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# THE NATIONAL GEOGRAPHIC MAGAZINE

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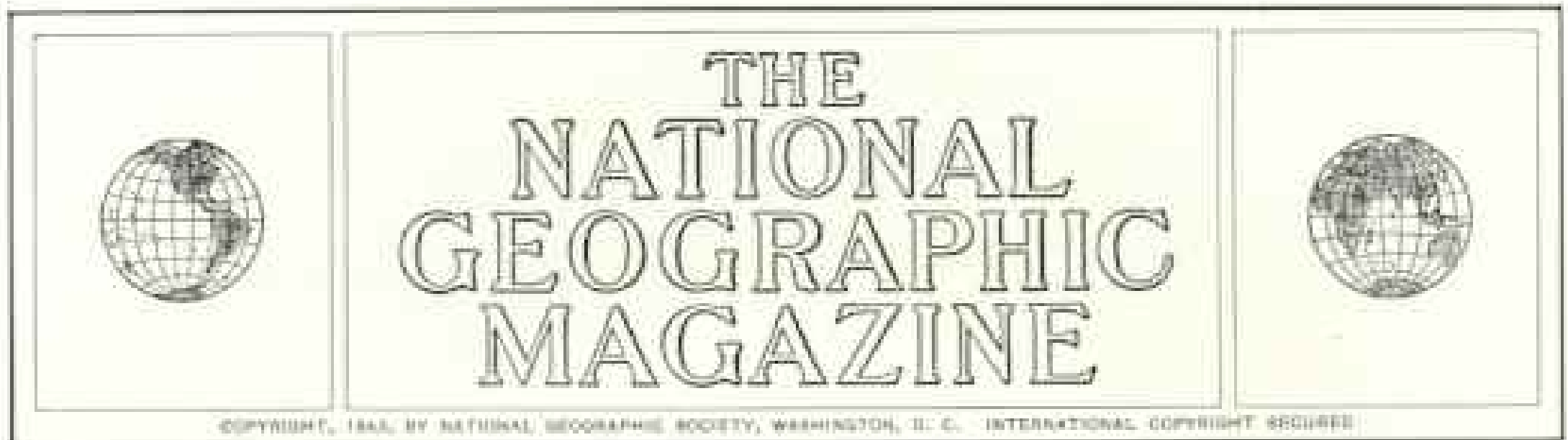
JOHN AND  
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## Parade of Life Through the Ages

Records in Rocks Reveal a Strange Procession of Prehistoric Creatures,  
from Jellyfish to Dinosaurs, Giant Sloths, Saber-toothed  
Tigers, and Primitive Man

BY CHARLES R. KNIGHT

**N**ATURE'S most fascinating continued story is the record of life on our globe and of the strange creatures which at one time or another have inherited the earth.

This venerable earth, on which through countless ages so many animate things have existed and then passed away, seems to have been at first merely a vast bulk of formless matter. Great clots or whorls of more or less gaseous elements, detached from the sun by the attraction of a passing star, gradually assumed a whirling or rotating motion which tended to compress the tenuous mass into ever more solid form.

Spherical in shape and possibly a third the diameter of our present planet, that little world was able to attract and hold an atmosphere of watery vapor augmented from time to time by outpourings of gases through violent volcanic action.

Water fell in the form of rain or snow. Accumulating in holes or depressions, it made our first seas and finally oceans. These bodies of water were not salty in their earliest phases, but later became so from the constant leaching of salts from the dry lands through which the streams and rivers flowed.

### Seas Cradled the Miracle of Life

Meanwhile a constant rain of falling bodies—scattered remnants of the primordial explosion which had created our planet—continued to enlarge the original bulk of the earth until it assumed practically the size and shape which we know today.

Naturally the now briny ocean depths were shifted more or less in their positions upon the surface of the planet, but this did not preclude the development, in course of time, of tiny living organisms. They found a congenial home in the warm and constant temperature of the seas that occupied so large a portion of that ancient world.

These minute objects, microscopic in size and simple in form, grew definitely larger as the ages passed. Cells were added to cells, while species developed and disappeared, giving place to new and more complicated forms in constantly increasing numbers.

By this time the great life experiment was fully established upon the baby earth, but the profound conundrum of its existence is still as much of a mystery as ever. We know, however, that once the living stream had fairly begun it has never ceased to function through all these millions of years.

Under the microscope we may see that life principle beautifully expressed in the lowly amoeba as it marches—or, rather, flows—in search of food. How efficiently it envelops the precious substance, extracting nourishment without which even an amoeba must cease to exist. For it seems that to maintain the elusive state of being which we call life, some help must be brought in from the outside, as no living thing is truly self-supporting. It cannot live upon itself indefinitely, but must bolster up its constantly failing powers by the ingestion of food in some form or other.

By a study of this shapeless little object,



Edwin Peckin

### Dinosaurs Left Their Footprints in the Sands of Utah

Here at Kanab this trail of a small one is still clearly visible, for the soft sand has turned to stone which has preserved the tracks. In one section of the State, imprints of eight varieties of dinosaurs have been discovered. Some of the huge beasts took strides 15 feet long.

then, we may see, as in a glass, the unfolding of the great story brought upward through the ages in a long succession of life expressions, some large, some small. All have been activated by the same impelling force, which forever urges them forward and which ceases only when that life becomes extinct.

### Creatures Dead Millions of Years Reconstructed

We shall never know, of course, more than a mere fraction of the thousands of types of animal life which have peopled this world through its long and ever-changing history,

The remarkable fact is that we are able, by intensive research and skillful deduction, to unearth and reconstruct forms of life which have been extinct for millions and millions of years.

Man's interest in such things began, no doubt, while he was still in a very primitive state, both mentally and physically. As his intellect improved, so did his innate curiosity, an attribute highly characteristic of the human mind.

Naturally our grubby and much harassed ancestors did not regard the finding of a fossil shell or piece of bone with much scientific interest. On the contrary, they were merely poking about in caves or wandering along streams and strands in the necessary but scarcely intellectual task of finding something to eat.

Even their practical minds and stomachs could make nothing of such highly mineralized objects, except as ornaments for their ugly persons, or, if the find was a good solid thigh bone, a club or persuader to be used in war

or the chase—or during domestic fireside chats.

Consequently, it was not until a much later period of man's existence that he became self-conscious enough to seek out these mute reminders of a vanished past merely to satisfy his curiosity, and not as a possible filler for a usually empty interior. At length, no doubt, he even began to see a possible connection between the living things by which he was surrounded and the stony but now familiar treasures which he was able to unearth.

With man at this interesting point on the highroad of his upward career, it was but another long step to a time when with fully

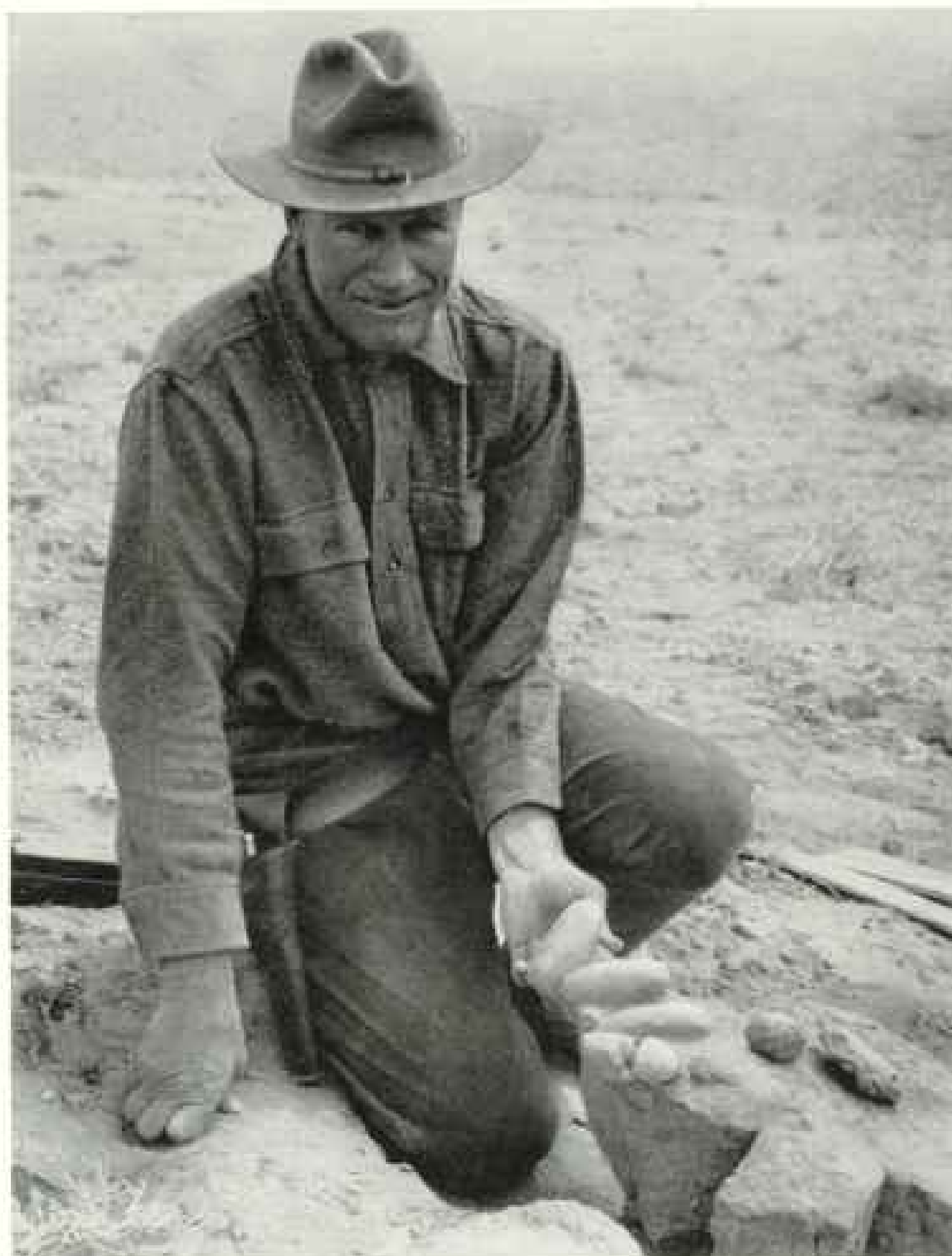
developed faculties he had learned to speculate upon the problems of his own personality, the mystery of life and death, and a possible after-life beyond the grave.

Our historic ancestors, both Greek and Roman, devoted a tremendous amount of time and thought to such momentous questions. These they strove to answer in part by a most penetrating study of everything concerning the secrets of antiquity, as evidenced by buried shells, bones, and other objects. Aristotle (B. C. 384-322) classified various animal groups and thus simplified the study of prehistoric animals as well, since many of them seemed to fall into the same classifications.

After long eclipse in the Middle Ages the torch of true scientific concentration was raised anew by Leonardo da Vinci, and much later the celebrated Swedish savant Linnaeus so interested George III, the King of England, that he fitted out an expedition to bring back rare and unusual animals from distant lands.

It remained, however, for the French naturalist Georges Cuvier (1769-1832) to perfect the science of comparative anatomy, which enabled him to reconstruct, from a few characteristic bones, a practically complete skeleton. He may be said to be the father of paleontology, though the restoration of a creature from incomplete material has proved an untrustworthy procedure.

Since Cuvier's day many able men, inspired by his zeal and acumen, have delved into the history of animal life on our planet. As a result, in the last hundred years, and particularly within the last fifty, large numbers of



J. H. Stockford

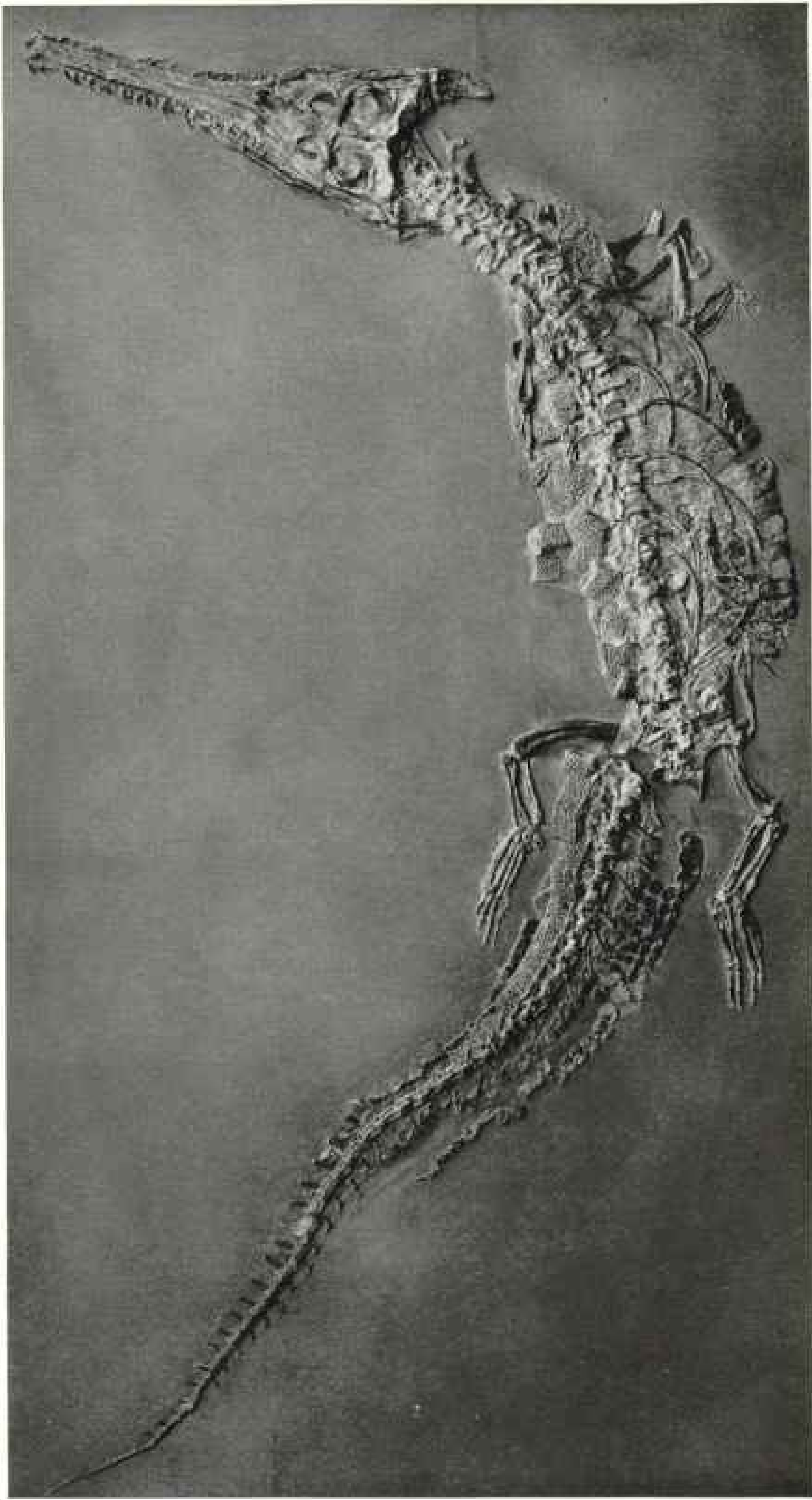
### Have a 150-million-year-old Dinosaur Egg!

Dr. Roy Chapman Andrews, veteran leader of many American Museum of Natural History expeditions to Mongolia, exhibits the first eggs discovered in 1922. George Olsen, expedition member, turned over a rock with his pick and found this fossilized clutch adhering underneath. The largest specimens were nine inches long. Two, broken open, disclosed parts of unhatched baby dinosaurs (page 165).

species of prehistoric animals have been discovered, classified, and described. Charles Darwin, Thomas Huxley, and Sir Richard Owen in England; Joseph Leidy, O. C. Marsh, Edward Cope, W. B. Scott, and Henry Fairfield Osborn in our own country—to mention but a few names—have greatly advanced the science of collecting and mounting these wonderful creatures.

