind. He stood for three or four seconds, huge head swinging, jaw sagging sullenly, snarling deep in his chest. Then Benson decided the bluff had gone far enough. He got swiftly to his feet beside the camera. Beals followed him and suddenly there were three men where there had been but one. It was too much for the bear. He lost his nerve, pivoted away, and put space behind him as if he knew all about the menace of the .30-06 that was backing the camera.

That left us free to look for the sow and her three cubs. It didn't take long to locate them. We crossed the ravine and started down the last hundred feet of slide, Benson leading. He stiffened suddenly and held up a hand in mute warning. I came up beside him, knowing the bears were dangerously near, but for the life of me I could see nothing of them. I searched the slope on both sides and as much of the canyon as I could see. The mountain was empty of bears. Then Benson pointed straight down the slide below us. What I saw was hard to believe.

The she-bear was sitting on her haunches on a mossy hummock just below, with her back to us. She was so incredibly close I had completely overlooked her in my survey of the landscape. I could have flipped my hat down on her from where I stood,



or so it seemed. She had climbed up from the creek and selected this tiny bench on the mountainside for a special purpose. She was lolling there in complete comfort, suckling the three cubs.

I moved as soft-footed as a cat while I set and leveled the movie camera. When it was focused and ready I glanced at the scale on the 6-inch lens. The bears were exactly 25 yards away!

Out of the tail of my eye I saw Benson slip off the safety on the rifle. He was standing with his feet braced wide apart, easy and cool, but I knew he was expecting trouble. Twenty-five yards is too close to come to a female brownie with cubs.

I had the bear's broad, golden-brown back centered in the view

finder and was feeling for the shutter with a forefinger when the trouble started. Obviously there was not room at the supper table for the three youngsters at one time. The one who was shut out was restless. He came scrambling suddenly around his mother, hunting mischief. He heard some small noise above him, looked up, and saw the three of us looming there about ten good bear jumps away.

I do not know to this day whether he gave the alarm vocally or by action, but he certainly gave it. The sow lumbered to her feet, staring up at us and covering the cubs with her huge body like an angry old hen. The seconds lagged on while she snarled and raged, and I waited for her to start and for Benson's rifle to smash out its flat report. I was certain there was no way to miss trouble now.

But I was wrong. It was the cubs that saved the day, whether on their own or under orders we could not tell. They broke suddenly out from the shelter of the she-bear and scampered off across the slide at top speed, with rocks as big as themselves rolling and clattering under them as they ran. The female threw one last rasping snarl up at us, and then she turned and galloped after them. She pushed them hard but stayed between them and us; and every few yards, until they dropped down into the canyon and out of sight, she would wheel about and warn us back with a full-throated roar of anger.

It was an hour later, shortly before dusk, that we saw the last of that brownie family. The old bear had led the cubs through the canyon and up the mountain on the opposite side. We spotted them a mile or more away, high on the snow field above us. The sow was leading now, and the youngsters were climbing slowly and reluctantly. We watched through the glasses. She walked ahead of them a few yards up the steep slope, turned, and waited patiently until they overtook her. Then she went on once more. Gray cloud masses lay on the mountain, and two or three times the bear family went out of sight for minutes in a patch of cloud. When we saw them last they were almost at the crest, plodding wearily up. All the mischief and play was gone out of them now.

In some remote valley over the sky line late that evening, we hoped, she gave those tired little imps a chance to finish the supper we had interrupted back there on the rock slide.

Australia's Living Legend of the "Lizard Man"

The ageless stories of the aborigines continue to exist in the strange and spectacular grandeur of the Australian desert—a curious mixture of fantasy and fact that preserves a fabulous past and keeps alive the customs and traditions by which these people live.

By CHARLES P. MOUNTFORD

All photographs by the author

ALL races have stories of their creation and that of the country in which they live. They are as varied as the people themselves and indicate, especially among the simpler cultures, their conception of the universe and their relationship to it.

Among sophisticated folk, like ourselves, such legends, unless linked with religious beliefs, have long since degenerated into old wives' tales or fairy stories that are still partly believed by the peasant folk. Many a native of Ireland has no doubt of the existence of the kindly little leprechaun with his pot of gold, or the banshee that wails at night over the peat bogs. And the graveyard at midnight still holds its terrors, even in this country.

The myths of ancient Greece, which were transmitted orally for centuries before Homer immortalized them in the magnificent literature of his country, were an attempt by those people to explain the topography and the natural phenomena about them. In their time, these stories formed the basis of the beliefs of the Greeks, but those days have gone forever.

Among the Australian aborigines, however, legendary stories are living in all their fullness. They are not fairy tales designed to amuse but are expressions of vital beliefs that not

only explain the origin of the natural features of the countryside but also lay down the laws of good living that one and all must follow.

The aboriginal legends explain that before life came, the world was a huge level plain, that extended away to the horizon as far as the eye could see, its surface unbroken by a hill, watercourse, or even a tree.

At some unspecified time, corresponding to our creation period, giant semi-human creatures rose out of the ground and started to wander over the countryside. They appear to have resembled various animals and birds although they thought and acted like human beings. They met, fraternized, and quarreled, and even in their travels performed the same humdrum tasks as the aborigines of the present day. But whatever they did, there is always some natural feature that today marks the place. Thus, a water hole was once the spot where a kangaroo-man camped; a concave boulder near by, the dish left behind by a woman; and a curious outcrop of rock, her body as she looked out over the plain. Every hill, every watercourse, every unusual tree, and even the large star clusters, are visible evidence, to the aborigines, of the exploits and actions of those giants of the long-distant past.

One legend that attracted me was the story of a lizard-man, Nintaka (now a large reptile that lives in the Central Australian deserts), who, while he was the guest of some smaller lizards, the Ninjuri, stole from them a much-valued grinding stone.

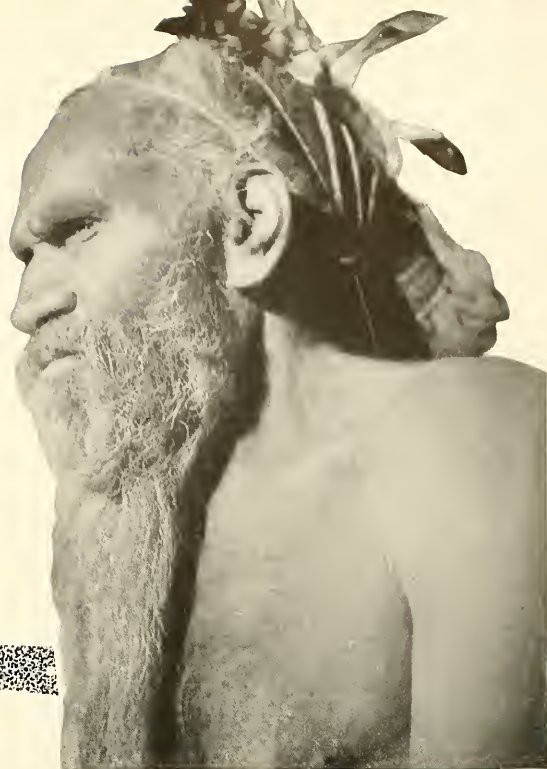
Away back in "dreaming" (creation) times, so old man Tjalarina explained, Nintaka the lizard-man paid a visit to the Ninjuri. According to the rules of that tribe, Nintaka was not allowed to live in the main camp. Every day food was brought to him: meat that had been caught by the men, and grass seed cake, gathered and ground by the women.

Nintaka noticed that the flour from which the grass seed cakes were made was not coarse like that in his own country, and much more palatable. When he made inquiries, he learned that the tribe owned an especially fine-grained stone which the women used to make the grass seed flour.

When Nintaka thought of the labor of his own women and the poor results they obtained with their rough grinding stones, he decided to steal the one belonging to his hosts and take it back home so that both he and everyone else would have cakes as good as those he was now eating.

And so, one morning, he pretended that he could not go hunting because a splinter of wood in his foot had made him lame. His hosts expressed their regrets, gave him some food, and went on their way. As soon as the

➤ TJALARINA, part-owner of the land on which a famous mythical character, Nintaka the Lizard-man, died. This native was the author's chief informant regarding the legend of the Lizard-man



▼ AUSTRALIAN NATIVES have a legendary explanation for almost every natural feature of their wilderness homeland. This hollowed boulder on a hillside is the carrying dish of Malili, a woman of creation times who camped too near a sacred cave and was chased by the owners. In her flight she dropped the dish

▲ MALILI WAS KILLED as she looked out over the plain. This is her body, now a block of stone. The upper boulder is her head, the next her trunk, and the lower one her legs



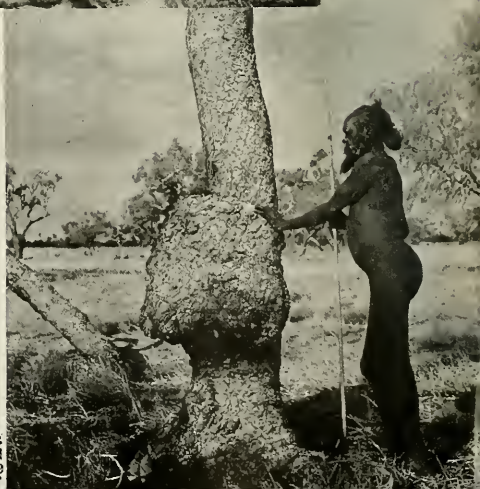


◀ THE PARENTIE LIZARD embodies the leading character in the legend of Nintaka, which is illustrated by the following pictures. The reptile is somewhat feared because its razor-sharp claws are capable of inflicting deep and dangerous wounds. But the flesh is good to eat, and one Parentie provided the small party of whites with enough meat for at least two days



▲ HAVING STOLEN a grinding stone from some smaller neighbors, the Lizard-man fled and halted here, at Wankarinya in the Mann Range of Central Australia, to see if his enemies were following. The left-hand rock is the stolen grinding stone, and the egg-shaped one at the base is the head ring on which the stone was carried

► THE BLOODWOOD TREE with a stomach-ache: a landmark at Tjitabidi in the Mann Range, Central Australia. This tree grew at the spot where Nintaka, the lizard, ate so many mistletoe berries that he suffered severe pains in his stomach



women had left, Nintaka went to their camp, picked up the grinding stone and made off, hiding his tracks as best he could.

The tribe, naturally angry both over the loss of their much-valued stone and the breach of good manners, set off in pursuit of the thief. Many and varied were the adventures of Nintaka, the lizard, as he dodged his pursuers. Finally, after a journey of over 400 miles, he lost all sight of them and started to relax his vigilance. On the eastern end of the Mann Range of Central Australia, he climbed to the top of a hill so that he could look out over the plain and make sure that his enemies were not following.

Today, there is a spectacular outcrop of rocks at this place. The upper

one on which the native is sitting is the lizard, with his head raised, looking for his pursuers. The one immediately below is the stolen grinding stone; and the egg-shaped boulder is the head ring on which the stone is carried.

As no one was in sight, the lizard, Nintaka, meandered along the range trying out his ill-gotten treasure. At one place, he ground so much grass seed that it is now transformed into cliffs many feet in height. At another, he ate so many mistletoe berries that he developed violent pains in his stomach. Today, a bloodwood tree grows in this place with a large bole at the base, representing the stomach-ache of the lizard Nintaka of so long ago.

But the end of Nintaka was the

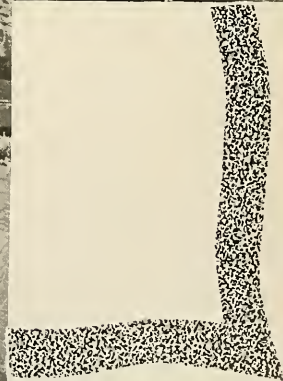
end of all evil-doers, both in story and legend. His enemies, who, unbeknown to the lizard, had taken another track, killed him while he was asleep in his camp on the hillside.

The body of the thieving Nintaka is now a long column of stone lying on the hillside; the stolen grinding stone, broken in many pieces, a pile of boulders lying at the foot of the hill; and the irate pursuers, the Ninjuri, dwarf desert trees growing near by.

This legend is only one of many that are all explained in the surrounding topography: the women of the Pleiades, who are always trying to escape from the unwelcome attention of the men of Orion; the giant, highly-colored serpent that lives in the water holes; and how the little lizards and birds got their markings.

► THE DEAD BODY OF NINTAKA, the lizard. The long column of rock, a geological curiosity, represents the slain lizard. The boulders at the foot of the hill are the stolen grinding stone (broken in many pieces by the irate owners), and the dwarf desert trees, the avenging enemies of Nintaka

▼ A CLOSE-UP VIEW of Nintaka's body. Notice that the aborigine does not even allow his spear to touch the "dead body." The natives believe that to touch the stone would cause the spirit of the dead lizard to emerge and make them ill



Do your friends ask to see your most recent photographs? Not if you have to rummage through a secretary drawer full of prints, sort them, and then sit down to explain each one in boring detail, citing all of the incidents that each particular shot brings to your mind. But they will beg to see those same prints, if you are able to hand them a slim, little booklet that tells a complete story in words and pictures about your vacation, your children's adventures at the shore, the set of tree pictures you have just begun, or how your victory garden grew.

Then they can sit by themselves in comfort and set their own pace for musing over each picture and reading the running commentary accompanying it. After the booklet has been absorbed from cover to cover, your friends are quite apt to comment, "Say, this is wonderful! Do you have any more?"

We always feel superior when we know that our pictures have made a hit. The way to ensure that feeling is to spend a few evenings creating a small album for each set of prints. The necessary materials are neither numerous nor costly—just some "cover stock" paper, a jar of cement, the prints, and a sprinkling of imagination. These story albums do not have to be pretentious. They have charm even when ten or twelve pages are used in a booklet. In the beginning we should strive for simplicity, a single print on each page. To enliven the pictures, we add a few concise comments that complete the story. After we have made a few booklets, we see our one-time messy batch of prints materializing into coherent groupings.

The first step is to dump out onto the dining room table or the living room floor all the prints that are to be sorted. Boxes will help to keep the different groups separate. When there is doubt as to where a particular print belongs, put it in the broader category—a seagull picture made while vacationing on Cape Cod should go into the bird box unless it actually added something to the story about the Cape. When the preliminary sorting is finished, pick out a box of prints that you know to be fairly complete. This will become your initial project in story-album making.

The next step is to clear away everything except the all-important collection of prints. Lay these out on the table and check the negatives to be certain that no pertinent ones were unprinted. If the group is complete, arrange them so that you have a closely knit, coherent unit. This does not necessarily mean that they should be kept in chronological order. When you can compose an interesting running commentary about the pictures in a particular arrangement, number the prints accordingly.

As a working example, we might take the snapshots that were made during the children's visit at the zoo. Several exposures may have been made of the same subject in the attempt to obtain a "well-posed" picture. If, after the prints are arranged on the table, we find two similar camel pictures, the tendency may be to select the better print and discard the other. But wait; can't we use both prints? By placing them on facing pages and adding a bit of conversation, we would

MAKE YOUR TELL A



*"Mr. Camel, won't you
bend over so I can look
at you better?"*

add to the interest of the story: "Mr. Camel, won't you bend over so I can look at you better?" and "My, what a big fuzzy nose you have!" Start the booklet on a note like this, and you will have "reader interest" immediately. Scatter the single pictures between the sets and retain that interest. If the story ends on a high note like the pony ride, your friends will want more (and so will the children).

Now we are ready to consider the construction of the booklet. The paper can be purchased from a paper supply house, art supply store, or from a large stationer. The "cover stock," which is a heavy weight paper, may be procured with either a smooth or a dull surface. It is often used to cover mimeographed or printed reports. Or you might buy some of the paper used for pastel chalks, which is obtainable in many soft colors. This paper can be used for the entire booklet, or, if you prefer, use a lighter

paper for the inside pages. Cut sheets of paper double the size of the page dimension and fold, producing four working pages. If possible, choose a size that will do for all the books, so that they may be stored neatly in the bookcase.

Place the prints in the proper sequence on the pages which have been arranged in book form, but not bound. If a pair of photographs that should face each other on a spread are separated, then the prints should be re-juggled. If the picture progression is continuous, as for a tree series, you might put all the pines or maples together; or in the case of a seashore series, you might start at high tide showing the plants and animals to be found along with the flotsam, and then work down to low tide and its denizens. When the final page location has been decided for each print note the print numbers on the pages and mark the corner locations for mounting. Leave plenty of room at the bottom of the page

SNAPSHOTS STORY

By THANE L. BIERWERT

Acting Chief, Division of Photography,
American Museum of Natural History



"My, what a big fuzzy
nose you have!"

for the text of the story. We are now ready to mount the prints.

Open up the booklet and spread out the pages with their respective prints. Of course, dry mounting tissue, applied with a hot iron, is the best material for mounting the prints, but most of us will be happy with synthetic rubber cement, which can be procured at most art stores. Small prints need only a thin smear of adhesive along the edges, because no great strain will be exerted when the booklet is handled. Mount the prints on one side of an open sheet at a time. Place the double spread under pressure to keep the prints as flat as possible. In the same rotation, mount prints on the reverse side, weight them down, and let them dry.

When the last picture is in place and the booklet made up, you may be surprised at how good the book looks. At this point we are ready for binding. One method is to staple the pages into the

cover. Most desk staplers will not span the distance to the center of the booklet, so open the book to the middle pages and face it down on an old magazine. Square up the edges of the pages and with a pushpin make holes along the fold half an inch apart about one and a half inches from the top and bottom edges. Insert the staples and bend over the ends on the inside center fold. Another satisfactory method for "binding" is the use of rings. This makes the book lie flat when open and avoids the curving of

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MAKE YOUR SNAPSHOTS TELL A STORY

the pages, which sometimes makes the prints come loose. After we have made several story albums we will find that cords or ribbons as fasteners would make too many loose ends and are too fancy. Our creations would look more like dance programs than booklets.

The finishing touches are now in order. On the cover we write our title: "Gleanings Between the Tides," "Trees Throughout the Year," or "Why We Go to the Zoo." Under the pictures, write your comments. You are forewarned that white ink is unsatisfactory because it is not opaque enough to remain legible and never flows uniformly from a pen. Ordinary inks are preferable. If you do not trust your printing or handwriting for legibility, you may type the commentary on thin sheets of paper that will blend harmoniously with the pages of the booklet. These can be cut apart and pasted under the prints to which they apply. Inject a bit of humor and make your style conversational. Everything should be terse; leave something to your friends' imagination. An obvious statement is usually more effective than a lengthy explanation. The empty, upturned hand of a wee youngster who has just fed an animal at the "Children's Zoo" requires only, "Aw-gone!" And under the pony ride print we write, "Let's do it again."

There are many ways to enjoy this story-album hobby besides showing them to your friends. You can use them as Christmas or birthday presents for those who have more than a casual interest in the many subjects dealt with in this manner. As you gain experience in making the booklets, you can mix enlargements and contact prints on the same pages. Study the pages of well laid-out magazines and notice how balance and composition are achieved. Before long, you will be planning the story-albums before you take your photographs. The moment that you do that, the bug has really got you.

If readers of NATURAL HISTORY have specific questions regarding photography in the realm of natural history or science, we shall be glad to try to answer them.—ED.

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amount of rainfall varies almost in accordance with the altitude, from 8 to 30 inches. Temperatures range from 110 degrees Fahrenheit in summer on the lowlands to below zero in the mountains in winter.

The measurement of floods in connection with these studies sometimes becomes a hazardous undertaking involving the risk of life and limb. Several years ago, one of the Arizona Department's staff members, while engaged in determining the velocity and amount of water flowing in one of the suddenly created rivers, was forced up against the understructure of a bridge. As the water rose higher and higher, he was in imminent danger of being drowned. Fortunately, at the last moment, an associate, aware of his disappearance, suddenly saw his plight and effected a speedy rescue.

On another occasion, an investigator observing stream action found it necessary to wade across a rapidly rising watercourse. It was a very warm day and the location was far from civilization, so the perspiring man removed practically all of his garments, both as a relief from the temperature and as a precaution in the event that unexpected currents might sweep him downstream and force him to swim. No sooner had he reached the opposite bank than the flood waters rose so high that any thought of recrossing was out of the question. Consequently, he had to remain, without clothing, marooned overnight in the inhospitable, cactus-filled desert, anxiously waiting for the turbulent flow to recede and hoping that he would not step on a wandering rattlesnake.

Perhaps the most dangerous condition encountered while measuring stream flow is quicksand. One stream wader, bent on determining mid-channel depths, found himself suddenly engulfed in the treacherous stuff. Rapid thinking, plus the possession of a rope and the ability to throw it accurately, enabled him to toss a life line around a convenient mesquite stump and extricate himself from what might easily have been his last wading exploit.

Other adventures experienced by staff members, especially in the work associated with well production measurement, have ranged from narrow escapes from the bites of rattlesnakes,

scorpions, tarantulas, and dogs to encounters with shotgun-bearing women and six-shooter sheriffs who disputed their right to be near isolated wells. To the survey crews, however, it's all in the day's work.

Many ranchers and farmers cooperate with ground-water investigators by supplying records of the amount of water pumped and the types of usage. They also report any unusual conditions affecting the water supply in their region. In the desert areas of Arizona, where few agricultural pursuits of any sort could exist at present without the use of water pumped for irrigation, land owners and operators naturally exhibit a keen interest in obtaining adequate supplies. Field office members answer many questions propounded by water users, and assist growers, wherever possible, to operate their lands successfully. Frequent requests are made by the state and by communities to find water in different areas, and this work occupies a great deal of time.

Methods employed to locate available ground water are far in advance of the use of the old-time "divining rod," which supposedly dipped earthward to indicate the presence of water, and the "doodlebug" of similar mystical propensities, familiar to many farmers and others for centuries. These superstitions have long since been blasted, yet even today and by no means in the backwoods alone, water diviners still practice their art for the benefit of the credulous. Present-day methods of discovering water, however, are based upon the practical application of scientific principles and the use of accurate devices, developed over a long period of years.

In addition to the expensive and time-consuming process of drilling test wells, the modern scientist has other systems at his command. Certain of these are somewhat complicated but efficient and rapid. One method involves the passage of electric currents into the earth's structure. These spread down and out in widening circles, after the fashion of ripples caused by the fall of a pebble on the surface of a quiet pond. The results are indicated on centrally located dials that are the focus points for wires attached to metal rods placed in strategic spots to receive the varying impulses. The electrical currents encounter different forma-

tions, and gradually a picture is built up revealing the depth of bedrock, the occurrence or absence of water-bearing sands or gravels, and similar pertinent information.

Various types of water prospecting have been of very real service in quickly locating water supplies for Army camps and war industries in America during the present world conflict. The accuracy of the engineer was well demonstrated when a ground-water expert, upon being requested to estimate the life of a particular well, stated after pumping tests alone, that at the rate it was being used, the supply would be exhausted in nine months. The well ran dry one week before the nine-month period had passed. Modern equipment, plus the knowledge, background, and experience to employ it successfully, was responsible for this surprising accurate prediction.

Thus the ground-water expert, in addition to being a geologist, must also be an engineer of considerable ability in order to use the mechanisms of his trade. And while the scientific divining devices are marvels of inventive genius and accuracy, they are only of value when used in conjunction with other methods that are brought to bear upon the problems. A knowledge of local geological features is one prerequisite. The use of aerial photographs is another useful adjunct, for it enables the scientist to study drainage systems and other important topographical features that provide clues to subsurface conditions.

Opportunities for important investigations of the natural history of ground water will continue to attract scientists for years to come. From the small boy who lies on his stomach, dreamily watching the flow of water from a hillside spring and wondering whence it comes to the scientist who risks his life to find out the amount of water that will recharge some far-off underground supply, the subject of the source and behavior of unseen water has captured human imagination since the dawn of man! Ground-water authorities do not lack vision either, especially when they strive constantly to inform the people that this priceless commodity is essential to the existence of innumerable American homes and factories and that ground water, invisible though it may be, is by no means an inexhaustible resource.

YOUR NEW BOOKS

Continued from page 347

COMMON INSECTS OF HAWAII

— by David T. Fullaway and Noel L. H. Krauss

Tongg Publishing Company, \$3.50
12 colored plates, 16 text figures, 228 pages

ANYONE undertaking to write a book about the insects of a fertile area of this globe—be that area part of a continuous land mass or a remote archipelago—has no easy task in setting bounds for his subject matter. In 1932 E. H. Bryan, Jr. compiled a census of the Hawaiian species of insects, which at that time totaled 4620. The aggregate is greater today. Limitations of space have compelled the authors to make a selection of only 335 species out of this abundant fauna, but their account often extends beyond the individual species to the group of which that species is a representative, thus opening up larger entomological vistas.

The information given about each species chosen for discussion includes its ordinal or its family affiliation, its general distribution, the date of its discovery or of its introduction into the islands, its habits and life history, its enemies, and—in the case of harmful insects—recommended measures of control. More un-

usual, each species is actually represented by a colored illustration, with indicated scale, which facilitates identification and justifies the authors in dispensing with keys. Credit is due the artist, Yasutaro Oda, for these graphic additions.

The book stresses the common insects, not necessarily those that are most conspicuous or most interesting. Abundance is, however, in many cases at least, an indication of the significance of a species in the insular economy.

Many of the insects of Hawaii belong to species represented elsewhere, and the native species, particularly those of the lowlands, have been waging a losing battle. One regrets that as a result a number of these endemic forms do not qualify as "common" and so fail to figure more fully in the account. Nevertheless, interesting facts are supplied regarding, among others, the native bees of the genus *Nesoprotopis* and the indigenous Eumenid wasps, both of which embrace many species.

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THIS is primarily a recreational volume dedicated to the art of walking and of observing. It properly states that "the benefits and pleasures of walking as a pastime and hobby are greatly enhanced if walkers know something of the historical and physical settings of the localities and regions they visit."

With this commendable statement to serve as a thesis, the various writers of this excellent volume plunge wholeheartedly into an amazing variety of subjects. These range from legendary history

through stories of the American Revolution, folklore and personalities, to the topics of geology, botany, zoology, and "impressions," all of the Hudson Highland region, largely within 50 miles of New York City. The chapter headings include: "Early Years of the Erie Railroad," "Indians of New Jersey," "The Catskill Aqueduct," "The Gremlin of the Woods" (Poison Ivy), "The Bear Mountain Bridge," "Old Appalachia or How the Hudson Highlands Got That Way," and a host of other diverse considerations.

The enthusiasm of the authors is contagious and is only paralleled by their courage in striking out boldly, regardless of the intricacy or scientific involvement of some of the subjects. Without hesitation they describe many millions of years of geologic history, the life history of ants, and the exceedingly complex and little known story of a Revolutionary highway bandit who was hanged for his sins. The absence of a bibliography or of any allusion to source material is to be regretted.

There are highly interesting chapters on the heights of mountains near New York City, the snakes of the area, the Jackson Whites, and the history of the Appalachian Trail. One of the best articles tells of that crowning botanical glory of the Highland, the Mountain Laurel. In concise, colorful language, it relates the salient facts of its life history and describes the significance of this beautiful plant in the early days of the country's development. In *The Hudson Highlands* is well written and adequately illustrated. It will stimulate many to go

forth and observe as they walk the woodland trails. It is a book that fills a need we have had for a long time. To one who lived for many years in the heart of the Hudson Highlands and through force of circumstance found it necessary to abide permanently thousands of miles away, this book brings an almost overpowering sense of nostalgia.

WILLIAM H. CARR.

NEW CROPS FOR THE NEW WORLD

- - - - - by C. M. Wilson

The Macmillan Company, \$3.50
295 pages, 32 illustrations

THE war has focused the attention of many people on the urgent necessity for the Americas to become as nearly self-sufficient as possible in vital and strategic plant, animal, and mineral materials. Plants and plant products which America in pre-Pearl Harbor days blithely imported from Europe, Asia, and Africa can and must now be grown and produced in the Western Hemisphere. Millions of dollars are being spent, and the labor of armies of workers is being expended, to introduce and establish new essential crops in the Americas. In time of war it is expected that these will help bring about hemisphere security through self-sufficiency; in time of peace they should prove most highly beneficial to a diversified inter-American economy.

In this handsomely illustrated book the fascinating and often exciting stories of over 200 of these new crops are told briefly and entertainingly. Fourteen recognized scientific authorities in botanical, horticultural, and agricultural fields have contributed chapters on rubber, drug and medicinal plants, forest resources, oils and waxes, fibers, fruits, insecticides, silks, bamboos, peppers, cane sugar, ornamental flowers, livestock, and a host of related subjects. There are descriptions of vast rubber plantations hewn out of Amazonian jungles; of the romantic international history of the Andean "fever tree"; of plant silks that are replacing the ancient silkworm; of "fish poisons" that now bomb man's insect enemies; of mango and avocado, lichee, kaki, and cherimoya; of belladonna, gambir, and ipecac.

Even so, the story is far from complete. No one book of this size could adequately discuss all the crops involved in this "biggest and most beneficial shifting of crops in a century." Yet one wonders if guayule, cryptostegia, and kok-saghyz, cork, balsa, and black pepper, vanilla, sisal, hemp, digitalis, and curare—to mention just a few—would not have been as worthy of inclusion as were cattle and corn, which are hardly "new crops."

HAROLD N. MOLDENKE.

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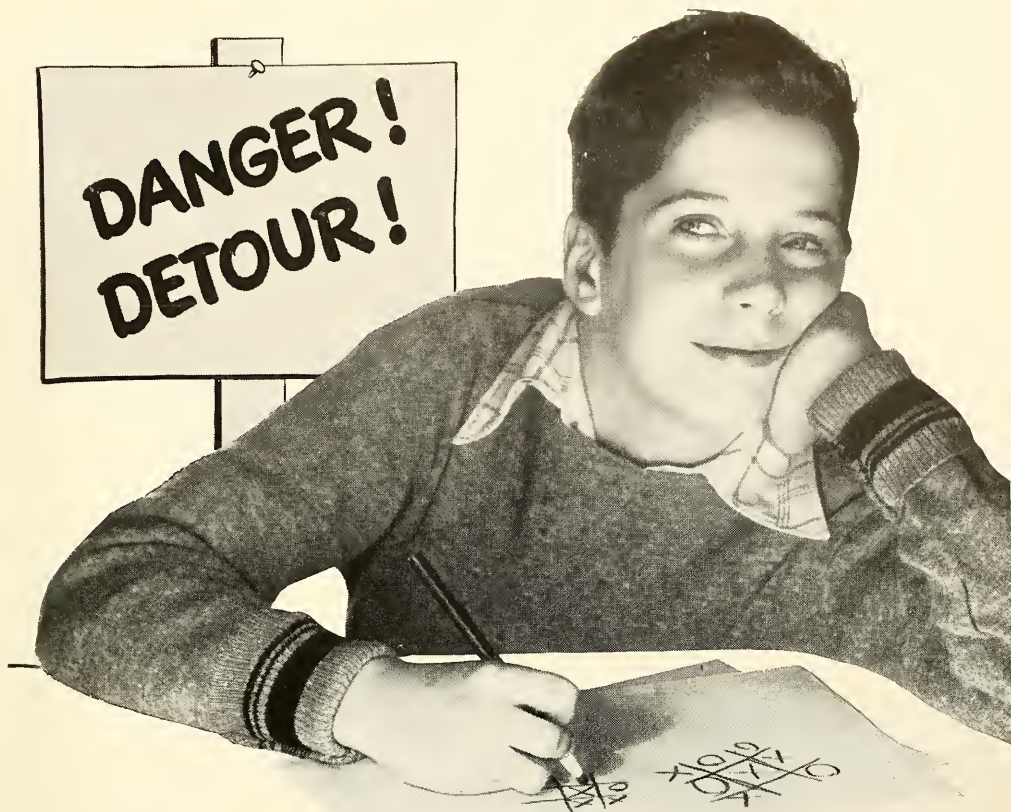
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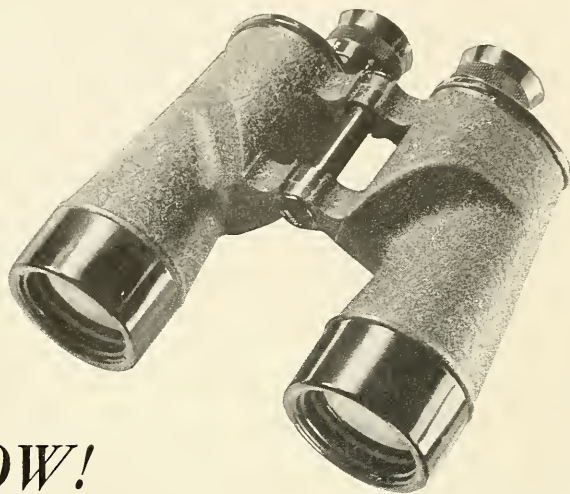
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LETTERS

SIRS:

Can you give me some information about cormorants and their fishing activities? This summer at Georgian Bay cormorants were observed for the first time nesting on the shoals outside the ring of islands. Ardent fishermen of the district were alarmed, fearing a depletion of the Bay's fish supply—chiefly small-mouthed black bass. I have somewhere read that cormorants take "chiefly slow-moving, bottom-haunting species such as, for example, the sculpin which is unfit for human consumption." This was denied by the finding of approximately 10-inch black bass in every one of the 20 nests discovered.