### Lowly Life in the Cambrian Ooze

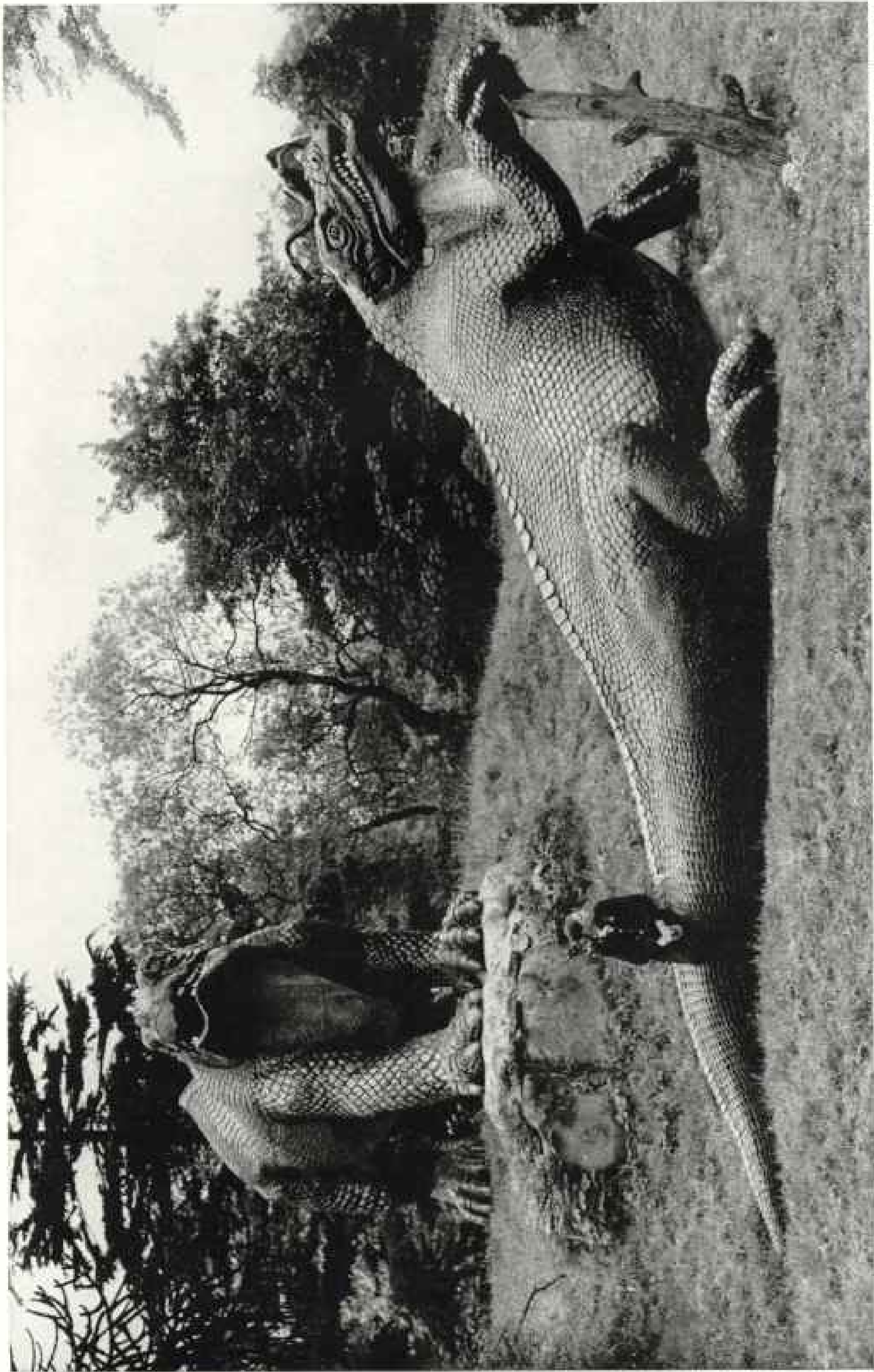
Today in our museums one walks through vast halls filled with splendidly restored skeletons of every shape and size, concrete



Von Hauff

### From a Bavarian Stone Quarry Came This Ancestor of the Crocodiles

The length of the skeleton, 13 feet, is almost equaled by that of its scientific name, *Myriosaurus boettleri*. Another Bavarian quarry has revealed much of our knowledge of prehistoric birds. A trace of the earliest of these, *Archaeopteryx* (Plate VIII) came with the finding of a single feather in August, 1861. A month later an entire specimen turned up, and in 1877 a second was found. The forerunners of both the crocodile and the birds lived in the Jurassic Period, about 150 million years ago (page 148).



Staff Photographer B. Anthony Stewart

### With a Few Teeth as a Basis, and a Lively Imagination to Draw On, Waterhouse Hawkins Created These Fantastic Iguanodons

Eighty-eight years old, the figures stand in the grounds of the famous Crystal Palace in London. Scientists who first discovered scattered remains of this dinosaur in Sussex, England, noted that the teeth resembled those of an iguana. The restorer jumped to conclusions, and made his animals look like giant iguanas. Today we know the Iguanodon was a kangaroo-like dinosaur with short front feet which it seldom used in walking.

reminders of days and eras long passed away.

Life of 500,000,000 years ago is shown in Color Plate I, a Cambrian underwater scene.

The name "Cambrian" was given to these deposits because they were first described from Wales, which the Romans called Cambria.

One can hardly conceive of the tremendous changes that have taken place in the world since that remote time. Yet a study of the lowly invertebrate creatures in the picture will disclose types not very different from those found in our present-day seas.

It is true that some of the forms have become extinct, but the wonder is that any of the original models have persisted through the ages. The glass sponges, seaweeds, jellyfishes, marine worms, and even the shrimplike creatures are not unlike those of today, but trilobites and others have long since passed away.

All this extraordinary aggregation, and many more besides, were discovered about 1910 by Charles D. Walcott, Secretary of the Smithsonian Institution in Washington, D. C. The fossilized remains were found at an elevation of about 7,000 feet near Burgess Pass in the Canadian Rockies.\*

Until this wonderful series came to light, our knowledge of the Cambrian fauna was comparatively limited and fragmentary, but some strange good fortune had preserved these delicate specimens so that in many cases even the soft parts of the anatomy can be studied. The scientific world rejoiced with Dr. Walcott over his lucky find and the material is now in the National Museum at Washington.

Discovery of these lowly sea creatures at such a lofty elevation is readily understood when one realizes that the land where they now lie embedded was once the bottom of the sea.

Since that distant day vast transformations have occurred in all the continents. Huge mountain ranges have risen, only to be worn away and washed into the waters. Snow-clad peaks now stand thousands of feet above the floor of those ancient Cambrian seas, so rich—even in that far-off time—with living organisms of many kinds.

#### Scorpionlike Creatures Crawl on Sea Floor

Old Father Neptune himself, in one of his worst moments, could hardly have conceived a more fantastic set of beings than the large scorpionlike creatures which bear the name Eurypterid (Plate II).

First discovered in fossils found in New York State, they vanished millions of years ago, leaving no actual descendants. Our mod-

\* See "Geologist's Paradise," by Charles D. Walcott, NATIONAL GEOGRAPHIC MAGAZINE, JUNE, 1911.

ern horseshoe crab and the present land-living scorpions suggest in a way these dreadfully ugly creatures, but they do not attain the size of the ancient types. Some of them, such as *Pterygotus*, were as much as eight feet in length and proportionately hideous.

Eurypterids were all aquatic bottom-living animals, presumably carnivorous but very slow and clumsy. It is possible that they lived in fresh water, but nothing is definitely known on this point. They were characteristic animals of the Silurian Period, at a time when the fishes, except for a few small sharks, were still in a more or less undeveloped state of evolution.

#### The "Terrible Fish" Could Have Snapped up a Man

The Devonian Period—named from the county of Devon in England—was a time when large numbers of primitive fishes swarmed the seas and oceans of the world (Plate III).

Some were heavily armored and curious in structure but foreshadowed later and more highly developed types. Others, such as the huge and sinister *Dinichthys* (terrible fish), rising from the bottom, had immense heads and gaping jaws with which they engulfed their prey.

The Terrible Fish had no true teeth, but the edges of the jaws had cutting points that performed much the same function. A full-grown man—if any had lived at the time—could have been snapped up by the mighty fish and swallowed with the greatest ease.

The stiff-bodied little shark (*Cladoseleche*), just escaping sudden death by its superior agility, belongs to a very early type of the shark family, a race of fishes which have well proved their staying qualities in the struggle for existence. The man-eating sharks of our own day have a long heritage of strength, speed, and ferocity and constitute the world's most dangerous class of sea-living creatures.

Life in the Carboniferous Period had pretty well advanced, both on land and in the water. Vast tracts of country were in a semi-swampy condition and the climate was moist and warm.

In such a favorable environment the flora developed amazingly. Huge trees of many kinds rose majestically from the surrounding ooze, their straplike roots spread wide for support in the moist soil.

Insects, including dragonflies and cockroaches, some of them very large, flew through the forest shades or crawled about among the leaves and branches.

There were no true reptiles, but many types of salamanderlike animals existed. Some of



### Bones of a Prehistoric Mammoth Tie Up a Los Angeles Excavation Crew

When workmen ran across the giant skeleton in Eagle Rock, digging stopped. The California Institute of Technology was notified, and the fossil remains, including skull and tusks, were carefully removed (Plate XIX). The fence was erected to ward off souvenir hunters and curious spectators.

these, such as Eryops, were large (eight or ten feet in length), with huge heads, long, powerful jaws, and small, soft feet (Plate IV). Our modern newts and salamanders are not unlike these ungainly beasts except in size.

They were all flesh eaters, snapping up anything which came their way, either of their own kind or some other species. Slow, ponderous creatures, shunning the sunlight, they swam or crawled about in dark, slimy pools under the masses of heavy foliage.

In these pools grew gigantic rushes, except for size not unlike our modern Equisetum, or horsetails. Such plants, with the vast masses of dead trees, leaves, and branches, sank gradually into the all-pervading muck, there to change through countless ages into what we now call "coal."

The warm and very moist climate of the Coal Age was followed by a much more arid and sterile period called the Permian, from the Province of Perm in Russia. Large areas

of dry land were now exposed. The fauna changed from a soft-skinned race of creatures like Eryops to the scaly-skinned, hard-bodied true reptiles.

### In the Permian Period True Reptiles Appeared

These early members of a mighty race were exceedingly varied both in size and in form. They numbered among their ranks some of the most grotesque creatures imaginable.

In Dimetrodon (double-measure tooth) we see an excellent example (Plate V). The long finlike decoration along the back is not a fin at all but the upward prolongation of the spines of the vertebrae. These delicate spines, no thicker than one's finger, are four feet in height and must have been connected, as shown, by a tough skin or membrane. The creature was carnivorous, some ten feet in length, and probably lived near water, where it could easily obtain its food.



The equally curious monster at the top of the picture is *Naosaurus*, a small-headed animal, herbivorous in habit but carrying on its back the same erect fin plus a number of short cross-bars like spars on the mast of a ship.

The two creatures shown are from the Permian of Texas. Many other species have been found in the same area and also in such widely separated regions as Siberia and South Africa. In those countries most of the types were large, heavy-bodied animals with interesting potentialities, since a study of their skeletons suggests a possible ancestry to the true mammals, which were finally to supersede them completely in the struggle for existence.

#### Diplodocus Was Gigantic But Harmless

Among all the strange and sinister creatures fashioned by Mother Nature, none can surpass the great family of dinosaurs, of which the 75-foot *Diplodocus* is a conspicuous example (Plate VI and pages 168, 169).

Dinosaurs first appeared in the time known as the Triassic Era, but their earlier ancestry is still a mystery. They were true reptiles, but fashioned along three or four general lines of development as to habits, structure, and the like.

*Diplodocus*, *Brontosaurus*, and several other long-necked and long-tailed species, all gigantic, were aquatic or at least spent most of their time in the water. All were harmless monsters, feeding and moving quietly about in the midst of large masses of floating vegetation and leading a placid and peaceful existence. Occasionally the great brutes must have come out of the water, either to deposit their eggs or to bask in the warm sun on some convenient sandbank.

The various land-living species arouse our curiosity by their strange and unusual attitudes and forms. Two main types are evident—those which walked upright on their hind legs and the races which progressed on all four legs.

Some of the erect species were the vegetable feeders and others were flesh eaters. Those that crawled about on all fours branched out into some bizarre and heavily armored monsters, spiny and terrific in appearance but in reality harmless.

As a class, the dinosaurs were distinctly lacking in brain power, yet they existed over a large part of the earth's surface for millions of years. Despite their feeble mentalities, they apparently succeeded in dominating the animal life of their time.

In Color Plate VII two characteristic types of Jurassic dinosaurs have met to settle an old score. The grotesque monster *Stegosaurus*

(roofed lizard) is bidding defiance to the smooth but ferocious *Ceratosaurus* (nose-horned lizard). The latter rears above him with wide, tooth-filled jaws and looks for some vulnerable opening in that wonderful array of plates and horns which presents such a formidable defense.

*Stegosaurus* is without doubt one of the strangest of all the dinosaur family, with its tiny head and very small brain cavity, its long legs and small feet, and—crowning touch—the thin-edged plates set diagonally on either side of the spinal column. Despite this elaborate protection, the creature was harmless, a feeder on plants which it cut off with its beaked jaws.

How such a small mouth could have secured enough food to sustain the 25-foot animal is a decided mystery; yet, being a reptile, it could no doubt sustain life for a long period without food of any kind.

*Ceratosaurus*, in contrast, consumed quantities of meat, even carrion, whenever it had the chance. The long, heavy jaws, armed with rows of sharp-edged cutting teeth, could seize and hold its prey in a viselike grip or tear off huge pieces of flesh to be swallowed at one gulp by the ravenous creature.

In *Ceratosaurus* we have an example of the upright two-legged dinosaurs. They habitually walked on the hind legs, leaving the smaller front limbs free for grasping the prey or for fighting. All of the numerous flesh eaters were of this type, from the little fellows no longer than a chicken to the great *Tyrannosaurus*, monarch of a later day in dinosaur history (Plate IX and page 165).

#### An Early Bird and a Flying Reptile

Both the little animals in Plate VIII demonstrate vividly two of Nature's early attempts at flying. The upper birdlike creature, *Archaeopteryx* (ancient wing), is on its way to becoming a true bird, while the lower figure is that of a flying reptile, or *Pterodactyl* (wing-fingered).

In *Archaeopteryx* we have one of those spectacular specimens which scientists are fortunate enough to discover only at rare intervals, a link, apparently, between the scaly, cold-blooded reptiles and the warm-blooded, feather-covered birds.

This interesting creature (it is about the size of a pigeon) is known to us from two unique and deeply instructive skeletons discovered in 1861 and 1877 in the Solnhofen slates of Bavaria. These celebrated deposits have long supplied lithographers with lithographic stones, in which a fine and peculiar texture is necessary. This same velvety

## Parade of Life Through the Ages



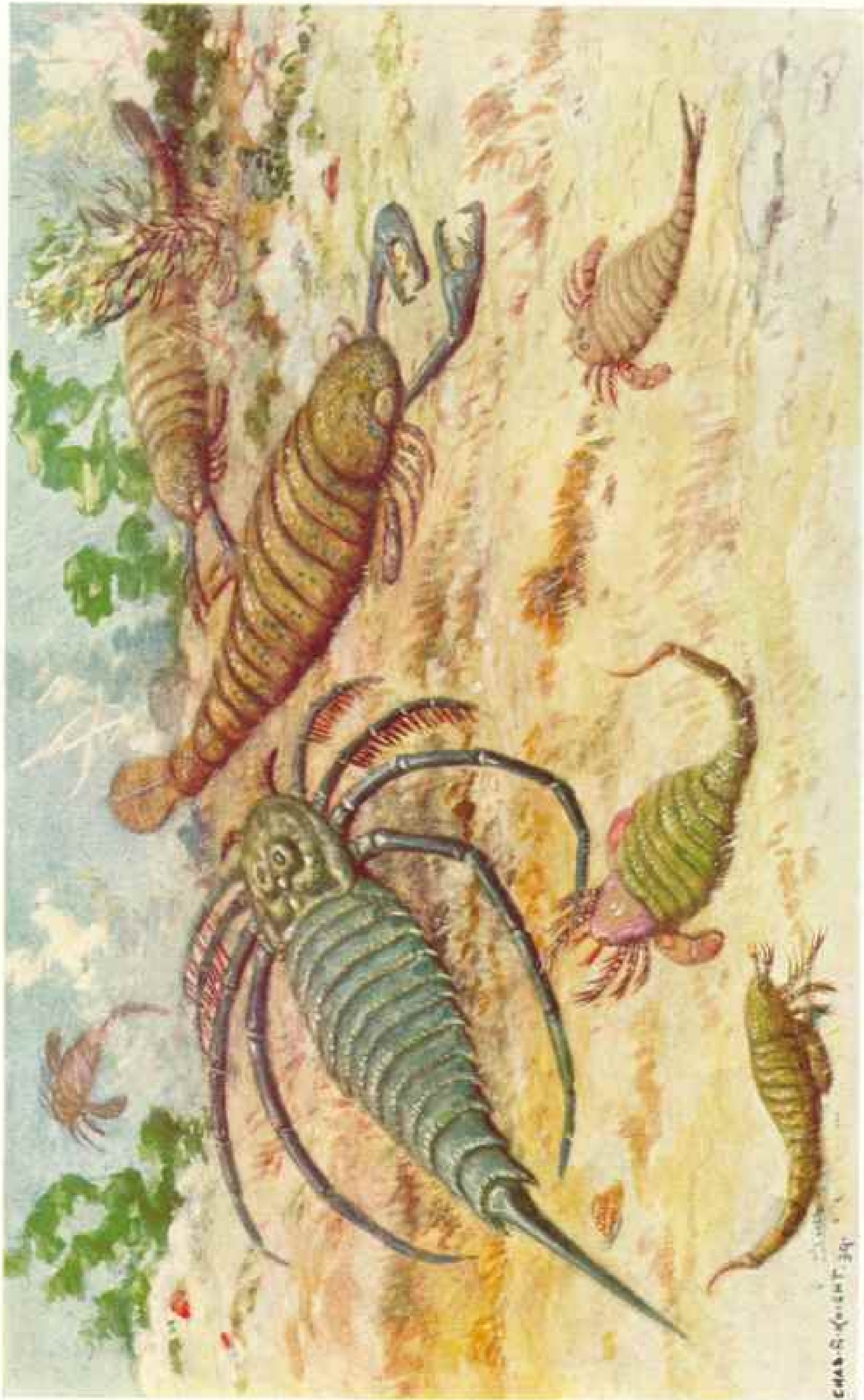
CRAIG-SWEENEY, 1900.

© National Geographic Society

Painting by Charles R. Knight.

### Earliest Life—Spineless Underwater Creatures of 500,000,000 Years Ago

Some forms, like jellyfish, sponges, and marine worms, survive today. This series on prehistoric life was painted especially for the NATIONAL GEOGRAPHIC MAGAZINE by Charles R. Knight, noted authority on paleontological art.



© National Geographic Society

Painting by Charles E. Knight

**Fantastic, Scorpionlike Eurypterids, Some Eight Feet Long, Spent Most of Their Time Half Buried in Mud**

The clumsy creatures lived under water and crawled sluggishly about in search of food. Their skins were covered with a horny substance dotted with scalelike markings. Eurypterids lived in the remote Age of Fishes. Much like them today is the familiar king, or horseshoe crab, with a stinging spine at the end of its body.



© National Geographic Society

### With Its Powerful Jaws, the Armored *Dinichthys* (Terrible Fish) Crushed Luckless Prey

Painting by Charles B. Knight

Resembling overgrown catfish, some of the giants were 25 feet long. Thick bony plates protected the immense head. Edges of the jaws were so sawlike and sharp that they resembled teeth. Eluding capture are three stiff-bodied, agile little sharks (*Cladodonts*), which do not differ greatly from the shark family of today. These creatures lived in the Devonian Period, named after Devon, England, where fossils of the epoch were discovered.

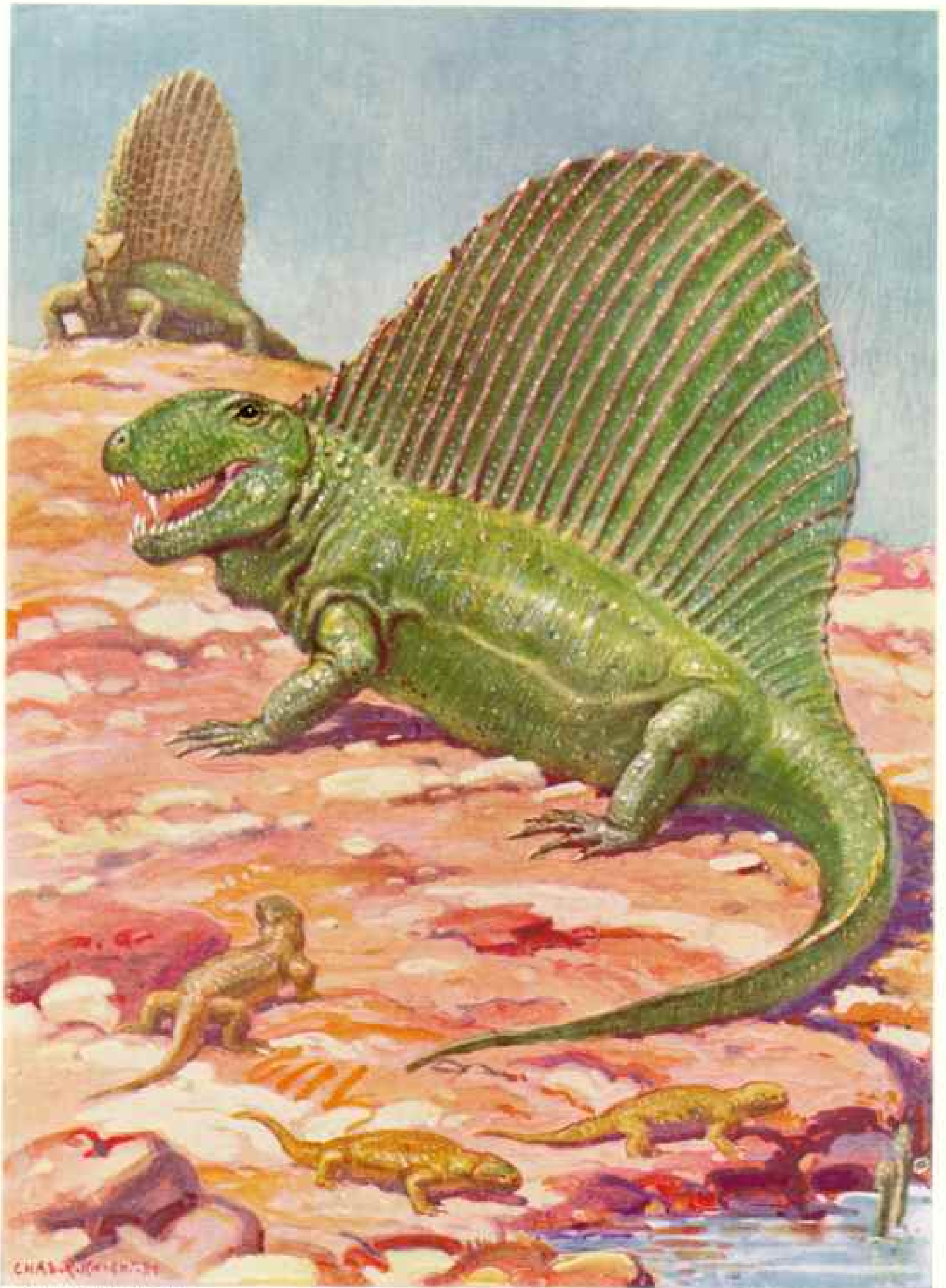


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Painting by Charles R. Knight

**Ungainly Eryops Lived in Slimy Pools When Earth's Coal Beds Were Forming**

This five-toed, small-brained amphibian was the highest type of living creature of the Carboniferous Period. In the mild, moist climate, giant trees and rushes sank deep into the muck when they died, and gradually turned into coal.



© National Geographic Society

Painting by Charles R. Knight

**Why the Dimetrodon Carried a Sail-like Crest Is Still a Puzzle to Science**

The delicate spines, no thicker than a man's finger, sometimes were four feet high. Similar in appearance was the small-headed Naosaurus (upper left). Both creatures developed at the close of the Coal Age.



© National Geographic Society

### Harmless and Stupid, the Grotesque Diplodocus Asked Only to Be Left in Peace

Long-tailed and long-necked, these giants attained a total length of 75 feet or more. Despite their great size, they could not fight well and had very small brains. They belonged to the vast family of dinosaurs, which roamed the earth during the Age of Reptiles, from 60 to 700 million years ago. Scientists put the weight of a full-grown Diplodocus at about 25 tons and estimate his normal diet at about 700 pounds of leaves or plants daily.

Painting by Charles B. Knight

CHAS. ROBERT



© National Geographic Society

### Plate Armor of the Roofed Lizard Protected It from the Sharp Teeth of a Flesh-eating Assailant

The array of thin-edged plates and horns was the only defense of the vegetarian Stegosaurus. Into this busy feeder's tiny mouth went a steady succession of plants, cut off with its beaked jaws, to sustain a body 25 feet long. Its brain cavity was exceedingly small. The ferocious, nose-horned Ceratosaurus walked upright on its hind legs—a trait of all carnivorous dinosaurs. Small front legs were free to seize prey or fight.

Painting by Charles R. Knight



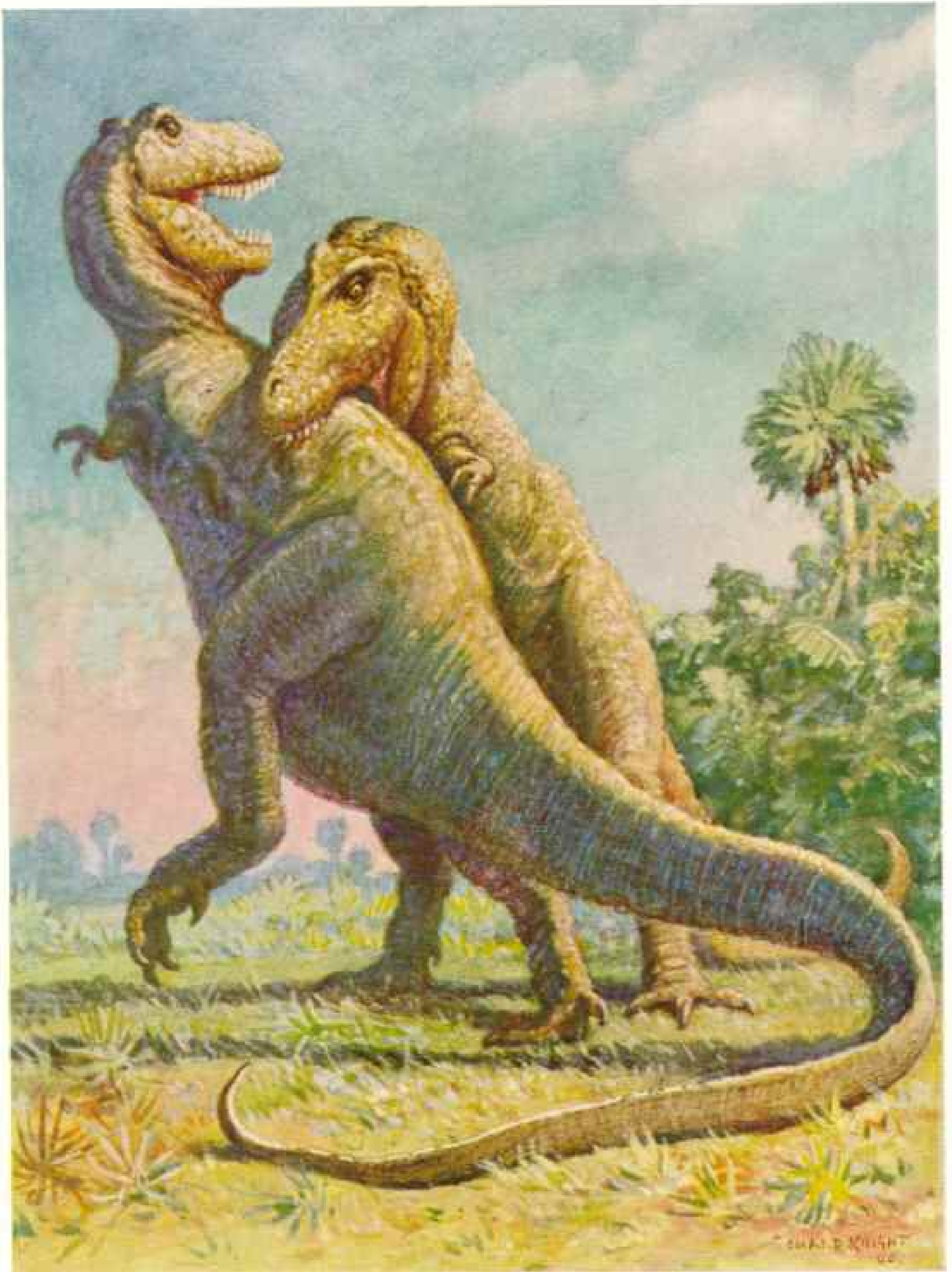


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Painting by Charles E. Knight

### Two of Nature's First Attempts in Aviation

Feathers sprang from the long tail vertebrae of Archaeopteryx, or ancient wing (upper). Clawed fingers grew from the wings, and teeth were set in the tiny jaws. Pterodactyl, or wing-fingered (lower), had no feathers. Wide membrane, connecting hands with knee and ankle joints, provided wings. Slim tail was tipped by membrane.

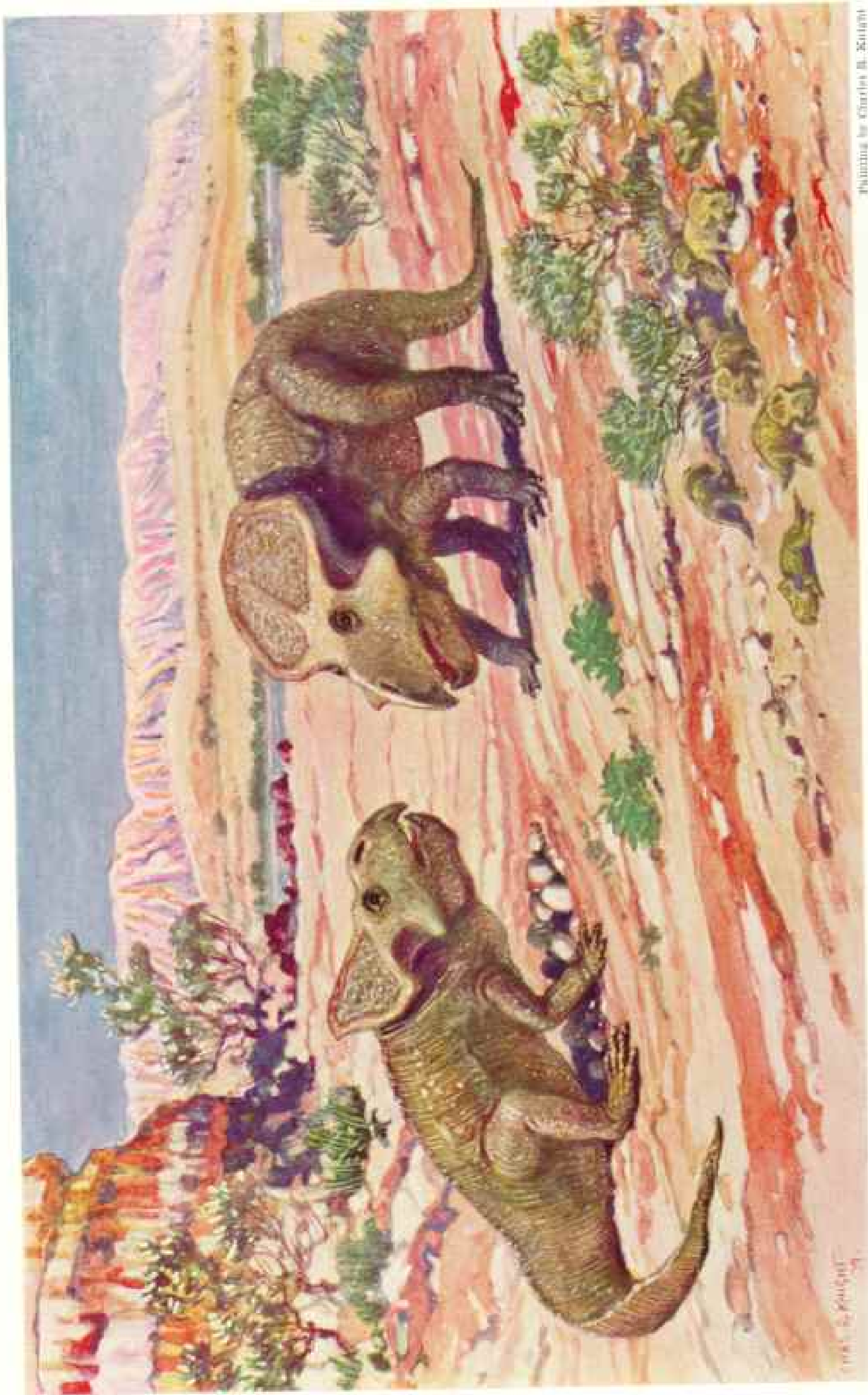


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Painting by Charles B. Kolzitt

**King-tyrant Lizards, Most Terrible of the Dinosaurs, Lock in Mortal Combat**

The sinister flesh eaters, 20 feet tall, roamed the Hell Creek region of Montana near the close of the Age of Reptiles. Hind legs with powerful talons contrasted with the puny, almost useless forelegs. Double-edged, dagger-like teeth, two to five inches long, made the king-tyrant lizard the most formidable monster of his time.



© National Geographic Society

### Egg-laying Dinosaurs of Mongolia Grew Broad, Bony Collars to Save Their Own Necks

An American Museum of Natural History expedition, led by Dr. Roy Chapman Andrews, in 1922, found a whole nest of eggs, left where they had been deposited millions of years ago by a female Protoceratops. Some had been crushed by sand. All had turned to stone. The dated explorers brought back from Mongolia not only the eggs but a series of skulls, ranging from the embryo to the full-grown reptile, which may be seen at the Museum in New York.

Painting by Charles H. Schultz



© National Geographic Society

Painted by Chester R. Knapp

**Six Feet of Head, Horns, Spines, and Collar Look Feroocious, But on the Mild-mannered Crowned Lizard It Was All Bluff**

Even the formidable beak of the *Styracosaurus* was used only to cut foliage. The beast was a vegetarian and a landlubber. *Safer* was the upright *Parasaurolophus* (pair at right). When danger threatened on land, this dinosaur could take to the water, wading or swimming to safety. The bony growth from the back of its head was a singular feature. For food this reptile gathered soft, moist marsh plants in its ducklike bill.



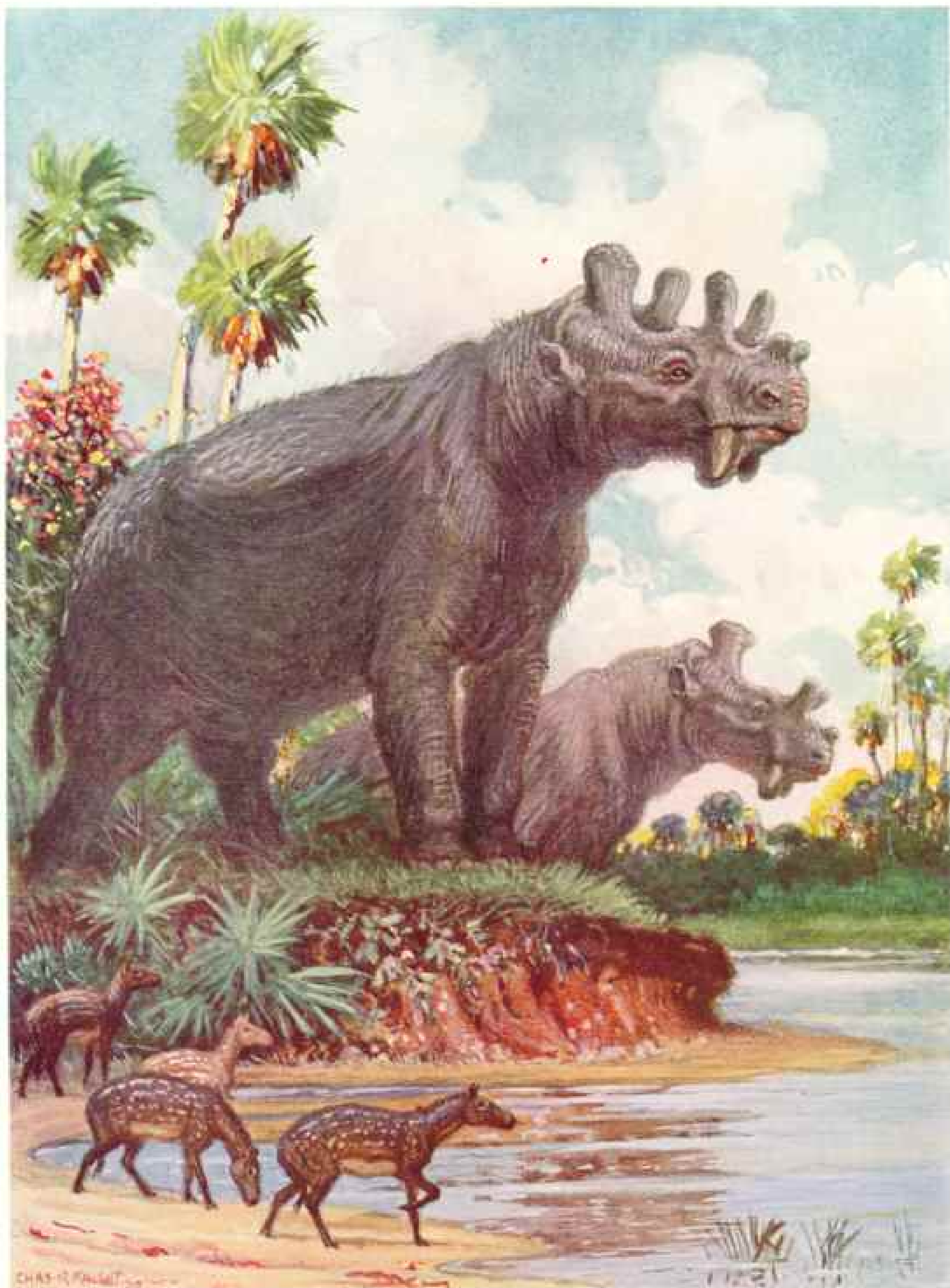
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Painting by Charles R. Knight

### Mosasaurus Ruled the Waves When They Rolled Over Western Kansas

Hundreds of specimens of this giant swimming lizard have been taken from the chalk bluffs of that State, which was submerged in a remote past. The 30-foot reptile had a powerful tail, four paddles, and sharp-toothed jaws. Here it tries to seize a low-flying Pteranodon, most highly developed of the Pterodactyls (Plate VIII).