In this particular place the birds were identified as Brandt's Cormorants, yet were also described as "all black." As you see, there seems to be much information and mis-information which I am anxious to straighten out.

A group of local fishermen who discovered the birds have obtained permission to exterminate them next spring. There were 20 nests on one shoal this summer. Could these birds, in your opinion, increase rapidly enough to deplete the bass in a bay the size of Georgian Bay?

MURIEL THOMSON.

Aurora, Ontario, Canada

* * *

The following information is offered by Dr. Robert Cushman Murphy, Chairman of the Department of Birds at the American Museum of Natural History:

The cormorants that have begun to invade the Georgian Bay region are in all probability double-crested cormorants, the only species common in the interior of northern North America. One of the foremost authorities on this bird is Dr. Harrison F. Lewis of the Canadian National Parks Bureau at Ottawa. He should by all means be notified of your present problem.

Cormorants in general are not very discriminating with reference to the fish they eat. Consequently the kinds which man

regards as food and game fish are always likely to be found in the bill of fare of these birds. Nevertheless, it has been shown beyond question that the principal prey of cormorants consists of species which have little value to man and which indeed are likely to be the enemies of more desirable fishes because of their spawn-eating propensities. Studies made along sea coasts and in bodies of fresh water in several different parts of the world have shown that the destruction of cormorants sometimes works against the very aims that fishermen cherish. The question to be decided is not whether the birds eat a certain proportion of valuable food and game fish, but rather whether their total consumption of food is likely to be advantageous or otherwise from the human point of view. Certainly there is nothing to recommend the snap judgment of fishermen on this question. Rather it should be decided upon the basis of a competent ecological investigation.

* * *

SIRS:

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Continued on page 392

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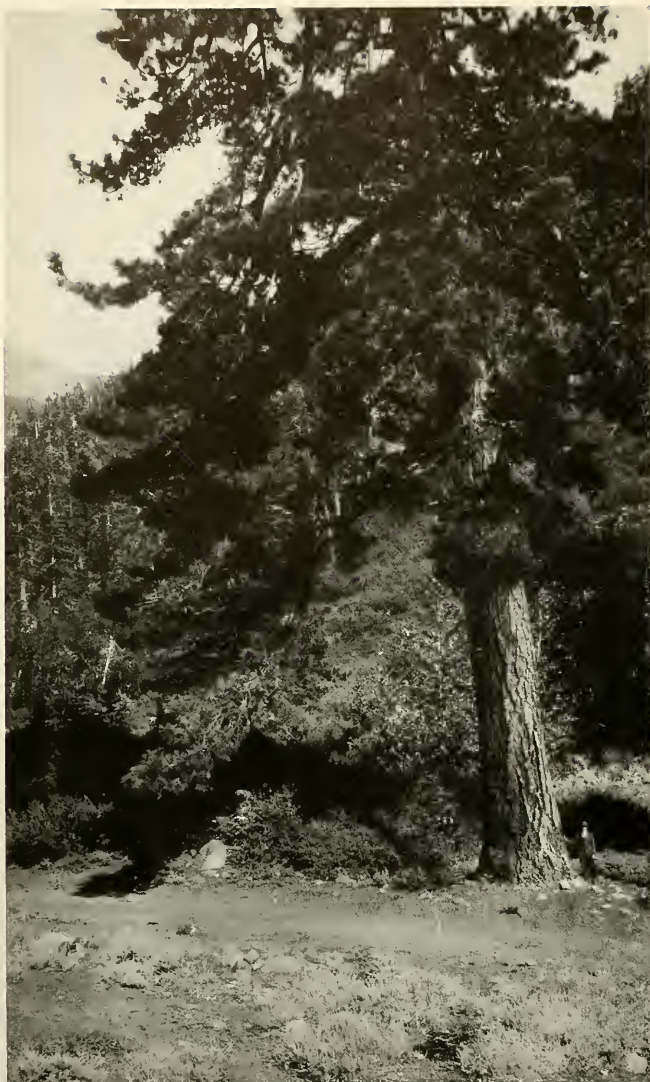
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Photograph by Willard G. Van Name

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LETTERS

Continued from page 389

before I get them home again. They were donated to the U.S.O. by someone in San Francisco, were given to me in Baranquilla, Colombia, and are now on Okinawa! They have been read by quite a few people, too.

LT. H. GORDON HANSON.
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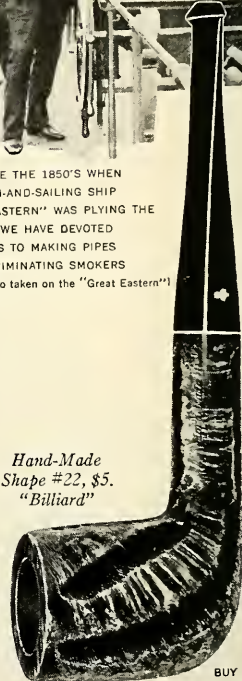
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REPTILES OF THE PACIFIC WORLD

----- by Arthur Loveridge

The Infantry Journal, Fighting Forces Series, \$2.25, 243 pages, 70 figures
The Macmillan Co., \$3.00

DESPITE the admonition that natural history pursuits were "all very well as a pastime, but not to be considered seriously as a remunerative occupation," the author of this book decided to become a museum curator at the age of ten. As a young man he journeyed to Africa to become Curator of the Nairobi Museum in Kenya Colony. As a volunteer in the East African Mounted Rifles during World War I he continued his collecting efforts (despite unsympathetic sergeant-majors) along with his military career. For the last two decades he has been at Harvard's Museum of Comparative Zoology. He is well provided therefore, with both the knowledge and experience essential for the preparation of this handbook.

Reptiles of the Pacific World is written for, and the Introduction is addressed to, "the Men of the Armed Forces," not as a technical guide, but as a readable, practical introduction. Couched in simple language, with a liberal sprinkling of colorful and illustrative anecdotes, the book was designedly made interesting, and yet its practical purpose was not neglected. General information is sandwiched in unobtrusively, along with keys and highly interesting life history notes dealing with both reptiles and amphibians from the tuatera, through the turtles, crocodilians, lizards, snakes, frogs, and toads inhabiting the vast Pacific region.

The task of assembling, sorting, and arranging the scattered information in usable and readable form was a tremendous one. By virtue of his training (and his experience in the field far removed from libraries) Mr. Loveridge was able to exercise admirable judgment, not only in deciding what to include but in deciding what to leave out.

Not only occupation troops but the professional museum curator who has long recognized the need for a general work on this subject will be pleased that Mr. Loveridge chose to ignore the warning as to the pecuniary disadvantages of a naturalist's career. As many service men will discover, there's more solid enjoyment in natural history pursuits than he can find in the "canned" entertainment that he has to buy.

C. M. BOGERT.

"HERE IS INDIA"

----- by Jean Kennedy

With photographs by Alice Schalek and others

Charles Scribner's Sons, \$2.75, 154 pages

WITH a very intimate knowledge of India, having lived there for many years, Jean Kennedy, born of American and British missionary parents, writes well and very interestingly of just the things we want to know concerning this colorful and potential land which so teems with multitudes of humanity.

Convincingly and easily narrated in a straightforward manner, this very neatly printed little book contains an amazing amount of most interesting information. The author tells of the fundamentals behind the uphill struggle of these industrious people, impeded by religious castes, great concentrations of wealth, and nation divided by many absolute and independent states. You walk quietly with her in their humble homes as they go about their daily lives, and she points out the significance of the customs and describes many of the lesser but interesting episodes of the household routine. Pleasantly free from statistical data, she tells of the great natural wealth, of potential industries, of the unlimited amount of good labor, of the crying need of storing the all-beneficent water of the great rains.

Now on the threshold of a new era under our new one world, with their old and new industries which can bring them a more progressive and prosperous life, they still find all too many impediments confronting them. How all these can be overcome no one knows, but to read Miss Kennedy's very excellent book with its remarkable amount of palatable and easily digested information on the multiplicit-

ties controlling the lives of these people, is to have the best possible information on this subject which is one of the world problems of today.

I know of no book that will give the average reader more pertinent and up-to-the-minute knowledge of the Indian's own problems in such a pleasant readable form as *Here Is India*, and I heartily recommend its reading.

JAMES L. CLARK.

TALKING TO THE MOON

----- by John Joseph Mathews

University of Chicago Press, \$3.00
244 pages

JOHN JOSEPH MATHEWS, a member of the Osage Indian tribe, is a graduate of the University of Oklahoma and has a degree in natural science from Oxford University in England. He is the author of *Wak'kon-tah: The Osage and the White Man's Road*, and of a novel of the American Southwest, entitled *Sundown*.

Talking to the Moon is a description of ten years of the author's life in a cabin he built on a ridge among the Blackjack Oaks not far from the old Osage agency. This sandstone house, although much more substantial, will remind one of Thoreau's cabin, and the book with its treatment of plants, animals, and weather, and its philosophical discussions, will make one think of *Walden*. Or, one will be reminded of John Burroughs's *Slabsides* and his essays, such as "Wild Life About My Cabin." Although Mathews is a gifted literary naturalist, he should be classed with the hunter naturalists along with Theodore Roosevelt, for he is as fond of hunting as was our naturalist president.

Following an introductory chapter on the building of the Sandstone House and one on the Blackjacks, the book is divided into twelve chapters, titled by the twelve moons of the Osage. The Buffalo-Pawing-Earth Moon (June) is particularly interesting, being mainly devoted to the ceremonies of the Osage. The author considers that he has been "extremely fortunate to be a witness to the last struggle of a native religion," and that "the passing of a concept of God seems to be almost as poignant as the passing of a species." The chapter of the Moon of Yellow Flowers (August) contains a fascinating description of the securing of portraits of a dozen old-time members of the tribe for the Osage Indian Museum. The chapter head-pieces



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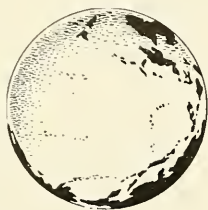
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were drawn by the famed botanist, Paul B. Sears, and the text illustrations by the author.

How the Osage came to call November the Coon-Breeding Moon is difficult to understand, since all the hunters and mammalogists that I have consulted agree that the coon mates in late January or during February, and this coincides with my own observation. Among the Ojibway, I believe February is the Coon Moon, as it should be. And naturalists will surely question the author's interpretation of the story of the mother or some other coyote bringing poison to the imprisoned young one, and the similar story of the young blue jays being poisoned by their parents.

The author gives in this delightful book the philosophy of a naturalist, who wished to get away from the artificiality and the crowded conditions of our so-called civilization. In it he discusses some of "the results of the biological urge which inspires the wood thrush to sing and the coyote to talk to the moon."

CLYDE FISHER.

PLANT LIFE OF THE PACIFIC WORLD

----- by Elmer D. Merrill

Infantry Journal. 298 pages, 252 drawings of plants, 2 maps. \$25
The Macmillan Co., \$3.00

HERE is a book for the serious student as well as the layman. It is the Fighting Forces Edition of the latest of the Pacific World Series of handbooks, prepared under the auspices of the International Committee for the Protection of Wild Life. A trade edition will be issued soon by The Macmillan Company.

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Merrill has succeeded in giving a remarkably broad and comprehensive, yet familiarly detailed view of the plant life of a very vast and complex region. The book takes in all the Pacific islands except New Zealand and a few minor southern ones, with special reference to the tropics, particularly Malaysia, and notes on specific islands and island groups including the Aleutians, Japan, Hawaii, and the Galapagos.

Starting with travelers' tales of the largely imaginary perils of the tropical forests, which are humorously debunked, the author further introduces his subject with a chapter on general principles of botanical classification and explanations of the simple descriptive terms used in later chapters. Sketches of the seashore vegetation, mangrove swamps, secondary forests and open grasslands, and of the primary forests are followed by discussion of noteworthy plants such as ferns, orchids, and strange parasites, and such phenomena as cyclic flowering and symbiosis between plants and animals.

There are chapters on jungle foods, on weeds and cultivated plants, telling whence and how they came to the islands, on the distribution and origin of local plant names, and a most valuable discussion of the problems of plant distribution in Malaysia and Polynesia.

Attention is drawn to the great opportunities that remain in botanical exploration and study, especially in the large islands from Sumatra eastward to New Guinea and the New Hebrides. About 45,000 species of higher plants are already known from this vast region, yet only Java, (and to a lesser extent the Philippines), have been adequately explored for plants.

There are instructions for preparing botanical specimens, a selected bibliography, systematic list of the plants discussed, glossary, and index.

This book will fill a long-felt want. The style is direct and very readable, the drawings excellent, though some have

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NATURAL HISTORY, NOVEMBER, 1945

suffered through reduction to fit several to a page. Few could have attempted a work of this kind and scope; only Dr. Merrill, with his great personal experience of the islands and distinguished background of research, could have done it so well.

L. J. BRASS.

PAY DIRT

----- by J. I. Rodale
Devin-Adair Co., \$3.00, 242 pages

THIS book is an impassioned plea for a wider use of composts and mulches and a bitter denunciation of chemical fertilizers and insecticides. It contains much data, many interesting facts, and quite a few statements that are highly interesting if they are true. The author is so convinced of the fundamental soundness of his position and the importance of organic gardening that it has become a religion with him.

This reviewer has for many years believed in composts and mulches and does not need to be sold on nature's method of soil conditioning. There is nothing in the interesting description of the cycle which returns vegetable and animal wastes to the soil to provoke disagreement. The part played by earthworms, by soil bacteria, and by all the vast micro fauna and flora which nature employs for the purpose should be known to every gardener. It is truly a fascinating story.

But the complete account of the soil and the plant and animal life it supports is a highly complex one. It involves so many factors as yet imperfectly understood that it is dangerous to become dogmatic in asserting the omnipotence of any small group of these factors. The widespread use of chemicals both as fertilizers and as insecticides undoubtedly leads to abuses, but the author will find few readers ready to accept his sweeping indictments of them.

This book resembles Faulkner's *Ploughmans Folly* in the reactions it will provoke. I imagine most readers with practical gardening experience will disagree with Rodale on many of his claims. But the book will make a useful contribution because it does stir people up. However, it suffers from repetitious style and reminds one of music based upon a "theme and variations."

Compost is great stuff and Rodale never lets you forget it.

H. E. ANTHONY.

SCIENCE YEAR BOOK OF 1945

Edited and with an introduction
----- by John D. Ratcliff

Doubleday, Doran and Co., \$2.50
224 pages

THIS is the fourth annual volume of this popular-science series edited by Mr. Ratcliff. Following a readable and quite thrilling introduction on the advancement of science, the main body of the book is made up of outstanding articles for the lay reader from the various

magazines of the country, only one of the 28 chapters having come from a book. There are ten chapters devoted to medicine, including such subjects as Penicillin and Cornea "banks." Nine chapters treat of subjects in physics and chemistry, including "The Electron in Industry," by Waldemar Kaempffert; one on War Research, being largely the work started and directed by Dr. Vannevar Bush; and two on DDT, the new insect killer. There are five chapters on aviation, including "Tomorrow's Airplane," "Rocket Ship," and "Buzz Bombs." In Part IV, titled "Other Sciences," is an interesting and dependable article on "Arctic Oil," by Wallace E. Pratt, calling attention to the untapped reserve in north-polar regions.

The next-to-last chapter, entitled "When the Comet Struck," is an unfortunate inclusion. In the first place, the theory that the Carolina Bays are meteoric in origin is presented with too much assurance. Even the speed of the "comet," as it is called, is given as 144,000 miles per hour—a "comet" that in all probability never existed. In his recent book, the late Prof. Douglas Johnson, famed geomorphologist and geologist, convinced most students that the Carolina Bays are not meteor craters at all. In this chapter, in the account of the Siberian meteor-fall of 1908, which the writer says was probably a detached fragment of the Pons-Winnecke Comet, we are told that Farmer Semenow was just knocked senseless, while a fraction

of a second before, a herd of 1500 reindeer was destroyed so completely that of all of them only a few charred carcasses were ever found.

It is stated that the articles were chosen for their readability and reliability, and this reviewer feels that the editor has achieved his ideal on the whole very well. In spots, however, there seems to be too little regard for the distinction between fact, theory, and hypothesis.

CLYDE FISHER.

THE STORY OF THE DUTCH EAST INDIES

----- by Bernard H. M. Vlekke
Harvard University Press, \$3.00
33 illustrations, 4 maps

THIS is an abbreviated version of the author's earlier book, *Nusantara*, reviewed in *NATURAL HISTORY* in January, 1944. Like *Nusantara* it gives the history of the Malay Archipelago from prehistoric times to the first half of 1942, thus including the Hindu, Mohammedan, and Colonial periods, the rise of Indonesian nationalism, and the Japanese invasion. To all those who wish to obtain an overall picture of the history of the East Indies without going into the more detailed discussions in *Nusantara* this very readable new edition will be very welcome and may be highly recommended.

R. VON HEINE-GELDERN.

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HAWAIIANS have a simple answer to the plural of mongoose. They merely say "*plahnty mongoose*," and they do not exaggerate. In the 60 years since the introduction of these small predators to the Hawaiian Islands, they have become the Islands' most common mammal. In 1883 the *Planters' Monthly*, a small magazine of limited distribution, proposed "the introduction of a little animal from India called the mongoose, as a destroyer of rats. He is a famous ratter, surpassing the cat or the ferret." One Hilo planter estimated that rats cost him

\$10,000 a year. Soon after this, and still in 1883, the Hilo Planters' Association raised \$1,100 for the importation of mongoose. This was the beginning of a plan that gained momentum with each passing year.

During the next 12 months, 72 descendants of the Java Golden Brown Mongoose introduced into Jamaica in 1872 were liberated on the island of Hawaii. In 1884 Mr. Austin, a Hilo planter, said in a speech: "These fields as well as the rest were infested with rats a year ago. Now there is not a stick of rat-eaten cane to be found, or a rat." Mr.

Austin also estimated "a saving of \$50,000 for one year." In subsequent publications the success of the mongoose in exterminating rats was contrasted with the ineffectual bounty system used before the predators were imported. It seems that planters offered cash for all rat tails, and received many. It was later discovered that the Chinese had been cutting off the tails and freeing the rats for breeding stock.

For several years the rats decreased in direct proportion to the increase of the mongoose, and then a few plantation workers, seemingly forget-

THE HAWAIIAN MONGOOSE— *friend or foe*

By LEWIS WAYNE WALKER

Photographs by the author



▲ THE MONGOOSE, now Hawaii's most common mammal, was not introduced into the islands until 1883

► THESE LITTLE ANIMALS were imported by the Hilo Planters' Association to help control rats



It depends upon how he fits into the balance of Nature. The mongoose has done yeomen service in some localities; but G. I. Joe is to be discouraged from any idea of bringing one home as a pet

ful of the former damage by the rats, complained that the new predators were taking poultry. This prompted a speech, the minutes of which are in a *Planters' Monthly* of 1888. "They complain about the mongoose eating chicken, but the little beggars save me thousands of dollars and I could well afford to import chickens from the coast. Besides, it is only a few chickens that they eat, and I do not believe that they destroy as many as the rats used to."

For the next score of years all seemed fairly serene and, aside from freely aired personal opinions, the rats and the mongoose fought their own battles without hindrance from mankind. Then came the movement for the introduction of game birds for shooting purposes. Ground nesting quail, pheasant, and partridge were liberated. Mongoose took their toll, and the gun clubs complained that the

mongoose were the cause of the decline of the native birds as well as those that were being introduced. In the light of written ornithological history the complaint contained many flaws, but it inaugurated a plan for the extermination of the mongoose. Most of the endemic birds disappeared with the clearing of wooded areas and the accidental introduction of tree-climbing rats.* Many birds were

*There are apparently five kinds of rats on the islands. One of them was native to the islands when they were discovered and was thought to be an ancient Polynesian introduction. Of these five, the common Norway is the only rat that will seek escape in a ground hole when pursued by a mongoose. All the rest, along with some of the smarter Norways, have learned to live in trees and like it.

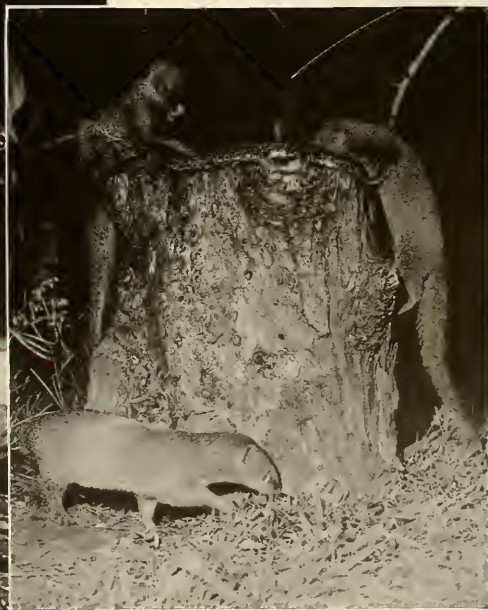
acknowledged to be extinct before 1883. These same hunting organizations, seemingly so concerned about the birds, advocated and maintained an open season on the Hawaiian Stilt. This marsh dweller, formerly inhabiting several of the islands, had even then decreased to about 500 individuals on Oahu.†

Every few months the pros and cons of the mongoose question are aired in public print. Agriculturists, through whose produce the islands are supported, are pro-mongoose; poultry raisers and hunters consider the alien predators pests to be shot on sight. The latter group created a bounty of fifteen cents per scalp and made it a misdemeanor to "introduce, keep or breed mongoose." After extensive research the planters concluded that 80 per cent of mongoose stools contain the remains of insects. Another pro argument compares the

† In spite of the mongoose, the meager remnant of this interesting wader has actually increased during the war, owing to the restrictions on firearms.

▼ AS THOUGH MIMICKING a prairie dog, the mongoose would rise to his fullest height every few yards as he approached the feeding station

▼ THEY came singly or in groups to feed at the bird feeding station





▲ SEVERAL MONTHS of feeding were necessary before a mongoose would take food from human fingers

rat population of those four Hawaiian islands where mongoose reside (Oahu, Hawaii, Molokai, and Maui) with that of the islands where they have not been liberated (Kauai and Lanai). Norway rats predominate on the last two islands, while three less destructive species of *Rattus* predominate on the other four islands.

This, in brief, is the history of the mongoose of the Hawaiian Islands. When I arrived there in 1944 the servicemen were calling them squirrels, prairie dogs, and many other things. They even had one yarn which absurdly credited them with the ability to interbreed with rats! At best, the views that these newcomers obtained of the mongoose were fleeting. Occasionally one was seen darting across a road from the sanctuary of one cane field to another. Sometimes an unwary mongoose fell into an excavation and courageously charged any human that ventured into the hole.

In a secluded valley on the island of Oahu, however, mongoose and man were friends. A bird feeding station had been set up several years before my tour of duty, and mongoose had learned to partake of the proffered foods. Soon after dawn, on my first visit, while everything was still sparkling from the nightly rains, the Pekin nightingales arrived in a compact, sociable flock. The birds tried

▲ ONE OF THE TAMER ONES would walk up and accept a bit of bacon held in his host's hand

► THE MONGOOSE is similar in many ways to the American skunk, to which it is distantly related. It exudes a slightly musky odor



► THIS MONGOOSE looks as though it were about to attack. The adversary that made the mongoose famous was the snake, but the Hawaiian Islands are practically snakeless

to remain hidden in the *Ti* (a plant of the lily family), but the food lured them out. For fifteen or twenty minutes they fed in comparative peace. Occasionally these oriental birds had to side-step blood-red cardinals from Mexico, mynahs from India, or doves from China and Australia, but they withheld their wrenlike *churrs* of disapproval until the mongoose appeared.

Finally the slim body of an early riser parted the deep grasses, and he progressed with a flowing, almost serpentine motion. Every few yards, as though mimicking a prairie dog, he would rise to his fullest height. His beady eyes, with elliptical pupils, surveyed the area for danger before he continued to the station. Doves and cardinals walked to one side and allowed him to pass within three feet of them without flying, but the night-ingales departed for the day.

Within a few minutes mongoose could be seen converging from all directions. Some came singly, some in pairs, and even a few mothers with twins pushed their way to the food. They were almost oblivious of the house windows and of the people watching from within. Food vanished as a dozen or more tore at the breads, fruits, cereals, and meats. More

scraps from the breakfast table were hastily gathered and taken to the station. Most of the mongoose ran for cover but several walked to one side and waited. Their host of many months held a bit of bacon in his finger tips. A black nose parted the bushes and a mongoose walked from his scanty cover, took the proffered offering, and retreated.

These mongoose had never been touched or caged in any way. Their trust in people had been developed entirely by food, over a period of months. When the station was first started, mongoose were occasionally seen dashing from cover to grab a morsel before retreating. Gradually they seemed to "catch on" to the human schedule of putting the food out first before eight o'clock every morning. Their slim, graceful forms became more in evidence in the underbrush as though they had been watching the clock. Several months passed before they would permit the approach of a person without dashing to cover. From this stage of tameness, progress was rapid. They could now actually see the food being served. The tamest got the choicest cuts, hence there was an incentive to be courageous.

Several months of feeding, however, were necessary before courage and trust combined to cause the first mongoose to take food from human fingers. Now, at least a year later, three of the dozen or more frequenting the station are brave enough to do so. At times efforts have been made to induce them to climb upon a lap for some tasty morsel. They will start readily enough but as soon as they feel the softness of flesh underfoot, they bite with their tiny sharp teeth and run off into the brush.

From the initial visits of the mongoose, it was noticed that the regular bird visitors showed very little fear of them. The mongoose were far more intent on picking up scraps than on any remote chance of catching feathered prey. Birds in the direct path of their charge between brush and station would fly eight or ten feet and re-land more or less unconcerned. Yet a house cat walking across the lawn would make the birds nervous for several hours. If the cat disappeared into brush where it could hide, the birds would forsake the region for the rest of the day.

That the Hawaiian Islands, practically snakeless, should become a land where mongoose thrive, is in-

▼ CONTRARY TO GENERAL BELIEF, the mongoose does not depend upon reptiles for survival but is omnivorous

▼ FRIEND OR FOE? The mongoose does not know what to do with its own image



congruous. The one snake, which by popular conception would be termed wormlike and not reptilian is only found at two localities on Oahu. This worm snake rarely exceeds six inches in length and spends its entire life burrowing in the earth. It was probably brought to the islands within the last 50 years in the roots of imported plants. There are four species of geckos, or night lizards, and several species of skinks, which no doubt also reached the islands as stowaways, but their arrival dates from the misty past of the ancient Polynesian migrations. Reptiles are not essential to the survival of the omnivorous mongoose, which will partake of a wide variety of foods, such as insects, meats, and fruits. They seem especially fond of papayas. As tree-climbers they are practically helpless and therefore only devour fallen fruit. Rats, however, do considerable damage to the fruits raised on the islands and have learned to escape the mongoose by spending most of their lives in the trees. This habit, combined with the rodents' choice of nocturnal hours, undoubtedly has prevented the complete extermination of the rats. I have never seen a Hawaiian mongoose out at night, and even those that have been hand-raised and tamed turn in at dusk.

Twins are the rule

Unlike most wild animals, mongoose do not seem to have a definite breeding season. Only during the months of October, November, and December are new-born pups not in evidence. They probably raise two or three broods a year, with two pups to a litter. Out of several score of family groups under observation only one mother had triplets, and one of these three was obviously a runt and disappeared in about a week. The young are kept hidden until they are well able to walk and run, or until they are about one-fourth grown. When first venturing from the burrows in company with the parent they are shielded under the stomach and widely spread tail and are extremely hard to see. At such times the mother becomes very shy, rarely bringing her family to the station when it is crowded with others of her own kind. Strangely, these young seem to survive under a white flag of truce until they attain a certain size. We have sometimes seen them slide from the protection of a parent and partake of foods being eaten by other mongoose,

without retaliation. If another adult tried the same tactics, a fight would result.

The mongoose are similar in many ways to our American skunks, to which they are distantly related. They exude a slightly musky odor, and the males seem to use certain trees or branches as signposts. Like skunks, their danger signal is an uplifted tail and an arched back. A mongoose pestered by one of smaller stature will often put on a skunklike dance with forefeet before charging to battle. Some of these battles are humorous. There seems to be a Marquis of Queensbury code which in some ways is difficult to understand. Some charges will be met head-on with slashing teeth. These mix-ups rarely last more than a few seconds before the defeated one retires. Other charges, and these are usually against a smaller opponent, are met with a shoulder, hip, or fluffed tail. In this case, where there is obviously no acceptance of the challenge, the aggressor moves off as though defeated. Strangely in all these battles there has never been any sign of bloodshed or injury, yet with a single bite these same animals can crush the backbone of a full grown rat.

After a filling meal they occasionally like sunning or playing. If a sunbath is desired, they lie on one side at some spot where their back is protected by dense brush or logs. They stretch and roll but always keep on the alert for danger. When they feel like romping, and I believe they outgrow this with age, they have rough-and-tumble fights like a couple of kittens, pursuing and tripping each other in turn.

It is generally felt that the introduction of mongoose to Hawaii was essential and that without their aid in reducing a steadily increasing rat population the cane industry in some areas would have been doomed. (In Puerto Rico the depredations of rodents forced several plantations to close.) However, most botanists and ornithologists of the islands agree that the necessity for the mongoose was caused by a breaking of the island's balance of nature by the introduction of rats. Had there been native predators, such as skunks or weasels, the alien rats could have been handled by home talent. The great majority of birds native to the islands are passerine (perching) and, therefore, were not overly molested by the terrestrial mongoose. A few species, such

as the endemic coots, gallinules, stilts, and short-eared owls are ground nesters. The first three nest and reside in marshland areas which are rarely frequented by mongoose, but the short-eared owl, a good ratter, has almost disappeared. Mongoose have, no doubt, taken their share of this beneficial bird, but many people believe that the burning of the cane fields (owl nesting areas) before harvesting is the main cause of their rarity.

Danger of importation

Some attempts have been made to introduce these naturalized Hawaiian mongoose into other areas, either as pets or as an aid in rat control. Luckily these have failed before the predators have become established. One crateload was shipped to San Francisco many years ago but was immediately destroyed on reaching port. Had these animals been liberated and become acclimated, they undoubtedly would have wrought great havoc. While the mongoose were eliminating rats they also would have been preying on the marsh hawks, short-eared owls, baby skunks, and other rat killers which are a part of the natural balance of the United States. Their depredations among the ranks of the so-called game birds and the scores of ground-nesting, insect-eating birds could have been disastrous.

Soon after the San Francisco consignment was destroyed, a congressional law was passed strictly prohibiting the importation of mongoose. One legislator at that time accredited them with unheard-of characteristics, claiming that the fierce beasts would tackle *venomous* boa constrictors with immunity and that they had six litters a year, consisting of from five to ten young each. Aside from the fact that boas are not venomous and that the mongoose is not immune to snake poisons and that they have two, rarely three, young to a litter, the basic idea of his crusade barring mongoose was commendable!

At the present time thousands of military personnel are passing through the Hawaiian chain and other islands where the mongoose reside. Some baby mongoose are being captured and raised as pets. Attempts to smuggle them through the quarantine will undoubtedly occur. In most areas their beneficial acts would not outweigh their depredations as they have in the Hawaiian chain.

Scientific tests with the powerful new insecticide help to define its value and its limitations. Important precautions are offered,—because it kills many innocent creatures and should be marked "POISON" on the family shelf

DDT

—the Atomic bomb of the Insect World

By C. H. CURRAN

*Associate Curator,
Department of Insects and Spiders,
The American Museum of Natural History*

FOR three years we have been waiting impatiently for the release of the sensational, world-renowned insecticide known as DDT. Today we can buy all we want of it. Now that we have it, what are we going to do with it? Are we going to use it wisely to control a certain number of pests for which it is particularly suited, or are we going to use it indiscriminately and possibly damage the life of our planet quite seriously? DDT is amazingly good—but it is also dangerous. If improperly used, it might actually prove more devastating to man's economy than the atomic bomb.

DDT is one of the most efficient insecticides we have, and it saved tens of thousands of lives during the recent war, but we must confess that we know too little about it even to guess at its true value. Potentially, it offers us the opportunity to eliminate certain insect-borne diseases. It may reduce the ravages of many household insects to negligible proportions, and it may prove of value in the control of a very small number of crop pests. But we can hardly expect it to destroy all household pests or all insects that carry disease.

It is still too early to state just where and against what insects DDT should be used. In many cases the published reports of scientists are inconclusive and conflicting. The general public does not see these reports, most of which are "dry reading" unless one is professionally interested in them. The reports that have reached the public are almost all of the sensationally successful sort, and it is only within the last few months that the public has even heard that DDT might be dangerous.