Parade of Life Through the Ages

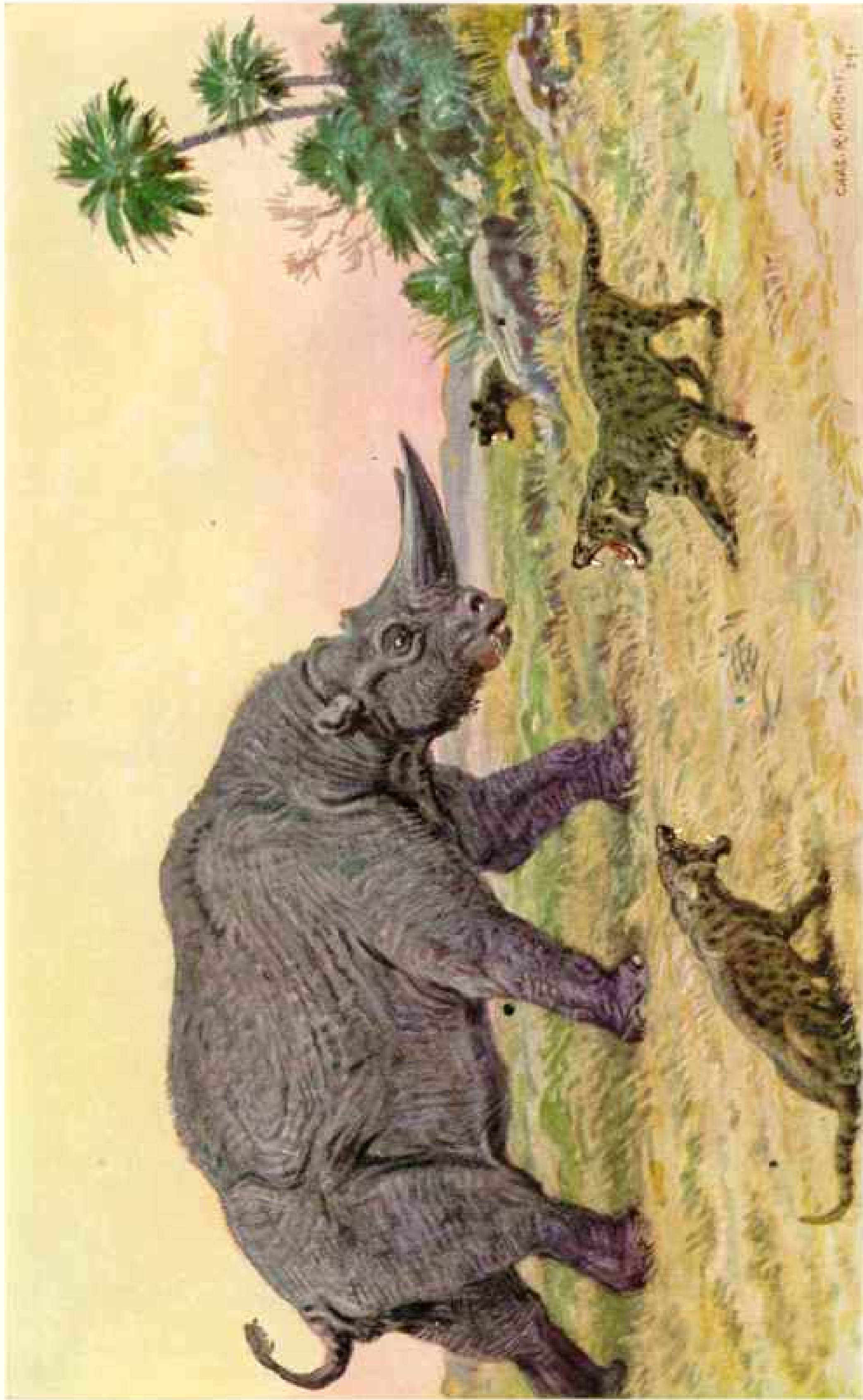


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Painting by Charles R. Knight

**Time Marches On—Huge Warm-blooded Mammals Replace the Vanishing Dinosaurs**

These six-horned Uintatheres flourished in Uinta County, Wyoming, 60 million years ago. At the river edge are Eohippi, or dawn horses. Fossils of some other ancestors of the horse were found in July, 1940, by the National Geographic Society-South Dakota State School of Mines expedition to the South Dakota Badlands.



© National Geographic Society

**Long Before the Pyramids Were Built, Mighty Arsinoitherium Fought Prehistoric Hyaenodons in Egypt**

The beast is named for the Egyptian Queen Arsinoë because its bones were discovered near the ruins of her palace. Although the animal resembled a rhinoceros, the two large horns on the nose were not true horns. They were bony growths from the skull, and enabled the animal to ward off the attacks of Hyaenodons (long-toothed hyena-like creatures). These savage but slow marauders also existed in North America.

Illustrated by Charles R. Knight



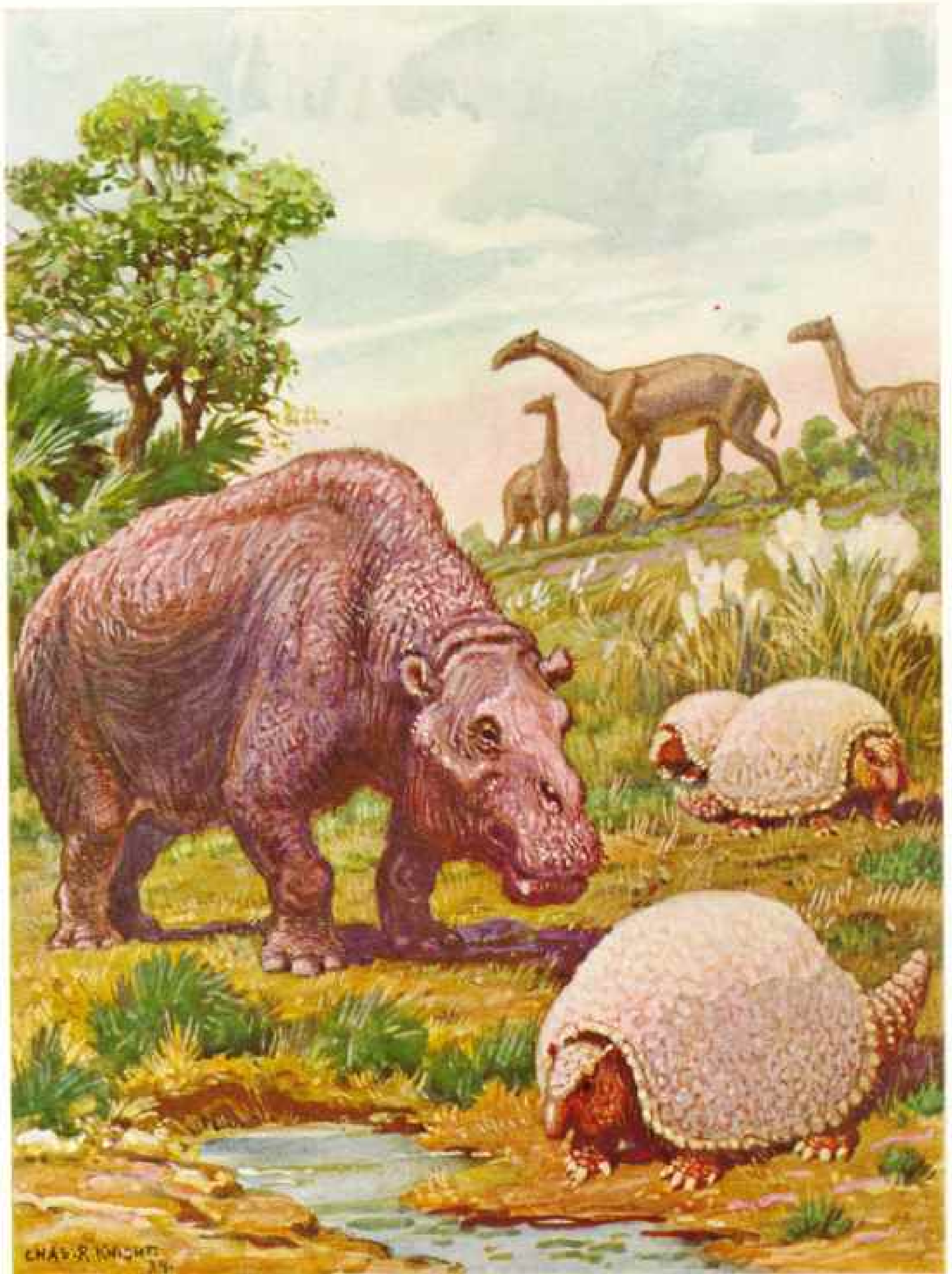
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### **Titanotherium, Last of the Horny-headed Giants, Once Roamed North America Like the Buffalo**

Painter: Charles B. Knight

Tough, thick skin covered the bony growths protruding from the saddle-shaped skull. Why so capable a fighter disappeared from the earth remains a mystery. Many skeletons have been found buried beneath large deposits of volcanic ash, suggesting that some, at least, were victims of violent eruptions. Their record has been preserved in the Badlands of South Dakota, where numerous fossils have been excavated.





CHARLES KNIGHT

Painting by Charles R. Knight

© National Geographic Society

### Prehistoric Denizens of South America

Toxodon, clumsy brute at left, used its long and heavy teeth to cut off marsh plants for food. Glyptodon, forerunner of the armadillo, could not curl up in a ball like its modern counterpart, because its bony armor was a fixed sheath. Llamalike creatures in background are Macrauchenias, long-necked plant eaters.

surface is also responsible for the almost perfect preservation of the delicate skeleton of the bird-reptile and also the imprint of the actual wing and tail feathers.

Without these precious imprints we should hardly dare to guess that the wings were almost like those of a modern bird or that a pair of feathers sprang from each of the long tail vertebrae. There are teeth in the tiny jaws, and clawed fingers on the wings—certainly an unusual set of characters to be in the possession of one diminutive creature, but significant for students of evolution.

Beneath this unique feathered being a long-jawed, goggle-eyed reptile hangs suspended by the sharp claws of the wings and hind feet. No feathers grace its ugly naked form, but the long-projected little finger of each hand carries a delicate membrane which is also connected to the knee and ankle joints of this little flying nightmare. The slim tail is tipped by a kitelike membrane undoubtedly used as a rudder to guide the gliding wing-fingered Pterodactyl through the air.

#### King-tyrant Lizard Was a Terrible Killer

King-tyrant lizard—so we translate the name of the huge and terrible flesh eater *Tyrannosaurus rex*, the greatest and last, apparently, of the carnivorous dinosaurs (Color Plate IX).

The sinister appearance of this dreadful killer can hardly be appreciated unless one comes face to face with the actual mounted skeleton. Some twenty feet in height, long-legged and long-tailed, the reptile towers upward in most menacing fashion even though no flesh or skin now covers its mighty frame. A huge and terrible head, the jaws filled with long sharp teeth, is a fitting crown to the whole spectacular impression of the world's most formidable flesh eater, which once roamed the Hell Creek region of Montana.

An upright fast-walking dinosaur, *Tyrannosaurus rex* had long hind legs and strangely birdlike feet, which gave the reptile an immense stride. But the little front legs and feet seem out of place on so huge a body. Indeed, they are so small that they could have been of little use and appear to be merely degenerate remnants of much more powerful limbs in the earlier types.

To the lesser dinosaur species which roamed the region inhabited by *Tyrannosaurus*, the sight of the enormous form of this rapacious beast must have been a signal for instant flight or certain annihilation.

Undoubtedly two males of the species would sometimes indulge in a Gargantuan tussle for supremacy, but such a battle probably ended

in quick retreat by the weaker animal. A combat between two such vast brutes must have been a sight worth witnessing, as the contestants whirled and threshed about, their fearful mouths agape and the long tails and massive legs entangled in a maze of swift evolutions.

The sword of a coming doom, however, hung over the heads of all this mighty race, so soon to give place to the tiny warm-blooded mammals of a later day. Changing conditions to which they could not adapt themselves resulted in their complete extinction at the close of the Cretaceous era.

#### Epoch-making Eggs Found in Mongolia

When in 1921-2 the American Museum of Natural History, in New York, sent out an expedition to collect fossils in Mongolia, it little expected to stumble upon what proved to be an epoch-making discovery in this field.\*

For many years scientists had considered the probability of the egg-laying habit among the various species of dinosaurs, but they were not prepared to discover in that far distant country so complete a confirmation of all their theories. Not only did this intrepid band (Roy Chapman Andrews, Walter Granger, George Olsen, and others) unearth one or two of these much sought and hitherto practically unknown rarities. They actually came upon whole nests in which the eggs, about the size of a large pear, were disposed just as the female dinosaur had deposited them millions of years before (page 143).

Not all were perfect, of course, since many showed evidences of crushing by the weight of sand above them; but a surprisingly large number—except that they were now turned to stone—might well have been laid only yesterday.

Here indeed was a find worth gloating over, particularly when in a short time the very species—perhaps the very individuals—of a new type of dinosaur which had laid those eggs also came to light under the skilled hands of the collecting party.

To cap the climax, two embryos, perfectly encased within the shell, definitely connected the eggs with the skeleton, now doubly valuable because of this unique association.

Protoceratops, the cause of all this scientific rejoicing, was a fairly small dinosaur, about nine feet long. It was big-headed, hornless, and therefore armored with a defensive collar over the neck as a protection against flesh-eating species. A series of skulls,

\* See "Explorations in the Gobi Desert," by Roy Chapman Andrews, NATIONAL GEOGRAPHIC MAGAZINE, June, 1933.

from the embryo to the full-grown animal, was also secured—all in all, a most significant and illuminating page in the history of exploration (Plate X).

Two Cretaceous dinosaurs of deceptive appearance were *Styracosaurus* and *Parasaurolophus* (Plate XI).

These grotesque creatures with the long and formidable names were found in Alberta, Canada. In spite of their remarkable and awe-inspiring silhouettes, they were both harmless, inoffensive reptiles.

*Styracosaurus* (crowned lizard), the armored beauty in the foreground, probably developed all this wonderful array of points and spines merely to protect its otherwise defenseless neck and head against the attacks of destructive species equally common at the time. The huge head with its massive bony collar is six feet or more in length and surmounts a massive slow-moving body of great bulk and clumsiness.

An enormous beak, used for cutting foliage, forms the front of the mouth and further adds to the singular appearance of this pathetic nonentity. A strictly land-living animal, it could take but could not give in its struggle for life in a world of danger.

*Parasaurolophus*, on the other hand, could seek protection in the water, wading or swimming to safety when necessary. The long and singular projection from the top of the creature's skull was a development of the nasal region; its use is unknown. The food consisted of soft and moist vegetation gathered by means of the ducklike bill, as the creature paddled about in lakes and lagoons.

#### Sea Monsters Once Swam Over Kansas

To us who dwell today upon its time-worn surface, this old earth gives the impression of great and lasting stability. But a closer study demonstrates that colossal forces have been and are constantly at work to upset the balance of the land and water areas.

We know, for example, that whole mountain ranges have been thrust upward from time to time, only to be worn away and finally washed into the sea. Vast areas of the ocean bed have risen hundreds of feet. On the other hand, equally large land areas have sunk beneath the waves for perhaps millions of years, only to rise again at a later time.

During the Cretaceous era a vast but shallow ocean spread over what is now the central region of our country. In that ocean monsters of various shapes and sizes disported themselves and cruised about in large numbers in search of food.

Among these mighty reptiles *Mosasaurus*

played a conspicuous part, for it was perhaps the most formidable of all that cruel and voracious tribe. Its remains have been found in Kansas. A length of thirty feet terminating in a powerful tail, four great paddles, and a long pointed head with sharp-toothed jaws, all combined to make this terrible marine lizard everything that our vivid imaginations conjure up when we think of a sea serpent.

Surging boldly forward through the blue water with light striking on its glistening body, one of these great sea dragons endeavors to seize the wide-winged *Pteranodon* (wings without teeth) soaring gracefully above the wave crests in Plate XII. This singular reptile, 15 feet across the wings, represents the last word in the evolution of the *Pterodactylis* (Plate VIII). The tiny flying creatures in the center of the picture are true birds, though the jaws were armed with small, sharp teeth.

#### Warm-blooded but Feeble-minded Brutes and Cat-sized Horses Appear

A vast amount of time now passes, and in Plate XIII the vales and forests are dominated no longer by scaly reptilian forms. The dinosaurs have vanished entirely, their places taken by warm-blooded animals of many species.

To be sure, these early mammals are primitive in form, with small brain power and consequently little initiative, but they are a decided improvement upon their predecessors.

In *Uintatherium*, the extraordinary-looking brute high on the river bank, we have an example of arrested mentality; the tiny brain-case seems out of all proportion for so large an animal. This weird being, with six horny knobs on the head and a pair of downward-pointing teeth resting against flanges in the lower jaw, belongs to a type no longer in existence. The teeth as well as the brain were very weak and small, so it is no wonder that the beast was eventually outclassed by smarter and more forward-looking creatures.

The little animal on the river's edge is in a wholly different class. Only a foot in height, it was an agile, graceful midget with four tiny toes on the front feet and three on the hinder pair.