All photographs by
JAMES POSTAL

▲ DDT POWDER looks like flour, is dangerous to fishes and other creatures, and should be used only with extreme caution

All of us who have experimented with DDT during the past years have recognized that we were dealing with a dangerous substance. From the very beginning, most of us were afraid of its direct effects on the human body. We knew how it affected experimental animals, such as rats and mice,—that continued dosages resulted in death. It was natural to suppose that human beings would be similarly affected. Under normal use, however, the evidence shows merely that a small percentage of people are allergic to DDT as they are to other things. In one case of which I have been informed, a residence was sprayed with DDT and the master of the house was unable to remain in it, because he developed "hay fever" as soon as he went in. No other members of his family suffered any apparent effects. DDT causes some other persons to develop an irritating form of dermatitis. But probably not more than one person in 10,000 is sensitive to DDT. Personally I have not been bothered greatly by it, perhaps because I have been suspicious of it and have been careful. But I have noticed that when I have been exposed to DDT in kerosene solution, I become nervous. Exposure for two or three days causes me to become quite irritable. Also it seems to cause me to suffer from sinus trouble to an unusual degree. All of these effects disappear within 24 hours after exposure to the material. Mr. V. B. Durling, who has been associated with me in many experiments with DDT, is rather similarly affected and in addition suffers from a backache, which may persist for some days.

In other cases there is no noticeable reaction to continued use; and in spite of the symptoms cited, I am still of the opinion that the insecticide does not bother most persons. George Severn and John Ryan, of the American Museum, have been more exposed to DDT in kerosene than any others who have assisted me in the work at Bear Mountain. Both were literally saturated with the solution every day for more than three weeks. Their work clothes were always oily and, like myself, it was possible to detect their presence by the odor. All the time that they were using the material I watched them closely. Actually, because I believe that the use of DDT is, in the present state of our knowledge, extremely

dangerous for other reasons, I should have been happy if I could have reported that the spray was directly dangerous to man. But I have no evidence that it is; and the work in Italy, which was very similar to my experiments during the past summer, showed quite similar results. In Italy the men started out wearing gas masks, rubber coats, boots, and hats. These were found to be extremely uncomfortable and were gradually cast aside—first the mask, then the hat and coat. Eventually the men were wearing only shorts and shoes, and not one suffered ill effects.

It is apparent that if we were to consider DDT only from the standpoint of the way it affects human beings we could not regard the spray as dangerous, but let us consider all the evidence before we decide whether it is safe to use it as a generally applicable insecticide.

Dichloro-diphenyl-trichloro-ethane is nothing new. It does not exist in nature but was discovered by chemists more than 70 years ago. Until just before the outbreak of the war it remained one of the many scientific developments that apparently had no practical value. Then it was found to be very effective in the control of potato beetles in Switzerland. This is the generally accepted story concerning the discovery of the value of DDT as an insecticide. A fantastic story has it that the Germans allowed soldiers who had been dusted with DDT to be captured by the allies in the belief that, although it killed lice, it was actually dangerous to human beings. There is no doubt that the Germans used DDT for the elimination of lice and the prevention of typhus before we did, and that many troops captured early in the war had been dusted with it.

From almost all the popular accounts, the world has been led to believe that DDT is the answer to all insect problems. Now that the product has been generally available in America for a few months, many people are complaining about its ineffectiveness, particularly against household pests. There have been so many complaints that entomologists have said the mixtures sold were too weak and that any solution to be effective must contain at least five per cent DDT. I have not found this to be the case but have obtained amazing results with solutions much weaker than most of those offered for sale.

Many of the household insects may prove difficult to control with DDT, but until thorough investigations have been carried out it will not be possible to do more than suggest that people try it. Up to the present it has not proved effective in the control of cockroaches. I have tested it under natural infestations, using powder with a strength of five and ten per cent and a spray containing from two to ten per cent, but without great success.

It would be surprising if inexperienced users should obtain perfect results with DDT. As a fly spray it is not as effective as pyrethrum or rotenone and is a much slower killer. Spraying rooms in the usual way is unlikely to give good results against flies or mosquitoes, since there is practically no residue and what there is mostly settles on places where flies are not likely to alight. The places where flies normally rest should be treated, and with mosquitoes the dark portions of rooms need attention. Bedbugs are very susceptible to DDT, but a thorough job must be done or results will be disappointing.

While fleas are very vulnerable to DDT, it must be used with care. The general practice is to dust the dog with a five or ten per cent mixture, rubbing the powder into the hair. The powder not only kills the fleas on the animal, but as the dog walks around and lies down in favorite spots, some of the powder drops off and kills fleas and their larvae on the floor. Cats should *never be dusted* with DDT. They lick themselves so frequently that sufficient powder may be swallowed to make the cat ill or even cause death.

Spraying the floor heavily with DDT should take care of fleas regardless of whether dogs or cats are responsible for the pests.

Some other household pests may be killed by DDT, but no perfectly satisfactory method of applying it for the control of clothes moths and carpet beetles has as yet been demonstrated. In due time suitable methods may be developed, but until then the householder should not be surprised if insect damage continues to occur.

Against agricultural pests DDT has given rather spotty results, though on the whole it is an extremely effective killer. In fact, it is too effective, and many entomologists agree that it is safe to use only for the protection of potatoes. When tried against the

pink bollworm of cotton, it did a pretty good job of destroying the larvae but it also killed the insects that pollinate the cotton. DDT is now considered much too dangerous to use as an insecticide on this crop. The same will apply to a great many other crops. Nor should we conclude that it can be safely used on all crops that do not rely upon insects for pollination.

DDT is especially effective against all soft-bodied insects, least effective against hard-bodied ones. Caterpillars are readily killed by it, but adult beetles are difficult to kill. Flies, including mosquitoes, are among the most vulnerable, but we should remember that of the approximately 25,000 different kinds of flies found in the United States more than 24,500 are either beneficial or at least known to be harmless. A very large percentage of them pollinate flowers; another substantial percentage prey upon injurious insects; while a huge group is parasitic on caterpillars, beetles, sawflies, bugs, and so on. Certain

groups of flies feed on mites and other tiny creatures, and mites are not easily killed by DDT. Of course, bees and wasps are also killed, but some of them are fairly resistant and practically all of them will stand heavier dosages than the more delicate flies.

The value of some of the larger bees and flies in apple pollination in Nova Scotia has been discussed by W. H. Brittain in the Dominion of Canada Department of Agriculture Bulletin, No. 162. In addition to honey bees, some 28 other bees and 20 kinds of large flies are listed. The hordes of small flies, which are extremely abundant about the flowers of fruit trees, were not included in Dr. Brittain's report. Many of these are of considerable importance as pollinators, and since they are quickly killed by DDT, it would seem reasonable to suppose that their destruction alone would impair the setting of fruit over a period of years.

In view of this it is obvious that the general use of DDT might very quickly upset the balance of nature by

destroying the pollinators as well as by eliminating the parasites and predators that are chiefly responsible for keeping potential insect pests in check. It would be bad enough to eliminate our flowering plants by doing away with the insects that pollinate them, but there are indications that the effects go far beyond that.

There were newspaper stories to the effect that the island of Saipan (it was not named at the time) had been sprayed with DDT to eliminate malarial mosquitoes before our troops landed. Actually, the spraying had nothing to do with malaria control, because the disease has never been known to exist on Saipan or adjacent islands. But it is true that the island was sprayed—many times. Pest mosquitoes were present, and so were hordes of green-bottle flies belonging to the genus *Chrysomya*. These had proved difficult to kill. They bred everywhere—in garbage, dead bodies, latrines, etc.,—and they were caught in traps by the bushel each day. It was chiefly against these that DDT was used. Today, according to information already furnished me, Saipan Island is approaching a condition of devastation. My informant stated that there was scarcely a living thing on it. No birds, no mammals, no insects, except a few flies, and the plant life was decreasing.

It seems possible that the same may happen on the island of Okinawa. On September 16 I received a letter from an officer informing me that the insects were being kept pretty well under control by DDT, adding that chickens had died as a result of having eaten insects killed by it. The symptoms were similar to strychnine poisoning. He further added that some natives who had used DDT as baking powder had died, and that post-mortems showed nerve lesions.

In America the manner in which thousands of birds were killed as a result of spraying or dusting with DDT has been debated. The fact that chickens die from eating insects killed by it seems to give the answer. Some of us had imagined that inhalation of the spray or dust might have been responsible, but none of the experiments that have come to our notice show damage to warm-blooded animals except when the material was ingested or injected.

Despite the danger of using DDT unwisely, experiments were conducted at Bear Mountain Park for the con-

▼ THE DDT on sale for public use is a solution in kerosene or other solvent. It is intended solely for household spraying. Birds that eat insects killed by it will also die



trol of mosquitoes, houseflies, and other pestiferous insects during the past spring and summer, prove that it has a very important place in our national economy, and it may eventually eliminate certain insect-borne diseases.

Bear Mountain Experiments

In the work at Bear Mountain DDT was used with caution. Since the Park is a wildlife preserve and a popular fishing center, the object was to apply the insecticide in such a way that it would not interfere with the normal development of other animals. We had two prime problems: the control (1) of mosquitoes in the Twin Lakes camp area and (2) of houseflies in the Bear Mountain Inn and near-by buildings. Other problems also confronted us, such as the presence of enormous numbers of No-see-ums or gnats, and black flies.

The housefly problem really involved two separate projects: the control of flies in the stable and the control of flies at the Inn. In any fly campaign it is necessary to eliminate breeding places, and this was obviously easy to do at the stables by treating the manure with one of the common insecticides. DDT was ruled out because we did not know how it might affect the manure as a fertilizer and because it seemed unlikely that its lasting qualities were sufficient to survive the whole summer when exposed to sunlight.

In late April, when houseflies began invading the stable, the first spray, containing less than one per cent of DDT in kerosene, was applied. The results were obviously good. The stable population of several hundred flies immediately dropped to less than a dozen, and it was not until the middle of June that it again increased to about its original level. Even then the stable was free of flies each morning.

Our April spray had been quite skimpy. We were testing the equipment, and much of the material was wasted in necessary adjustments. As a result we applied less than two gallons of liquid, and one side of the stable was scarcely touched. A second application covering the whole of the stable and using a full five gallons was made in the middle of June. This, I think, was too little, since the wood was very dry and much of the DDT must have been carried well in from the surface, where it could not come



▲ SPRAYING THE PONDS in the test area in the Palisades Interstate Park with plain kerosene to kill mosquito larvae. Addition of DDT in amounts safe to fishes would not have been worthwhile

► THE FLIES in the stable at Bear Mountain were easily and effectively checked by spraying DDT in kerosene

in contact with the flies' feet. Despite this, the results were remarkable. Even on the worst days the fly population never exceeded an estimated 200 and in the mornings the stable was completely free of flies. As a result, the horses were able to rest during the day as well as at night, and their generally fine condition reflected the benefit they derived from the treatment.

Early in June an occasional fly made its appearance at the Inn. It was hoped to delay treatment of the building until spraying at Twin Lakes camps had been completed, but an emergency developed in the form of Punkies or No-see-ums. The season was perfect for the development of these insects, and they were a terrific pest. They are very tiny and capable of going through all but the very finest screens. They were going through the Inn screens and making the guests utterly miserable during the night. It was impossible to sit on the side porch in the evening, and since the Inn is wide open, with screening only in the bedrooms, they invaded the whole building, being attracted at night by the bright lights.

This was a problem that I had not



counted upon and one which was tackled with little more than a vague hope of success. But I had told Jim Martin, the manager, that we would take care of it. In the Inn area we used a stainless type of kerosene. We



▲ **INDOORS**, flies and No-see-ums were quickly eliminated by use of DDT in kerosene. Against flies, saturation of light cords proved particularly effective. Properly used, DDT is a valuable insecticide; but anyone employing it should observe the precautions explained in this article

not designed for throwing a high spray but we managed to spray part of the walls, the side porch, some of the eaves, and many of the screens from the outside. The screens that we could not reach were sprayed from the inside.

The results came immediately, and the guests were able to sleep in comfort. The effects lasted throughout the summer. The pests were present at a distance from the Inn, but it was possible to sit in comfort on the porch and few insects entered through open windows.

started with only a .8 per cent solution of DDT and increased it to 1.5 per cent, though I am still far from sure this was necessary. Spraying at the Inn and adjacent buildings was not an easy task. Our equipment was

Having started work on the Inn building, we decided to take care of the housefly situation. It had been my original intention to do a thorough spray job, but there were difficulties connected with this because the building was fully occupied and the people were on the move from dawn until past midnight. So we sprayed only the light fixtures in the dining room, cafeteria, lobby, and other rooms. The kitchen presented a more serious problem, but I finally decided simply to make new light pulls saturated with a 2 per cent solution of DDT. All the light pulls in the kitchen were removed and the treated ones were substituted. Members of the kitchen staff looked at me as though I were crazy when I told them that these simple strings would control the flies. I wasn't sure they would, but—they did. We obtained excellent control, and very few flies were present. In order to insure against an influx of the pests during the late part of the season the building was again treated early in September.

Mosquito control

The control of mosquitoes both in the Bear Mountain area and the Twin Lakes camp section constituted our largest experiment. For this we decided to use DDT only in the treatment of camp buildings. For one thing we wanted to limit our destruction of insects to mosquitoes as far as possible. We knew from published reports and from our own experiments that DDT was dangerous to all cold-blooded animals, including innumerable insects that furnish food for fishes. Also we were worried because there was a possibility that sudden floods might carry the chemical to the water supply system and possibly result in human illness. Because of these considerations, plain kerosene was used in spraying pools and swamps to destroy mosquito larvae, and a system of water level control took care of them in the large swamps.

The camp buildings, of which there were 300, were sprayed thoroughly inside and out with DDT in kerosene, with the result that within the camp area there were practically no biting insects during the whole of the camping season. There is some reason to believe that residual DDT will have some effect on them in the coming season.

Considering our mosquito con-
Continued on page 432

LIFE OF THE

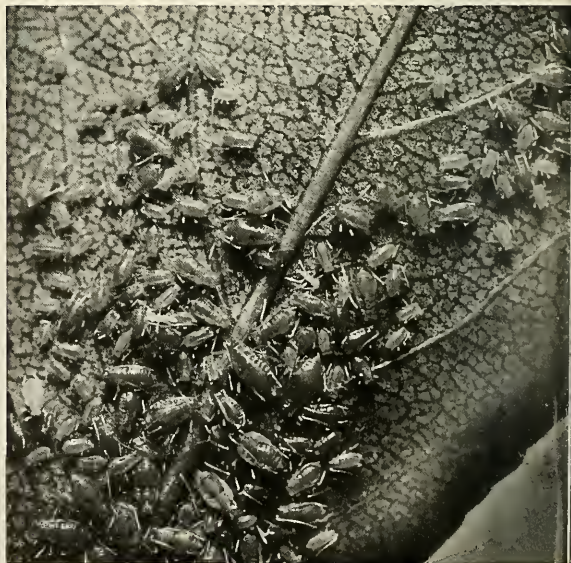
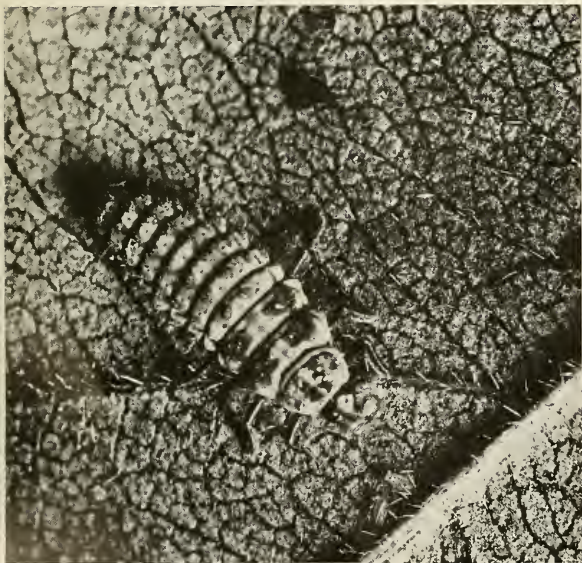
Lady Beetle

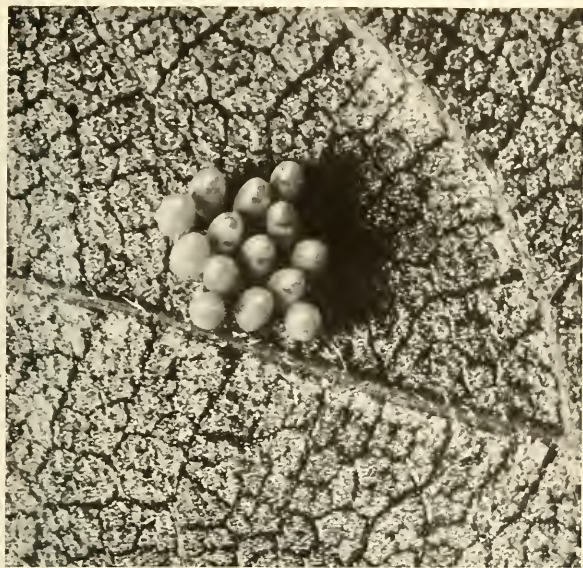
By LILO HESS

"Ladybird, ladybird, fly away home. . . ."

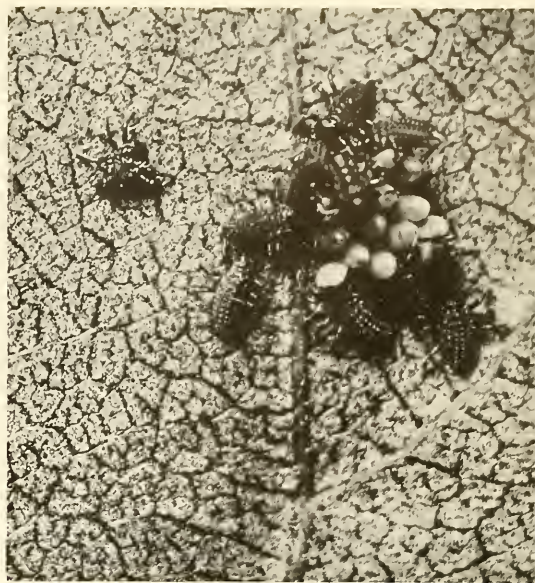
three THE LARVA eats a great deal, sheds its skin frequently, and grows rapidly. After the first moulting, spots appear on its back. The larva is usually yellowish or purplish with dark spots

four THE APHIDS consumed by the ladybeetle's larvae live on leaves or stems of plants, and are harmful to them. They vary in shape, size, and color, but are all relished by ladybeetles and their larvae





one THE EGGS of the ladybeetle are small and are of an orange or yellow color. They are laid in clusters of from 3 to 30 on the underside of leaves



two AFTER 5 TO 10 DAYS the tiny blackish larvae hatch. They are very active and go immediately in search of food, which is never very far

five THE LARVAL STAGE of the ladybeetle lasts about 3 weeks



six THE FULL GROWN LARVA is almost $\frac{1}{4}$ of an inch long and quite plump. It becomes sluggish as it matures





WHEN IT IS READY TO PUPATE, it attaches itself to the underside of a leaf with its tail end and starts to fold up its legs



IT MOVES back and forth until, after several hours, the skin splits and slips back, exposing the pale and translucent chrysalis

↑ seven

↑ eight

eleven ↓

twelve ↓

WHEN THE LADYBEETLE EMERGES, it is lemon yellow and has no spots. The markings on the head are already there. The process of emerging takes but a few minutes

AFTER A LITTLE WHILE the color changes and the spots appear. The wings look crumpled and protrude backwards. They are not folded up until later. This emerged ladybeetle is *Adalia bipunctata*





THE CHRYSALIS darkens after a while and hardens. It is firmly attached on one side to the leaf. When touched, the unattached end snaps back and forth



EXAMPLES OF THE TINY PUPA can be seen almost all through the summer and fall, since there are several generations of ladybeetles in one season

↑ *nine*

↑ *ten*

thirteen ↓

fourteen ↓

THE LADYBEETLE is one of our most valuable insects because of the amount of harmful aphids and scale insects it destroys. A large cluster like the one shown here may be eaten up within an hour

A HARMFUL SCALE INSECT which almost destroyed our orange industry in California is relished by a certain species of ladybeetle from Australia, introduced into the United States to control this pest. Collectors now go out to gather ladybeetles in bags and distribute them to farmers. The farmers liberate the beetles in their orange groves and thus protect their crop

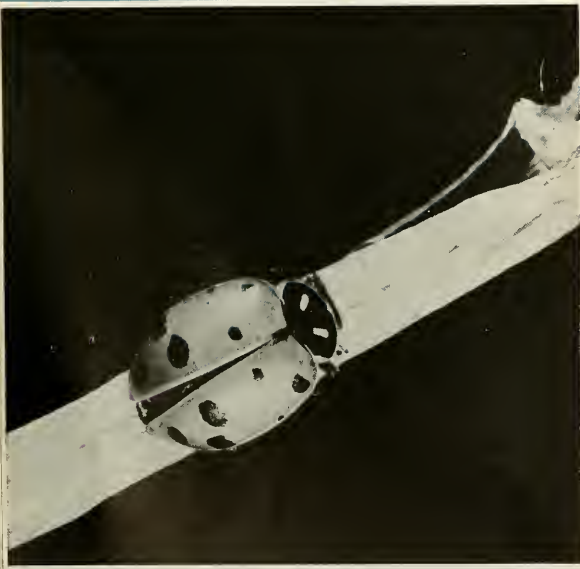




fifteen THE LITTLE BEETLE does not have many enemies. One way in which it protects itself is by "playing 'possum'"—by dropping to the ground and remaining motionless until all danger is past. Also, it gives off a repulsive odor when frightened. A young and inexperienced bird may eat a ladybeetle by mistake, but after finding it distasteful will avoid them in the future. Red is usually considered a "warning coloration" in nature and most ladybeetles are at least partly red



sixteen THE PRAYING MANTIS is one insect that does not seem to mind the odor of the ladybeetle and can be considered a true enemy



seventeen TWO THOUSAND SPECIES of ladybeetles are known. Some have spots, some are striped, and others are plain. Two of the more common ones around New York City are *Adalia bipunctata* and *Hippodamia convergens*. The one shown here is *convergens*



eighteen LADYBEETLES live usually not much more than a year, or even less. They hibernate under leaves, rocks, roofs, and windowsills. Frequently they hibernate in clusters. Such a cluster on a mountain height in Colorado is illustrated in this American Museum group



BOUNDARY DISPUTE

By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

JUST as the boundaries of states and empires shift, the geographical ranges of animals change through the years. There are ebb and flow, periods of expansion and of contraction. The King of Beasts once ruled a much larger domain than now. Today lions are restricted to sections of Africa south of the Sahara and to a few localities in southern Persia and western India. Not long ago the lions of southern Africa disappeared. A hundred years before this the lions that were once common in North Africa were exterminated. Within historic times lions roamed Palestine and Asia Minor and were found in Bulgaria and parts of Greece. During the Pleistocene, or Ice Age, they lived through much of Europe as far north as the British Isles and in southern Russia. With bears and wolves they were fearsome enemies of our early ancestors. If the California "lion," found in the Rancho La Brea tar pits, should be considered a true lion, as some students of fossil cats believe, the lion

of the Pleistocene must have had a truly extensive range.

A large flesh-eater like the lion can only exist where there is an abundant food-supply,—game animals of large size. Only grasslands support herds of the large plant-eating mammals, and the lion appears to have always preferred regions where grasslands flourish. Today lions are absent from the dense rain forests of West Africa and the Congo, although they are common in brush country and open savanna forest. Deserts that are completely waterless are also avoided, but lions are found in many hot, dry regions provided there are waterholes at which antelopes and zebras gather.

The range of a species of animal may be reduced because of climatic changes, yet the lion lived with reindeer and woolly mammoth in the Ice Age in Europe, and captive lions in northern zoos stand rather cold weather without injury. It may have been failure of the food supply that caused the lion to vanish from western Europe at the end of the Pleistocene. At the same time, the lion was probably prevented from spreading eastward by the tiger. These two great cats, about the same size and closely related, seem to be mutually

antagonistic, and the tiger appears to be the more powerful and better suited to conditions in India. It is a general rule among the back-boned animals that the closest relative of a species does not share the same territory but lives in an adjacent area.

Man, however, has been the chief enemy of the lion, and it was he who wrested much of the territory from the King of Beasts. The Egyptian, Assyrian, and Persian kings and nobles hunted lions with bow and arrow, partly for renown and as training for war, partly to benefit the peasants whose livestock the big cats raided. The cattle-herders of southeastern Europe and Asia Minor were natural enemies of the lions living in those regions and hunted them down. Against men working together, even when poorly armed, the large beasts of prey cannot defend themselves. Lions first were reduced in numbers, then destroyed in the settled areas of Egypt, the Near East, and Europe. When guns were added to the other weapons, the extermination of the lion in North and South Africa was certain. Only in national parks and in parts of Africa unsuitable for settlement will lions persist in their wild state.

Through unexpected circumstances came the rare opportunity of witnessing the private life of this normally wild bird of the desert

Watching the White-Winged

By WILLIAM H. CARR

Photographs by MARVIN H. FROST

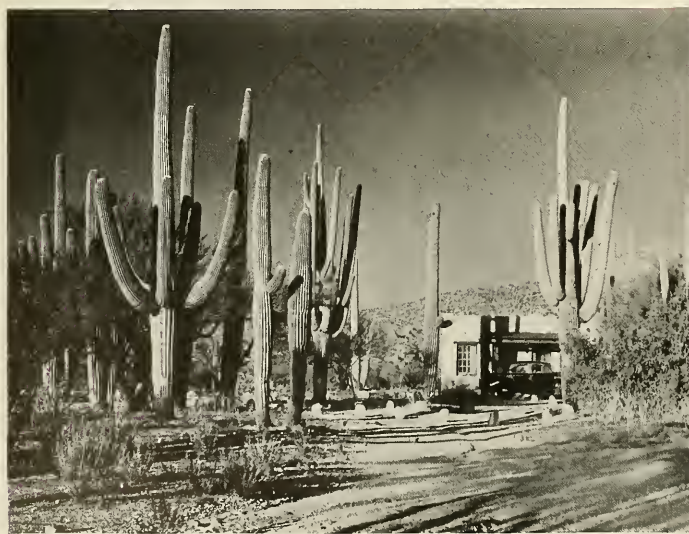
Good fortune often plays into the hands of the exploring naturalist who seeks one thing only to discover something more unexpected. An unusual sequence of events was responsible for my making the acquaintance of a normally wild bird, with a degree of intimacy surpassing all my expectations. It happened because a White-winged Dove built its nest in a paloverde tree in a desert turkey yard and a glistening black colt got a cholla in his nose. Each link in this seemingly unrelated

chain of incidents led us directly to the bird.

My photographer-naturalist friend, Marvin H. Frost, and I were visiting at the isolated Lazy Three Ranch, in the foothills of the Tanque Verde Mountains. We sought information about wildlife in the surrounding wilderness of thorn, spine, and giant cactus.

The colt came into view, following his mother into the open corral. I noticed at once that he was in distress and then observed the cruel

► THE VANTAGE POINT from which the desert dove was observed and photographed. Helen Knagge, the Ranch Lady, studies the progress of events in the nest on the Lazy Three Ranch (below), in the foothills of southern Arizona's Tanque Verde Mountains



Dove

► "SHE was a beautiful dove with trim, clean lines"



cholla clinging to his velvet-soft nose. For the uninitiated, this particular "cholla," pronounced "CHOY-yah," is an obnoxious, though handsome, form of plant life known as the "jumping cactus," thanks to its marked propensity for coming loose from the parent plant whenever its spines are brushed or barely touched by passing man or beast. It was obvious that the thing to do was to remove the barbs from the infant as speedily as possible. The capable and hospitable ranch lady, who acted as guide, grasped a stick and coaxed the unhappy animal until he was within reach. Then with a quick downward stroke she disengaged the offending spines with an efficiency born of long practice.

When the stick came in violent contact with the cactus, the startled colt kicked protestingly against a tin siding that separated the corral from the adjoining turkey yard. The resounding impact shook a paloverde tree that supported one end of the metal, and the woman gazed into the sparse branches with a worried expression. "I hope all the noise doesn't frighten my dove away," she said. "Liza has been sitting on some eggs for a long time and I watch her every day when I feed the turkeys. I'd hate to have her leave those eggs in all this heat. Her nest is so shaky anyway. You'd think the eggs would fall out!"

In this way I was introduced to the White-wing and its seemingly flimsy nest some twelve feet up in

the desert tree. There sat the dove, shielding we knew not what. We watched from a distance of about fifteen feet and the quiet brooder showed no alarm whatever as we talked and moved about. In fact, I could never have had a better chance to observe this lovely desert bird at closer range—or at least so I thought then. She was a picture of avian grace and devotion as she sat with the utmost patience while the glaring sun appeared to be doing its best to ignite the universe. Her wings were a light gray with white showing along the folded margins, and her lines were as trim and clean as could be.

I had admired the White-wings for some months, since the time of their arrival from near-by Mexico in mid-April, when I saw them flapping and sailing over the desert with their white wing-patches flashing in the sunlight. I had watched them through binoculars as they fed from the cactus blossoms in the springtime. They would perch upon the very tops of the skyscraper plants and probe the handsome white petals seeking nectar, pollen, or insects. I never learned what they secured in the hearts of the white flowers. Later, when the red fruit of the Saguaro replaced the blossoms, the doves would feed greedily upon them.

The call of the White-wing had attracted me too. The vocal accomplishment of the "Sonora Pigeon," as the White-wing is sometimes called locally, resembles a somewhat labored "cuckooing." The bird seems to re-

peat over and over again, "Who cooks for you? Who cooks for you?" Apparently no one has ever answered the question.

Certainly the nest of the turkey-yard White-wing was admirably suited to the place and temperature. It was the first of many I was to see and consisted of a seemingly haphazard collection of very small, loosely interlaid twigs placed upon a small crotch in the tree. The construction, however, was certainly adequate, for it permitted available air currents to circulate from beneath and from the sides, providing whatever relief possible from the heat.

Presently, of her own volition, the bird flew off and perched upon the top of a saguaro, repeating, "Who cooks for you?" I immediately took advantage of the opportunity and placed a small stepladder beneath the nest so that I could investigate. In addition to two eggs there was a very small, unprepossessing nestling that paid no attention to the face peering over the edge of its natal platform. One of the eggs was typically that of a dove, white and slightly elongated. The other was smaller and was covered with brownish spots. It was not a dove egg but belonged to that opportunist of the bird world, the Cowbird, who lays its eggs in the nests of others, thus giving the unwitting foster parents the dubious privilege of hatching and rearing unwanted young along with their own.

I had barely had time to grasp the situation when the parent bird flew toward us and alighted upon a corral rail, to walk restlessly up and down, impatient to return to her duties. I left the spot promptly and retired a sufficient distance to ease the bird's agitation. I had scarcely gone when the dove settled upon the twigs once more and resumed her sheltering position.

The nest site was an ideal one to photograph, so without disturbing the bird further, we made plans to return the next day. The next day we arrived early to find the dove temporarily missing. Placing the stepladder beneath the tree once more, I soon learned that the cowbird egg had disappeared. Only the dove's egg and the little bird remained. I examined the fledgling closely, but it did not acknowledge my presence by any sign whatsoever. It was dark gray, almost black, and its incipient feathers were bound in tight little sheaths upon

wings, sides, and underparts. Its dark eyes were closed most of the time, but occasionally it would open them and look nowhere in particular, only to close them again in the face of the relentless sun.

Mr. Frost, who had taken my place on the ladder, had barely completed making his photographs of the infant when the faithful mother once more appeared. This time she alighted on the roof of the turkey shed, six feet away, and paced up and down until our paraphernalia had been removed and we had left the yard. The bird then returned to her parental duties, almost at once.

Later Mr. Frost returned and made a photograph of the mother on her nest. In the meantime we had taken the precaution of building a temporary support so that if the bird became too nervous we could operate the camera by remote control. However, the dove permitted Mr. Frost to hold his camera practically on a level with her head and did not budge when the mechanism clicked. Neither the camera nor the photographer seemed to disturb the bird at all, then, or at any future time.

All this time we had been as quiet as possible, trying not to alarm the bird. I was amazed at her "tameness," for experience had taught me that, while it was possible to approach to within about ten feet of some White-wings, whose nests were located in the desert far from human contact, the brooding birds would nevertheless fly off if one came too close. On a later occasion I had examined a particularly attractive White-wing nest, situated in the heart of a large cholla cactus, and another on the limb of a mesquite tree. The brooding dove, in each instance, would leave the nest when I was some 30 feet away. I attributed the relative tameness of our bird to the fact that her particular nest had been placed where people frequently came and went without ever disturbing the dove.