*Eohippus* is the name of this interesting creature—"Dawn Horse" to us. But in reality it was not yet a horse by any means, though it is undoubtedly an ancestor of our present magnificent animals (page 170).

We have been fortunate in finding, particularly in this country, whole series of these little first horses. They range from the one shown here up through succeeding and ever larger three-toed and finally one-toed types, like those of the present day. The story of

this evolution is remarkably comprehensive, considering the very long time since the first chapters were written.

Curiously enough, the horses, though they had existed in millions on the American Continent, were gone when man arrived. The Indians had never seen a horse until some were brought over by the Spanish Conquistadors, and were amazed at the size and strength of the animal. The sight of a man riding on its back filled them with awe.

With the exception of the species known as *Equus przewalskii*, from the steppes of Turkistan, no truly wild horses are found in the world today. Our western "wild horses" are descendants of ancestors which were once domesticated, and our various types are the result of domestication through a long period of human history.\*

Long before the Pharaohs raised their magnificent temples to the glory of the gods of Egypt, a great but now extinct fauna had lived about the ancient Lake Moeris in the region south of Cairo. Today this country is a desert, and we find the bones of numerous extinct animals buried in the hot dry sand of the vanished Eocene lake bed.

One of the largest and most characteristic of these animals is known as *Arsinoitherium*, in honor of the old-time Egyptian queen. This primitive and unique order of animals resembles at first sight a rhinoceros, but the two huge horns projecting forward on the nose are bony growths from the skull and not true horns, as are those of the rhinoceros. Two



C. Anders Co.

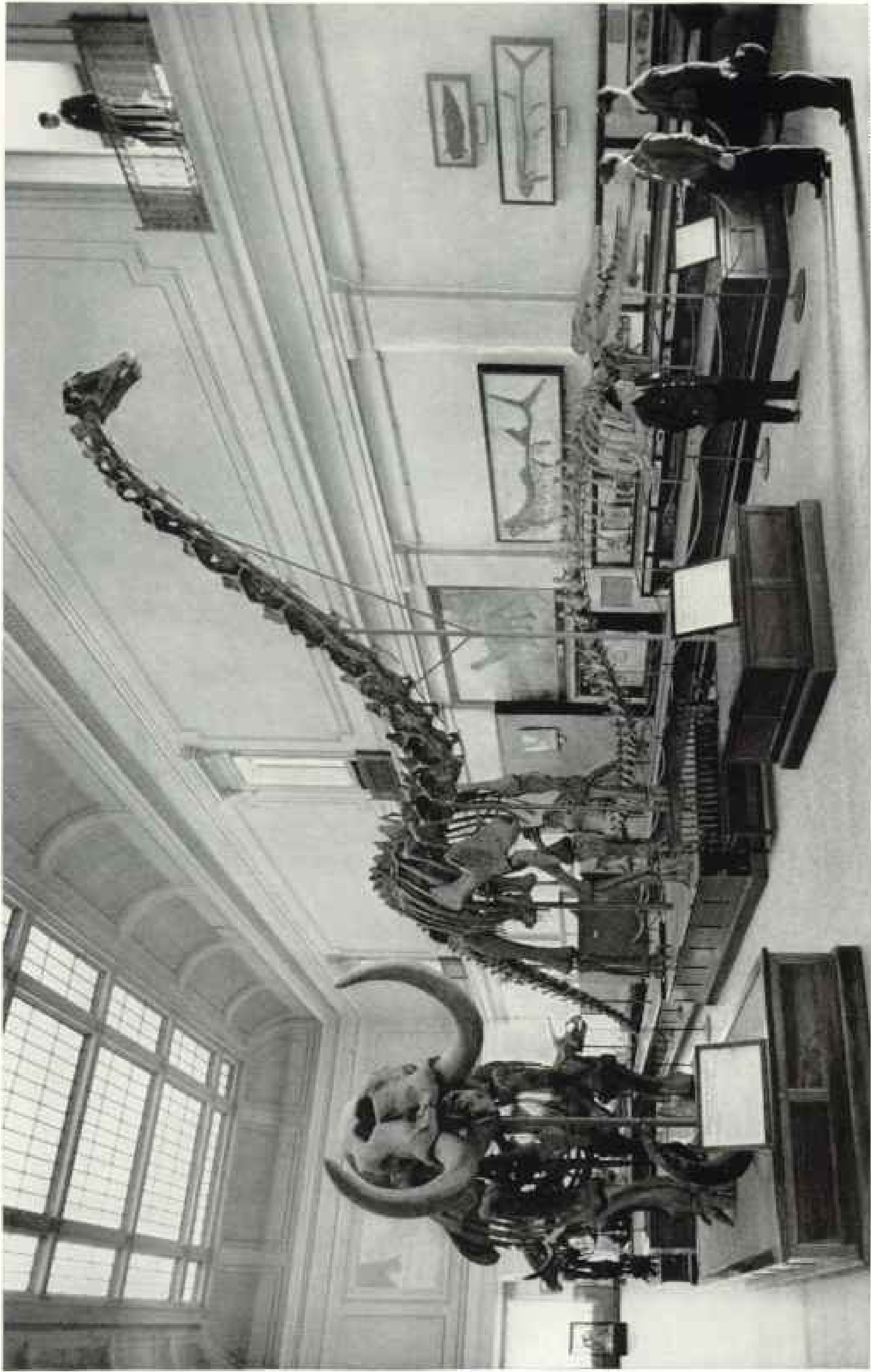
#### Fake German "Prehistoric Wonder"—a "Lobster" Embedded in Amber

From the photograph, scientists can detect the counterfeit. The small artificial "creature," suggesting a lobster, is arranged too symmetrically to have met death while struggling in sticky resin. Often insects were thus trapped thousands of years ago. The amber spread over them, then fossilized, preserving the prisoners. Such pieces, found along the Baltic coast, often are shaped into ornaments. To make this counterfeit, a piece of clear amber, or artificial amber, was cut in half; then the "embedded" object was placed in a scooped-out depression and the two pieces cleverly melted together.

smaller horns rise, one over each eye, and the body, legs, and feet are rather elephantine in structure (Plate XIV).

With its mighty nose horns *Arsinoitherium* could ward off the attacks of such hungry carnivores as the three *Hyaenodons*, long-toothed hyenalike creatures, by which it is surrounded. These savage but slow animals also existed in our own country.

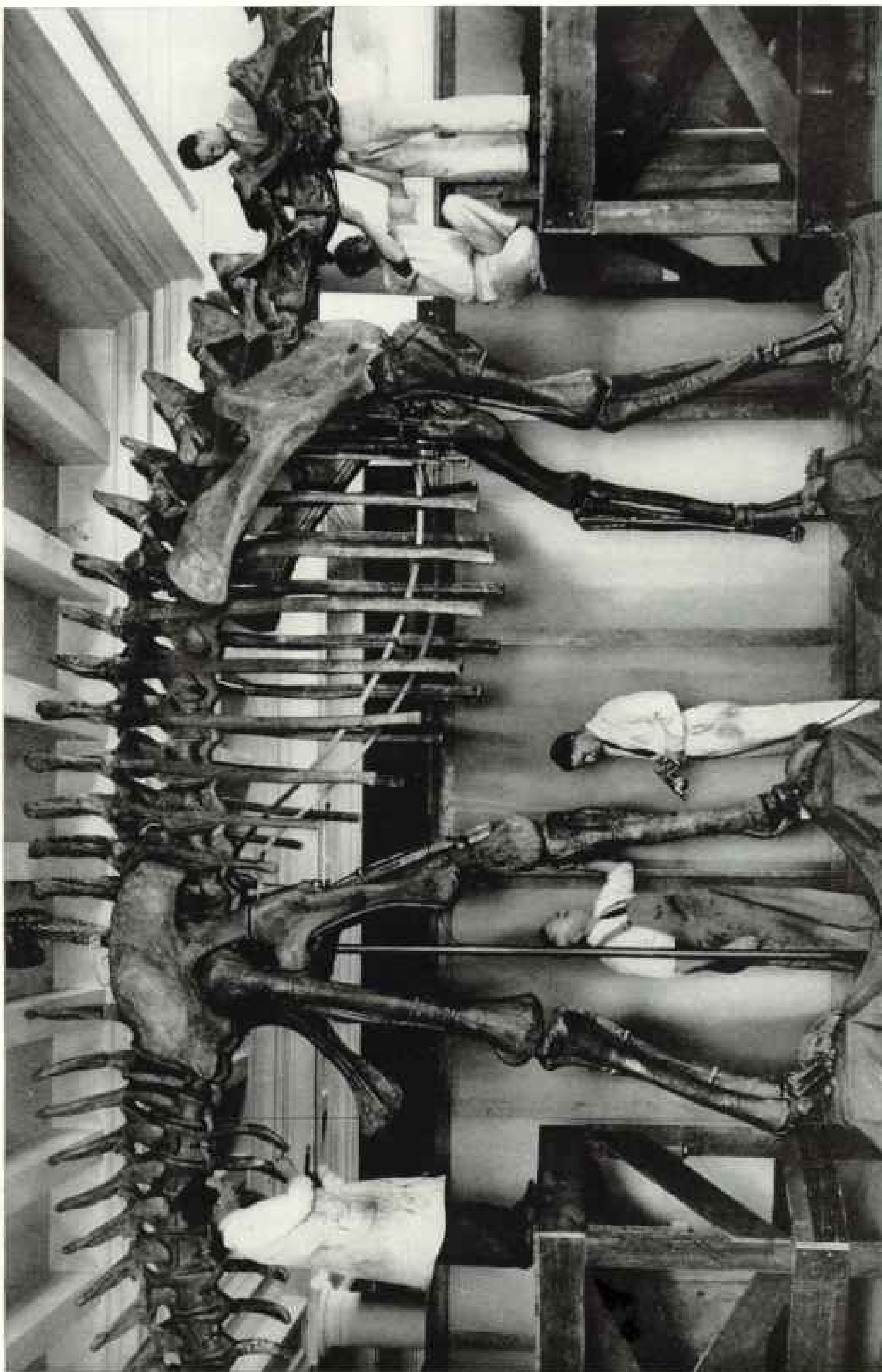
\* See "Story of the Horse," NATIONAL GEOGRAPHIC MAGAZINE, November, 1913.



Chief Photographer B. Anthony Stewart

**With the Aid of Iron Piping, a Giant Diplodocus Keeps Its Chin Up**

The elongated dinosaur (Plate VI) is flanked on the left by a long-tusked American mastodon (Plate XVIII) and on the right by the ancestor of the whale, a *Basilosaurus*. The latter finds in *sauros*, the Latin suffix meaning lizard, because early scientists who first found its remains thought the teeth looked like a reptile's. Later discoveries proved that it was a mammal, but the name stuck. This group stands in the U. S. National Museum in Washington, D. C. (page 148).



Colorado Museum of Natural History

**Colorado Museum Restorers Perform a Humpty Dumpty Miracle as They Put a 75½-foot Diplodocus Together Again**

The huge tail sticks straight out from the colossal hips at left, finally coming down in a long curving sweep (Plate VI). This is a modern innovation. Old restorations showed the tail turned down directly from the hips. The correct way of mounting was learned when several sets of firmly locked vertebrae were found.



W. B. Corbin

### Trotting Through the Ages, the Horse Lost 10 Toes and Grew Larger

This Amherst College panel of skeletons traces the evolution of the horse. Millions of years ago, 12-inch-high Eohippus, left, scampered about with four tiny toes on each front foot, and three on each hind foot. By stages the toes disappeared, until only one hoof was left on each foot of the modern horse, right (page 166).

About this Egyptian lake there were elephants as well, little fellows about the size of a tapir, their noses terminating in a short proboscis, but most decidedly elephants in miniature. From these first examples we are able to trace a direct connection to the great mammoths, mastodons, and the true elephants of a later day.

In these diminutive individuals the two little tusks or incisor teeth projecting downward from the upper jaw meet a similar pair growing upward from the lower jaw. Recent elephants have entirely lost these two lower teeth, but they persisted for ages in the long-jawed mastodon of our own country and Europe. Not until comparatively recent times did the great curving tusks of the later species become such a prominent feature.

### Horny-headed Giants Roamed Our West

The name Titanotherium (giant animal) fits well the mighty, ponderous beast portrayed in Color Plate XV. In appearance it suggests a great rhinoceros, but it is not related except in a very general way.

Last of a long line of horny-headed ancestors, this giant of the Oligocene Period was of a type which flourished for ages upon the Continent of North America. Great herds of the huge creatures wandered over the vast reaches of our western country, much as did the buffaloes of a later day.

The two nose horns are really not true horns at all, but bony growths from the skull, and were covered with a thick, tough skin. The horn of the rhinoceros, on the other hand, is simply a mass of hairlike fibers pressed closely together and stuck more or less firmly upon the nasal projections of the skull.

No doubt Titanotherium was a fighter of parts, and the big males could ward off attacks by the ever-present wolllike animals which hung about on the edge of the herds to snap up possible young stragglers.

Strangely enough, a very similar beast has been discovered among the fossils of Mongolia, a fact which vastly increases the range of these large, powerful creatures.

The disappearance of so many important races of animals after a long period of existence is always a mystery, because at first sight they would seem abundantly able to take care of themselves under all climatic changes and conditions. Nevertheless, they did disappear, through famine, pestilence, or some other natural agency.

The volcano in action in the background suggests one method of destruction. As a matter of fact, many of the American Titanotheres were found buried under large deposits of



© Field Museum of Natural History

**Early Art—a Cro-Magnon Man Draws a Picture of His Own Hand on a Cavern Wall**

With a tube he blew ochre pigment around his fingers pressed against the side of the cave. When he removed his hand, the outline remained on the wall. This scene is one of the prehistoric exhibits in the Field Museum of Natural History in Chicago (page 103).



volcanic ash of sufficient weight and density to have caused easily their final extinction.

The great Continent of South America, particularly in its southern plains area, supported a large and varied assortment of interesting animals, many of them found in no other part of the world. Fairly representative are the three types shown in Plate XVI.

Toxodon, the clumsy-looking, big-headed brute at the left, was strictly herbivorous. Perhaps it inhabited a more or less marshy country and cut off its food with the long, heavy teeth, much after the manner of a rhinoceros.

Glyptodon, at the right, was related to the modern armadillo and had perhaps similar habits, though vastly greater in size. Its food, however, consisted of vegetation, whereas its modern relative is a meat eater. Eggs, insects, worms, and even carrion are all acceptable to the armadillo.

The power of rolling up into a ball was also out of the question for Glyptodon. Its bony armor was fixed in shape, not separated by rings or bands of movable flesh, which enable the little armadillo to curl up tightly when attacked.

There were many species of Glyptodons in both North and South America. Some were very large, with a spiked tail-club which when moved swiftly from side to side proved to be a most efficient dissuader of marauding enemies. Indeed, these large animated cylinders were almost like our modern war tanks as they glided slowly along on the four short but stout clawed feet which projected just below the edges of the long, heavy carapace.

Macrauchenia, the long-necked animal walking in the background, is yet another of the singular herbivores of the South American region.

Combats such as that in Plate XVII were perhaps no novelty in the time of the giant ground sloth called *Megatherium* (great beast) and the fierce and voracious animal known as Saber-toothed Tiger.

The sloth—huge, massive, and proportionately slow in movement—was no match for the fast-moving cat armed with its terrible nine-inch fangs and sharp claws. There can be only one result in this sanguinary conflict, for the long, sharp teeth will be buried in the thick, tough skin and flesh of the great sloth and then, by repeated and powerful thrusts, plunged deep into the vitals. Loss of blood will quickly end the unequal struggle and the victorious feline can feast at will.

Both were extraordinary animals. The sloth, with its big limbs, bent down the branches of trees to secure the leaves on which

it fed by means of the long prehensile tongue. The creature also dug for succulent roots, easily tearing them up with its powerful claws. When attacked, the sloth could not escape by running away but merely stood stupidly at bay, hoping by some lucky chance to impale its terrible adversary.

The saber-toothed cats, found also in North America and Europe, were the masters of their kingdom, wandering about in search of prey and killing it without much difficulty. Despite their name, they were not true tigers, but large felines with powerful front legs and feet, sloping backs, weak hind limbs, and short, lynxlike tails.

#### Mastodons Once Abundant in America

The American Mastodon (nipple-tooth), shown in Plate XVIII in a Florida environment, has long figured in the annals of scientific research.

As far back as the time of Thomas Jefferson keen interest was aroused by the finding of huge bones and teeth which were generally regarded as those of giants. Wiser heads frowned on this supposition as too fantastic, but the fact that the huge teeth somewhat resembled the molars of a man was evidence enough for those who wished to believe in such wonders.

Apparently the huge creatures had a wide range, particularly in the eastern and southern part of the continent. Abundant remains have been found at Big Bone Lick, Kentucky, and many other favored sites.

Mastodons were related to modern elephants, but they were more primitive in many ways and were distinctly inferior mentally. The head was flat; the tusks were larger, recurved slightly, and rather thick and heavy for their length.

The animal attained a height of ten feet at the shoulder, with a long, massive body and short, stocky legs—all in all, a very bulky creature. Its food consisted of twigs and leaves which it masticated easily with its huge molar teeth. The body was covered with a dense coat of long, coarse hair and wool.

Whether the early Indians ever really saw a living mastodon is still a much discussed question, but many excellent authorities seem to think that they might have done so.

A nearly perfect skeleton, known as the Warren Mastodon, was unearthed in 1845 by workmen digging for loam in a dried-up pond near Newburgh, New York, on the Hudson. After being exhibited throughout the country, it was purchased for \$5,000 by Dr. J. C. Warren of Boston, in whose private museum it was mounted and remained for 57 years. When

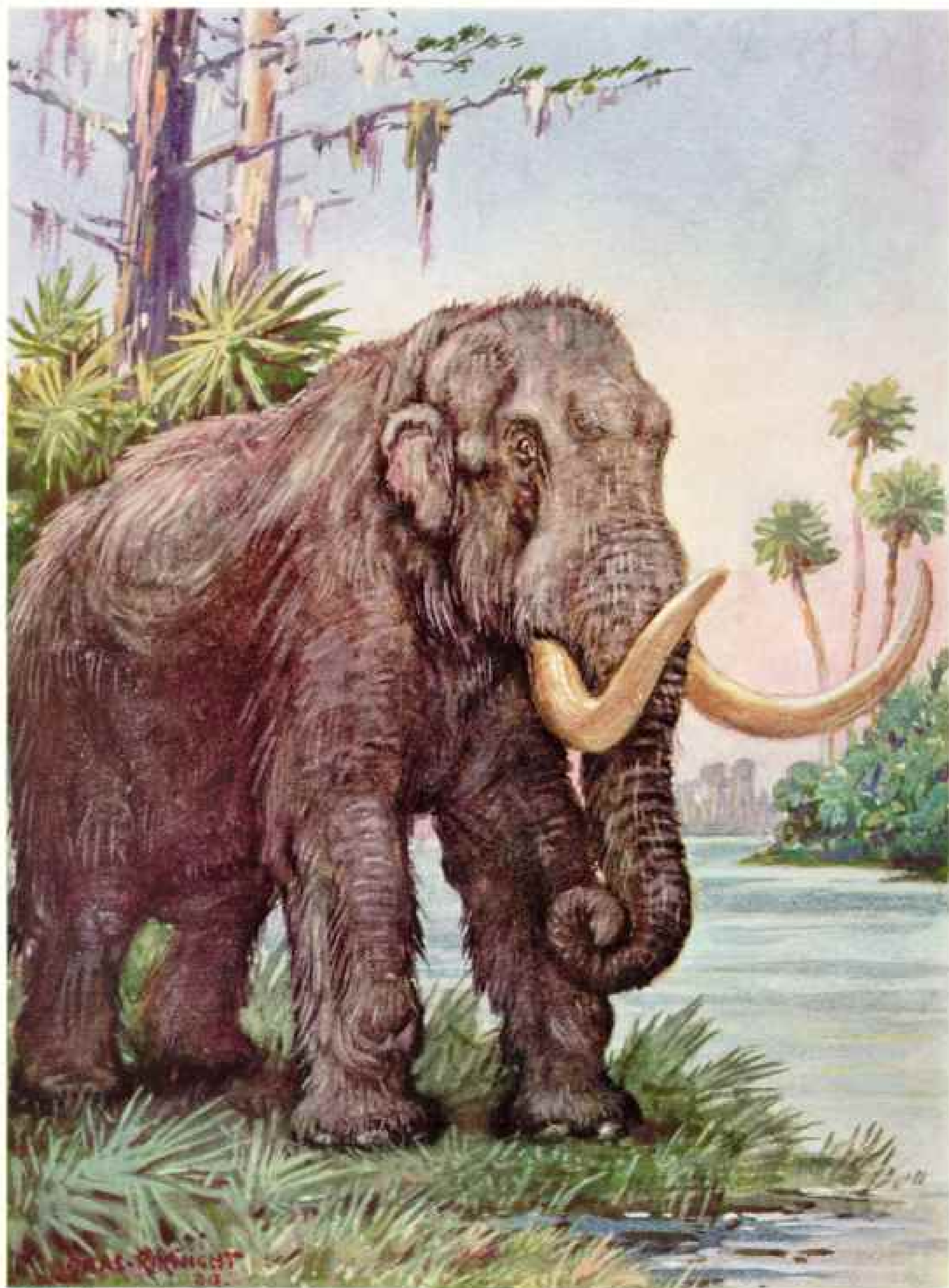


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Painting by Charles R. Knight

**No Match for the Saber-toothed Tiger Was the Stupid Giant Ground Sloth**

Too slow to run, the Megatherium stood at bay, vainly trying to seize the agile cat in its powerful arms. Nine-inch fangs, used only for stabbing because of their unwieldy length, sank deep into the monster's flesh.

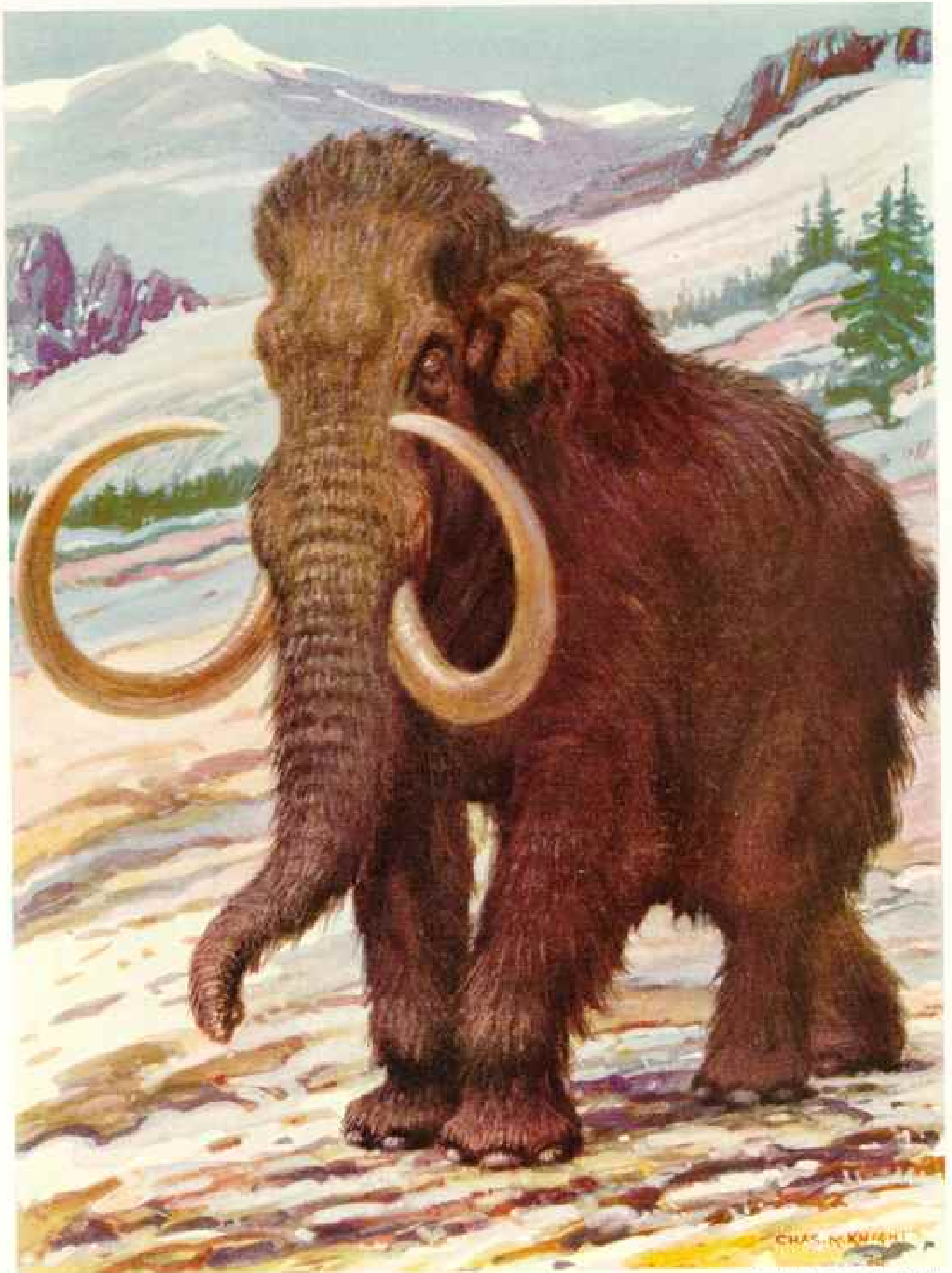


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Painting by Charles R. Kittin

**When the Age of Man Began, the Mastodon Still Inhabited the United States**

The creature's name, meaning "nipple-tooth," comes from the queer conical projections on its molars. Bones and teeth of hundreds of American mastodons have been unearthed. Best skeletons come from New York State. In colonial days many credulous persons thought they were evidence of a vanished race of human giants.



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Painting by Charles B. Knight

### Close Relative of Modern Elephants Is the Woolly Mammoth

Perfectly preserved specimens have been found in Siberia, where they lay frozen in the ice for thousands of years. The bodies were covered with dense coats of thick, reddish-black hair, mingled with undercoats of wool. Skeletons have been discovered in widely separated sections of the United States.



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### Early Man May Have Annihilated the Moas, Huge Flightless Birds of New Zealand

Less than a thousand years ago, when human beings and their dogs came to the islands, searching for food, the fate of the feathered plant eaters was sealed. Occasionally today travelers find small heaps of rounded pebbles lying in unusual surroundings. They are the gizzard stones of these extinct birds. Some of the creatures were ten feet tall. Despite their resemblance to the ostrich, there is no close relationship.

Painting by Charles H. Kulager

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### Early American Hunters, Folsom Men, Attack a Giant Bison with Darts and Arrows

Painting by Charles B. Henshaw

A peculiar type of arrow or spear point was found embedded in the skeleton of an extinct species of bison at Folsom, New Mexico, 15 years ago. This led to discoveries which have pushed back knowledge of man on the American Continent by several thousand years. No longer do scientists believe that the early Basket Makers of the Southwest were the first Americans. Some think such a hunting scene as this may have occurred 15,000 years ago. The use of the bow at that early date is not established.



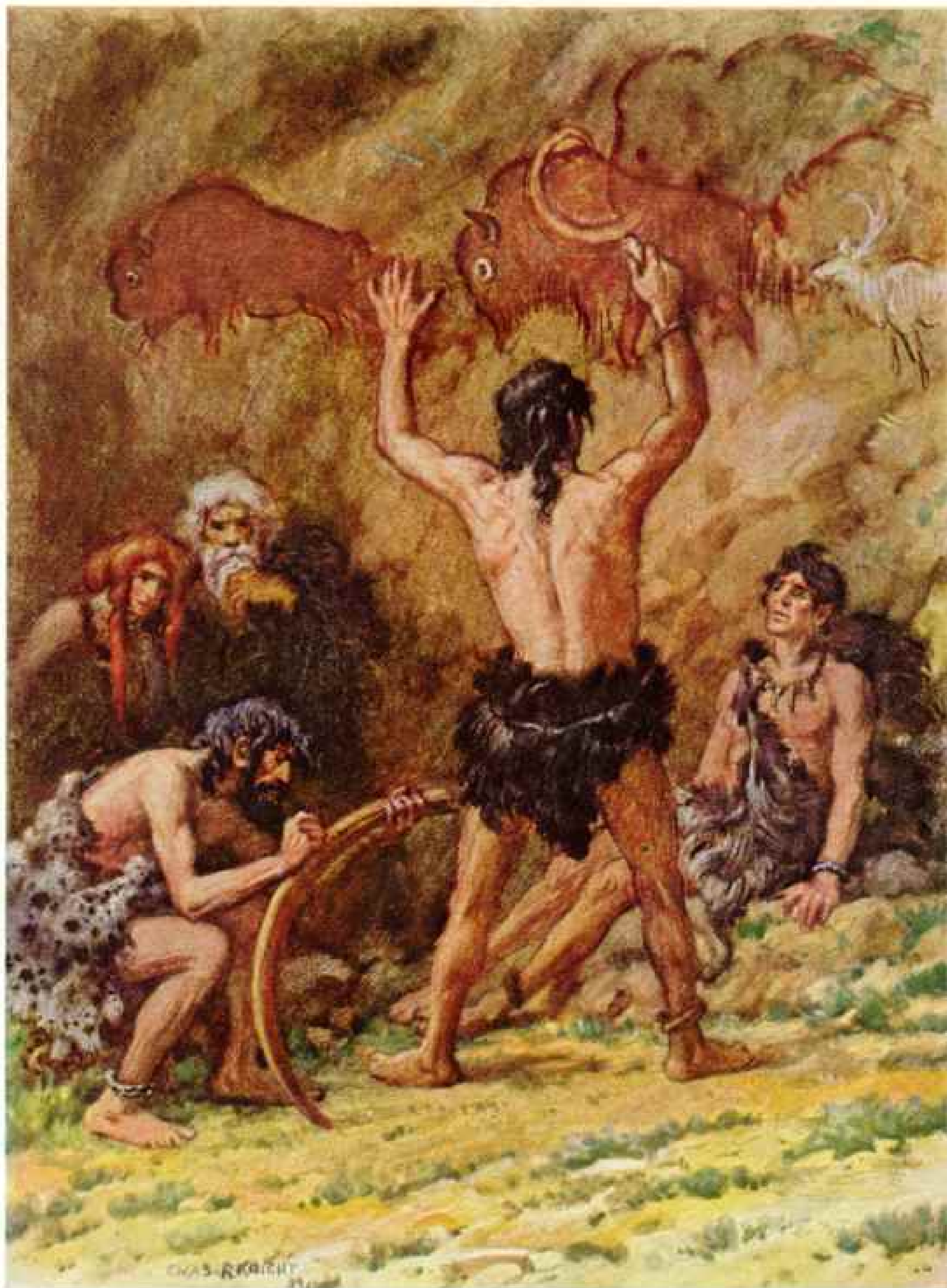
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Painting by Charles R. Knight

**With Flint-tipped Spear, Stone Ax, and Rocks, Neanderthal Men Repel an Invader**

Their women and a child cower in the cave behind them. The race is named after Neanderthal, a valley in northwest Germany, where fossils of these human beings who lived in the Ice Age were first discovered. These primitive men had low foreheads, thick necks, short legs, and big hands and feet.

## Parade of Life Through the Ages



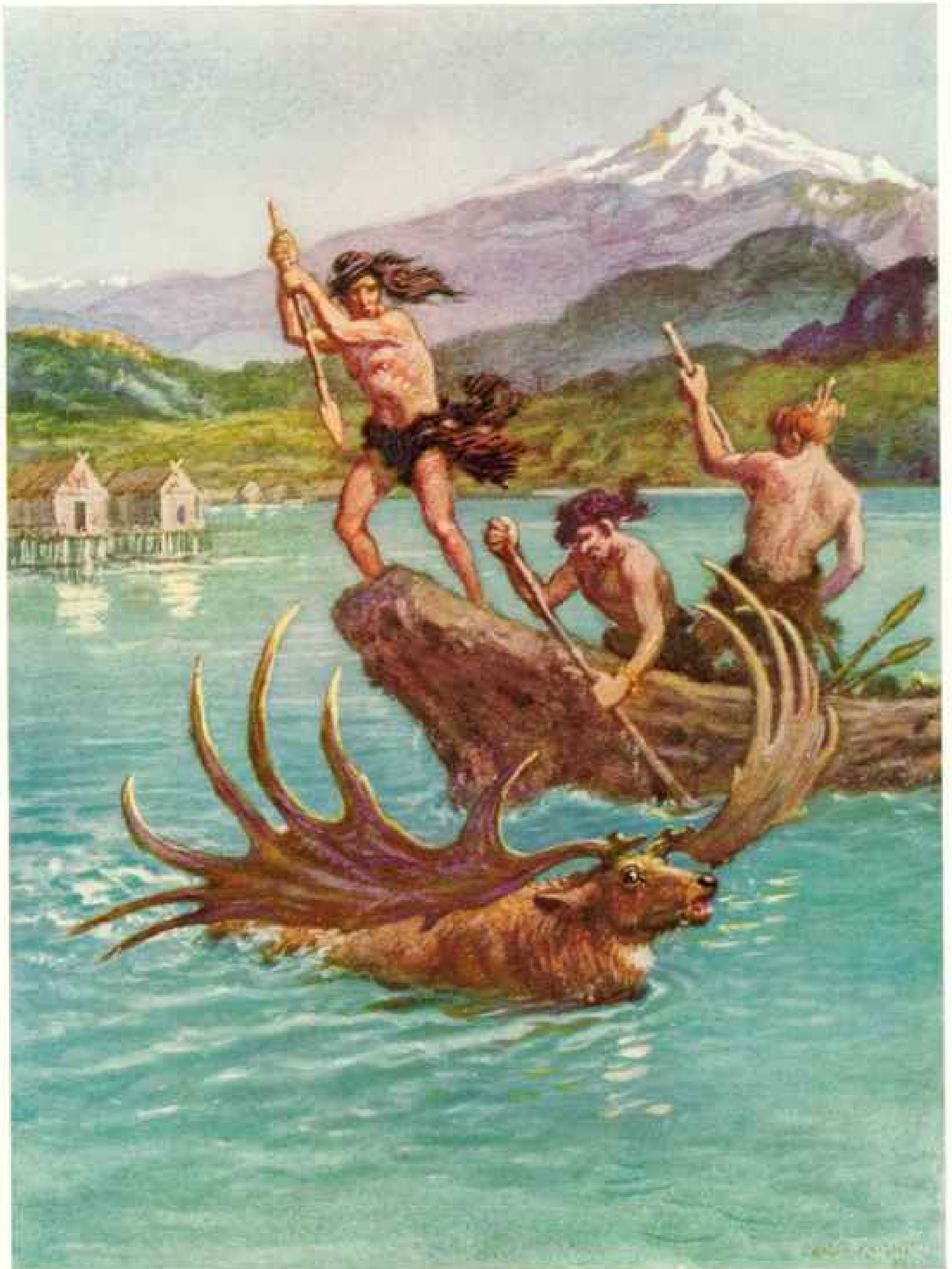
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Painting by Charles R. Knight

### Ten Thousand Years Ago, Cro-Magnon Men Drew Pictures on the Walls of Their Caves

Principal subjects were bison, mammoths, horses, reindeer, and other animals. Cro-Magnons were as tall as most modern men; their name comes from the caves in the Department of Dordogne, France, where paintings and fossils were found. See "Discovering the Oldest Statues in the World," in *THE GEOGRAPHIC* for August, 1924.





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Painting by Charles R. Knight

### Lake Dwellers of the Early Bronze Age Relentlessly Pursue an Irish Elk

Standing in the bow of his dugout, the hunter aims his bronze-tipped spear at the giant stag (*Megaceros*), now extinct. No one knows when men learned to fuse tin and copper into bronze, but about 1500 B.C. the metal was in wide use. Homes were built on piles above the waters of many European lakes.

the doctor's estate was settled, the now celebrated specimen was presented by the late J. P. Morgan to the American Museum of Natural History, in New York.

In contrast to the mastodon in the details of form, teeth, and shape of tusks, the Woolly Mammoth (Plate XIX) is more nearly related to the present-day African and Indian elephants.