I could never be certain of the sex of the ranch White-wing, for the male and female are difficult to distinguish. I knew that both parents took turns incubating the eggs, but I never saw more than the one bird on any of my visits. On every occasion when the bird flew off and returned, I observed that it was the same individual, for it had a slight injury on one of its reddish legs that had resulted in a blackish discoloration.

On the one morning that I was able to come early, I found the dove on the turkey-house roof waiting to enter the nest, and I felt certain that this would be the other bird. Naturalists who have repeatedly observed the bird's nesting habits, and have gone to the length of killing brooding doves to prove their point, maintain that the female of the species cares for the young during the early morning, late afternoon, and night, whereas the male takes over during midday. But again it was the same bird. We called the dove "she," because it displayed such outstanding maternal characteristics, but to this day we are not certain it was not the male.

We gleaned additional information from the other nest, out in the cholla cactus. Frost and I visited the nest as frequently as we could, and one day we had the luck to see *both* parents at home at once. One bird was brooding characteristically, and the other was half-reclining upon the nest edge, its breast feathers touching the back of the sitting bird. It almost seemed that one dove was attempting to shelter the other from the intense sunlight. When the birds flushed at our approach, we found a tiny infant that had just hatched. The newly broken egg lay beside one that had not yet been opened. The very small dove clutched the nest side, actually some distance from the bottom of the shallow receptacle. Its miniature feet were attached to the twigs with surprising strength for a newcomer into the world.

The blind mite was amazingly active. It struggled upward with somewhat the same erratic motions that one associates with a little bird straining to free itself from the egg. Its head tossed from side to side, rather violently, as it progressed. Perhaps it had not yet been thoroughly "convinced" that its freedom had been gained! Very gently I disengaged its toes and placed it down in the nest. Could it be that some birds, struggling to emerge from eggs, find their release quickly and with comparative ease and employ the remaining "unused escape energy," unwittingly, to clamber up and out of the nest? Possibly the wind is not responsible for blowing as many newly hatched young from their nests as is supposed. Certainly our dove seemed bent on self-destruction. Its feet were capable of grasping and holding onto the twigs with firmness, to say the least. Per-



▲ THE WHITE-WINGED DOVE NEST. So well was this platform concealed from the ground that if the parent had not flown off, it would never have been discovered

▲ JUNIOR'S BRIGHT EYE peers from beneath its parent's wing as both birds survey the photographer

▼ EVEN when the ladder was brought within three feet of the nest the dove did not move. But if a hand were offered, she would strike it violently with her wing. In this picture her wings are poised to deliver a downward blow



haps the instinct that prompted the naked infant to cling to the twigs when I replaced it in the nest bottom might have saved it from falling when the edge had been reached! Who knows!

As for the adults: whether the second bird was standing by, to protect the young one while its mate continued to sit upon the unhatched egg; whether it was there to attend the delivery of its offspring; or whether the entire incident was mere happenstance, I truly do not know. It is often far too easy and too dangerous to interpret certain behavior in nature by assigning motives to the performers. Too often speculations may be idle, but they are food for thought anyway. Sometimes they produce worthy results, especially if repeated observations bear out one's conclusions.

Mr. Frost returned to the cholla nest the following day only to discover that the second egg had barely hatched and that both parents were present as before. They left as he approached. While he watched, the "mother" returned and flew off again for a distance of about 75 feet, to drop the broken egg shells, making two trips to accomplish this. The actions of the parents at the nest practically duplicated those of the previous day. The newly arrived dove clung to the side of the nest too, not upon the bottom, and to use Frost's words, "It gave a bad beating to the empty egg shells, kicking them all over the place!"

A week passed before we were able to visit the Lazy Three Ranch again. This time "Liza" was firmly ensconced upon the nest and the young bird had grown apace. The wing and tail feathers of the youngster were revealed in color and pattern. Early adolescence was in full swing. "Junior" was much more active than formerly and observed our approach from the protection of the mother's wing. We could not learn whether the other egg was present or whether a very small dove had recently emerged and was completely hidden by the older bird's body.

We moved the ladder even closer to the nest, and the patient Mr. Frost mounted it in his very best slow-motion style, barely moving as he inched his way upward until he was in the proper position and his camera was some three feet from the subject. The parent watched him curiously but



▲ WITH EVERY FEATHER in place and white showing along the wings, the faithful dove shelters her young from the desert sun



▲ "JUNIOR" in pinfeathers, photographed during one of the rare moments when the parent bird was away. The other egg vanished

did not seem overly alarmed. The little dove showed interest in the proceedings too, and looked at the strange apparition with no particular excitement.

Several exposures were made, then we decided to encourage the mother to vacate the nest for a time so that the little one could have its portrait made. To accomplish this we obtained a taller ladder and placed it carefully against the palo verde, very close to the nest. We also wanted to learn what had happened to the other egg, photographed on our first visit.

Though the ladder was only three feet away, the dove did not depart. She merely turned about, the better to watch us. I climbed the ladder and still there was no particular action

in the nest. Then Mr. Frost climbed up and once more brought his camera into play. Quickly he secured several more pictures of the parent, expecting her to fly at any moment. Finally he extended his hand toward the White-wing, positive that she would leave. To his surprise, which was so great that he almost fell off the ladder, camera and all, the mother suddenly raised her wings and struck his hand with all the strength she could command. While the blow, in itself, was not painful, the effect of the unexpected action was decidedly startling.

Here was a real exhibition of parental defense. "Liza" simply would not leave! Later I gently tried to lift the bird with a small stick. She merely repeated the wing-striking and

moved about the nest to avoid the stick. The baby, in the meantime, climbed out on a convenient branch far enough to avoid the defensive operations carried on so strenuously in its behalf. There it stood, teetering back and forth, appearing very much disturbed and woebegone. We discovered that the other egg was no longer in the nest. What had happened to it, or to the cowbird egg, we never did know.

We desisted and retired to the ground to discuss further strategy. We did not want to lift the dove bodily from her position, so we decided to try to obtain a photographic record of the mother's behavior. One of us climbed the ladder while the other manipulated the camera from an adjacent stepladder. Once more the mother beat the offending hand as the shutter clicked. While she was engaged in her courageous campaign, she spread her tail, fanwise, and fluffed her feathers generally so that she appeared much larger. We had observed this procedure in many

birds, particularly the Great-horned Owl, which "swells" enormously when excited.

My point of observation was so close that I was actually touched by the bird and was able to examine her minutely. When her slightly rounded, white-tipped tail was spread, several brownish feathers were revealed in the center. An exquisitely colored bright bluish patch surrounded each eye. When the desert wind ruffed the sitting bird's feathers she would close her eyes momentarily and we could see that the eyelids were bluish too. The pupil of the eye itself was black, encircled with a ring of orange red. A suffusion of greenish iridescence upon the neck shaded into the soft grayish back. There was a short black line on either side of her throat. When the wings were folded, one could see a white edge. When viewed from a

distance, especially against the sun, a great deal of this detail was naturally lost. When our observations were concluded, we left the birds to themselves, never to disturb them again.

One morning, several days after we had left, the ranch proprietress went out to feed her turkeys and discovered that the White-wing nest was empty. No doubt a young dove was flying among the cactus giants, not far off in the desert, learning the art of perching upon the spines that guard the tips of the saguaros. Possibly its mother or father, or both birds, accompanied it. In any event our adventure with the doves was at an end, and the very last connection we had with the entire incident was when we drove past the Lazy Three Ranch some weeks later and saw the same little black colt following his mother through the cholla cactus, this time without any spines in his nose.

▼ ANOTHER DESERT WHITE-WING NEST was discovered in this chollo cactus plant, well fortified with spines against marauders. The bird was on the nest when this photograph was taken





F E TU

Mrs. Snapper's habit is to
inquiring photographer

◀ ADULT SNAPPING TURTLE, showing the powerful razor-like jaws. Snapping turtles are found east of the Rockies, from the Gulf of Mexico to southern Canada

▼ CLOSE-UP of the tail



I HAD contracted to make a moving picture for educational purposes on the life story of the Snapping Turtle. It is one thing to take a snapper's portrait and quite another to show its life cycle. Having had quite a few years' experience with creatures of the fields and woods, I knew what happens in the life of the snapping turtle; but matching one's wits with these creatures and being at the spot when some of its most important duties are performed is something that takes planning. Then too, there were lighting problems. If and when these activities occurred, how could I tell whether the lighting would be suitable for camera work?

I set to thinking about how all this could be accomplished in a setting that would be right for good photography. I came to the conclusion that the first thing necessary was a pond with authentic surroundings in a spot where sunlight would be available from early morning until late in the afternoon. In such a setting I would have my subjects where I could study them. The only solution was to have a pond constructed on my premises.

FERTILE TURTLE

By LYNWOOD CHACE

Photographs by the author

bury her 20 to 30 eggs, but the
wanted to see what was going on

So I secured the services of a contractor and constructed a pool 20 feet wide by 40 feet long.

When the pond was completed, I went into the swamps, collected water plants, and planted them in and around the pool. All this was not done in one day. Many trips to swampland had to be made before the setting was properly arranged. At one end of the pond I made a sandy beach where Mrs. Snapping Turtle could lay her eggs, because that was the sort of spot she would want. After working strenuously for about a week I had my pond ready for occupancy.

The next thing on the program was the actors. I hadn't the time to go hunting them myself, so I inserted an advertisement in our local newspaper and also in the news broadcast on the radio, stating that I wanted some snapping turtles and also the eggs. This worked out very well, for within three days I began to get results and in two weeks I had fifteen specimens in my pond and 84 snapping turtle eggs. I buried the turtle eggs in a sand pile I had carted to my premises.

One of the shots I was planning to get was of the baby turtles in the process of hatching from the eggs. I knew it took three months for turtle eggs to hatch, but I wanted to know



▲ MOTHER TURTLE preparing to lay her eggs. She digs a hole in the sand with her hind feet and covers the eggs. The sun incubates them

▼ SHE deposits the eggs at the rate of about one a minute, until 20 to 30 are laid. Here the sand has been scooped away to give a better view. The young turtles hatch in about three months, but the author had to build a plate glass window into the ground so he could see when to get his photographic equipment ready for the event





▲ EXTREME CLOSE-UP of the first stage of hatching. The baby turtle has pierced the shell with its head and one foot

▼ "EVERYBODY'S DOING IT": a half-dozen young snappers taking their first look at the world

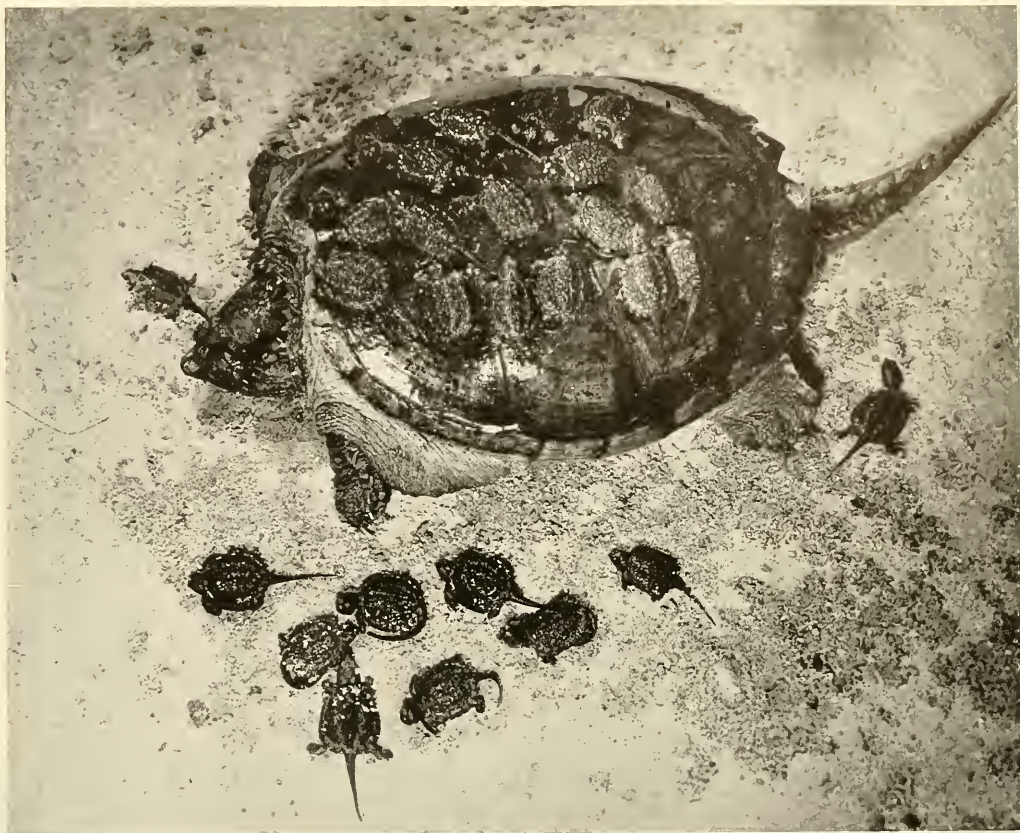


the exact minute when this was going to happen. The only way to be certain was to have some way of checking on the turtle eggs, yet it would not do to interfere in any way with the process of incubation. So I placed a piece of plate glass upright in a hole dug in the sand, and put the turtle eggs in the hole down one side of the glass and covered them. Then I scraped the sand away from the back side of the glass. In this way I could see what was happening to the eggs at any time. The arrangement was entirely successful, and I was able to photograph the whole process of hatching.

Then came a much more difficult problem; getting the sequence of Mrs. Snapping Turtle in the act of laying her eggs. I had fifteen snapping turtles in the pond; and the special sand beach was just right for a turtle inclined to lay eggs. But when would this happen? It was just a matter of patiently waiting and hoping that a turtle would crawl out of the pond one day and put on her act. Two months passed and nothing happened, and the constant vigil was beginning to tell on my partner and me. One evening we were busily engaged in drilling a hole in the concrete floor of the pond to insert a sub-pump so that we would be able to drain the pond, because the water had to be changed at times. The pond was empty of water at the time, and the turtles were all up on the embankment walking about. My partner had just started off to get a drill when he noticed a snapping turtle digging about in the sand. On further examination we soon came to the conclusion "this was it."

We certainly were caught off-guard. All the photographic equipment had to be brought to the scene and set up. It was about 8 P.M., and darkness was falling so rapidly that artificial lighting would have to be used. I have never worked as fast as I did that evening. The turtle, by now, was making great progress with the hole in which to lay her eggs, and our whole aim was to get shots of the entire procedure.

I rushed into the basement of the house to connect a 100-foot extension cable and run it out to the pond. Wire fencing enclosed the pond, and this had to be cut with wire clippers in order that the camera and equipment could be brought close enough to the spot Madam Turtle had chosen. After the fencing had been cut,



▲ TWO-DAY-OLD SNAPPERS are small compared with the bulky adult. The snapping turtle does not mother its young. The baby turtle must face life alone from the time it hatches

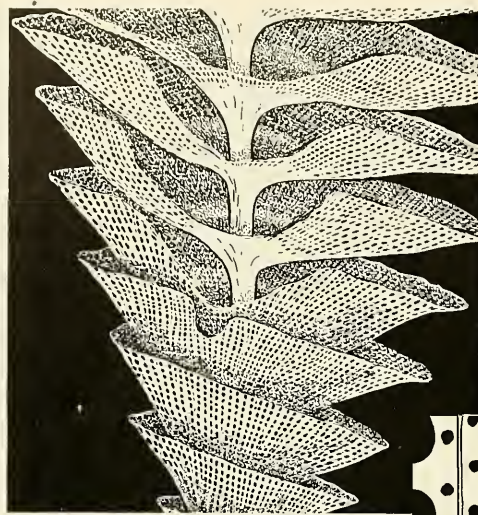
◀ YOUNG SNAPPERS swimming under water, where they will secure much of their food. If very lucky, they may grow into huge two-footers



in the greatest haste, I began setting up the lights. At the same time my partner, with all speed possible, was loading the film magazine. When all the equipment was set to go, I jumped to the camera and began focusing, fearing that the turtle might become discouraged at any moment with all this interference of her domestic duties. However, I began shooting, and once under way, nothing seemed to change her plans. She went right ahead and laid her eggs as though it were specially for us. So we succeeded in photographing the whole process.



▲ THE *Archimedes* SPECIMEN, seen *below* through the lens, slightly enlarged, with frond almost entirely preserved, though crushed. Its details are well recognizable



Drawings by Paula Hutchison

◀ PARTIAL RECONSTRUCTION, about three times enlarged, of an *Archimedes*, with part of the frond broken away to show the "screw." Both obverse (inner) and reverse (outer) sides of frond are visible

▼ DETAIL (enlarged about 30 times) of obverse side of frond. Large holes are fenestrules ("little windows"); small pores on vertical branches (marked by keels) lead to cells which house individual zooids



A Sample of Sea Floor of 260 Million Years Ago

By OTTO HAAS

Associate Curator of Invertebrate Paleontology,
The American Museum of Natural History

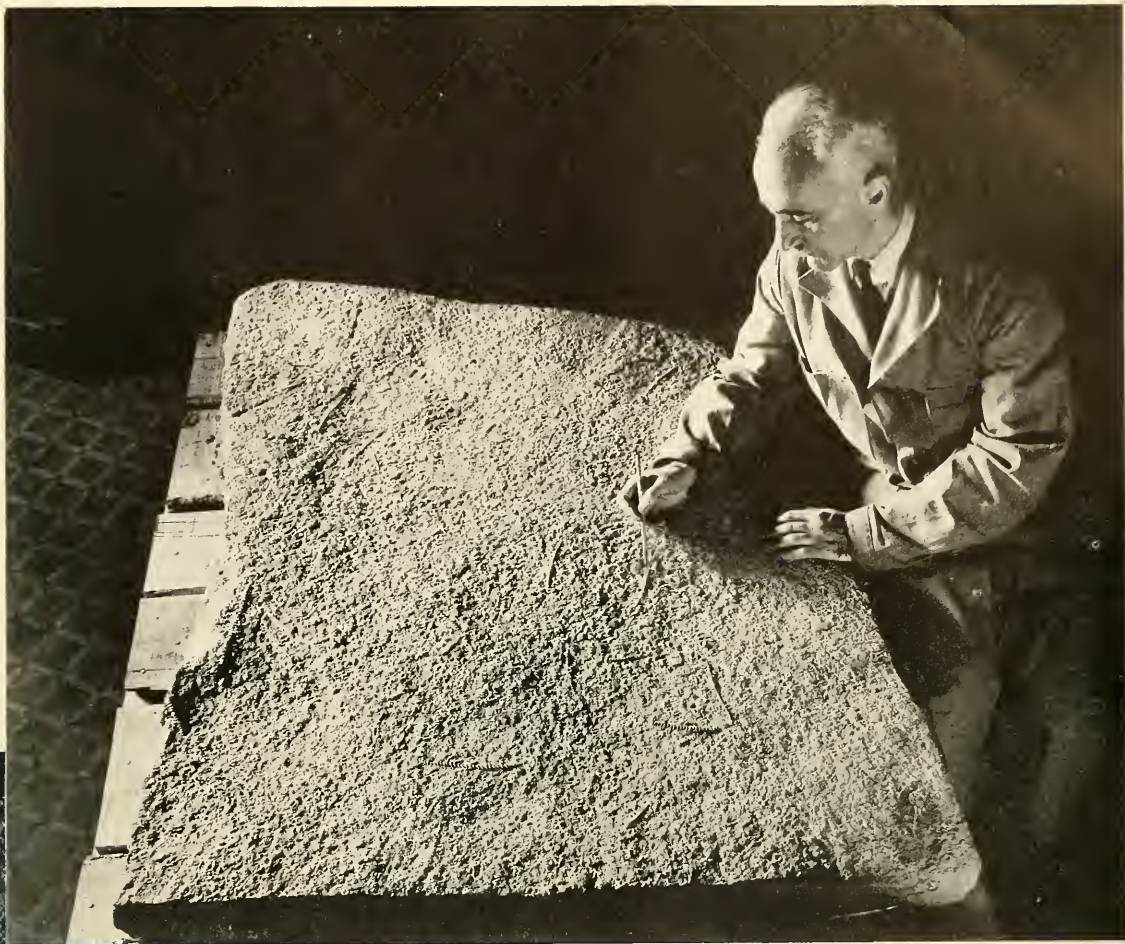
THE slab of rock shown on these pages, four feet five inches long and three feet seven and a half inches wide, is now being prepared for exhibition in the American Museum's Hall of Geology and Invertebrate Paleontology. On arrival at the Museum it weighed more than a ton and a half; for reasons of safety its weight had to be reduced by halving its thickness.

This slab, which the writer collected about a year ago near Crane, Indiana,* consists of Glen Dean limestone, one of the rock formations of the Chester series. Its surface is covered throughout with the hard parts of almost 50 different kinds of animals that inhabited the sea of the Mississippian period which, about 260 million years ago, deposited the Glen Dean limestone. Thus, the slab presents an almost complete picture of the animal life of that sea.

The total number of animals pre-

*The story of its discovery, recovery, and shipment to the Museum is attractively told, in a fairy tale fashion, by Mrs. Jane Capen Dale in the article "*Archimedes* and I," published in the current issue of *Junior Natural History*.





◀ PART OF SLAB, showing the same *Archimedes* surrounded by many fossils of various kinds

▲ WHOLE SLAB, with the writer pointing to the specimen whose frond was so unusually well preserved

served on the surface of this slab, not counting many more within the rock, may be estimated conservatively at several thousand, if the colonies of bryozoans or moss animals, which predominate among them, are counted as individuals. However, each of these colonies includes tens of thousands of cells, or zoecia, which, as long as the colony lived, were inhabited by a zooid each. If the zooids were counted as individuals, a total of many millions of animals would be readily reached.

Most conspicuous among all the fossils contained in this rock are the spirally coiled "screws" which supported the delicate, lacelike skele-

tons of certain moss animals (bryozoans). Science named them *Archimedes* after the famous Greek philosopher and scientist who lived between about 287 B.C. and 212 B.C., because they exhibit the spiral curve that also is known under his name. To some of these screws the meshwork of the skeleton, called the "frond," is still attached; its structure is illustrated and explained opposite. Many other bryozoans, brachiopods (lamp shells), gastropods (snails), and a few representatives of other groups of marine invertebrates ("backboneless" animals of the sea) round off this picture of teeming life of long bygone days in the earth's history.

The Naturalist on a "BUSMAN'S HOLIDAY"

By DILLON RIPLEY

Ardent collectors on service in far corners of the world have found time to pursue their scientific hobbies, and museum collections have continued to grow despite international unrest

N OBODY can prevent a sailor on furlough from taking a row-boat out on Central Park lake. Apparently it was almost as hard to stop a naturalist or a museum man from indulging his profession wherever the war happened to carry him.

A well-known student of birds from Cape Cod was a Navy officer on a small vessel carrying cargo and munitions in the Bismarck Sea. Taking advantage of a brief stop at one remote island after another, he managed to make a valuable collection of bird specimens from the Solomons. His collecting equipment was crude enough. One look at it, and the average meticulous scientist of peacetime would have thrown up the sponge. His only weapon was a twelve-gauge sawed-off shotgun, known as a riot gun; his ammunition, slugs or buck-shot. And yet with this assortment of

firepower he secured a couple of hundred specimens of great value to museum research. Some of his specimens, believe it or not, are the size of our local warblers and sparrows.

In the last year or so museums all over America began to receive packages from servicemen in far places. Some of the names on the boxes of specimens are those of well-known museum collectors of peaceful times. Others are of enthusiastic amateurs. Some of the collections run to hundreds of specimens. Others are small boxes with a handful of birds or a single tin of fish or shells. But all are welcome and are gratefully received by the biggest museums in the country.

Most of the specimens had blank labels tied to them with numbers but no localities. Censorship had seen to that. The collector could carry a notebook with names, numbers, places, and other information important to the

scientist, but he couldn't mail it home.

The complications of collecting in wartime were many and varied. The average serviceman didn't have much time to go around poking through the bushes looking for specimens. It's not even an easy way to relax. But it is educational and offers enormous diversion from the ordinary routine of life in camp or aboard ship. The easiest collecting I know of was done by a friend of mine, a well-known expert on snakes from Kansas. He was stationed somewhere in India. Every day the camp area was policed, and the chances were very good that someone would find a snake. At first the GI's used to shoot them full of holes, but later they brought them back to "Doc," who carefully put them into old tin cereal containers filled with preservatives. So far he has collected about 23 species ranging from cobras and Russell's vipers to harmless rat snakes. It's as easy as the proverbial rolling off a log.

One of the largest collectors in this war was the United States Government. The Army and Navy sent out a number of museum specialists to the jungles of the South Pacific. It was the job of these men to study small tropical forest mammals, rats, squirrels, shrews, or marsupial forms, like miniature kangaroos and opossums. Many of these animals may be carriers of fleas or ticks bearing deadly diseases such as spotted fever. By studying the occurrence of these diseases, lives of servicemen could be saved on the jungle battlefronts. Specimens of these animals and often of birds as well were collected and sent back to Washington to the Navy or Army Medical collections, from which they were finally transferred and deposited in the United States National Museum.

Collectors sometimes have to be ingenious. One Army officer on a mission in the Himalaya mountains walked through southern Tibet and western China. Birds are scarce at high altitudes. Above 11,000 feet the few patches of trees and gardens where they would be found are mostly close to the Buddhist monasteries. But the Lama priests are very strict about killing animals, and guns are forbidden. My friend met a British government agent who taught him how to use a slingshot, "firing from the hip" so that the Lamas wouldn't notice. He finally managed to get a round dozen of specimens,

Continued on page 436



Drawing by Felicien Philippe

"Now I've seen everything!"

People of the Past

By ALFRED MÉTRAUX

Bureau of American Ethnology, Smithsonian Institution,
Washington, D. C.

On a barren and desolate plateau in the heart of South America live the Chipaya Indians, a carry-over from the days of the Incas, untouched

All photographs by the author

* MOTHER AND CHILD. The hair of the Chipaya woman is dressed like that of the mummies. Notice the large silver pin, or "topu," in her hair



THOSE who have journeyed across the highlands of Bolivia, south of Lake Titicaca, can never forget the strange "villages" that loom over the horizon along their road, either perched on mountainous slopes or scattered along barren plains. The modern Indians avoid these places, and, if forced by necessity to approach them, they never fail to recite a prayer or to present as an offering their *acullico*, a quid of coca leaves taken from their mouth.

Seen from a distance, the structures are not terrifying. They are small, square towers with low doors, invariably turned to face the rising sun, and their construction shows the care of men who have worked long and hard. Age has left the towers intact, and though made of adobe, they appear neat and clean. Were they not so geometrical, a casual observer might confuse them with huge termite hills.

The industrious, stern-faced people who built these structures are still there, wrapped in heavy woolen garments and huddled in the grim chambers, as if driven there by a sudden storm. But they are silent, for they are only *chullpas*—the dried mummified remains of the folk who once owned the land.

▼ IN THIS VILLAGE, situated south of Lake Titicaca in the highlands of Bolivia, live the Chipaya Indians, descendants of the ancient Collas. Their claim to distinction lies in the fact that they are the only living people who can give us an idea of rural life at the time of the great Inca empire



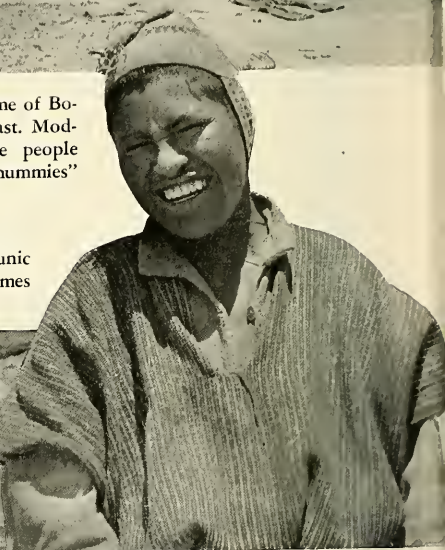


▲ A CORNER of a "ghost" village. Modern Indians try to avoid these towers, because they contain the dried, mummified remains of the people who once owned the land



➤ A CHIPAYA HUT, home of Bolivia's people of the past. Modern Indians call these people "the leftovers of the mummies"

➤ THIS CHIPAYA BOY's woolen bonnet and woolen tunic are typical of garments worn in pre-Hispanic times



◀ EVEN the gestures remain unchanged. Before she drinks, the woman spills part of the contents of the cup on the ground in honor of the gods

These people were the ancient Colas or Aymaras, whose descendants form the bulk of Bolivia's population. Modern Indians, however, deny any relationship with the "gentiles" clustered in these burial places, for they believe the chullpas were heathens who were banished from life by a divine curse. Strange legends circulate about them. It is rumored that the "antiguos" (the ancient ones) had fabulous treasure hidden somewhere in the crevices of the mountains. But few are those who succeed in gaining access to it. The dead "gentiles" are dangerously vindictive and always ready to inflict misfortune on the poor Indians.

To the Aymara Indians of the region of Carangas and of the Poopó, the race of the "gentiles" is not entirely extinct. They know that in the south of the Department, near the Salinas de Coipasa, there is still a village inhabited by their descendants. They call them *chullpa puchu*, "the leftovers of the mummies." These living mummies are not a mythical people; they are the isolated Uro-Chipaya whom I studied during two anthropological expeditions in 1932 and 1939. They are the last representatives of a primitive people who occupied large areas of the Bolivian Highland in remote ages, but who were already on the decline when the Spaniards arrived. The conquistadores heard strange stories about them: they were reputed to be so primitive and so filthy that the Inca, unable to obtain any tribute from them, had or-

dered them to bring every year to the Cuzco, tubes filled with their own lice. They lived mainly around Titicaca, subsisting on fishing and building the reed balsas on rafts which have become so famous.

Today, the last Uro are a handful in the village of Ancoacui, near the mouth of the Desaguadero. The Chipaya are another group of Uro that had remained unknown until Max Uhle mentioned their existence toward the end of the last century. The first scientist to visit them was Dr. Posnansky of La Paz. He brought back from this trip a short vocabulary which proved beyond doubt that the Chipaya were closely related to the Uro of Ancoacui. Dr. Rivet of Paris attempted to demonstrate that their language was related to the Arawakan dialects of the tropical lowlands and that the Uro were perhaps the remnants of an old population that had come from the eastern forest and occupied the valleys and plateaus of the Andes.

The poor Chipaya themselves admit that they occupy a strange position in the world. They readily recognize the differences between themselves and the Aymara Indians of the region, and they comprehend that they share some common heritage with the grinning "mummies" they have glimpsed in the darkness of the adobe chullpas. They explain their presence in the deserts by a myth, which I shall summarize: "Long ago, the sun would rise in the west. Man said: 'We

shall put the doors of our houses in the east.' As soon as they had uttered this wish, the sun altered its course and rose in the east. All the men, women, and children died in the huts. They are the present-day chullpas. But one man and one woman escaped by diving into a river. They went downstream walking under water. Finally they arrived at a barren and desolate plain, where they built a village. They labored at night as other people work by day. At length they were discovered by an Aymara Indian, who summoned a priest. The latter came and sprinkled the village with holy water. The spell was shattered and the children of darkness once more could enjoy the beauty of light and the warmth of the sun. Now these people live as everybody does, but being the children of the dead, they wear the costume of the chullpas and still put the doors of their huts toward the east. The language they speak is the same as the one used by the 'gentiles.'"

"The barren and desolate plain on which we live . . ." I still remember the bitterness with which this phrase was uttered by one of my informants. I know of no other region that causes such an overwhelming impression of isolation and emptiness. A flat immensity, patched by white saline deposits, is dominated by unnamed mountains towering over the 12,000-foot plateau. Life here is brutally harsh. One awakens in the morning with limbs numbed by cold and heart

▼ AN ARTIFICIAL FLOOD is created by the people during the rainy season when the river is high. This fertilizes the barren and desolate plain and enables the people to maintain their meagre pastures



▼ LLAMAS pasturing near Chipaya village. The people also raise sheep and pigs





▲ "NECESSITY IS THE MOTHER OF INVENTION." There is not a single tree, not even a cactus, from which to construct a house, and the soil is unsuitable for making sun-dried brick, so the Chipaya make huts of sods cut from the marshy ground



▲ BUILDING THE HOUSE. The Indians heap the sods to form round huts somewhat like Eskimo snow-houses though structurally different



▲ THE SOD WALLS of the houses sometimes have thatched roofs made of arched bundles of tola, a shrub that grows on the highlands

▼ CHIPAYA RELIGION is a blend of old Andean beliefs and rites with some Catholic practices. The tower of their church is worshipped as a powerful fetish



▼ THE CHIPAYA worship a host of spirits, or *mallkus*, represented by cones of sod built on low platforms in isolated spots about ten miles from the village



▼ CONSECRATION of a llama before sacrifice. The animal is decorated with woolen tufts, exposed to the smoke of incense, sprinkled with alcohol, and covered with coca leaves



oppressed by the thin atmosphere. Only at noon, when the sun burns intensely and one dozes lazily against the wall of a hut, does one feel rid of the night's spell. On these highlands a feeling of emptiness seizes the mind, and wherever the eyes turn they are caught by a gray expanse, relieved only by the ardent blue of a midday sky. Grimmiest of all is the great silence, an iced, unearthly stillness which is never interrupted and to which one can never become quite accustomed. It is a silence unbroken by human voice, or even by the remote cry of a bird or animal.