The mammoth was a tall, rather delicately made animal with a high forehead and very long, sharply recurved tusks. In the northern form, at least, the body was covered by a dense coat of thick reddish-black hair mingled with an under coat of wool.

Our almost complete knowledge of the life appearance of this giant animal lies in the fact that perfectly preserved specimens have been discovered in Russia where they had lain frozen in the ice for thousands of years. Russian scientists were able to secure most of the hair and flesh and all the bones of an individual discovered in 1900 in Siberia.

Some of the flesh was consumed by the bears and wolves attracted to the scene, but the greater part of the extraordinary monster was removed to the Museum in St. Petersburg (now Leningrad) where it was preserved and mounted under the direction of experts.

In our own country mammoths have been found in such widely separated regions as Alaska, Florida, California, Texas, and New York State. The Woolly Mammoth, protected by the thick, weather-resisting coat of hair, lived in colder parts of the country, associated with the reindeer and the semi-Arctic animals.

Man and the mammoth were perhaps associated in this country. Its relation to man on the Continent of Europe is proved by the wonderful drawings in French caves (Pl. XXIII).

From time to time in various parts of New Zealand travelers have chanced upon small heaps of rounded pebbles lying on the ground. Such pebbles are now known to be the gizzard stones of the great extinct and flightless bird known as the Moa (Plate XX and page 182).

These huge birds—some of them ten feet in height—may have existed until after the coming of man to the islands. This event, most unfortunate for the Moas, took place, we think, about six or seven hundred years ago.

From that time onward the fate of the giant birds was sealed. They must have suffered terribly from the attacks of these hungry invaders and their voracious dogs. The fact that the Moa was flightless and had no means of defense except its huge feet and claws spelled disaster for this race of feathered giants.

We know the Moa's size and structure from practically complete skeletal remains. In spite of a casual resemblance, there is no close rela-

tionship between the Moa and the modern ostrich. The foot ended in four toes, three in front and one behind, while that of the ostrich has only two toes, one much larger than the other. The feathers were not unlike those of a Plymouth Rock chicken in color and pattern. No wings were visible.

The Moa's food consisted entirely of plants, and the huge eggs must have proved toothsome dainties to the hordes of encroaching human beings whose one idea was to destroy these magnificent and inoffensive birds.

#### Early Americans Attack a Giant Bison

The antiquity of man on this continent is naturally a matter of keen interest to specialist and layman alike, but despite intensive research no very ancient evidence in this region has as yet materialized.

Our knowledge of man in America has been extended back for several thousand years, however, by the discovery, near Folsom, New Mexico, in 1925-26, and later, of a new and peculiar type of arrow point associated with the bones of a long extinct bison. These strangely shaped artifacts were unlike any known type and had evidently been secured to the arrowshaft in some ingenious manner.

With these piercing weapons, impelled by the force of a powerful bow, even such a creature as the giant bison was slain (Plate XXI). A fierce struggle must have taken place in the locality of these finds. Several skeletons of the giant bison are scattered about and intermingled with the sharp flint arrowheads.

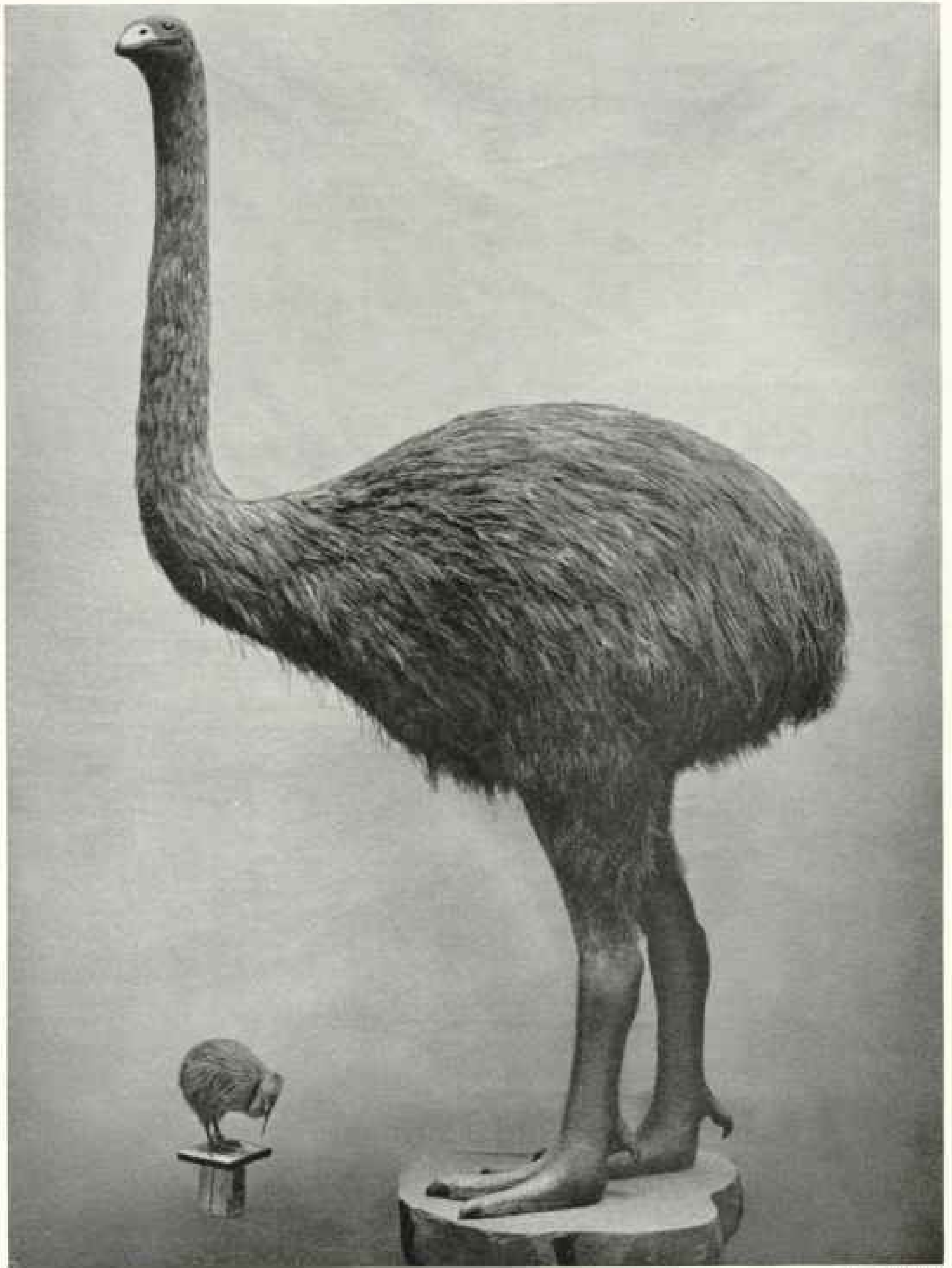
At any rate, the discovery of these implements gives rise to interesting speculations concerning early man in the New World.

In 1856 a human skull of an unusual type was found in the Neander Valley in Germany. Experts who examined the specimen declared that it belonged to a new and peculiar form of the genus *Homo* and gave the name "Neanderthal" to the new species, meaning Neander Valley Man (Plate XXII).

Later exploration has more than confirmed the opinions of anthropologists who detected in these stocky little men a most important connecting link between the past and present in human history.

From what we are able to glean by measurements of more or less complete skulls and skeletons, the Neanderthals were short men with thick necks, big hands and feet, and legs quite short below the knee. The forehead was low, the face and jaws projecting forward, and the ridges over the eyes were most pronounced.

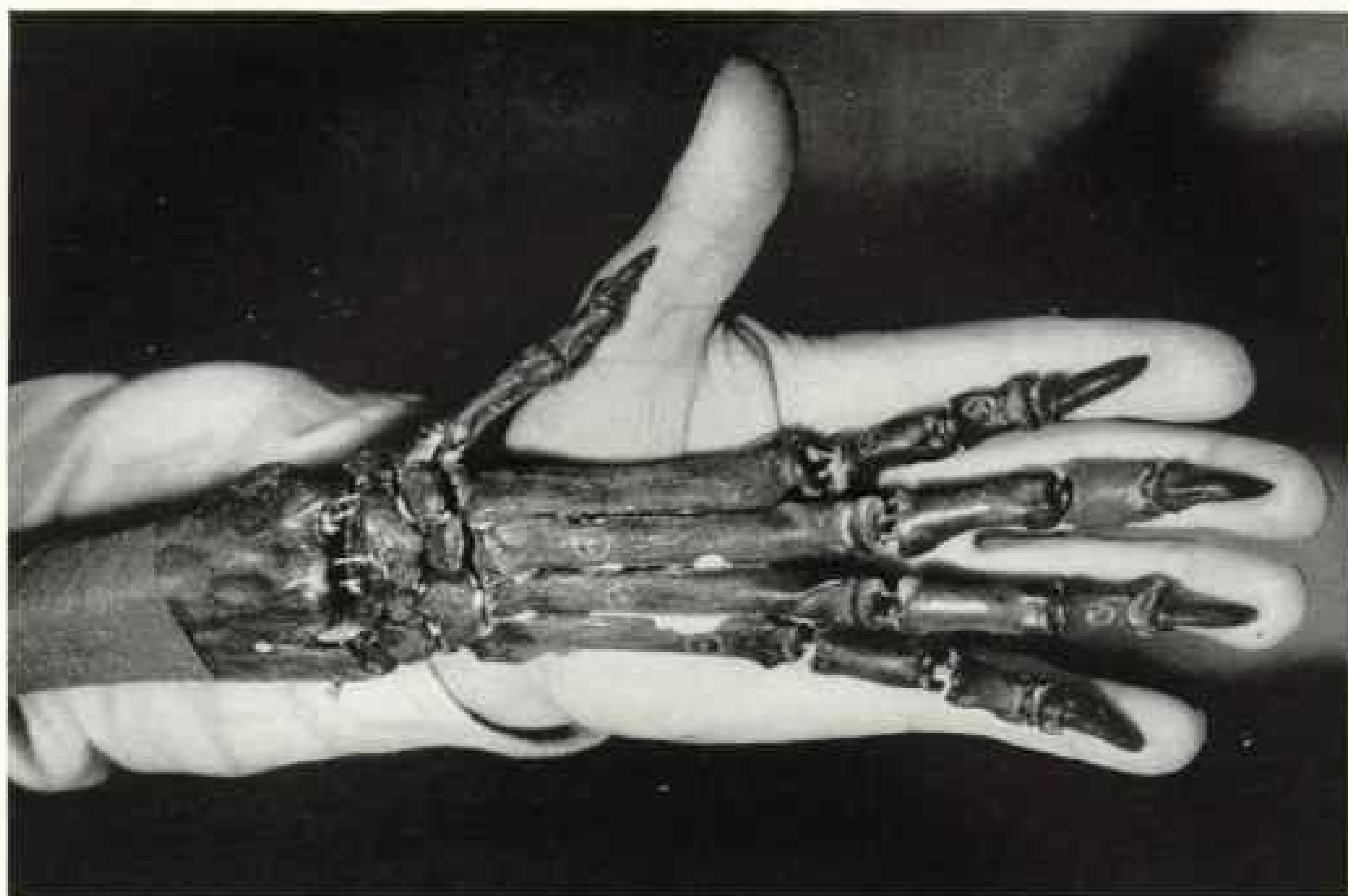
All in all, the Neanderthal man was a most unprepossessing little fellow, but abundantly



© Howard Ward

### Using Tiny Kiwi as a Model, Scientists Re-create a New Zealand Moa

They believe the nearest living relatives of the huge flightless bird are the kiwi (lower left) and the cassowary—not the ostrich (Plate XX). This restoration of the extinct Moa was made in England under the supervision of Lord Rothschild for his Natural History Museum at Tring Park, Hertfordshire (page 181).



Andrew B. Stone

### Larger Than a Man's Hand Was the Dire Wolf's Paw

These perfectly preserved bones of the right front foot were found in the La Brea tar pits at Los Angeles. Larger than present-day American wolves, the ferocious animals ranged over all the United States. Their massive teeth were capable of crushing big bones.

able to look after himself in the cold, wet, and dreary climate of his time.

Our picture shows two men repelling an assault from below their rocky shelter at the little Grotto of Le Moustier in the Dordogne region of southwest France. The short flint-tipped spear, a heavy club, and the so-called *coup de poing*—a sort of crude stone hand-ax—comprise their rather scanty arms, but the two women and a child cowering in the cave will be defended to the last by their hardy champions.

Life was difficult in those far-off days when Alpine glaciers flowed down over parts of eastern France. But despite all the drawbacks, these tough and tenacious little savages were perhaps the dominant race in Europe for many thousands of years.

Just why the men of the particular race known as Cro-Magnon should have devoted so much time to matters artistic is difficult to say. It is possible that mystical cults, or the propitiation of animals to be hunted, may have had to do with this trait in early man (Plate XXIII).

The drawings are usually in color, but they naturally show considerable variation in quality. Reddish ocher, black, yellow, and white are the chalky colors extensively em-

ployed in these famous renderings of bison, mammoths, horses, reindeer, and many other animals of the time. Some of the pictures are deeply engraved and others raised in low relief. Certain examples are not paintings at all, but actual sculptured surfaces (page 171).

As a rule, the pictures were done on the stone walls, more rarely on the ceilings, of dark and sequestered caves. They are principally found in many parts of France and Spain.

Light for the work must have been produced by very primitive means. A tiny stone lamp, with perhaps a piece of moss in oil or grease, was the only thing possible under the conditions. A torch or a small fire would have given off too much smoke, since there is little ventilation in most of the caverns.

The Cro-Magnons, in contrast to the Neanderthals (Plate XXII), were a tall, long-limbed, and rather spare people, much like some of our Indian tribes. They take their name from the French cavern of Cro-Magnon. Their weapons were small and delicate, and the many bone needles and awls found in the deposits indicate a possible use of crudely fashioned clothing of tanned animal skins.

No primitive people since their day, with the possible exception of the recent Bushmen



Harold E. Brooks

**This Big Tortoise Roamed the Lakes and Rivers of New Mexico Millions of Years Ago**  
 Found near Espanola, the fossil weighs 500 pounds and is 34 inches long. The head is missing from the front of the shell (left), but finger bones of a left flipper were found.

of southern Africa and certain Australian tribes, have attempted the representation of animals with such excellent artistic results. We are fortunate that after a lapse of 10,000 years or more so many fine examples of their work remain in a fair state of preservation.

Man, in the course of his long history, has employed many materials in making his various tools and weapons. Wood, stone, bone, and shell have all served their purpose under the manipulation of his clever fingers. None of these substances, however, could compare with bronze.

Bronze is a mixture of tin and copper, two metals associated in nature in many regions. We do not know how or when primitive man made the discovery of this valuable blend. At any rate, after a certain period in prehistory—about 1500 B. C.—one finds an increasing use of bronze in most of the sites containing

remains of man and relics of his activities.

In Plate XXIV a group of Lake Dwellers are pursuing a giant deer, the so-called Irish elk, through the calm, blue waters of a European lake. Their clumsily made dugout canoe is laboriously propelled by two of the men, while a third, poised in the bow, hurls his bronze-tipped spear at the stag.

In the distance may be seen two houses built on piles, a favorite method of the period. Whole communities lived in carefully constructed huts above the water, more or less safe from the attacks of their enemies.

Relics of every kind have been found on lake bottoms in the vicinity of these former habitations. Many are well preserved and denote a fairly high degree of culture among these primitive people, who were just emerging from the restrictions which the use of stone implements had imposed upon their ancestors.

# Facts about the Philippines

BY FREDERICK SIMPICH

*With Illustrations from Photographs by J. Baylor Roberts*

**B**Y LAW we're pledged to give the Filipinos full independence and hand them back their islands in 1946. Whether this now can or will happen, in our swiftly changing world, nobody can foresee. "After all, that's no longer important," said Joaquin Elizalde, Philippine Resident Commissioner in Washington. "Now, with the Japs making war on us, it's important only that we survive!"

Look at their map spot, and you see why Japan struck at the Philippines in her drive south for the oil, rubber, and quinine of the Netherlands Indies. They lie right in her path (Map Supplement and page 187).

Look at their size, their natural riches, and you wonder why, for 40 years, Americans have not shown keener interest in the Philippines.

After our war with Spain, we bought the islands, pacified them, and gradually brought home most of our soldiers. Then our people, busy here, forgot the Philippines. So did homeland newspapers. As a onetime Manila journalist, I know. About all the Sunday editors wanted from Manila was some fantastic tale about head-hunters, Moro pirates, or home life in the harem of the Sultan of Sulu.

But Uncle Sam himself never forgot them. Far from it! He set up a sound, unselfish civil government in years of patient work to train them for home rule.

Only now, with war raging over them, all America looks again to the East and asks, "What about the Philippines?"

For the first time since Dewey sank the Spanish fleet at Manila, in 1898 (page 193), these islands again make news, maps, and pictures on all our front pages.

## What and Where Are the Philippines?

Slightly smaller than the British Isles, these 7,083 islands have a land area of 114,400 square miles and some 16,000,000 people. They stretch about 1,150 miles from north to south, or from 21° 07' down to 4° 45' north latitude. Trade winds, with a rainy and dry season, give them a lush, soothing climate, gentle to work in but easier to loaf in.

West and north of these fragrant green isles there beats the stormy South China Sea, which has piled many a wreck on their palm-fringed coasts. Japanese-owned Taiwan (Formosa), in fact, is only 88 miles from Y'Ami Island,

most northern tip of the Philippines. To their east rolls the vast Pacific, with 7,000 miles of blue water between Manila and San Francisco.

Long-savage Borneo's pirate-haunted coastal waters and the glittering Celebes Sea lie south of the Philippines; at one point, in fact, Borneo is only 11 miles distant.

Some of these islands are as large or larger than certain States in our Union. But 4,642 of them are small, uninhabited, and even unnamed.

## Luzon, Biggest Isle, Where Japs First Landed

Examine Luzon, largest island in the group, lying farthest north. It is almost exactly eight times the size of Connecticut. In a vast, sheltered bay on its southwest coast stands Manila, ancient capital of the archipelago.