Here, in the midst of a cursed country, the Chipaya have their village. They are as isolated on their desert plain as natives on an island surrounded by a vast sea. Not one segment of their history is known. Their position in these dreary surroundings speaks, however, of their struggles against the warlike Aymara, who must have driven them into this desert abode. To this lost village of the desert has been given, by an irony of fate, the curious destiny of perpetuating down to our times, the architecture, dress, social organization, and religious beliefs of the people of the Inca empire, four centuries after the disappearance of that civilization. For the Chipaya have preserved far better than the Aymara the traditions of the past, both in material and spiritual culture.

I arrived at Chipaya late on the eve of New Year in 1932. The mirage this day was playing all sorts of tricks on us: at times full lakes were formed and disappeared, towns sprouted like plants above the horizon, llamas were changed to colossal camels. We advanced across the plain, guided only by the spire of a church. Coming suddenly upon the village, we discovered that the Chipaya were celebrating a feast, and our arrival was totally unexpected. Yet, no surprise was shown. The calm of the highland was not disturbed by the trifle of our presence. I entered the hut of the chief, to find myself surrounded by a group of ghostlike men. They exchanged few words and remained perfectly immobile, squatting on the ground.

A single glance about the hut was sufficient to solve many minor problems of Andean archaeology. The hair of the Chipaya women was dressed like that of the mummies we had seen. The brown robes and the white and black belts were identical to those we

had exhumed just a few days earlier in some chullpas of the region of Huachacalla. Even the folded cloth worn by the women on their heads had been depicted on Inca pottery. Miniature bronze idols jingled in their braided hair. These were antiques that the Chipaya had adapted to their own use and were exactly like those discovered in the ruins of Tiahuanaco, the mysterious city of the Titicaca, which was already a heap of ruins when Columbus discovered America.

Indeed, all the objects about me seemed to have been rescued from the archaeological past. Even the gestures remained unchanged; the chicha, or maize beer, was served in two cups as it used to be among the Inca. This custom was explained by a Spanish chronicler: "It was politeness and courtesy at the court of the Emperor to present the guest with two cups, one of which he offered to whom he wished." Then, as now, part of the content was spilled on the ground in honor of the gods.

The Chipaya managed to survive in their inhospitable homeland by a prodigy of work and skill. They dug across the plains an intricate system of small canals, which drain the waters of the Rio Llauca, west of their territory. In the rainy season, when the river is high, they create an artificial flood, which fertilizes the plain and allows the people to maintain their meager pastures. Thus, they raise sheep, llamas, and pigs. With the milk of the sheep they make cheese, which they trade with their neighbors for coca, alcohol, potatoes, and maize.

The problem of building a dwelling is the most difficult the Chipaya face. Nature has refused them any natural shelter and deprived them of everything that might be necessary to construct a house. On their desolate plain there is not a single tree, not even a cactus, and the soil is not suitable for making sun-dried brick. Yet here ingenuity has again overcome all obstacles. Like the Eskimos, who cut blocks of snow to make their snow-houses, the Chipaya hack large sods and heap them to form round beehive huts that have a strange likeness to the winter houses of the Arctic people. In the village, however, the sod walls of the houses have a thatched dome-shaped roof made of arched bundles of tola, a shrub that grows on the highland.

What has been called Inca communism still prevails in Chipaya. The pastures belong to all members of the two moities into which the village is divided. In the village itself the individual owns nothing except the little patch of land upon which are built his house and corral. The arid lands cultivated by the Chipaya are divided into long strips 30 feet wide and are redistributed each year among the different families.

January and February on the highlands are months of storms and rain. Swollen rivers flood the sandy plains, and the entire territory becomes a vast swamp. Grass grows taller and greener; pigs find better food in the bogs. These months can be a time of unaccustomed abundance; from them comes prosperity, existence,—or annihilation. In some years the rain is late and storms break up beyond the horizon. Then the blue sky becomes a threat and the clans feel the pangs of fear, for if the rains do not visit the Chipaya, it means death to the herd, hunger and famine for the people. In order that the waters may come to fertilize the sands, the men beseech their pagan deities and the ancestral ceremonies are celebrated once again according to rites almost as immutable as the blue Andean mountains.

Chipaya religion is a blend of old Andean beliefs and rites, with some Catholic practices intertwined. The main deities of their public cult are the Earth-Mother, who is often confused with the Virgin Mary, and a host of spirits (*mallku*) represented by cones of sod built on low platforms in isolated and secret spots about ten miles from the village. They also worship the mountains on their horizon, the Llauca River, and the tower of their church, which is a powerful fetish. The community is also under the protection of sacred stone fetishes, or *samiri*. Each household also recognizes spirits represented by stuffed wildcats or hawks.

The high point of the ceremonies observed for these deities is the sacrifice of the three animals on which the pastoral Chipaya depend for their subsistence: a llama, a sheep, and a pig. Each animal, decorated with woolen tufts, is exposed to the smoke of incense, sprinkled with alcohol and covered with coca leaves. Then the ceremony begins. The native priest, or *yatiri*, slits the throats of the animals. As the blood gushes from the arteries, it is poured into bowls con-



◀ THE PRIEST, or *yatiri*, slits the throat of the animal, pours the blood into bowls containing flour, and throws it toward the four points of the compass as an offering to the spirits

taining flour and is thrown toward the four cardinal points of the sky, as an offering to the spirits who own the world. When the spirits of the air have received their share, the cone fetiches, or *malku*, are smeared with blood, which in red streaks covers the dark brown stains of past rites.

No aspect of Chipaya religion is dissociated from blood sacrifice: even the Catholic crosses and the chapels are splashed with blood offered to the Saints. When a house is built, a sheep is sacrificed and its blood is sprinkled against the walls and roofs. These Indians also offer to their deities a curious beverage—a brew of maize beer, feathers, incense, copal, flowers, crystals, pulverized sweets, mineral powders, and leaves of gold and silver paper. The same mixture was spilt in honor of the God of the Inca, but instead of leaves of silver and gold paper, costly gold and silver jars were

presented in days gone by. The offerings today are a shadow of the past—make-believe treasures suggesting the splendors of a vanished age.

The hard struggle for life has made the Chipaya sordid and miserable, but when the blood of their herds is lavished on their deities, they seem to emerge from their usual apathy. They dance to the sound of drums and flutes, shout and pray with profound fervor. They heartily devour in a communal meal the flesh of the victims, drink themselves out of their minds, and resume their dances until they fall exhausted to the ground.

At carnival time, they symbolize the desired fertility by huge wreaths of fruits and cheese hung from the tower of the church, and by the outfits of the dancers, who carry bundles of fresh grass, strings of brown eggs, dead ducks, stuffed vicuñas, and other objects.

Between feast periods, life is dull and monotonous. People scatter to their small huts in the pastures, where they watch their herds. Their exist-

◀ CUPS containing a sacred brew are offered to the deities. It is made of maize beer, feathers, incense, copal, flowers, crystals, pulverized sweets, mineral powders, and leaves of gold and silver paper

▼ THESE INDIANS are so dependent upon llamas, sheep, and pigs for their subsistence that the women will even play wet nurse to young animals



▼ CHIPAYA WOMAN nursing a baby





▲ CHIPAYA INDIAN spinning yarn for their woolen garments and blankets

▼ A CHIPAYA COUPLE. Family life lacks tenderness. Quarrels between husband and wife are frequent and often terminate in mutual thrashings



ence is not idyllic. The village is rent by the rivalry and jealousy between the two main clans; and pitched battles with slings or with cudgels are fought over the water rights. Stealing water is the supreme crime and is the cause of many internal feuds. Family life lacks tenderness. Quarrels between husband and wife are frequent and often terminate in mutual thrashings. In too many cases, parents-in-law interfere, with consequent turmoil. Sometimes these family spats end seriously. A few days after I had first arrived at Chipaya, I joined a crowd rushing toward a small hut. Entering, I found a woman on the ground. Her eyes were widened, her face convulsed, her tongue swollen. She had just taken her life by pulling a woolen rope around her neck with one hand, while she held her baby with the other. The Indians regarded the scene dispassionately, none showing pity or fear. Even the parents and relatives stared at the body without apparent comprehension. Suddenly, as if prompted by a signal, the women sank to the floor and started the shrill chant of the bereaved. Meanwhile, I asked questions, believing that a crime might have been committed. But the Indians merely informed me that the woman had killed herself to annoy her husband, with whom she had quarreled at breakfast. Perhaps she had hoped to loose a spirit that might plague the man who had spoken to her so harshly.

Another aspect of Chipaya life that is particularly impressive to a white man is the unbelievable filth of these Indians. Dust and grease build around their bodies in a thick crust, which breaks at the joints. Lice, also, constitute an unpleasant part of the Chipaya personality. In the whole world, only Tibetans possibly rival the Chipaya in bodily filthiness.

Yet this sad people, squalid, indolent, untutored, and indescribably poor, are a carry-over from the days of the Incas, whose nation once ruled over large parts of South America with fabulous wealth and mighty armies. The Chipaya are the only Indians who may still give us an idea of rural life in a remote corner of a great empire. Time has passed them by, leaving them almost untouched. When the round Chipaya huts and the blood sacrifices to the Inca Gods vanish, one of the last living remnants of the Inca empire will also have passed from the earth.



▲ THIS WOMAN is weaving with a loom common in pre-Columbian days. One end is supported by pegs stuck into the ground, the other end is attached to her belt

▼ LITTLE GIRL and her piglet. Pigs are important economically to the Chipaya, yet on occasion the Indians make pets of them



DDT—THE ATOMIC BOMB OF THE INSECT WORLD

Continued from page 405

trol program as a whole, DDT actually played a very small part. The addition of DDT to the kerosene for control of larvae, would not have added greatly to its efficiency, since tests have shown that DDT is effective for only about three weeks in strengths that are safe for fishes. One part of DDT in 10,000,000 parts of water will kill fish. The same concentration is not as effective in mosquito control as oiling, although it can be applied at much lower cost.

Exit Malaria

Malaria, carried by certain species of *Anopheles* mosquitoes, is one of the most serious diseases in the world. It occurs throughout the tropics and over much of the temperate zones, and approximately 300,000,000 people suffer from the disease or its effects at all times. The number of deaths exceeds 3,000,000 annually, but this huge death toll represents only a fraction of the ravages of the disease. Those who suffer from it often require months to regain their strength and vitality. Every possible method of reducing the number of victims is obviously worthy of trial.

The mosquito control program in Panama, consisting of draining swamps and oiling temporary pools, together with screening of buildings and treating of patients in mosquito-

proof rooms, is a classic example of malarial control. The actual control of the *Anopheles* is directed against the larvae, and it is a year-round job. Fresh mosquitoes are always invading the edges of control areas, and victims of the disease bring the plasmodium parasite into the zone in their blood and are potentially dangerous carriers if adult *Anopheles* are present.

The use of DDT is changing our tactics in fighting malaria, and there is every reason to believe that the disease can be wiped out over very large areas. The new system of attack has been thoroughly tested in Italy and is being tried in this country on a large enough scale to determine its efficiency under American conditions.

This control measure aims at the adult mosquito. It consists of spraying the insides of buildings with DDT in kerosene, making sure that all dark places are very thoroughly treated. This does not prevent mosquitoes from entering the treated building, but it pretty well guarantees that they will not escape from it. Any mosquito resting on a treated surface is practically certain to die. Even though it may have sucked the blood of a malarial victim, there is little chance that it will live to transmit the disease to anyone else.

The great value of DDT in this type of treatment is that a single application will remain effective for at least six months, perhaps for a year or more. In Italy it was proved to be

effective for eight months. Also, the cost of the material should not exceed two or three dollars for the average home—a very cheap price to pay for the elimination of malaria, not to mention the riddance of pests.

The same treatment should also control dengue, a less dangerous but debilitating disease that is transmitted by the yellow fever mosquito, *Aedes aegypti*. Indeed, it should be even more effective, because *aegypti* breeds in larger numbers about urban dwellings. Its distribution is limited to areas having an average temperature of 65° F. or higher.

Do's and Don't's

In closing, it might be well to give some brief advice regarding the use of DDT.

DDT is a deadly poison if taken internally. It should always be marked as such and kept out of the reach of children and animals. We know nothing about its possible cumulative effects on human beings or pets. It causes skin eruptions on some people and "hay fever" in others. There is no evidence that it is injurious if inhaled in the open. Spraying in a closed room should be strictly avoided—all windows should be open.

DDT is no more effective in the control of *Anopheles* larvae than Paris green. It is generally less effective against bottom-feeding mosquitoes than oiling is, and its effects do not persist any longer, but it is cheaper to apply. However, it is deadly to cold-blooded animals when used in mosquito-killing quantities.

DDT kills birds as a result of their eating insects killed by it.

DDT should not be used outdoors at the present time. We may discover safe ways to use it against certain plant pests, but we know too little about it to recommend its general use.

DDT, used properly in the household, will destroy pests and it promises to eliminate malaria and dengue, two widespread diseases, if applied inside all buildings where these diseases occur. It is much less efficient as a fine spray than as a coarse one.

Finally, do not use DDT unless you know you are using it properly. Your results will be most disappointing unless it is properly applied.

All remarks concerning DDT will apply also to Gammexane, a British product said to be even more toxic than DDT.

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Prehistoric remains

In Southern Nevada

Photographs by RICHARD L. CASSELL

IN southern Nevada, 20 miles north of Las Vegas, a dry wash yielding the remains of numerous prehistoric animals was discovered by Mr. Fenley Hunter, of Garden City, N. Y., and announced by George Gaylord Simpson in 1933.* Captain Richard L. Cassell, whose nature photographs have been seen from time to time in *NATURAL HISTORY*, recently sent the accompanying photographs of the locality, where he is on Army duty, showing the tusk of an Imperial Elephant in the ground.

These finds are interesting chiefly because there is evidence that human beings lived in the region at the time of the extinct animals, as indicated by charcoal and a hand-worked piece of obsidian. Not only have elephant remains been found, but also those of horses, camels, deer, bison, ground sloths, and at least two small rodents.

"Except for the cobblestones of the 'stream' bed," writes Captain Cassell, "the entire vicinity of several square miles is of a fine compacted silt, which crumbles freely and is of an off-white color. It is within this material that the prehistoric remains are found. Unlike the almost perfectly preserved prehistoric remains from the La Brea Tar Pits of southern California, however, these fossils have undergone marked disintegration.

"It is thought by some that the remains were carried by floods into the region from the mountains that bound the entire section. The nearest range is about 30 miles distant. However, what forces have been acting in these parts for the past 40,000 years or so is anybody's guess."

Considerable work has been done in the area by the Southwest Museum and the California Institute of Technology. The readiness of the fossils to crumble is urgent enough reason for amateurs not to disturb them.

*American Museum Novitates No. 667.

➤ **CRUMBLING RESULTS** from even slight stresses in these delicate remains, preventing the removal of specimens by any but the most skilled hands

PREHISTORIC REMAINS



▲ A TYPICAL SCENE within a few hundred yards of where the tusk was found, showing a cliff of the fine compacted silt characteristic of the region



▲ THE TUSK of an Imperial Elephant which roamed southern Nevada thousands of years ago. There is reason to suspect, however, that primitive man had entered the region by the time the deposits were laid down



TWO SQUARE YARDS

—And down you go, to study nature
photographically at ground level

WE hold our heads high because evolutionary forces are strong. Who has thought of crawling about on his hands and knees as an occasional change? We miss many wonderful sights by not getting down to earth once in a while. On the ground and near it, innumerable plant and animal situations can be observed. Unbend the man-made dignity and become as curious as a child seeking an adventure.

Despite the threat of November's leaden skies and the too crisp air, dress for photographic action and journey to a wooded area adjacent to a field. Wander along the transitional zone, head down for better study of the plant life on the ground. Watch for a spot that contains a wide variety of specimens. When you find it, get down on all fours, probe around a bit, and clean the area by removing dead leaves, twigs, etc., but take care to retain the naturalness of the setting. If your woods and meadow are away from the beaten path of cityfolk, a few square yards of ground will reveal various types of photographic subjects.

For this day's photography, we need a low tripod and some method for making close-ups. The tripod can be one of the small, table-top models or of the larger type if spreading the legs will lower the head close to ground level. With the latter, a prop may be needed to hold the camera the right distance above the ground. A panoramic and tilting tripod head or a universal joint will permit easy maneuvering of the camera while you are composing the picture. Close-up lenses and a collapsible ruler are packed in the gadget bag. The complete set will enable cameras that are not equipped with long bellows to work as close to the subject as ten and one-half inches. At short distances, the depth of field is exceedingly shallow; so remember to use as small a lens aperture as the sunlight and wind will allow. The camera is operated at crawling eye-level so that we may avoid the foreshortening that occurs if we photograph plants from a standing or even stooping position. Backgrounds must be surveyed carefully from this low angle. To think of pictures in terms of so low an eye-level will cause more wear and tear on the knees than on the head.

Among the prominent plants will be the slowly browning burdock with its burry, globular seeds. Instead of the usual over-all picture, select a section of the plant showing the thick stems, heavy leaves, and viciously hooked fruit. The

By **THANE L. BIERWERT**

*Acting Chief, Division of Photography
American Museum of Natural History*

All photographs by the author

illumination will be best when the rounded fruits have a shadow along one side to show the shape. Another large plant is the milkweed, which early in the month may still have a few pods with parachuted seeds undispersed. A striking portrayal of this plant can be made by shooting upwards at the pointed pods silhouetted against the sky, with the sunlight streaming through the white, silky, buoyant down.

On the ground in the shady spots will be the creeping club-mosses, which are often used for Christmas decorations. This shiny, dark green plant with its cedarlike leaves produces erect candelabra-like fruiting stems. A carpet of club-mosses offers many possibilities for interesting compositions. A low camera position and glancing sunlight will create pleasing pattern photographs. It will be wise to use the exposure meter, because of the dark tones in the deep green caused by the acute illumination.



▲ THE SHAGGY YELLOW WITCH HAZEL offers one of the few opportunities for flower photography at this season



▲ FOWLER'S TOAD will pose readily on a warm day—if you can find him

Even smaller, but just as noticeable as any other plant, are the lichens that grow just inside the woods. Some will appear to be splashes of paint on rocks, while others will have definite forms and shapes. The flat, round, gray-green *parmelia* clings tenaciously to smooth rocks. An acorn or a leaf should be included in the picture to show the relative size of this interesting plant. Near by, on rotting branches you can photograph the minute, coral-like, gray *cladonia*. To show the form of this species, which may be all of one inch in height, the negative must be sharp enough to stand enlarging. These small plants are exceeding fascinating, and once you know them, you will search for new species as diligently as most of us do for wild flowers.

The flowers are gone at this time of year, except those of the shaggy, yellow witch hazel; and to photograph them, we stand up.

It may not seem possible, but on our two-square-yard plot we are even able to find animal life, if we look for it.

Under stones, branches, and rotting logs huddle beetles, ants, spiders, and crickets. The coolness of the weather makes them sluggish and more inclined to pose for a picture. Select a natural habitat for an individual animal. Vary the scenery for each animal so that it will not be obvious that all the pictures were made on the same day. Set up the tripod and camera, and focus on the spot where



▲ "BRITISH RED-COATS": one of the lichens that will attract the "down-to-earth" camera-man in his autumn explorations. (*Cladonia cristatella* enlarged about $3\frac{1}{2}$ times)

the animal is to be placed. Gingerly place the "model" in position, being careful to cause no damage to the legs, wings, or antennae. Within a few minutes the creature will warm up in the sun and strike a natural pose. As a reward for such good behavior, return it to the protection of its winter home.

In the humus beneath the leaf matting and just below the surface of the ground in the wooded area, we might be able to uncover a red eft, a toad, or a wood frog. These batrachians have but recently dug in for the winter months, and if we get out early enough in November, we shall not harm them. On a warm day these animals will pose very readily. Place the creature on a predetermined point, facing in the direction for the best illumination. Slowly coax and guide it into an alert stance. Because of the unnatural temperature, this type of work is quite critical. Unless a person is a good naturalist, he should not attempt to dig out and then return amphibians or other hibernating vertebrates to the winter quarters. There are too many other interesting subjects waiting to be photographed at this time of year.

On our small piece of ground, but above crawling height most of the time, we might see a number of cocoons waving in the breeze. A common one is the brown, silky, pointed bag of the *cecropia*. These are a problem for the impatient photographer on a windy day. Fortunately, they are anchored so strongly that they come to rest very rapidly when there is a lull. Photograph them against a blue sky, without a filter, with textural illumination to show the structure of the cocoon surface.

It is not necessary to venture far afield for a variety of pictures. They can be found on a small piece of ground that has been chosen for its diversity of natural material. Two square yards is a tremendous piece of ground if you undertake to record everything on it. Should you have facilities for working closer to specimens than a distance of 10 to 12 inches, you can select an area of only one square foot.

The few plants and animals mentioned above are but a small percentage of the dozens that grow on a two-yard plot. How many different ones can you find?



◀ A LOW CAMERA POSITION will give pleasing effects with the club mosses, which are often used for Christmas decorations

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THE NATURALIST ON A "BUSMAN'S HOLIDAY"

Continued from page 424

including a pair of white pheasants, common enough in parts of Tibet, but known only by a handful of specimens in American museums. The Britisher and the Army officer made a ceremonial call one afternoon on the Grand Lama of a large Tibetan town and afterwards went for a walk along the river bank in their best uniforms. They noticed a duck swimming in an eddy of the stream. Taking careful aim, the Britisher fired a pebble with his slingshot with perfect precision. But to their horror the bird floated out into midstream. And so the surprised townsfolk were treated to the sight of two solemn representatives of the United Nations capering up and down the bank of the Brahmaputra river, waving branches of driftwood and trying frantically but without success to reach their prize.

Sometimes this indulging of hobbies can be a bit dangerous. An authority on insects from Harvard stationed on New Britain Island was mauled by a crocodile not long ago. For some reason or other he stepped on the beast while out for a stroll, looking for bugs no doubt.

A buck private, an old hand in peacetime at searching for birds and their nests, got himself up into a sort of tower in a deserted barn in North Africa. There were four stork's nests, one at each corner of the tower. Just as he was getting absorbed in the problem of which stork's egg to pick for his collection, the Germans began shelling the place, thinking it an artillery observation post. There was a big hog-wallow down below, and the private lost no time in jumping. He landed safely but at the cost of one uniform and a cracked stork's egg. Finding that the egg was just about to hatch and being a thrifty soul, our hero attacked the problem with infinite patience and succeeded finally in skinning and preserving a good specimen of baby stork.

And so it goes. All around the word today are scientists and naturalists in uniform. Many of them have been able to get to places that were little known even to museum explorers before the war. Most of these men worked up to twelve hours a day; some, of course, were on the fighting fronts, and yet nearly all of

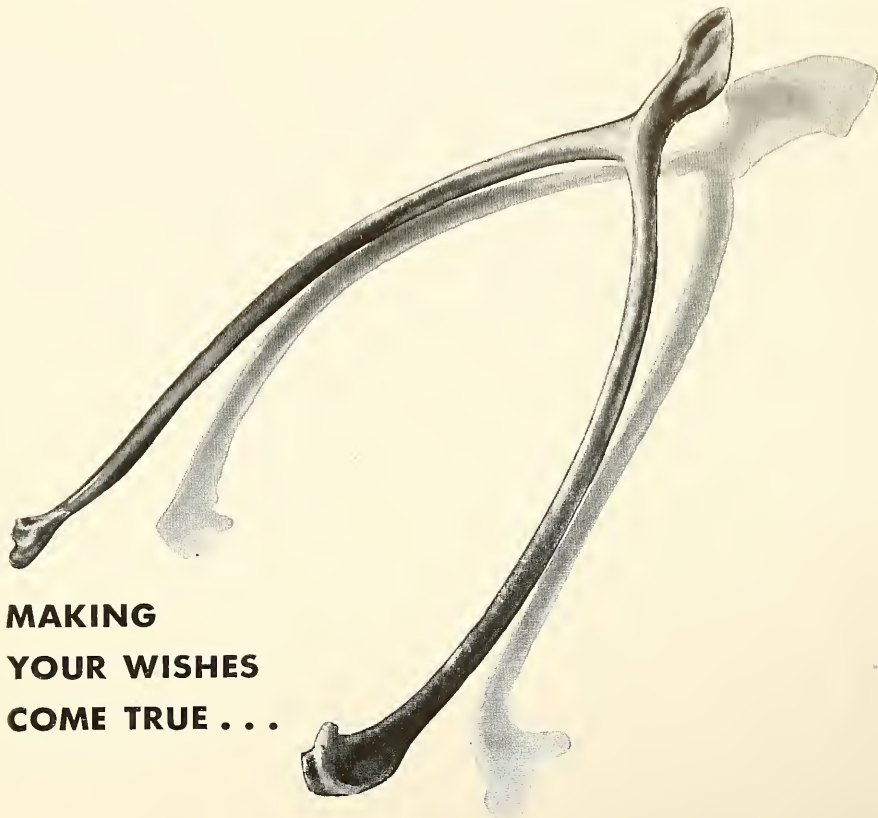
them have tried from time to time to look about and do some collecting. Furthermore, the Army encourages this sort of thing up to a point, knowing full well the morale value of hobbies for men often bored and lonely at unfamiliar sights and places far from home. A considerable number of men, particularly in isolated posts, have written through Special Services to the United States National Museum in Washington, asking for copies of the "Field Collector's Handbook" printed by that museum, which tells how to make a collection of everything from fish to fossils.

Collectors are hard to embarrass. Not long ago I was staying at a small Army camp in India. It was late afternoon. Dressed in a towel, I was standing at the window of my palm leaf hut shaving. Suddenly I saw a green woodpecker fly into a tree about 75 yards away. It was a forest bird which I had not seen before. Without thinking, I grabbed up my small shotgun, which I had been cleaning, and ran out. I stalked the tree, finally saw the bird and fired. In the silence that followed I heard a murmur of voices and looking round, remembered what I had completely forgotten, the C.O.'s cocktail party. There on a small hill in full sight was a large group of guests staring open-mouthed at the sight of a gawky creature, towel precariously hitched, stalking out of the bushes with gun and bird.

"I knew it," said somebody. "Crazy as a coot."

Now that the war is over, I am sure that other rare specimens will be secured, particularly in the Pacific. Few people know that there is a small swamp bird, a rail, found only on Iwo Jima and one of the Bonin Islands. There isn't a museum in America that has a specimen. Has anybody seen one yet? To be sure, they may be extinct, but they can hide better than any Japanese soldier I've ever heard of. There should still be some around. I wish somebody would find out.

One of the Ryukyu Islands, just south of Okinawa, is called Miyako. There's a kingfisher on Miyako known only from one specimen in the Tokyo Museum. It's probably not rare at all. Before the war no one ever got to Miyako to find out. Well, now's the chance. If I know my collecting friends, one of them will manage to take a busman's holiday on Miyako Jima sometime soon.



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NATURAL HISTORY Magazine





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Yet wartime conditions give TB a new lease on life — *human life*.

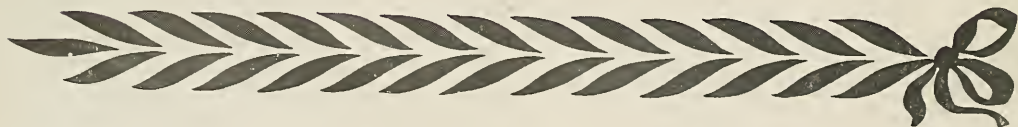
So please, *help us bring up the reserves*. This year, buy *extra* Christmas Seals. Remember, *there can be no peace treaty with tuberculosis*.



BUY CHRISTMAS SEALS

Because of the importance of the above message,
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NATURAL HISTORY MAGAZINE





December **NATURAL HISTORY** 1945

Aleutians—Island Necklace of the North • Holly

Petrified Forest • Wildlife Refuge • Cats' Voices



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The Magazine of the American Museum of Natural History

FREDERICK TRUEBEE DAVISON, President

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VOLUME LIV—No. 10

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DECEMBER, 1945

THE COVER THIS MONTH

Snowy Owl.....Cover Design

*From a Kodachrome by Edward Bailey and Leon Boltin.
See description at right*

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You will find NATURAL HISTORY Magazine indexed in *Readers' Guide to Periodical Literature* in your library



THE SNOWY OWL

The snowy owl is one of the interesting inhabitants of the Arctic regions in both the Old and New Worlds. As with various other animals of the far north, its white dress makes it inconspicuous against a snow-covered background, but does not serve so well against brown fields and evergreen vegetation.

This owl hunts by day and feeds largely upon lemmings, rats, meadow mice, hares, squirrels, and such prey, but it also captures a few ptarmigans and ducks and even fish. Some individuals make their way south to our borders every winter, but in years when food is scarce—which happens every four to nine years—a real invasion takes place and hundreds or even thousands are reported in many parts of this country, sometimes as far south as North Carolina.

The snowy owl nests on the open tundras and makes its simple nest in a mere hollow on the ground or on a low tussock, with little or no lining. The white eggs—usually five to seven or eight—are laid at broken intervals, and incubation starts with the first egg, so that by the time the last egg is hatched, the oldest young may be two weeks old or more.

JOHN T. ZIMMER.

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LETTERS

Continued from page 437

Your question might serve to introduce a "tercentenary celebration" commemorating the discovery of "animal hypnotism," for in 1646 a Jesuit priest, Athanasius Kircher, published a book in which he described the trick of "hypnotizing" chickens in exactly the manner to which you refer. The result so astonished his contemporaries that the phenomenon became known far and wide as *Father Kircher's Wonderful Experiment in Bewitching Hens*.

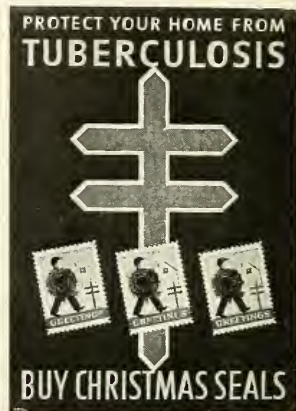
It might have been better if the term "bewitch" had been retained, because the phrase "animal hypnotism," which was introduced about 200 years later, only served further to confuse an already obscure subject. The condition observed in animals bears only the most superficial resemblance to true hypnosis as seen in human beings. So little is known concerning the basis of hypnosis that there would be no profit in any extended discussion of the subject, but it should be emphasized that the hypnotized subject or patient is put in a peculiar mental state which permits him to accept readily the suggestions of the "operator." Everything depends upon the subject's maintenance of a receptive frame of mind. The transference of ideas, feelings, and emotions from operator to subject is the keystone of the hypnotic trance.

Nothing like this occurs in lower animals. The so-called hypnotic condition in animals involves two unique types of behavior. The individuals affected remain

relatively motionless for varying periods of time, during which they fail to show any response to many external stimuli that ordinarily would elicit a definite reaction. Physiologists and psychologists who have studied this phenomenon in animals refer to it as *tonic immobility*.

Inducing the state

Tonic immobility can be induced in a wide variety of animals, ranging from planaria to higher mammals; and in different species the condition may persist from a few seconds to more than an hour. Among the invertebrates, certain arthropods are particularly susceptible and become immobile in response to light touch



upon any one of several critical regions of the body,—the thorax, antennae, or the bases of the wings. To interrupt the motionless state it is necessary only to touch the animal's feet.

Some amphibians and reptiles show tonic immobility when properly stimulated. The American chameleon can be induced to remain motionless if it is suddenly turned on its back and restrained from any immediate righting movements. Many common frogs and toads "freeze" under similar treatment, and I have seen the same condition induced in alligators.

Many birds and mammals pass into a state of tonic immobility in response to sudden inversion followed by a brief period of restraint, and, as your friend correctly informed you, guinea pigs react readily to this treatment. In the library of the American Museum there is a book entitled *Human and Animal Hypnosis* which contains pictures of crabs, toads, frogs, lizards, alligators, crocodiles, pigeons, owls, peacocks, hedgehogs, rabbits, guinea pigs, cats, lions, foxes, bears, monkeys, and chimpanzees, all in the condition of tonic immobility produced by suddenly turning the animals on their backs and temporarily preventing them from righting themselves. I hasten to add that I have not personally observed this experiment with any mammal larger than a cat, and I confess to some wonderment at the man whose scientific zeal is strong enough to induce him to play catch-as-catch can with a bear or lion,—but the important point is that tonic immobility

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NATURAL HISTORY, DECEMBER, 1945

unquestionably can be induced in many different animals by the same technique.

The explanation

Although no one knows for certain what bodily changes may be responsible for this curious behavior, it is suspected that the treatment causes the release into the circulatory system of specific glandular secretions, and that these hypothetical chemical agents partially paralyze certain higher nervous centers in the brain. It is significant that in any given kind of animal the condition of tonic immobility usually persists for a definite and relatively unvarying period of time. This observation has been taken to indicate that the chemicals lose their potency at a predictable interval after their introduction into the blood stream.

One very interesting aspect of tonic immobility lies in the similarity of this condition to the behavior known as "playing possum" or "death feigning." Members of several animal species react to the appearance of a potential enemy by assuming an "upside-down" position, remaining quite motionless, and failing to exhibit normal responsiveness to many types of stimulation. This behavior, which is often erroneously interpreted as a rational response intended to deceive the would-be enemy, is probably nothing more than a variant of tonic immobility.

Although tonic immobility and true hypnosis have very little in common, it is reported that the former state can be induced in human beings. Perhaps you are sufficiently adventurous to try the following instructions, taken from a very serious scientific article, "If a man bends forward at the hips to form a 90° angle, places his hands upon his abdomen, takes a deep breath, and is then suddenly thrown violently backward through 180° by two men, one standing on either side of him, a state of pronounced tonic immobility lasting some seconds may result." To this lucid understatement I can only add that I regard the predicted consequences as being highly probable! Should you care to carry out a practical test, I would be interested in learning the nature of your findings.

* * *

SIRS:

At first glance your October issue, containing articles on the atom and on Arizona ground waters, looks most interesting and worthwhile. I shall get at it soon.

At the same time, I confess to a grouch on your magazine because the portrait of an Arizona scorpion you published in the June issue shows so little of the normal *joie de vivre* of those desert cusses—so little "punch" in its attitude and so obligingly poised a tail. . . . Having known them intimately and endeavored to photograph them, I can only conclude that this scorp had either bitten the photographer and was repentant or that the creature had been anaesthetized, as I personally have often done.

I further desire to say that the writer had certainly never been punched by a scorp, or he would not talk about bee stings. I have seen a six-foot 200-pound man put into a coma for almost 24 hours by one punch from a 2-inch Arizona scorp, and there was little utility left in



CACTI AND OCOTILLO near Indio, California. A photographic study by Gladys Diesing

him for the next 48 hours. And this is not just one instance. . . . As for myself, I have had the same experience and the same prostration. The pain is very great. I would prefer to deliberately caress a hornet's business-end every day than get punched once in 30 days by a scorp. . . .

NATHAN C. JOHNSON.

Englewood, N. J.

Dr. Willis J. Gertsch, Associate Curator of Insects and Spiders at the American Museum, offers the following explanation:

"I believe that the difference of opinion expressed by Mr. Johnson is due to a consideration of different species of scorpions. The 2-inch Arizona scorpion that he mentions as having laid a 200-pound man in a coma for almost 24 hours is doubtless one of the two extremely venomous Arizona species. About these we would have told a very different story. They are dangerous, and people fear them with good reason. However, most scorpions, in fact 95% of them, do not have a venom that is capable of causing serious systemic distress. As Dr. H. L. Stahnke,

Continued on page 477

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MEET YOUR ANCESTORS:

A Biography of Primitive Man

— by Roy Chapman Andrews

The Viking Press, New York, \$3.00

WAR or no war, interest in human origins continues. For several years now many professional and amateur archaeologists have been away in the armed services, but neither the collection nor the publication of new data has entirely ceased. Digging foxholes and clearing ground for airfields in various parts of the world have yielded not a little new and valuable material. Meanwhile, the stay-at-homes, like the author of this book, have not been idle. The steady accumulation of new facts about early man makes it necessary to retell his story every few years in order to keep it up to date, and Dr. Andrews, possessed of more enthusiasm than the average professional, is well fitted for the task.

His book is concerned primarily with the physical evolution of man and only secondarily with his cultural development. It names and describes the principal skeletal discoveries of our direct and collateral ancestral human and pre-human types as made in Europe, Africa, and Asia during the last 125 years, with emphasis on Asia as the probable place of origin. Some attention is given also to finds of ancient man in America which, however, while suggestive, are mainly cultural. The romance connected with these discoveries must be taken for granted, but even the more or less technical descriptions should prove of interest to the lay reader. In addition to a lively and readable text, the book is illustrated with a space distribution map, a time distribution chart, and 18 drawings—five of which are copies of ancient cave paintings. Finally, the end papers supply a "family tree" to connect up the various parts of the main story.

Space does not allow extended critical comments. It must be said, however, that the author is a trifle too generous with Neanderthal man, both as to his antiquity and his cultural achievements. He might to advantage have filled out with additional names the empty spaces in his time chart. A specific slip is the word "first" for "fist" axes on page 148. But these and other minor details do not, of course, seri-

ously affect the value of the presentation as a whole.

To meet our ancestors, even thus indirectly through the sterilized medium of a book, may not for all readers be an altogether pleasant experience. Like some of their present descendants they were rough fellows. But, on second thought, after becoming acquainted with man's past physical and mental achievements, one should—in spite of present doubts over the world turmoil—easily recover complete faith in mankind's future.

N. C. NELSON.

JAPAN AND THE SON OF HEAVEN

— by Willard Price

Duell, Sloan, and Pearce, Inc.,
New York, \$2.75

M. R. PRICE, the author of *Japan and the Son of Heaven*, is already well known for his previous books on the Japanese, particularly for those dealing with the Japanese administration of their mandate over the Pacific islands. In this one he is concerned with the very core of the Japanese problem. What are we going to do with Japan and the Japanese after we have defeated them? It is, by this time, no secret that the Japanese militarists prepared their country for a career of aggression by a series of calculated moves. They built up their emperor into a figure of divine descent, inviolate and in theory all powerful. They fixed the seat of real power in the inner circle of the army and navy, with the chief of staff alone having direct access to the Mikado. By this device the emperor, ostensibly the point of all authority, was in reality a creature of the military and a façade to conceal the secret sources of power. To obtain national unity and complete subservience, the divinity of the emperor was inculcated into every Japanese, primarily through the educational system but also via every other available means of propaganda and emotional pressure.

The personal observations on the way the system worked are provided from Mr. Price's first-hand experiences from living in Hayama, the village where the Mikado maintained his summer home.

The solution Mr. Price offers is in direct opposition to the policy that seems to have been adopted by the Department of State. He believes the Mikado should be removed and an interregnum established, since he is the very symbol of Japanese power and continuity. Shintoism in its form of national worship of the emperor must be destroyed. With these measures accomplished, Mr. Price has no

doubt that some form of democracy can assert itself among the people, once education is cleansed of its rank propaganda and the intellect of the country again exposed to the sanity and the light of the outside world.

HARRY L. SHAPIRO.

THIS IS THE PLACE: UTAH

— by Maurine Whipple

Alfred A. Knopf, \$5.00

222 pages, 102 illustrations, 4 in color

"UTAH is more a condition of mind than a country," states Miss Whipple in this recent volume of the Borzoi Books on the American Scene. As one reads the text and marvels at the scenic beauty so well portrayed in the fine illustrations, he comes to wonder just what that condition of mind may be. I, at least, could not find a satisfactory answer in the text, which reminds me of a fine meringue covering a palatable pie. Light, pleasant, and interesting, it is not the substantial material which gives the pie, at least, the basis of a satisfactory food.

Yet, as one considers the book, in retrospect, there is the consciousness that it does contain a vast amount of information on such diverse subjects as the history of the State, its more picturesque inhabitants, and its interesting and scenic sites. The trouble seems to be that all these diverse subjects are so intermixed and intertwined as to result in a lack of continuity. Like a vast grab-bag, one never can be certain what the next paragraph will discuss. The result is a text that seems frustrating and completely unorganized, yet it is one of the most provocative that I have read in many years. There is a short history of the Mormon church with a revealing insight into the modern rebellions that are now affecting it; as I lay the book down I want to know more about this. There are a multitude of

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stories, anecdotes, and descriptions of back-country Utah; I am conscious of the desire to have a more rounded picture of these people. In short, if it was the author's intent to tell the story of Utah and its people, I can not concede that she has succeeded; but if it was her desire to rouse our interest, to whet our appetites to know more about this desert wonderland, she has been remarkably successful.

H. E. VOKES.

VERTEBRATE PALEONTOLOGY

— by Alfred Sherwood Romer

University of Chicago Press, \$7.50
Revised edition, 687 pages, 377 figures

A LONG-ANTICIPATED and welcome event in the field of evolutionary studies is the appearance of the second edition of *Vertebrate Paleontology* by Alfred S. Romer. The first edition of this most excellent textbook has been available since 1933, and during the twelve years of its existence it has been widely used the world over by students interested in the evolution of the backbone animals. It may be confidently expected that the new edition will continue the outstanding reputation established by the first one.

The new edition is considerably larger than the first, the ratio being 687 pages as against 491 pages. The increase is due in part to the addition of new material throughout the book, the inevitable result of new discoveries and new research, and in part to the important and useful addition of three new chapters on the history of vertebrates. Also, the classification of the vertebrates, a very valuable feature of the first edition, has been considerably revised and expanded in this new edition. Virtually all genera of fossil vertebrates are included.

Naturally, the addition of much new material to the existing chapters has re-

sulted in the rewriting and rearrangement of considerable portions of the text. Details of the changes are too numerous to mention; suffice it to say that they bring the text up to date with a thoroughness characteristic of Dr. Romer's very comprehensive knowledge of the backbone animals.

The book is brought out in a new format, conformable with other textbooks of the University of Chicago Series. This is particularly apparent in the new type face and the cover.

Such criticisms as may be leveled against the new edition of *Vertebrate Paleontology* fall in no way upon the author. It is unfortunate that the publication of this book during the war made necessary the use of an inferior grade and weight of paper. The index is set up in type rather difficult to read. But these are minor criticisms. This new edition of *Vertebrate Paleontology* is a book that every student of vertebrate evolution will want to own.

EDWIN H. COLBERT.

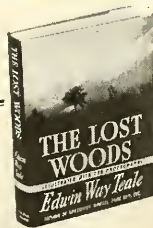
THE LOST WOODS,

Adventures of a Naturalist,

— by Edwin Way Teale

Dodd, Mead & Company, \$4.00
326 pages

HERE is a new book by the author of *Grassroot Jungles*, *The Golden Throng*, and *Near Horizons*. Mr. Teale,
Continued on page 478



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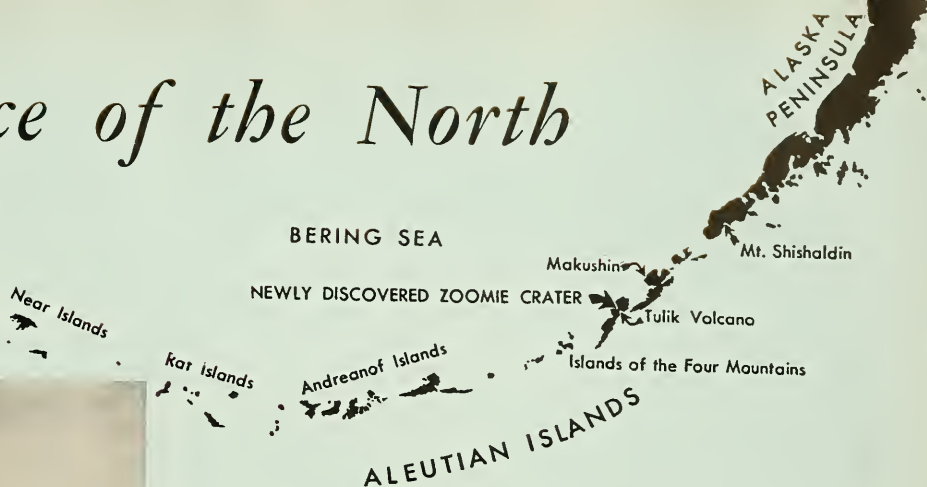
THE ALEUTIANS—*Island*

▼ MONARCH OF THE ALEUTIANS: Shishaldin (9387 feet), the largest and most perfect of the 30 or 40 volcanoes in the islands. Isanotski Peaks (8088 feet) and Roundtop Mountain (6155 feet) loom in the background

Awe-inspiring natural wonders, previously shielded from human eyes in the lofty Aleutians, yield their secrets to men of our armed forces exploring by Jeep and Duck



Necklace of the North



By DEAN FREIDAY

All illustrations official U. S. Navy photographs

IT was a pleasant surprise to find myself on duty in a virtually unexplored corner of the world. Friends had ribbed me about the cold, the fog, and the williwaws when they heard that I was going to the Aleutians in 1942. Things looked pretty black when we sailed from Seattle. All kinds of stories had circulated about the hardships and the weather we would have to endure. The hardships were exaggerated, but the weather lived up to its reputation. Gradually, as the work became routine and a little recreation was in order, the surroundings became interesting and a number of us took up a study of the natural history of the region.

My training had been along geological lines, so I was naturally most interested in the earth history of the region. Correspondence with the American Museum of Natural History brought out the fact that almost nothing of the geology of the area was known. The only professional paper published was Capps' "Notes."^{*} It outlined the over-all story of the region.

The Aleutian Islands form one of the great volcano belts of the Pacific rim. Geologically, they begin back on the mainland with Mount Spur in the Saint Elias range, and extend in a great arc 1500 miles to the westward, terminating in the Komandorski Islands. Geographically, they comprise some 14 large islands and approxi-

mately 55 smaller ones,—a group that is 900 miles long, beginning with Unimak and ending with Attu, as far as the American boundary is concerned.

Breath-taking sights abound throughout the chain. No one who has seen Mount Shishaldin from the air will ever forget it. Rising nearly 10,000 feet, directly from sea level, it smokes almost constantly. Not content with this masterwork, Nature outdid herself by providing a background of two unusually beautiful mountains—the twin-tipped Isanotski Peaks, and Mount Roundtop, giant sentinels in stone and snow.

East of this, on the peninsula, is Mount Pavlof, another giant that puffs out huge smoke rings every few minutes. Still farther up the peninsula are the Valley of Ten Thousand Smokes (the Katmai area), the Agihleen Pinnacles, and Aniakchak Crater. The Valley of Ten Thousand Smokes was created, achieving fame and the status of a National Monument, when Mount Katmai had an explosive eruption in 1912. It blew the top off the mountain and killed all the vegetation for miles around. It has even been said that some of the famous Kodiak bears lost their fur from the reaction of the rain and the volcanic ash. The Agihleen Pinnacles are jagged needles of rock and are of mysterious origin. Aniakchak achieved renown when it was discovered to be the largest crater known on earth, with a circumference of 22 miles.

The Aleutian region is studded

^{*} Capps, Stephen R.: "Notes on the geology of the Alaska Peninsula and Aleutians." U. S. Geological Survey Bulletin 857-D, 1934.



with 30 or 40 active volcanoes. Some of these smoke continuously and cast a fiery glow against the night sky that can be seen miles at sea.

Beyond that, little was known, except for spot observations at various places along the line. The most recent maps of much of the area, at the beginning of the war, were those completed by the Russians in 1836.

When the Japanese took Kiska and Attu after the raid on Dutch Harbor, hydrographic reconnaissance suddenly became very important to our armed forces. If we were to keep from losing vessels on uncharted rocks, more had to be known in a hurry. Detailed terrain studies also had to be made to facilitate emergency plane landings, and for the many other uses of war.

Some of this work was done by the photo lab to which I was attached. I flew many hops in our amphibious Duck over the near-by islands, photographing the country below. Gradually in such work, you get the feel

◀ **GIANT OFFSHORE PINNACLES OF ROCK** are so huge that they lose scale: Priest Rock, Unalaska Bay, 204 feet high

▼ **WATERCOURSES FOLLOWING GLACIAL VALLEYS** that end at the coast, back up fresh-water lakes behind the spits. Unalaska Island





▲ AKUTAN CRATER, 4,244 feet above sea level, has lost its top, either by explosion or subsidence

of the country and become interested in the various features of the landscape.

The Aleutians are one of the most fascinating areas in the world from the air. Miles of utter desolation spread out below you,—peak after peak stretching as far as the eye can see. It is a country with its feet in the water. Bays and channels are everywhere. Two-thousand-foot cliffs are commonplace on the sides exposed to the sea. The atmosphere is sometimes so clear that smoking volcanoes several hundred miles away can be seen clearly. Giant offshore pinnacles of rock are so huge that they lose scale until a ship makes its way into the scene and assumes toy proportions. Extinct cinder cones and craters are everywhere.

The panorama spread below you is a textbook on the igneous geology of a newly-formed land. Formation began in the Eocene period, 35 to 50

million years ago, and the process is still going on. You see knobs of bare rock exposed everywhere, with lush tundra filling in the hollows. U-shaped valleys give evidence of the part glaciation has played, and as scenic features they are surpassed only by the theatrical volcanoes. Hanging valleys break off abruptly at the sea's edge, and waterfalls hundreds of feet high tumble off into the sea.

Bay heads soon give rise to sand spits and begin the cycle that can be seen over and over. Watercourses following the glacial grooves that end in bays, back up fresh-water lakes behind the spits. As time goes on, the suspended sediment brought down by the rushing streams silts up the lakes. Muskeg swamps make a smaller and smaller oval of them. Finally, the whole area becomes marshy, and the stream meanders lazily across it.

Straits and passes fill up in similar fashion and unite islets into islands.

By this process, the Alaska Peninsula was gradually formed. Originally it was a series of islands similar to the Aleutians, but it methodically extended its way outward. The channels between the islands silted up through the action of shorewise currents, and layer after layer of volcanic ash was deposited from the many eruptions. The process is still going on. In historical times Isanotski Strait, or False Pass as it is more descriptively known, has filled in until it can no longer be used even by small craft. At low tide, the water is so shallow on the Bering Sea side that animals can migrate to and from the mainland. Eventually Unimak Island will lose its identity in a merger with the Alaska Peninsula.

Topographic maps reveal that this process has gone on in various places in the chain also. Some of the larger islands are groups of small islands bonded together in this way. Hydrographic studies reveal very shallow passes between many of the islands, which will probably disappear with

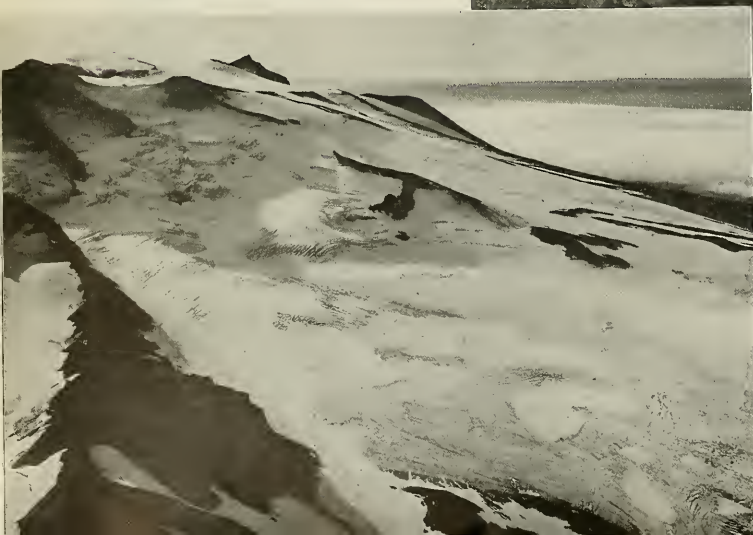


▲ MAKUSHIN appears to have no distinct peak. Smoke issues constantly from the gigantic mound, which is visible miles at sea

► THE VENT OF MAKUSHIN emits steam and smoke from a number of places. This remarkable aerial photograph was taken in late summer, when the snow was lowest



◀ PART OF MAKUSHIN'S GLACIAL SYSTEM. The area shown is about four miles wide



► IN WINTER, Makushin is completely covered, and the steam appears to be coming out of the snow

a little more uplift, plus silting and the addition of material extruded or blown out of active vents in the vicinity.

The chain breaks naturally into five major subgroups, separated by the truly deep channels. They are, east to west: the Fox Islands, the Islands of

the Four Mountains, the Andreanofs, the Rat and the Near Islands. The Russian Komandorskis form a sixth group, if added to their American relatives.

Probably the most spectacular place in the whole chain is the group called the Islands of the Four Mountains,

which takes its name from the four perfect cones that dominate the area. Two of these, and several smaller ones, form complete islands in themselves, rising directly out of the sea. In winter they are completely covered with snow and look like giant morning-glory blossoms dropped face-down



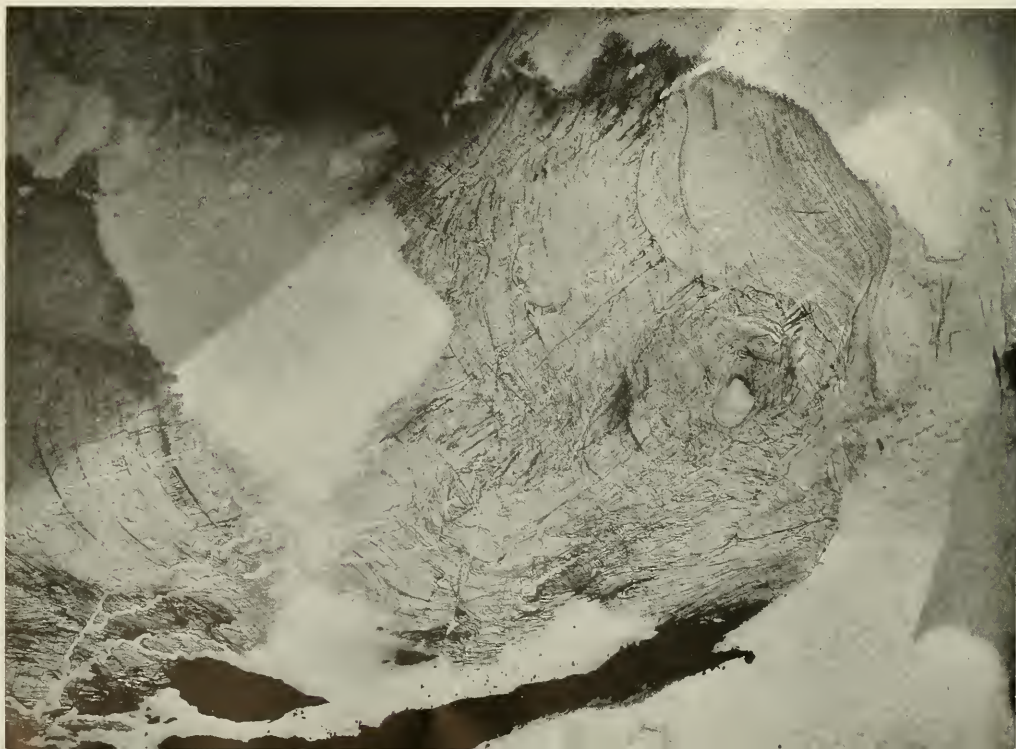


▲ ICE FALLS, ICE CASCADES, and many branches of Makushin's glacier were exposed to view when the snows melted off in September, 1944



▲ ICE CLAWS AWAY AT A PEAK on the side of Mount Makushin, hollowing it out in what is known as a cirque

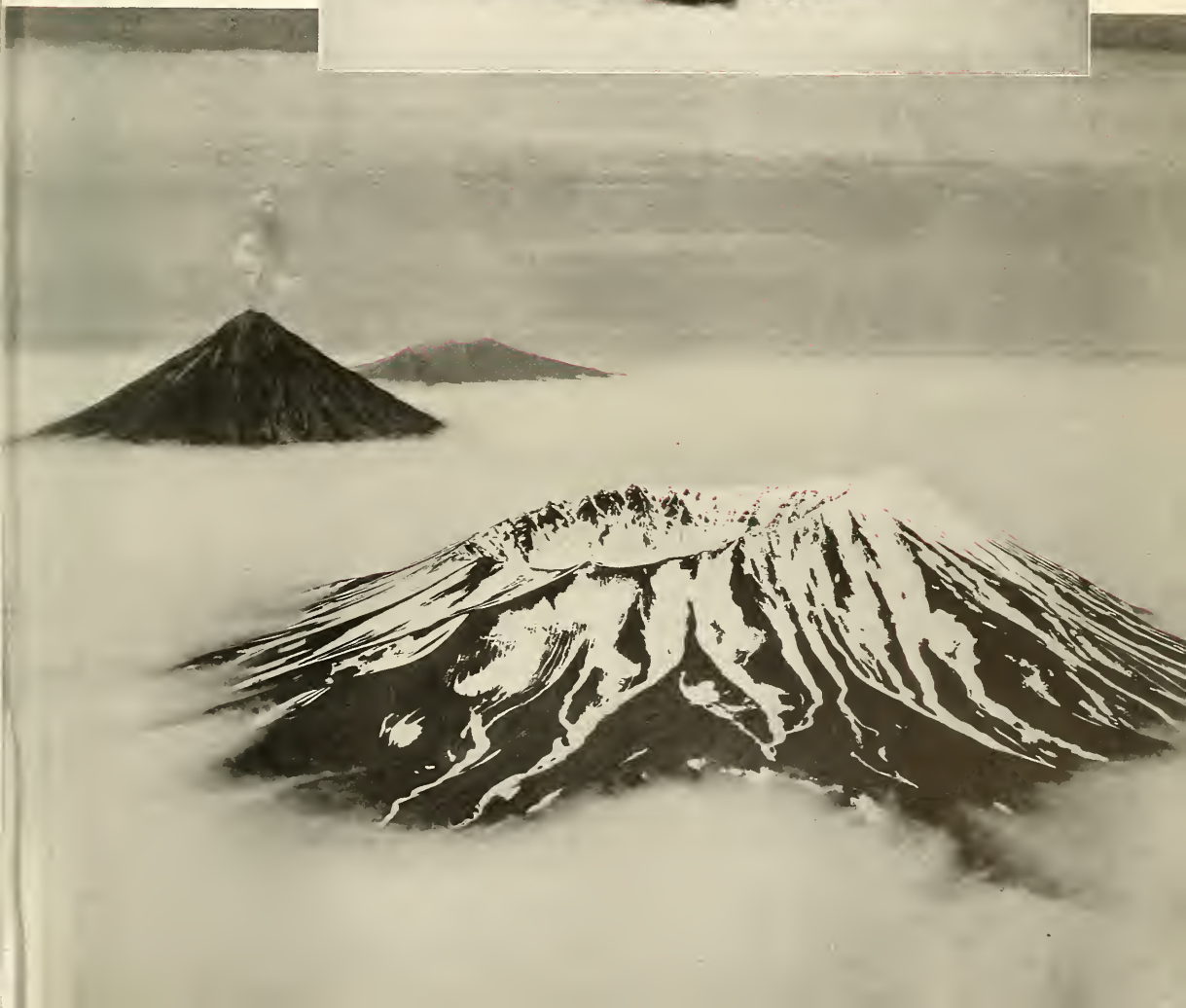
▼ CENTURIES-OLD CREVASSES AND FISSURES form a pattern resembling wood grain on this Makushin glacier, seen from the air



► MT. CLEVELAND, "knee-deep" in a sea of clouds, shortly after its 1944 eruption. Mt. Carlisle is visible behind it to the northwest



▼ ISLANDS OF THE FOUR MOUNTAINS, shortly after Mount Cleveland (smoking) erupted in June, 1944. Herbert Island crater is seen in the foreground. A blanket of fog hides the ocean





◀ JEEP TRAVEL requires relatively level ground, a good back to withstand the jouncing, and strong shoulders to do a lot of digging

▼ THE PLAINS OF UMNAK are an ideal place for jeep travel, with weird igneous formations cropping up. This is the "Gateway" on the trail to Inanudak Bay

into the sea. In the spring and fall they lose all but the spectacular striping of snow that fills their ravines. In summer they are pretty drab, but even then they are interesting.

Akutan and Makushin Volcanoes are fairly well known. Before the war, a sulphur mine was in operation on Akutan. While its cone is only 4244 feet high, the crater is interesting. It has lost its top, either by explosion or subsidence, and the vent rises from near the center of the relatively flat floor. Hot springs bubble in the crater and flow out over the side through a small gap. Bright yellow patches mark the sulphur deposits on the floor.

Makushin has a gigantic base but does not rise into a distinct cone. It is relatively rounded, except for abrupt slopes on the west side. It has a large glacial system that was clearly exposed to view from the air in 1944. An unusually warm summer melted the snow right down to the ice, and

centuries-old crevasses and fissures were exposed in all their terrifying depth. For a week or two in September, ice cascades, huge ice falls, and the interrelationships of the many branches of the glacial system were fully exposed to view. For the first time in three years, it could be seen that Makushin had a true crater. For the snow had previously been piled so high on top that it appeared only to have several vents, off-center on a mounded structure. When the crater was revealed, it was quite similar to that of Akutan, with an off-center knob containing the vents, and with the crater marked out by a circle of cliffs.

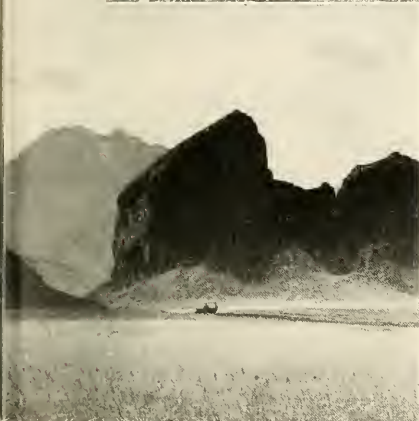
The pictures of the glaciers on Makushin, taken by Marion Thornton, are important, because they are probably the first to show clearly the basic structure of an Aleutian glacial system. Stephen R. Capps mentioned glaciers on the Alaska Peninsula and evidence of past glaciation in the



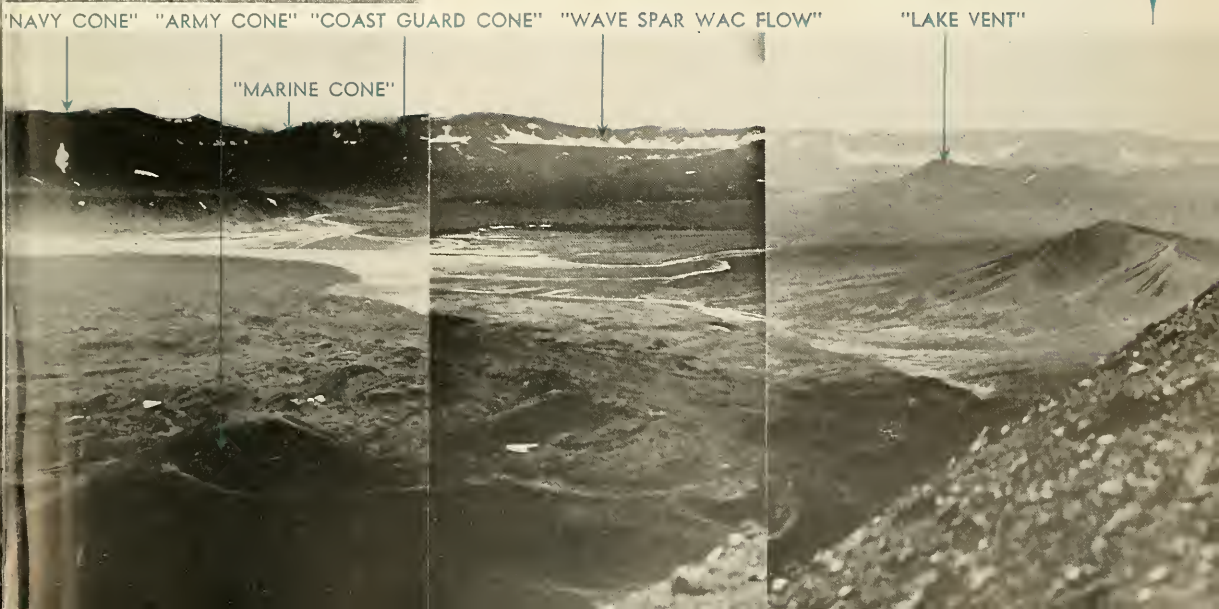
"GLACIER GAP"



▲ FIELD TRIP: part of the photo lab gang enjoying a picnic supper on a summer outing. Left to right: H. M. Thornton, of Blanchard, Washington; J. S. Siegfried, of Oak Harbor, Washington; W. F. Nichols of San Francisco, California; C. A. Prade, of Waco, Texas



▼ NEWLY-DISCOVERED "ZOOMIE CRATER." This panorama shows the principal features as seen from the ground. There is a small portion missing in the center



chain; but he did not state whether glaciation was still active. In the summer of 1943, glaciers were observed on Mount Vsevidof (6920 feet) and on an unnamed peak, which I have dubbed "Glacier" Peak (6510 feet), in the central portion of Umnak Island. Unfortunately, the light conditions weren't right for pictures, and those taken a few days later don't show much detail because of a light blanket of snow over the whole area. A trained eye can pick out the glaciers, however.

More beautiful shots of volcanoes were taken when Earl Robison had a chance to fly over Mount Cleveland shortly after its eruption in June,

1944. A few days before, it had been throwing up boulders "as big as pianos." Lava flowed down the sides, and aerial observation reported that a cloud of steam and ash was estimated to level-off at 15,000 to 20,000 feet.

One of the most interesting trips I had was by jeep on Umnak Island. We were recording some of the natural features for topographic studies. We bounced over mile after mile of tundra. The eastern part of Umnak has large areas of relatively flat ground that can be negotiated by jeep with the aid of shovels and a couple of strong backs. Travel is fine until you hit a marshy spot. Then the digging

begins. We covered miles of ruggedly beautiful country exhibiting all kinds of odd igneous formations. At one place, a natural gateway leads between two isolated mounds that go almost straight up for several hundred feet.

The crowning feature of the Umnak trip, however, was the jeep ride up to the rim of a giant craterlike basin, or caldera.* Reports had been reaching us of a crater large enough for airplanes to fly around in. It was said to be traversed by streams that flowed out over a high waterfall. It sounded fantastic, for there was no record of it anywhere, and the recent Hydrographic Survey Charts didn't show it. It was there, all right, eight miles in diameter, with walls 2800 feet high and rising 1500 feet from the floor. By following up the valley of the stream that flowed out of the U-shaped notch on one side in summer, it was possible to drive right up to the rim.

Once there, the view that greeted us was breath-taking. Spread out at our feet was a good-size river system that worked its way between five cinder cones. Several lava flows were clearly visible. One was still warm, for an aerial view showed the snow melted off a large part of it. Streams drained into the crater from all sides, adding to the volume of the rivers on the floor. The whole system drained out of the notch on the north side and flowed into Bering Sea. We followed the flow downstream and found a weird "hoodoo" area with oddly shaped rock formations, extending over a distance of several miles. We didn't have time to piece the whole story of their formation together, but the area was traversed by deep gullies that gave evidence of glaciation in their rounded grooving and in the presence of numerous erratic boulders with clearly defined markings.

Debris and ash are scattered for miles from the gigantic cataclysm that produced the caldera. To interpret the whole region would require a lot more time in the field than we had.

* A caldera can be formed in two ways. It can result from a violent volcanic explosion that partially destroys the volcanic cone. Or it can result from subsidence of the lava in the pipe of the volcano, causing the cone to collapse into the void.



▲ FROM THE AIR, ZOOMIE CRATER reveals activity. Melting on "Lake Vent" and in some areas of "Wave Spar Wac Flow" indicates that heat is still present. The difficulty of securing these remarkable photographs of the Aleutians will be fully sensed only by those familiar with the notorious weather of the region. It was estimated that Zoomie Crater, for instance, was invisible during all but about eleven days of the year



◀ THE "HOODOO" AREA is deeply grooved by gullies. Here the glacier broke through the wall of Zoomie Crater and flowed out to Bering Sea

Roughly the story is this. After the explosion, glaciers filled the gaping hole, piling on layer after layer, until the outward force of the ice mass probed a weak spot in the rim. Here it burst through and cut the notch where the drainage leaves. The notch has been little altered by erosion and has the characteristic U-shape.

The valley that the stream follows is considerably wider than water action would carve in the time that has passed, and the lack of erosion on its slopes further indicates its glacial origin. The hoodoo area probably represents the deltal zone where the ice stream fanned out. Whether it is carved in a lava flow or in a maze of debris was not clear, and night was falling. We took our pictures in a miserable blowing rain that drenched us even through our foul-weather gear, and started back for the base.

It seemed unbelievable that the caldera had been unreported until military operations began in the area. Since it was probably first sighted by an Army or Navy pilot, we christened it "Zoomie Crater" and named the features of the floor after the various branches of the services.

Further observation revealed why it hadn't been previously discovered. From land or sea the only feature of it that was visible was Mount Tulik, a peak that rises from the rim on the Pacific side to an elevation of 4103 feet. This has been a landmark in the Aleutians for years. Tulik gives no hint of the crater, because it appears to build up gradually to a peak and seems self-sufficient from any angle on the ground or water.

It is possible that even the Aleuts didn't know "Zoomie Crater" was there. Their interests were principally with the sea rather than the land. They seldom traveled overland when they could avoid it; water offers the only convenient avenue for a primitive people in this country. Their village of Nikolski was miles away on the west end of the island. If, by chance, they knew of the crater, they probably had their remarks discounted because of their hazy use of the relative term "big," which could have been supposed to refer to Tulik.

The only way it could be spotted was from the air, and air operations were unheard of before the war. The

U. S. Coast and Geodetic Survey charted Umnak's shore line, and the Navy Hydrographic Office made aerial traverses of it in 1935 and 1936, but a large blank area was left where the crater existed. Possibly the reason was overcast, for the crater is rarely clear. The peculiar air currents it generates usually fill it with clouds or fog, and even moderately clear weather is a rarity in the Aleutians.

The diameter of the crater as measured from the air was estimated to be six or seven miles. Subsequent surveys by Army Engineers indicate that in some directions the diameter is as much as eight miles. Points estab-

lished on the north rim range from 2807 feet elevation to an even 3000 feet. Other points on the rim reach 3100 and 3310 feet. But the rim apparently dips to about 1300 feet where the brink of the waterfall offers an exit to the drainage-water of the basin. From this we can estimate that the floor in the level areas would probably average a little over 1500 feet.

Further studies that are being made of the crater will doubtless yield much additional information of interest, because this is certainly one of the largest formations of its kind in the world.



▲ U-SHAPED VALLEYS give evidence of the part glaciation has played. Unalaska Island



► TWO-THOUSAND-FOOT CLIFFS are common on the sides exposed to the sea. Unalaska Island near Inanudak Strait

NIGHT MUSIC

By JOHN ERIC HILL

Drawing by

G. FREDERICK MASON

WHETHER we live in city, town, or country, most of us have often heard the nighttime serenading of cats. It is a wild sound, uttered with such intensity of feeling that it would be frightening if we did not know the animals that thus express their longings. The sounds are far from pleasing to our taste, but they have all the qualities of great music except beauty. Clarence Day, in his revealing book of some years ago, *This Simian World*, suggests that had cats become the dominant animals and developed a feline mentality comparable with that of man, they might have valued the arts more highly than we do, especially the art of music. Imagine how sublimely a feline opera star would have been able to sing.

Caterwaulings (crying of cats) are produced in the same way as the songs of human beings, by the combined action of the vocal cords in the larynx or voice box, the tongue, the lips, and

the throat. The sounds are not hard to imitate, some of them being very similar to the wailing of a baby, the cry of a person in agony, or the screech of an excited member of a mob. The sounds given out by courting cats are different from those used by antagonistic members of the same sex. The quarreling duets are sung in a different key, and different "cat-words" are used—vocalizations which have been anglicized as *ah, aah, ooh, waa, wah, wow, and yah*, in various combinations, mingled with spitting and hissing sounds, screams and screeches. Sometimes the vocal conflict may end in a truce, but often the rival cats resort to clawing and scratching that work havoc with ears and noses.

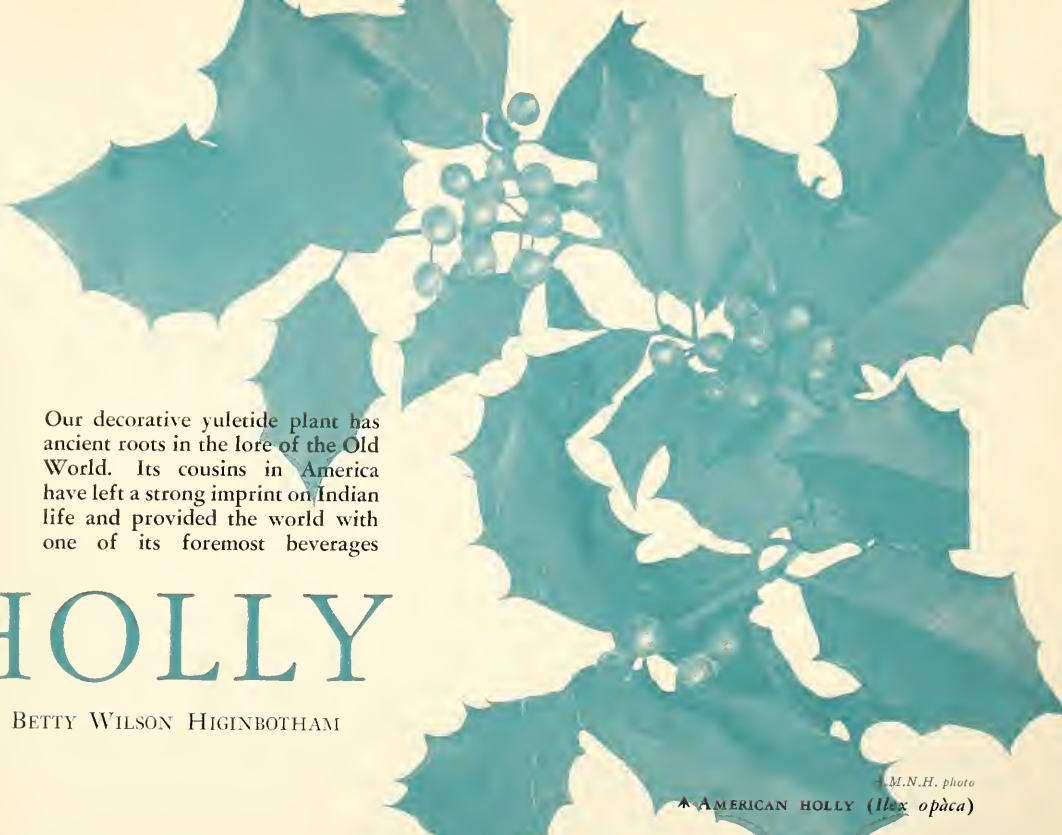
Still other sounds and voices are given out when a cat is hungry and begs for food. Miaowing is the descriptive name for this language and resembles a half-spoken, half-sung line somewhat like that used by certain radio and night club entertainers.

The growl is another kind of "cat-language," shared with all or most members of the great order of flesh-

eaters, or carnivores. A warning growl given by a mother cat will cause her kittens to hide. Other growls warn rivals away from food.

The purring of a cat is much like the humming of human beings, but while we hum almost exclusively during exhaling, a cat purrs both during intake and expulsion of the breath. The air as it is drawn in and forced out passes through the larynx, or voice box. Here the cat has two pairs of vocal cords, whose tension is regulated by muscles. The cords vibrate strongly, and their vibration is transferred to the larynx and often to the entire rib-basket, which trembles in time with the purr. Purring is, of course, the cat's way of expressing contentment and pleasure. Kittens begin to purr at an early age, as young as nine days. At first they purr in a single note, but adults develop two notes, often connected by a slurring intermediate one. The larger cats—lion, tiger, leopard, and mountain lion—purr when contented, at least in captivity. Their purring is vigorous and loud, like the whirring of a powerful machine.





Our decorative yuletide plant has ancient roots in the lore of the Old World. Its cousins in America have left a strong imprint on Indian life and provided the world with one of its foremost beverages

HOLLY

By BETTY WILSON HIGINBOTHAM

A.M.N.H. photo

★ AMERICAN HOLLY (*Ilex opaca*)

As our European forefathers, merry with wassail, cavorted about in search of branches of holly for their yuletide festivities, they little dreamed that on distant and still undiscovered American shores the Indians were gathering holly for the purpose of garnishing their alimentary interiors with its potent properties.

Not having heard of Columbus or America, our ancestors blithely decked their homes with boughs of holly and kept alive a custom far older than Christmas itself, a tradition begun long before the birth of Christ. The Romans in their midwinter festival, the Saturnalia, not only adorned their halls with holly but exchanged gifts decorated with sprigs of holly. Because of its association with this pagan rite, the use of holly in Christian ceremonies was frowned upon by the early church, but holly has survived all the changes of religion, time, and custom, and its influence and roots have even spread into countries where it was unknown before.

Completely outgrowing its old association with the Saturnalia, holly became known in some countries as

Christ's Thorn and has been associated with the crucifixion as symbolic of the crown of thorns, the scarlet berries representing drops of blood.

In old English, holly was called holm or hulver bush, and an early Lenten custom of the French and English included the making of effigies of a boy and a girl dressed in holly and ivy. The holly boy and ivy girl were paraded through the streets and then, with proper ceremony, burned. This custom has been interpreted as being a sort of official closing of the new year season and opening of the spring or Lenten season.

It is interesting to note that some holly trees are entirely male in sex, and the early Lenten celebrants seem to have been cognizant of this. Male hollies produce no berries, of course, much to the chagrin of some holly planters; but fortunately the holly usually produces both male and female flowers on the same tree, thus ensuring fruitfulness.

Perhaps because of its close relationship with the Christian holy season of Christmas, holly acquired the reputation of a thing of terror against

the forces of evil. Witches in particular feared this plant as they feared an angel, and a holly tree planted beside a house safeguarded it from the machinations of wicked spirits. The efficacy of a lone holly tree might today be doubted, but there is no question that a holly hedge can bar the way of man or beast. Whether for this reason or for its beauty, or both, holly hedges are popular in England.

No doubt to recompense for its hostility toward evil spirits, holly was said to have received divine intervention from the depredations of cattle. The intervention consisted of having its lower leaves armed with sharp prickles which safeguarded it from hungry cows, while the upper, out-of-reach leaves remain defenseless. Southey refers to this characteristic of holly in one of his poems:

Below, a circling fence, its leaves are seen
Wrinkled and keen;
No grazing cattle through their prickly
round
Can reach to wound;
But as they grow where nothing is to fear,
Smooth and unarm'd the pointless leaves
appear.



Courtesy of New York Botanical Garden Library

▲ ANOTHER MEMBER of the holly genus: the source of the "black drink" which had ceremonial significance among the North American Indians (*Ilex vomitoria*)

▼ A THIRD SPECIES of holly supplies some 25 million persons with their customary beverage, maté. It is brewed in a gourd more or less like tea and is sipped through a silver or reed tube.

This peculiarity is common to both the English and the American holly, which can scarcely be distinguished by the layman except by the slightly less brilliant berries on the American holly. Both species are cultivated in this country, but the American holly also grows wild in the eastern half of the United States, that is, where it hasn't been killed off by holiday garland seekers.

The holly's ability to protect its lower leaves may have given it the meaning of foresight in the Language of Flowers. The Language of Flowers, apparently now one of the dead languages, formerly provided a means of sending messages to genteel ladies,—messages discreet, diplomatic, or otherwise, since practically any thought a lover might wish to convey could be sent without putting down a word in black and white. Several books were published giving the "code" words for the flowers. Using the floral dictionary, one would learn that a bouquet of heath and pansies meant, "My heart would be at ease, if my solitude were blest with your society," or that a single dried white rose conveyed the poignant thought that "Death is preferable to the loss of innocence." In like manner holly, which stands for foresight, might be

included in a bouquet of lily of the valley and filbert to signify, "I foresee a return of happiness with our reconciliation."

While the American and the English hollies are the species commonly meant by the term "holly," there are other species of holly that have an equally colorful history and appearance, and one is of economic importance.

The yaupon (pronounced yo-pon) is a holly that was highly esteemed by the Indians, so much so that whole tribes would migrate in the spring to southern coastal areas where they could find the shrub in abundance. This plant cannot be said to resemble holly closely, but it does belong to the same genus as our familiar yuletide variety.

The purpose of these treks was the preparation of a beverage called "black drink," often mentioned by early explorers and travelers. The potion, made from yaupon leaves, was mysterious and ceremonious, though in a somewhat different way from the peace pipe, with its smoke blown to the four winds and to the Great Spirit. From this black drink came the power of foresight—a coincidence tying in with the Language of Flowers though far separated from it in time and space. The full significance of the drink is veiled in the enigma of Indian ways, but it has been recorded that the draught gained insight for the Indian brave who drank of it. A young



Indian boy just coming of age was introduced to manhood and to the black drink at one and the same time. In preparation for his induction into adult life the Indian was put through purification rites that included drinking the beverage. If the youth was not purified spiritually he was most certainly thoroughly cleansed physically for in strong doses the drink is both an emetic and a purgative. If the poor lad were not too preoccupied with these physical reactions, he too may have had visions, not one of which, let us hope, was an insight into the sad fate of the race. Sometimes Indians drank of this concoction simply for the medicinal effect, and occasionally a weak infusion was used as a beverage.

Although early colonists at one time adopted yaupon as both a tea and a medicine, today its potency is forgotten and its chief glory is its beauty.

In the southeastern states where it is native, yaupon (called by botanists, realistically, *Ilex vomitoria*) is common in the gardens and yards of homes, where its rich evergreen leaves and abundant scarlet berries are conspicuous in the wintertime. Branches

from the wild thickets are popular for Christmas decorations.

In America before the time of Columbus, most members of our holly family took the place of beverages obtained at our modern roadside stands and offered the makings of a spot of tea to the Indian, who seemed to relish his "tea" as much as the Englishman. And it might be mentioned that a recent book on plants claims that yaupon is the best native "tea plant" we have. Yaupon's reputation would not encourage one to experiment with a strong dose. But it is rather extraordinary that so many species of holly have been used for tea over such a wide area and before there was any communication between these lands, particularly when the berries of most are considered poisonous.

In North America the Indians, and later the colonists, made drinks from the yaupon, dahoon, common winterberry, inkberry, and the American holly, all members of the holly genus. In England a tea and a medicine were formerly extracted from the English holly. But it is in South America that one of the hollies has reached its greatest importance as a beverage. Yerba maté was in wide use when the European invaders first arrived. The natives had probably been drinking this tea over a very long period of time. This species of holly had endured the changes of time, custom, and race; and the white man even found himself converted to

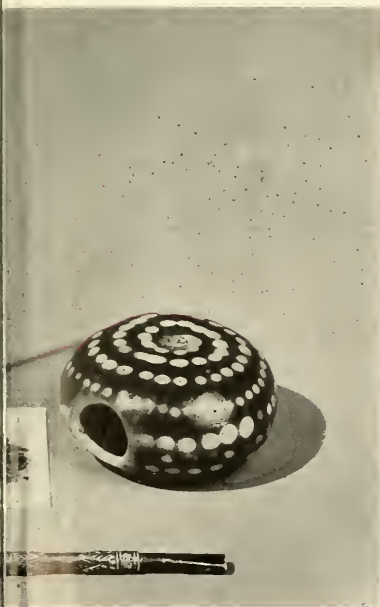
its use and furthered its growth in well-tended plantations. Today, yerba maté has become an article of considerable commercial importance.

Yerba maté, or Paraguay tea, is obtained from several species of holly but mostly from *Ilex paraguayensis*. As usual with infusions from holly leaves, we find the beverage is a stimulant.

The brewing of maté is similar to that of our tea. The leaves are dried and broken into small flakes. The beverage is drunk through a tube, usually silver, called a bombilla, which has a small perforated bulb at the base serving to strain out the leaves. Maté is exported from the countries that produce it (chiefly Paraguay and Brazil) and is to many South Americans what coffee is to North Americans. In the United States maté is seldom seen except in the markets of our larger cities.

In spite of all of its medicinal, mystical, and potable possibilities, the safest thing to do with your Christmas holly this year is to hang it up and admire it from a distance; any of its other uses may yield more or less violent results.

▼ THE SIPPING TUBE has either a perforated bulb or a woven strainer at the lower end to sift out the leaves



HOLLY

▼ A SPRIG of the plant from whose leaves maté is made

New York Botanical Garden



▼ THE "MATÉ TREE" develops a well-rounded head in the natural state. Under cultivation the quality of the tea improves, but the plant remains a small shrub with many stems

Photo from Ewing Galloway





The rainbow-tinted logs of the Petrified Forest tell a fascinating tale from the days before the dinosaurs



By JOYCE AND JOSEPH MUENCH

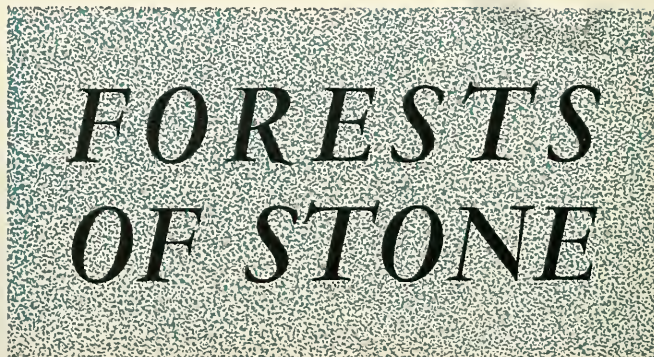
All photos by the authors

WHEN the world was younger by some 200 million years, there was a great valley covering a large part of what is now southwestern United States. It was flanked on the east by the forerunners of the modern Rockies, and there was another incredibly old range to the southwest. A long plain sloped clear to the Pacific Ocean.

It was the age when the long reign of the dinosaurs was just beginning. Giant crocodile-like reptiles known as phytosaurs lived along the rivers and lakes. In a warm and temperate or subtropical climate, thick jungle-like forests margined the streams. These were the trees that were to be transformed into the stone giants we see today in Petrified Forest National Monument. They were conifers, related to our modern pines but more like the araucarian pines of South America and Australia.

After many of the trees had died, floods buried them in silt. In time they were covered with 1000 feet or more of rock, some of it laid down as sediment, some as volcanic ash. Percolating waters, carrying various chemicals, gradually transformed the trees to stone.

The Rockies and the Sierras were pushed up into place, and the plateau was lifted with them. The trees, though still far below the surface, were now high above sea level. It was



this great uplift that permitted them to be uncovered by the action of streams and other agencies of erosion—the same that carved out the Grand Canyon. This vast erosion occurred only within the past million years or so.

What happened to the trees while they lay for many millions of years under the earth? It has generally been thought that all the material of their original cell structure was dissolved out and replaced by silica. Recently, however, evidence has been presented indicating that if one dissolves the silica out of a piece of petrified wood, the structure remains unchanged and merely becomes soft so that it can be crushed between the

fingers.* Just as seaweed can absorb more salt than is to be found in the water surrounding it, the wood of the submerged trees apparently absorbed silica, iron, and other miner-

*See "Changing Views of Petrification," by William G. Darragh (*The Pan-American Geologist*, August, 1941), and "The Petrification of Wood," by Chester A. Arnold (*The Mineralogist*, September, 1941).

The writer wishes to acknowledge the kind help of Mr. Floyd L. Keller, Park Naturalist, in preparing this article.

➤ **POLISHED AGATE:** a section cut from a petrified tree. Rougher pieces of ancient trees support it. In the Petrified Forest National Monument there are six whole forests of petrified trees



als, without losing all of the woody structure. These chemicals pushed into the intercellular spaces and into cell cavities where some decomposition had already taken place. Iron oxide gave the petrified wood its red shades, manganese oxide its darker hues.

The early Spaniards apparently never saw this area, with its giant trees of rock. It was not until 300 years after Coronado had visited the Southwest that official notice was taken of them. Lt. Sitgreaves reported finding the forest in 1851. When the Santa Fe Railroad (then the Atlantic and Pacific) was thrown across Arizona and completed in 1883, settlement began. More and more people heard about and saw this surprising spectacle. There was a scurry to collect the semiprecious stones for jewelry, and one company set up a cutting and polishing laboratory with the purpose of selling sections for table tops and desk fixtures. It would not have taken long to destroy all this marvelous work of the ages. Fortunately, the threat was averted

in 1906 with the creation of the Petrified Forest National Monument.

The following years added to the discoveries, and the protected area was enlarged. John Muir, the celebrated naturalist, found and named the "Blue Forest" in 1906. In 1911 the Agate Bridge, a petrified log spanning a 30-foot ravine, was strengthened by stone pillars. This great tree is 111 feet long in its exposed portion and forms a natural bridge 40 feet long.

In 1930 the Blue Forest and Newspaper Rock were added to the Monument. Newspaper Rock includes some of the petroglyphs, or rock carvings, found on the sandstone cliffs along the western side of the Monument. These, together with Agate House and various other ruins speak of the early people who lived among the petrified logs from about A.D. 500 to about A.D. 1400. They used the

petrified wood as building material as well as for tools and weapons.

What the early people who inhabited this region thought of the petrified forest, we may never know; but the modern Indian has several stories. One tells how a goddess wandered into the forest, cold and hungry, exhausted from travel. With one swift blow of her club, she killed a rabbit and prepared to cook it. But the logs were wet and would not burn. In a rage of disappointment, she turned them all to stone so that they could never burn.

The Paiutes say that the logs are broken weapons of the Wolf God. These are the battlefields on which he waged war, and by the size of his weapons you can know the strength and ferocity he must have possessed.

The Navahos tell a third story. To them, this is the burial ground of a dreadful monster whose name was

▼ LOGS LIKE THESE are found in the Second Forest of the Petrified Forest National Monument. They are the petrified remains of ancient trees that were buried deep in the ground and ages later uncovered by erosion



► IT MAY HAVE SEEMED A BIG JOB TO POLISH a piece like this, but it took Nature millions of years to transform the living tree into agate



▼ APPROXIMATELY 200 million years ago this was a living tree. At the end of its life, it fell and was covered by deep layers of earth and rock. Changes took place within it over a long period of time, transforming it into beautifully colored stone



Yei-tso. He was destroyed by the Sun God, and these are his bones.

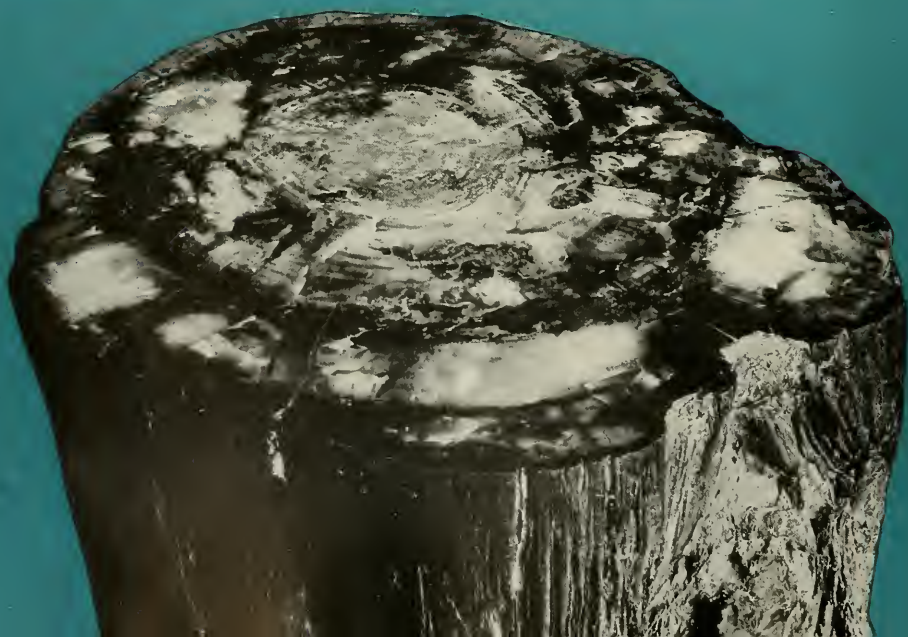
Petrified wood has been found in various parts of the world. In the coal measures of England an old forest was uncovered. Yellowstone has some fine examples, and Napa County in California boasts some large trees of long ago, to mention only a few. But in northeastern Arizona is the most colorful display to be found in the world. Besides all the petrified logs that lie on the surface, eroded into view after an amazing life history, there is reason to believe that many more lie still buried, waiting the magic wand that time is sure to wave over them.

Northwest of the Petrified Forest lies the beautiful Painted Desert, a fantastic area of canyons and mesas, where colors run riot and the landscape is banded with shades of purple, red, and yellow. This section was added to the Monument by President Hoover in 1932. Now a little over 90,000 acres are under the Park Service, with six separate forests. All of these but one are within reach of the motorist, being only a short walk from parking areas. The Black Forest is well beyond the rim of the Painted Desert and is accessible as yet only by trail.



◀ A LOG OF TRANSLUCENT AGATE. Far back in the days of the dinosaurs, these trees fell and were buried. Silica in solution and the stain of other minerals entered their intercellular spaces and cell cavities, giving them the beautiful colors for which petrified wood is famous

▼ THIS HIGHLY POLISHED BLOCK of agate shows the structure of the tree it once was. It was to save pieces like this from destruction that the Petrified Forest National Monument was created in 1906



▼ COUGAR. This fierce creature was scratched in the rock by a prehistoric people that lived in Arizona between A.D. 500 and 1400. It may be a clan symbol

▼ PAINTED DESERT. Lying northwest of the Petrified Forest, this section was added to the Petrified Forest National Monument by President Hoover in 1931. Now a little over 90,000 acres are under the jurisdiction of the Park Services in the Petrified Forest area





▲ WONDERLAND IN THE DESERT. Rainbow hues enliven the landscape along this portion of the Blue Forest road. The petrified tree at the right is balanced on a base that is slowly being eroded away

▼ THE "GIANT TEPEES" are among the strange shapes cut from the alternating layers of bentonitic clay and sandstone in the Petrified Forest National Monument. When dry, the disintegrated clay is hard, so the tepees keep their form between the infrequent rains



The Jumping Spider

Photographed in action
at 1/30,000 of a second

By WALKER VAN RIPER

*Curator of Spiders,
Colorado Museum of Natural History*

A NUMBER of naturalists have been interested in the behavior of the jumping spiders, or Attidae. Various methods have been employed to determine just how they jump, but the action is too quick to be observed accurately by the unaided human eye. Photography with a high-speed flash brings out every detail not only of the act of jumping, but of the use of the safety-line as well. The accompanying pictures were taken at about 1/30,000 second with a homemade high-speed flash.

The shot of the spider in mid-air presented difficulties. Snap shooting wasted a lot of film. Finally a spring-board was devised so that when the spider jumped, a contact was made which closed the circuit and flashed the light. The spider was kept in place by putting a ring of vaseline on the perch behind it and a pan of water beneath. Then, with the room in semi-darkness except for a little light on the finger to which the spider was to jump, the creature could be prompted by a little teasing to leap almost at will.

► **LANDING.** The safety-line, as it emerges from the spinnerets, is made up of a number of filaments which coalesce and harden on exposure to the air. If the spider misses, the safety-line enables it to haul itself back up to the perch

THE JUMPING SPIDER



▲ "ONE FOR THE MONEY." Jumping spider getting ready to jump, with the safety-line attached behind. Actual length of spider is $\frac{3}{4}$ inch



▲ "FLYING through the air with the greatest of ease"



Wildlife Refuge

By GRACE E. BARSTOW MURPHY*

A Christmas visit to one of Nature's island sanctuaries—where the majesty of wildlife is preserved by those who see that steel and stone are not enough to make a nation great



▲ *Ornithologus americanus*, represented by Bob and Amos, were transient fauna on Bull's Island



SEVENTY thousand ducks! And every one of them protected by the Government of the United States! Mallards, black ducks, baldpates, pintails, blue-winged teal, green-winged teal, shovelers, ruddies, scaup, canvas-back, and wood ducks fly out of every waterway. They fill every vista. They practically pose for the amateur who wants to learn one from another.

Such is the Cape Romain National Wildlife Refuge, one of the larger of the 279 sanctuaries maintained by the Fish and Wildlife Service. This refuge, north of Charleston, South Carolina, is a six-mile-wide strip of

land, marsh, and islands stretching for 21 miles along the coast and embracing 28,000 acres.

My husband, my son Amos, and I passed the Christmas holidays there last year. A launch waited to carry us through the channels to Bull's Island, where 5000 acres hold as thrilling a natural history experience as can be found. This and the other sanctuaries are helping to see that bird populations are protected and increasing, and that the natural beauty of our countryside will be preserved. The wild turkey was a symbol of the unspoiled land of our forefathers. Wild turkeys would have become extinct had they not been protected. One hardly walks a road at Bull's Island without seeing a turkey or two. I soon saw exactly what I had wanted: a huge cock flying from the road to the top of a tall tree, his great wings lifting his heavy body lightly. The iridescence of his back shone in the sun, and the colors of his wings, tan at the tips, were completely clear.

Crab grass, wild rice, and various legumes are planted for the turkeys, and the kind of open space they like is provided for them, so that they will multiply. I went with Mr.

Waring Hills, the Refuge Aid, to bait the traps, which is not the sanguinary proceeding it sounds. Corn was placed in wire enclosures that looked like natural clumps of palm or shrub. When the turkey goes in, the trapper in the blind pulls the string and the door falls. The bird is then banded and may be shipped to another refuge and there released.

The up-turn for geese

Five years ago there were 16 Canada geese on the refuge. When we were there last winter there were 200—and one lone snow goose. Soon there will be more. The proper food is now growing, and they come to get it. Their calling could be heard at night. Mr. William P. Baldwin, the Manager, took us in the launch to Cape Island to see them. We counted flocks totaling probably 150 birds. One flock of about a dozen, looking like gray, feathery balls, was asleep down on the beach. One after another the birds woke up and stretched their long, graceful necks as I watched through the glasses. Then each in turn, fearing nothing, settled down with head under wing.

* As readers of NATURAL HISTORY will recall, the wife of Dr. Robert Cushman Murphy, head of the Department of Birds at the American Museum, shares keenly her husband's absorption in the living cosmos that is our natural environment. They have made many trips together with various scientific objectives, and her poetic interpretation of nature has expressed itself in a number of articles in this and other magazines. Not long before the experiences in South Carolina she describes in this article, she traveled by airplane to Ecuador ("Flight to Ecuador," NATURAL HISTORY for September, 1943), and more recently she visited Venezuela.

—ED.

The refuge is the northernmost home of the brown pelican, which breeds there in large colonies, sometimes 300-strong.

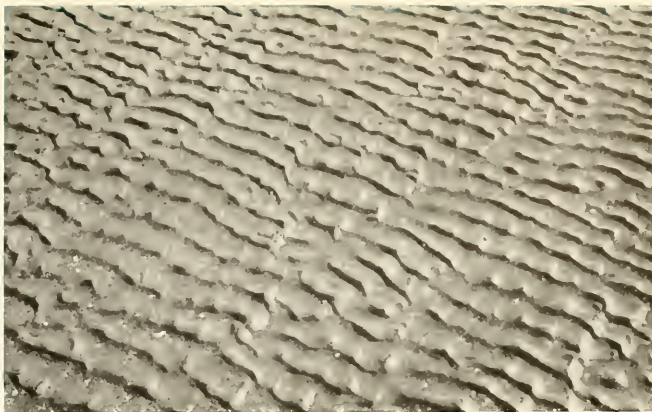
The range of research in conservation carried on at the refuge, as viewed through Mr. Baldwin's *Quarterly Narrative Reports*, is staggering to the outsider. The whole bird and mammal population is covered, including their relation to each other and to the plant life of the region. Every fact of weather and every change in the vegetation must be at the fingertips of the man responsible for all that is happening in this sample of wilderness. For wilderness it is, with the natural flora and fauna as they were 300 years ago, yet directed, in infinite patience, by skillful and accurate scientific knowledge.

Not content with the full-size job of daily surveys and reportings and recordings, Mr. Baldwin has made many specific studies in the refuge. He spent four months on the beach of Cape Island observing the enormous loggerhead turtles and writing a paper on them. Great numbers of them, some weighing 250 pounds each, come there in summer from tropical oceans and lay their eggs, which, Mr. Baldwin says, is an awesome thing to watch. He had a Roman holiday when 65 blackfish, 8 to 17 feet long, were washed ashore and died. It was an unusual opportunity, and the beach was for the time an outdoor anatomical laboratory. These small whales were studied inside and out, even to the unborn young. But the work had to be rapid, because 65 large animals rotting on a hot beach presented problems that were not alluring even to the most enthusiastic scientific man, in spite of help from the black vultures. Mr. Baldwin's "Notes on the Vegetation," which include careful botanical maps drawn to scale, are a study of every bit of growth in the whole refuge. We are told that "wild rice appears to be spreading"; and the differences between the mainland and the island vegetation are explained, with data on the soil and growing conditions. All desirable species are encouraged, not only for themselves but also for help in crowding out the undesirables, such as cord grass and cattail.

Wildlife careers

I mention Mr. Baldwin's work partly because it seems that there is a new and growing opportunity for

WILDLIFE REFUGE



▲ RIPPLE MARKS at tide-line were sculptured in the sand



▲ A BANDED SCAUP DUCK, released to carry the message of its age and migratory travels to some other ornithologist—if it falls to a gunner or ever again blunders into a duck trap



▲ DUCKS in the tail of the trap become frantic before they are seized but seem to calm down once in the hand. They rarely struggle while the numbered band of the United States Fish and Wildlife Service is being attached to one leg

our young people in a most interesting profession. In 279 wildlife refuges, with jobs for the two types of naturalists—those who conduct serious research and those who apply these studies in refuge management—it looks as though there are careers which could bring the utmost satisfaction to a great many young people.

Bull's Island used to be a shooting preserve; now it is a haven for wildlife, sold at a fraction of its value to the Government for the cause of conservation by Mr. and Mrs. Gayer Dominick.

Dominick House, originally the Lodge, is located in a clearing near the boat landing. It has big rooms, plenty of beds and open fires, and is now in the charge of Mr. and Mrs. Hills. Mrs. Hills plans wonderful meals which could easily increase one's girth. There are so many oysters and fish near-by that the Hills practically whistle them into the kitchen for Anna, the maid, to cook. Mr. Hills knows every bird and beast and tree on the island and is ready to share his knowledge.

On the Cape Island trip we located clams in the sand by their little "key-holes" and used shells to dig them. Later we ate them in front of the Baldwin's fire.

Bird banding

Bird-banding has always been a major interest, naturally. Birds that have been tagged and numbered have been picked up again all the way from Canada to Florida. Shortage in personnel and in metal bands has curtailed this work during the war.

In winter, the ducks keep one completely enthralled. I have been close enough to a black duck for his weather eye to look right into mine as he gained height on his silver-lined wings. The mallards, with their gleaming green heads and white-edged tails, usually rise with the black ducks. We always crept up to the ponds without speaking. The ducks don't notice steps, but the voice or sight of man generally disturbs them at once. Some of them refused to pay any attention at all. Handsome black-and-white pintails frequently posed without flying off. I had always thrilled to the brilliant colors of the wood duck. "Take the binoculars," Bob said. "There's one sitting on that post." On Bull's Island I could look and enjoy as long as I wished.

Sometimes a pond would be full of baldpates, which stayed right where

they were, or there might be myriads of ducks of all kinds among the duckweed which shone vivid green in the sun.

A special pride of the refuge is a great flock of oyster-catchers, black and white, with vain red bills. They feed on the flats of the channels or fly along the beaches of Cape Island. Bob described their song to me as "the most exciting and hysterical song in nature, not excluding the loud trill of the pileated woodpecker."

The raccoons, beautiful animals though they are, do so much damage that some have been shifted to other areas. Christmas night we went out to look the 'coon situation over. The three men put on their rubber boots, because we were to be in the swamps.

"You three are protected from snakes, but I am not," I pointed out. "They won't strike you," said Mr. Hills. "They are asleep in winter."

The dog Bruno found the first 'coon and treed it. He was so excited he ran part way up the tree himself, barking furiously. The men played the beams of their flashlights along the branches and in among the Spanish moss. Two gleaming eyes in a round bunch of fur could be seen 40 feet up a loblolly pine, indifferent to the clamor below.

We came out into a clearing and looked up at the three-quarter moon. Orion stalked across the sky, the middle star of his belt over the equator. Venus was gorgeous in the west. The young men wanted to explore further, so Bob and I walked home through the delicacy of the moon-shadowed woods, with their Spanish moss, palm fronds, and here and there water glistening among the trees.

After a Christmas morning celebration of filled stockings and a tree, we three started out on a memorable walk. Cardinals flew in and out of the cedars, and mockers were near-by. A few yards from the house stands a live oak, whose branches enclose a "room" 150 paces around. Spanish moss hangs thickly. Usually this so-called moss is associated in one's mind with live-oaks and deciduous trees, but on Bull's Island moss-covered loblollies gave us a surprise.

"The Road"

Beyond, we stepped over a white fence and were on The Road. There are 25 miles of wood road on the island, but only one Road. It is to us one of the most beautiful and excit-

ing roads in the world. Wagon-wide, grass-grown, mile-long, it runs straight across the island to the ocean beach. The first part of it divides duck-filled ponds and is open to the sky.

We walked quietly, watching the small birds in the edging bushes and palmettos, and presently clouds of ducks flushed from almost under our feet. A tiny ruddy duck looked up at us placidly and plunged again and again. Even when Bob climbed down for close-up photographs, the little duck eyed us with friendly trust, swimming near us for at least ten minutes.

The ponds edging the road are varied in a design of sedge and little islets. A view may be framed by a gap in vegetation with an undulating skyline of forest for a background. Sunshine is usually beating down pleasantly, often warmly enough so that one needs only a light sweater at noon-time.

Beyond the chain of ponds, one looks through archways of heavy woods to the light over the ocean at the far end of the Road.

The diversity of the trees makes these woods unusual. The main trees are live-oak, loblolly, and palmettos. There are feathery cedars, a few hollies and the dark glossy foliage of the southern magnolia with scatterings of red gum, maple, elm, and others. The forest vines, the palmetto, the long gray Spanish moss, which takes on a green tinge in sunshine, the clumps of mistletoe,—all lend a pleasing tropical appearance without, however, tropical density. The palmettos grow out of the earth whole, like soldiers from the dragons' teeth. First heads appear, full-grown, then gradually full-size trunks press upward. This makes a charming undergrowth, with palm tops waving their fans at all levels from the ground to the tallest ones.

The carpet of the woods, mottled with sun and shadow, is made of palm fronds and pine needles of warm brown, designed with little running vines such as partridge berry, fallen cones, and bits of branches covered with gray lichen. The moss, touching one's face as one passes, is cool to the skin.

A far-off deer jumping, flashed its white rump. These deer are smaller and darker than those on the mainland. Their tracks and those of many other animals were everywhere on the island. Tiny shore-birds' tracks,

turkey tracks as big as a man's hand, tracks of many fox squirrels, and pretty raccoon tracks—all were companionable markers of every trip afoot.

The growth next lower to the trees, and also behind the open beach over the dunes, is largely wax myrtle, closely related to our bayberry. Along the dikes, the red-berried cassina almost alone holds sway, though it also grows throughout the woods. It is as decorative as holly for the Christmas table.

When we left the Road and broke through to the beach without a path, it was hard going. Catbriers and berry-laden vines were festooned everywhere. The burs were terrible, and even worse were the cactus spines, some of which pierced through my heavy leather shoe into my foot. Mr. Baldwin told us he once found an oyster-catcher with a two-inch spine in one of its feet. Quiscal, our unclipped black poodle,—not the kind of dog for Bull's Island,—could pull off some of the cockleburs but had a bad time with the cactus. She learned to sit down and wait for one of us to relieve her. She never lost her exuberance, but we spent quite a share of our time getting snarls out of her coat. Her favorite sport, and a harmless one, was chasing sanderlings on the beach, leaping the wavelets as they rolled in. It didn't hurt the birds and it gave Quis—and us—a lot of fun.

Unexpectedness was our constant delight. One time, migrant monarch butterflies flew over our heads. Again, a fungus on the trunk of a tree was shaped like a clinging imp. In thick woods one day with Amos, a raccoon passed in a split second of high speed, his gray body and color-circled tail sharply clear. I asked about pelicans. "No," someone said, "we will see none at this time of year. They are all in Florida." The next moment, Amos called triumphantly and we were watching one flying low over the water.

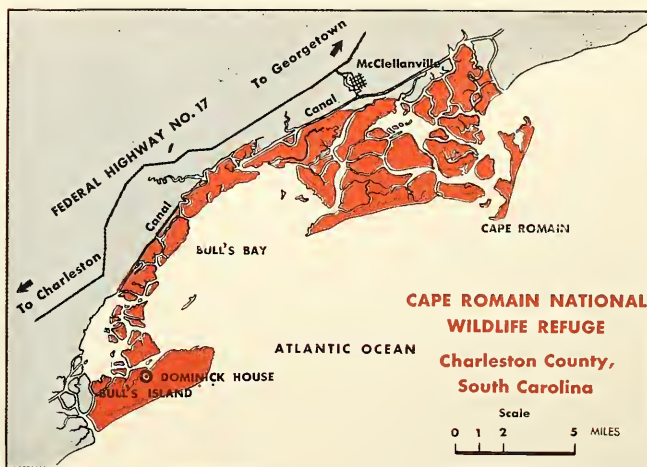
Bird census

The Christmas Census, the High Mass of the year for the ornithologists, was taken on December 27. It is approached with a height of fervor under the fun and laughter of a day out-of-doors. To get a big list of birds—bigger than last year's or than the other fellow's,—requires determined work from dawn to dark, with no time out.

WILDLIFE REFUGE



▲ THE AUTHOR releases a banded male wood duck, one of the most beautiful of North American birds, after Mrs. Alexander Sprunt, Jr., has recorded its number and other data



▲ ONCE this 21-mile stretch of South Carolina coast was favored shooting country. Now it is as safe a place as a bird can find in which to build its nest



▲ HOME POND, near the road, feeding-ground for many kinds of ducks

While the Charleston Group was combing the mainland, we worked the island all morning. I wore in my hat the lapwing badge of the International Ornithological Congress, held in Denmark in happier days. I started to call Quiscala. Bob looked shocked. Frolicsome pups were not included on a big Christmas Census.

For me, the out-of-doors means beauty of line and color, with the stir of living things. Wherever I looked on the Island, I saw a bird or the motion of a bird. But I hear none of the sounds. My men tell me about the bird calls, some of which I clearly remember, and other sounds, like wind in grasses, come back in thought. My eyes are so busy that I "take the cash and let the credit go." Dr. Frank M. Chapman, who is the dean of all ornithologists, helped me about that, though he does not know it. In Denmark, everyone was listening to a nightingale. Thinking the others had gone in, I tried to get close to the bird, holding up my hearing aid, hoping to catch one note. I couldn't, and turning, looked straight into a world of sympathy in Dr. Chapman's eyes. By the strange law of opposites, that look, in its understanding, has stuck by me ever since. I think of it and not of what is missing.

Alligator!

The men, walking ahead over the dikes which cross and recross the marshes and ponds, stopped at a sea of yellow grasses that were full of light held over from yesterday's sun. It was cloudy and cold. I came along behind them, calling myself their old squaw. They were too busy with birds to see anything else, so passed right by a six-foot alligator asleep in matted watery weeds. I called them and they came back. Amos threw a stick, but the beast did not budge. We flicked water on him with a palm branch. Still he did not move. Finally a long plank tossed at him spoiled his sleepy sun bath; he plunged and swam away underwater, a trail of bubbles marking his direction.

"We would have missed that fun but for Mother," said Amos, which put my stock up, for my usual way of identifying birds is to say: "Bob, there is a little brown bird in the path. What is he?"

"A swamp sparrow, dear."

Yet the tide of devotion to natural history rises through the years to engulf anyone who stops for it.

Some knowledge is bound to sink in!

"Don't miss the pileated woodpecker, Bob," I would call, as the beautiful red-tufted bird flew near. There were many of them this year.

All over the Island great flocks of redwings streamed above the grasses in undulating waves or fed on the seeds of the tallest pines, in close and graceful formation. My husband says the observation may be a new one. Their way of flying is a kind of music: close—whir, close—whir.

Bob made a squeaking sound, and a sharp-tailed sparrow flew out of the grass. "That was the one I wanted," he said.

A flicker crossed the path ahead, golden-winged. A thrasher flew here, a hermit thrush there. Brown creepers, red-breasted nuthatches, house wrens, blue herons, snowy egrets, a bald eagle on a post—these were only a few of the birds on the long list we were making. Above us sailed red-shouldered hawks, red-tailed hawks, and turkey vultures, whose wings end in "fingers" of clear silhouette. At noon, the Charleston Group arrived in the launch. Drizzling rain forced us to eat sandwiches indoors, but we were quickly out again to cover the whole island in three groups. By the end of the day our own list totalled 131 species. I wondered whether I would dare come back in spring, when in the dead of winter there is so much to see. Spring must be overwhelming at Bull's Island!

Not even on the island could we get away from war reminders, for there was a bomb target on a far meadow. The student aviators had pitted the surrounding country with practice bombs, and one fire had been started, burning some palmettos. It was extinguished quickly by the Army fire guards, with little damage.

At this end of the island the ocean has within a few years encroached over three miles. The most recent of the undermined trees were twisted skeletons on the beach. Forlorn? Perhaps, but it is an interesting procedure. For the waves that have broken down will again, under other circumstances, build up. It makes one feel the unimportance of one isolated event in the long history of the ages, with their surge and tide, even though that event be the most painful war. What has been done will be softened, and time will continue. The pain will be forgotten in the majesty of the succession of the centuries and in their

effect on the forests, the beaches, and even on humankind.

Balanced nature

In an unplanned wilderness of olden times, the balance of nature took care of itself. Predatory animals were kept down by being preyed upon, and their victims were numerous enough to multiply in spite of depredations. But when man's hand is brought into the situation, the balance is often upset. Out of 22 wood duck nests Mr. Hills had found in hollow trees, 18 sets of eggs had been destroyed by chicken snakes or raccoons. Alligators like to eat ducks, which is not a diet the refuge approves of. Which of the animals are living in a relation of balanced adjustment and which are not? A study is under way to find out how much damage deer ticks do to the turkeys. There are five kinds of ticks on the Island. I picked one off me on the beach.

"Bob, is this a dangerous tick?"

"Yes," he answered, "the kind that spreads spotted fever." As they are easy to get rid of, there is no danger. The ill effect of the ticks on the turkeys is more important.

My husband is almost as full of surprises as is his mistress, Dame Nature. He is always bursting into a new branch of his profession about which I had heretofore thought he knew next to nothing. This time it was shells. He filled his pockets with them. Quiscala caught his ardor and came bounding to bring him specimens. He packed them, brought them home to New York, and identified them. His notes bristle with sketches of shells and other beach gatherings, with their Latin names. There are several kinds of whelk and several clams, including the razor. There are skates' eggs, sea urchins, sand dollars, purple-red corallines, and cockle shells. The ocean beaches of the Island hold fully as much variation as the woods. Gannets plunge far out, wings closed. An eagle flies low. Porpoises leap. There are great flocks of various kinds of gulls. There are red-billed terns, with black-tipped white wings. There are white-winged scoters. Small shore-birds, sanderlings and other sandpipers, and plover eat their fill along the incoming waves' edges. The wind makes little sandstorms. And ripple-marks at tide-line are sculptured in the sand.

I have no space to tell of the winter insect life, the fiddler crabs, the

ground spiders' webs white with mist, or the several kinds of lizards.

Our whole coast was once as rich in wildlife as the Cape Romain Refuge is today. The work the Government is doing all over the United States reclaims and improves similar areas ideal for its protection. Yet not until the public is really educated to their value, can the tide of destruction be turned to a strong one of construction. As Russia and Mexico can turn an illiterate people into a literate people in so short a time, so our alert Americans can be more thoroughly awakened than they are now to this all-important matter of conservation.

If all sorts of commercial products can be made household words in every corner of the country, certainly an adequate campaign on this far more important subject can reach every American. Then public feeling and public knowledge will curb the minority who care more for selfishness and profit than for the general welfare.

People used to throw out their great-grandmother's china. No one does so now. We put it on display. We are alive to its value. Our wildlife is worth at least equal care. As a people we love the out-of-doors. Our National Parks show this with their attendance statistics. Yet the basic principle of conserving our out-doors is still known only to the intelligent few.

During the year of 1944 in my job of war grandmother, I was in 32 states. Erosion in one place or another, bad logging with all rules broken, bad farming, even on Long Island, wild flowers wiped out, birds scarce for lack of cover and because people do not even know their value in relation to crops, are all common matters.

Here and there, hopeful signs appear, such as a roadside advertisement by a pulp company's experimental station: "In 1943, 178 trees were cut on this acre, 163 trees were left."

Yet not until all of us know and really care with our whole hearts and minds will destruction stop.

Can't we sell the idea as Victory Bonds are sold? Our men fought united. Can't we unite to conserve the physical value and beauty of what they fought for, with every child and every adult knowing the reason and all the ways of doing the job? The Government and increasing members of people are pointing out the road.

WILDLIFE REFUGE



▲ SHOWING HOW WILD TURKEY TRACKS compare in size with the print of a man's hand: a photograph taken among the dunes behind the ocean beach



▲ A RACCOON has passed, leaving its "finger-prints" on the wet sand. The 'coon is the only abundant predatory mammal at Bull's Island, which has neither opossums nor foxes



▲ AT THE NORTH END of the Island the ocean has within a few years encroached over three miles. Trees are twisted skeletons on the beach



▲ 100% CONCENTRATION ON THE OBJECTIVE. The gooney orphans found Shipfitter 2/c Wagner just as good a provider as their lost parents. It takes about three days before these youngsters will accept food from human beings. They have to be hungry, and patience is necessary. Wagner has a natural talent for taming birds.

FATHER NATURE

By EDWIN D. NEFF

Official photographs U. S. Navy



ARTHUR J. WAGNER, Shipfitter second class, may never find his name in boldface on the records of this war, but to the men and officers now on Midway Islands, he has brought many a tug at the heartstrings, and many a smile to leaven the melancholy between mail planes.

Wagner is a diminutive, sparsely built sailor of indefinite age whose daily selec-

tion of uniform would appall the admirals' tailors. His only consistency of dress is an outside baseball cap. From under its visor a thatch of blond hair competes with his vision and half obscures a grin as catching as the measles.

To Midwaymen, Wagner is known as "Daddy"; for in addition to his official duties, he has become the founder, pro-

prietor, and principal dietician of the Gooneybird Orphan Asylum and Fairy Tern Annex. The Gooneybird Asylum is located in a patch of grass near the dispensary's maintenance shack, while the Fairy Tern Annex has been grafted to an ironwood tree athwart the shack itself. Both institutions had a spontaneous beginning. From time to time tragedy over-



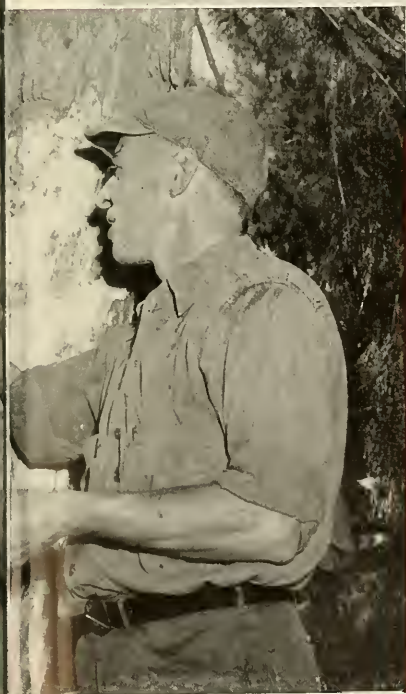
▲ THE MIDWAY FAIRY TERN ANNEX. This is the house that Wagner built for his tern infants. Each had lost its parents and now depends entirely on human kindness

◀ IT ISN'T MAMA, but a youngster has to eat. Infant terns demand fresh minnows for breakfast, lunch, and supper. This one looks a bit doubtful, but he's going to give in

takes the parent gooneys, leaving their young to starve. Next to the gooneys, the fairy terns are the most popular birds on the islands. They are dainty as girls, snow-white with shoebutton eyes. Sometimes the infants fall from their trees, or are kidnaped by overzealous nature students picnicking in the ironwood groves. If a man has had a few cans of beer, it may be difficult to say which tree he plundered, and the only decent course is to turn the youngsters over to Wagner for care and feeding.

When word got around that Wagner was adopting bird orphans, his institutions began to fill. Because he is built rather close to Mother Earth, Wagner had to nail several lengths of wood to the ironwood tree within reasonable distance from the ground. These are now crowded with hungry terns, and from day to day Wagner must add new wings to the annex. Upon these the fluffy, chick-like infants crouch, demanding food interminably.

While all of Wagner's infants are orphans, some are victims of additional misfortune. One of the young gooneys broke a leg, another fell into a tar pit, and a third was so long without food that it could not support its head. This



last Wagner named "Wobbly," and it became his favorite. After getting its strength back, Wobbly charged across the street to attack another (well-fed) youngster, who, doubtless, had been smirking at him. The attack was a mistake, for the youngster's parent appeared from behind a scaevola bush and beat Wobbly within an inch of all his feathers. Wagner rescued him.

The "tar baby" was more difficult. He had had the bad judgment to explore the perimeter of a tar pit and, when only his beak was protruding, was hauled out. Wagner sliced five pounds of tar from his feathers with a succession of razor blades. For a day or so the miserable bird associated all his troubles with his benefactor and pecked at him furiously, refusing all food. Finally he was seduced with an unusually fragrant bit of tuna. Now he follows Wagner around like a puppy.

Occasionally Wagner finds himself with an adult to care for. One was brought in with a broken leg, and Wag-

ner rigged up a kind of bosun's chair which supported the bird and permitted its legs to hang beneath. Wagner taped its wings to keep the bird quiet, and reset the leg. He had to make a sling to support the bird's beak, since normally gooneys sleep with their bills tucked under their wings like a canary. Wagner's excursion into orthopedics came to nothing. The ungrateful bird waited until night and somehow escaped.

Wagner now is feeding nearly a dozen young gooneys and eight infant terns, all of whom had been written off the books by Mother Nature.

It is hard to say whether he knew what he was getting into, but he had some warning.

About in the middle of his experiments an adult gooney suddenly appeared and made little visits with each of the youngsters. She spent a night with each, "talking" to them and grooming their feathers. Wagner figured she was passing them the latest word on the bird community, and named her "Scuttlebutt Sally." But

Sally may have become appalled at her undertaking, because she soon vanished.

Wagner's life is becoming increasingly complex. He finds himself starting at the slightest sound, and a chirp from his youngsters sends him scampering to the galley doors for scraps of fish. The gooneys will settle for one feeding a day, but the tern youngsters are voracious and will eat only freshly caught minnies. This poses a problem in ethics for Wagner. He so loves all animals that he finds himself debating whether he should take the lives of the minnows in order to feed the terns. He fights this battle with himself every day. So far the terns have always won.

A baby tern is scarcely as large as a baby chick, yet its capacity for minnows is beyond science. Each can account for a dozen or so a day, though you would think two or three would be the limit.

This routine is running Wagner ragged. Close friends swear he is losing weight while his orphans grow fat.

"At least he has his evenings to himself," we offered.

"By no means," a bystander replied. "Look over there in those bushes. That's his moaning bird pet. That one will eat only after dark!"

▼ SOMETHING ON A STICK. Wagner shows off his whole tern family. The little one on the end was afraid of the older boys and sat in splendid isolation



LETTERS

Continued from page 441

one of the foremost authorities, says, "The venom of most scorpions, then, is not dangerous to man. The characteristic reaction to this venom is a local, often painful swelling—sometimes accompanied by discoloration at the site of the sting. In some cases the pain may travel a short distance from the original site. Where normal conditions of health prevail, there is absolutely no danger of death, even in tiny infants."

[An article giving further information on Arizona scorpions may be expected shortly in *NATURAL HISTORY*.—ED.]

CATS AND BABIES

SIRS:

When we brought home our new baby boy, many persons asked me if I dared let our very affectionate cat in the house any more. "He'll snuff the breath out of the baby," several said. Our cat showed no signs of jealousy, though I know cats do become jealous of babies. I can hardly believe the stories about cats deliberately putting their nose to an infant's nostrils to take its breath. Would such an action have any attraction for a cat?

MRS. BILL LANCASTER.

Kent, Washington

I do not know the origin of the story that a cat will suck a baby's breath. It probably originated in ancient times, for cats have always had an occult significance, whether as good or evil spirits. Among primitive peoples the breath was considered the soul, spirit, or life, and the story probably at one time involved the idea of a devil removing the soul of the infant, replacing it perhaps with a demonic soul.

It would be physically impossible for a cat actually to suck the breath from a baby; and what would a cat want with the partly exhausted air from the lungs?

However, there may have been a case or so where a cat caused a baby to suffocate. The warmth of a young child is quite attractive to cats, and I have seen on several occasions a cat crouching down on the chest of a child, purring away with comfort. The weight of a large cat might collapse the thoracic bellows of a baby and smother it in this accidental manner.



▲ A REMARKABLE LIKENESS of a prehistoric monster, photographed by Bernice Band Darley on an Oregon beach

More dangerous are disease germs which cats may scatter about.

JOHN ERIC HILL,
Associate Curator, Department of
Mammals.

The American Museum of Natural
History, New York, N. Y.

SIRS:

Your magazine is the best literature on nature, animals, and people that I have seen in many a day. Keep up the good work! . . .

STELLA D. JACOBI.

New York, N. Y.



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If readers of *NATURAL HISTORY* have specific questions regarding photography in the realm of natural history or science, we shall be happy to try to have them answered.—ED.

When communicating with our advertisers please mention Natural History

YOUR NEW BOOKS

Continued from page 443

one of the leading literary naturalists of the present day, writes with a pen which "not only accuracy governs, but imagination inspires." This volume is made up of 30 short essays on a variety of subjects, each one, as indicated by the sub-title, being a real adventure of the naturalist-author. The collection gets its title, *The Lost Woods*, from the first essay, the Lost Woods being the one on his grandfather's farm in the dune country of northwestern Indiana, which he knew as a small boy and which disappeared in the subsequent 30 years,—a world that was, but now is just a memory.

"Boundaries of the Night" (Chapter 15), an imaginary spanning of the continent, from Maine to California, with the advancing night, is a particularly fine piece of writing.

Although the book is remarkably free from error, the author's naturalist friends will probably question his reference to the king crab as "the oldest existing form of life." How about the lingulids? The statement that the song sparrow is "the commonest and most widespread of North American birds" is open to question, for the breeding range of the robin is greater in extent than that of the song sparrow. Most naturalists will doubt the pilot's observation that a duck hawk passed him at a speed estimated to be twice that of his plane, when he was flying at 175 miles an hour. And where the author speaks of the spectacular "love dances," of the great blue heron, we wonder whether he has not confused the bird with the sandhill crane.

But these are trivial matters in a book which this reviewer found to be altogether fascinating. Two hundred of Mr. Teale's superb photographs add greatly to its attractiveness.

CLYDE FISHER.

MODERN BIRD STUDY

----- by Ludlow Griscom

Harvard University Press, Cambridge, Massachusetts, \$2.50
15 photographic illustrations, four maps and diagrams, 190 pages

DR. GRISCOM'S book *Modern Bird Study* is an outgrowth of a series of eight lectures delivered at the Lowell Institute, Boston in 1944. These lectures have been thoroughly revised and extended to ten chapters.

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There are a few errors, for example the facial markings of the Eastern and Western Flickers on page 30 and again on page 177 are confused, but such errors do not in the least detract from the great value of the book. Every student of birds should have a copy of *Modern Bird Study* in his library.

ALFRED O. GROSS.

THE LIFE OF AN AMERICAN NATURALIST

----- by Francis B. Sumner

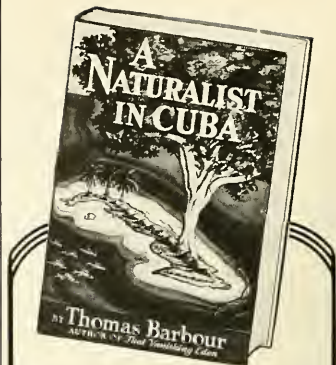
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THE author of this autobiography was a zoologist of world-wide fame. His graduate work was done at Columbia under Edmund B. Wilson, Bashford Dean, and Henry Fairfield Osborn. After taking his Ph.D., he taught a few years at C. C. N. Y. For eight years he was director of the biological laboratory of the U. S. Bureau of Fisheries, at Woods Hole. Since 1913, until his recent retirement, he had been Professor of Zoology at Scripps Institute, La Jolla, California. For three years he was a research associate of the Carnegie Institution, Washington, D. C. In 1899 he was a member of the Columbia University Zoological Expedition to the Egyptian Sudan.

This reviewer was attracted to this volume by a very realistic and candid article in *The Scientific Monthly* of August, 1945, entitled "A Biologist Reflects Upon Old Age and Death." On September 6 of this year, Dr. Sumner died at La Jolla at the age of 71 years.

The narrative begins with his earliest recollections, which he calls "The Farthest Limit of Retrospection." A discussion of his immediate ancestry he calls "The Shuffle of the Genes." We have a brief chapter on his social adjustments and maladjustments. He describes his undergraduate

Continued on page 480



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Dr. Sumner has given us a carefully written story, for he possessed unusual literary ability. One is bound to admire his evident and convincing honesty and frankness. He must have been a serious-minded person, for through it all there seems to run an under-current of realism bordering on pessimism.

CLYDE FISHER.

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of geckos, mongooses, and the rare Hawaiian monk seal, are superb examples of the natural history photographer's craft. The cartoons and the verse (or worse) on facing pages are rough stuff. The least (and the best) to be said is that the drawings and text are not without point, and in some instances might even create interest and sympathy for the gorgeous subjects of the photographs. If the lonely, long-suffering and sometimes bored men in naval and military service on the Pacific islands like their phenomena served with such sauce, who are we to criticize? Any naturalist would be lucky to possess this book for its photographs, and perhaps a thousand times as many human beings will buy it mainly for its drawings and text!

Particularly notable among the photographs are several showing the juvenile appearance and behavior of the fairy tern, which never knows a nest as either egg or chick. Other superb shots include the wing-and-bill salute of the Laysan albatrosses and a particularly exquisite photograph showing the overlapping nesting grounds of this species and its neighbor, the black-footed albatross. Among so much that is lovely, however, it is difficult to pick out favorites, and this book must be destined to be equally at home in ornithological libraries, barracks, and barrooms.

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