Railroads and fine motor highways connect Manila with many parts of rich Luzon. Yet on maps some eastern heights are still marked "unexplored." Coastal steamers and airplanes tie Manila with populous centers on other islands.

Aparri, on Luzon's north coast, is where the Japanese first landed.

Cagayan Valley, in north Luzon, grows vast fields of excellent tobacco. Dense hardwood forests cover its mountain slopes. Around Bontoc its Igorots and other not-wholly-reformed head-hunters grow rice on the terraced sides of steep hills.

In southeast Luzon iron is mined which, till now, has all been sold to Japan.

Baguio, summer capital of the islands, lies high in the Benguet hills 130 miles north of Manila, and is easily reached by an air-cooled train plus a picturesque bus ride along an American-built mountain road of breath-taking beauty. Daily planes also make this trip in an hour.

I remember when Baguio was a mere village of pine shacks and Igorot huts. Then came gold, of which more soon. Now Baguio is a city of 25,000, with paved streets, theaters, hotels, fine markets, and a hot-season population of many thousands more. Here numerous wealthy Manila people have summer homes, and here live a few old-time Americans, retired from the Army or civil service.

Dean C. Worcester began to study Luzon's wild tribes in 1900, and his published works attracted world-wide attention. Later, as a



Photo Fichtling Copy.

### The American High Commissioner's Official Residence at Manila Overlooks the Bay

Present incumbent is Francis B. Sayre. An additional Mansion House, summer residence for the Commissioner, is maintained at Baguio, up in Luzon's mountains. Cavite, with its U. S. Naval Station, lies in background behind the two ships, and is visible as a long, dark line.

member of the U. S. Philippine Commission and in the days when William Howard Taft was Governor General, he did much to develop Baguio.\* W. Cameron Forbes, a later governor, founded a polo club, built roads, and encouraged both Americans and Filipinos to make Baguio a summer resort.

Here now is Camp John Hay, a great hospital, a school for cadets, an agricultural school, and many other useful institutions—among which enemy bombs lately fell.

But gold, and not head-hunters, polo, or the weather, is what Baguio talks most about. You hear "gold" more than any other one word (page 201).

#### Nearly as Rich as California in Gold Output

Years ago, in a rocky Benguet gulch, near Baguio, I watched one lone American named Eye bossing a small crowd of nearly naked Igorot workers. In cold, drizzling rain they struggled to assemble a small stamp mill, which had been laboriously packed and dragged into the mountains, one piece at a time, by man power.

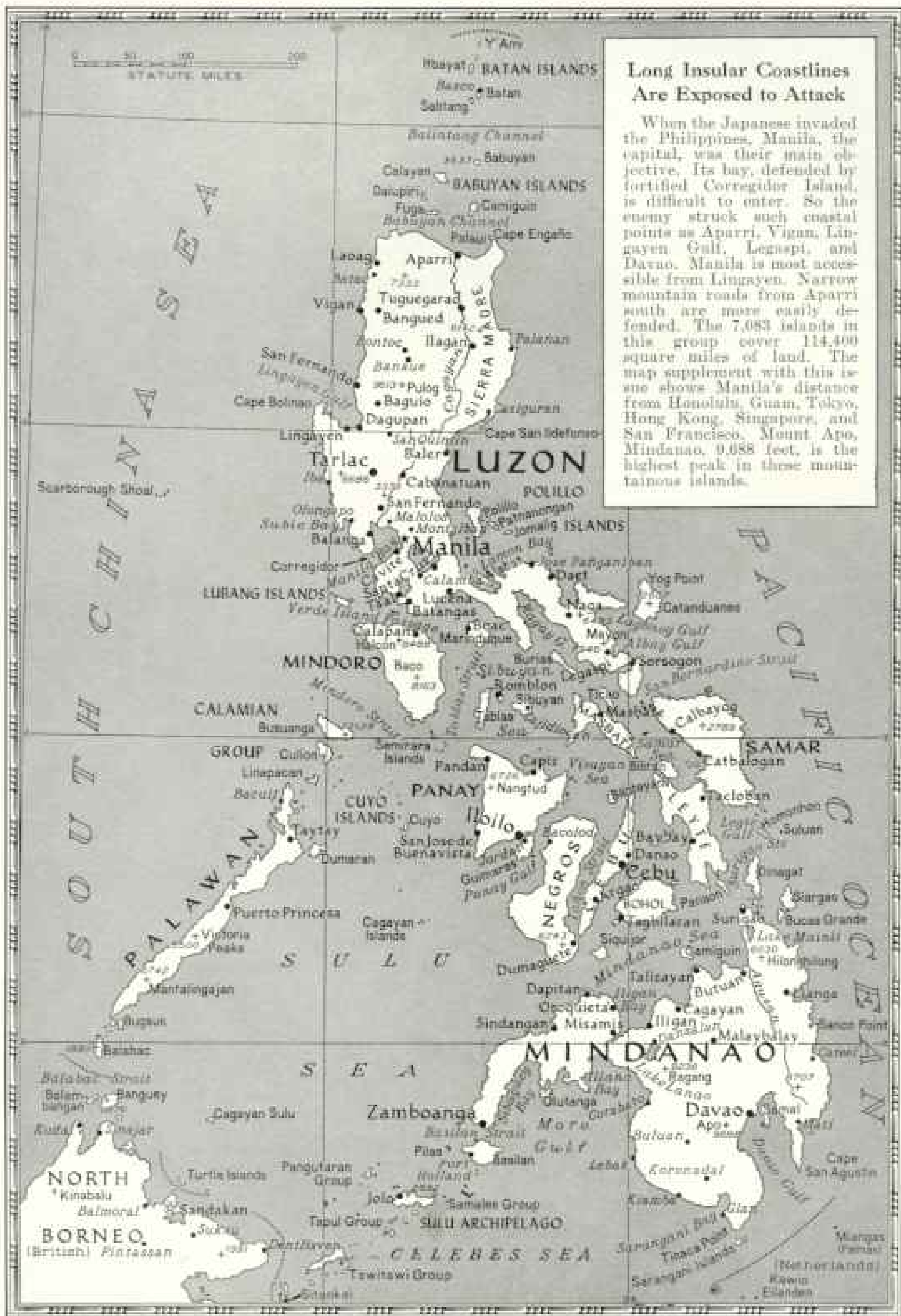
The audacious, persistent man putting up the money was an American cafe owner in

Manila named Met Clarke. He told me he started life as a boy peddling doughnuts with Barnum's circus. Now every cent he could scrape up went into that Benguet gold mine. I wrote advertising copy for his restaurant. He paid me with 700 ten-cent shares of stock in his mine, which I later traded back to him for two months' board at the restaurant. He went broke finally, and so did the mine, when mountain floods washed away the mill, the workers' shacks—everything.

Then creditors took hold to save what they could. They struck it rich; Benguet Consolidated became a gold bonanza of worldwide fame. It yielded and still yields millions and millions. Its shares soared so high that I figure I paid board to Clarke at the rate of \$4,350 a week for eight weeks!

Gold has been mined and washed from streams here for nobody knows how long; certainly since before Magellan.

\* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Field Sports Among the Wild Men of Northern Luzon," March, 1911; "Head-Hunters of Northern Luzon," September, 1917; and "Non-Christian Peoples of the Philippine Islands," November, 1913, by Dean C. Worcester; "Philippines," August, 1905, by William Howard Taft; and "Return to Manila," October, 1940, by Frederick Simpich.







### Manila High School Graduates Dine and Dance at a Class Reunion

Girls wear both modern European and old-style Philippine national costumes. All food was cooked American style, except the fish. Coconut ice cream was delicious. Conversation, in English, was mostly as to whereabouts and well-being of missing classmates. Many graduates had finished college. Two were cadets from Camp Henry T. Allen, Philippine Army officers' training school at Baguio. A few of the married girls brought their children.

Moro pirates long raided the Luzon coast towns, stealing gold, women, and other less valuable loot. In José Pañganiban (Mambuan), south Luzon, lived a rich woman named Doña Panay; she wrote the Queen of Spain and begged for protection against these Moros.

To win favor, Doña Panay sent the queen a life-size, solid gold hen, sitting on a solid gold nest full of golden eggs. So goes the story. Anyway, that gift must have pleased the queen, for, to this day, near José Pañganiban and its rich gold mines, you can see the ruins of an old fort.

### Sailors Prefer Manila Hemp

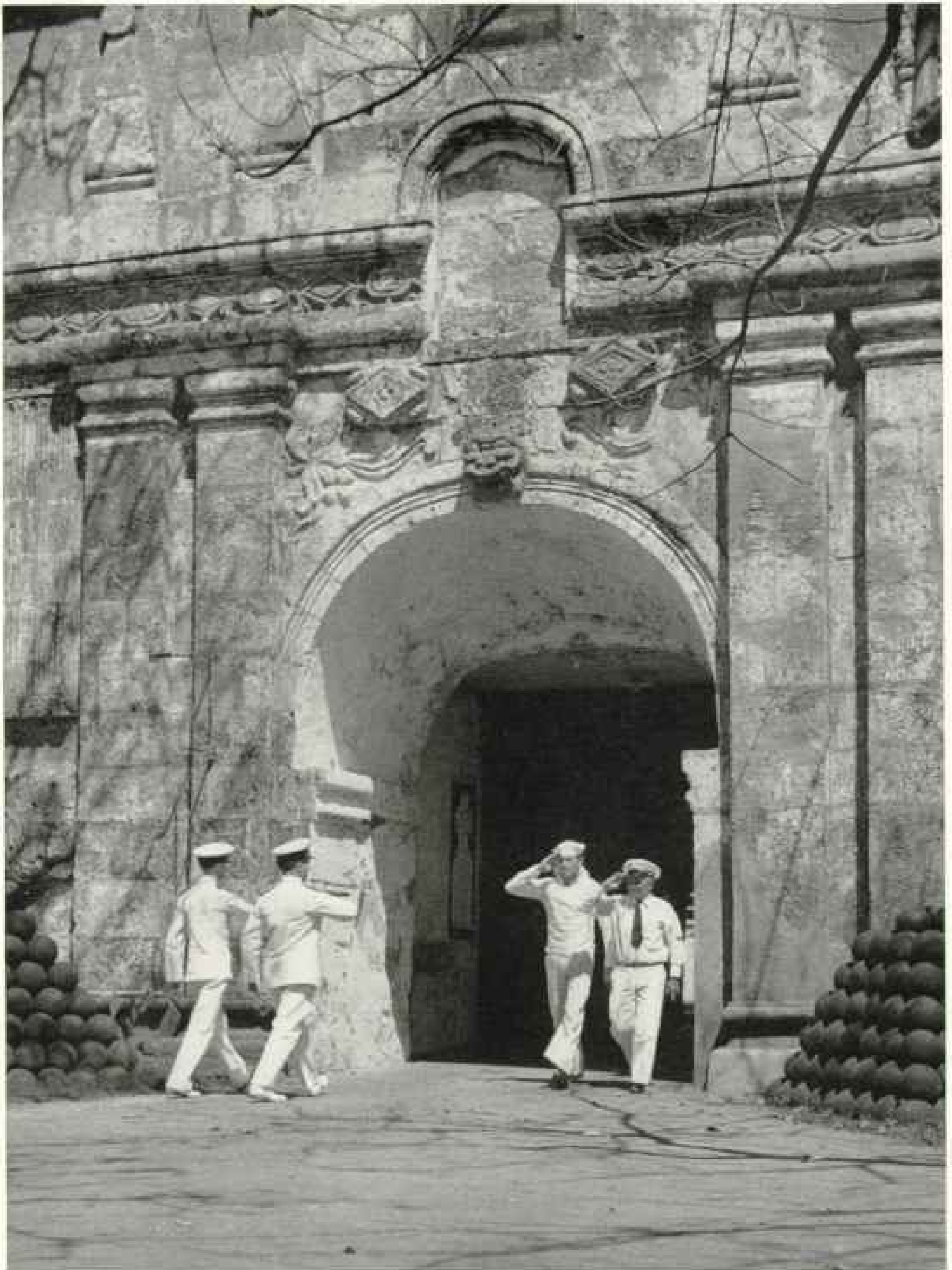
Now Philippine gold output approaches \$40,000,000 a year, or about equal to that of California, our chief gold-producing State.

Next to Luzon in size is Mindanao Island. With nearly 37,000 square miles, it forms the south end of the archipelago and is a little

larger than Indiana. Zamboanga and Davao are its chief cities.

Our Army post most remote from continental United States is Pettit Barracks at Zamboanga. The town so musically named fairly reeks with South Sea atmosphere. Its palms whisper in soft breezes, monkeys chatter at dawn. Grass huts stand on stilts over the water, and languorous beauties with bright flowers in their dark hair pluck softly on guitars and sing South Sea love songs to lonely sailors.

Most readers know Mindanao best for gory tales of fights there between fanatic Moros and American soldiers. These Moros, or Moors, are sword-carrying Mohammedans, given to running amuck occasionally and killing Christians to win quick transit to Paradise, going up on a white horse, even as the Prophet. They fought the Spaniards, they fought us even as late as 1913 when General Pershing



**Spanish Commanders Occupied Fort San Felipe, Later Headquarters of the U. S. Navy**

Pyramids of solid shot stand beside the gate where entering United States naval officers take salutes from a chief petty officer and a sailor. Just off Cavite, Dewey sank the Spanish fleet in 1898. The pole on which he raised the Stars and Stripes still stands here.



### Filipino Forestry Students Learn to Tap a Rubber Tree

Vast forest resources here have barely been scratched. Development of rubber and quinine industries are among island possibilities. This class is at work in the Government's Forestry School, which stands on the slopes of Mount Maquiling, near Calamba, Luzon. On this one heavily wooded mountain, where the author used to hunt wild pigs, between 2,000 and 3,000 different trees have been classified, as against about 1,200 species in the United States.

had a last crack at them; and now, when they feel good, they still jump the Philippine Constabulary. No fate is more terrible to a Moro than to be buried, after he is killed in a battle, in the same grave with a pig. Knowing this, Christian soldiers, in other days, made the most of it.

Most of the pictures that illustrate this article were made by J. Baylor Roberts, of the National Geographic staff—my faithful companion on many a trip. "These Moros in all their bright colors and wavy crises looked only like stage pirates to me," he says. "But I noticed when we crossed a stretch of Mindanao jungle, the Constabulary officer guiding me about always took along at least ten armed men. . . . I guess he knew his stuff."

To the world, however, Mindanao is important for the hemp it grows (page 194). Hemp makes the best of all rope, as every sailor knows; and, for some reason of soil and climate, better hemp grows in the Philippines than anywhere else in the world, and most of it grows on Mindanao.

Jealous of this monopoly, Filipino authorities years ago outlawed the export of Manila hemp seed. Despite this embargo, seeds have been smuggled out and are growing now in Borneo, in the Netherlands Indies, and in Panama the United Fruit Company has a trial farm. Bulk of the world's hemp supply, however, still comes from here.

Japanese, settled about Davao, grow heavy crops in the shadow of Mount Apo. Despite

antialien land laws, their hemp-growing colony numbers around 18,000 Japanese.

At Davao they built a consulate. Here in normal times their merchant ships dock to unload Japanese-made goods for retail shops run by Japanese, and to load hemp, coconut oil, dried fish, and other products for Japan.

Tea houses, schools, parks, shrines, experimental farms, costumes, speech, even the beer, are all Japanese. Good roads traverse Mindanao, a "big green spot on the path of the Southern Cross."

"Cleanest, best-kept hemp fields I saw anywhere in the islands lie around Davao," reads a line from the notebook of our keen-eyed cameraman. "Here Japanese boss everything, but most of the hard field work was being done by the Filipinos. I saw Filipino women hanging out the hemp to dry, after it had been stripped on machines made in Germany. Japanese villages lie between the big plantations."

#### Filipino Home Seekers Migrate to Mindanao

Because parts of Luzon and Cebu are so overcrowded, and because vast, rich Mindanao is so thinly populated, the Philippine Government aids migration here and land settlement. This movement is growing. Thousands of families, it is planned, will finally be homesteaded or "resettled" in the fertile valleys of Mindanao.

The Moros, however, still make up about 25 per cent of all Mindanao's population; they look with sullen eyes on this Christian invasion. Much of this land they claim, as our Plains Indians claimed their buffalo lands, not by right of title recorded in books, but by tribal heritage.

Some 29,000 Japanese now live in the Philippines, as against 117,500 Chinese. In times past, without any doubt, the slant-eyed sons of Nippon were less unpopular than the Chinese.

But since there are some 16,000,000 Filipinos, speaking 87 dialects, it is difficult to say just "what the Filipinos thought of the Japanese" before this war started.

Some few young Filipinos have gone to Japan to study aviation, scientific fishing, and agriculture. One or two subversive movements in the Philippines were probably directed by Filipino radicals living in Japan.

Among Filipinos, too, there are a very few who may feel that the white man's day in Asia is over, and that they may as well cast their lot with the Japanese.

Till now, however, almost all educated Filipinos merely looked on the Japanese as a

thrifty, sharp-trading foreign element that controlled most of the deep-sea fishing, were developing a giant hemp industry in Davao, gaining a foothold in lumbering, and spreading an annual \$10,500,000 worth of their cheap rubber-soled shoes, cotton cloth, crockery, toys, and other manufactured goods about the village markets.

#### Sugar Is the Biggest Crop

Small Negros Island, near the heart of the group, grows more than 75 per cent of all the annual Philippine sugar crop of one million tons. In a big year the crop has been 1,500,000 tons, but production is now controlled for quota reasons (page 193).

Near by, east, is poor, overcrowded, recently bombed Cebu Island, where Spain started her first Philippine colony in 1565. Across the strait from Cebu is tiny Mactan Island, where Magellan fell in 1521.

Northwest from Negros is Panay, another poor island. From here, and from Cebu, some 200,000 hungry workers go each season to Negros to work in cane fields and sugar mills.

Sailing along Negros coast, you see some vast cane fields, looking from a distance like tall corn. They spread from the coast back into the foothills. High smokestacks from sugar mills, or *centrals*, rise here and there.

Some 2,000,000 Filipinos earn their living working with cane. Twice that many work with coconuts, which are scattered all over the islands.

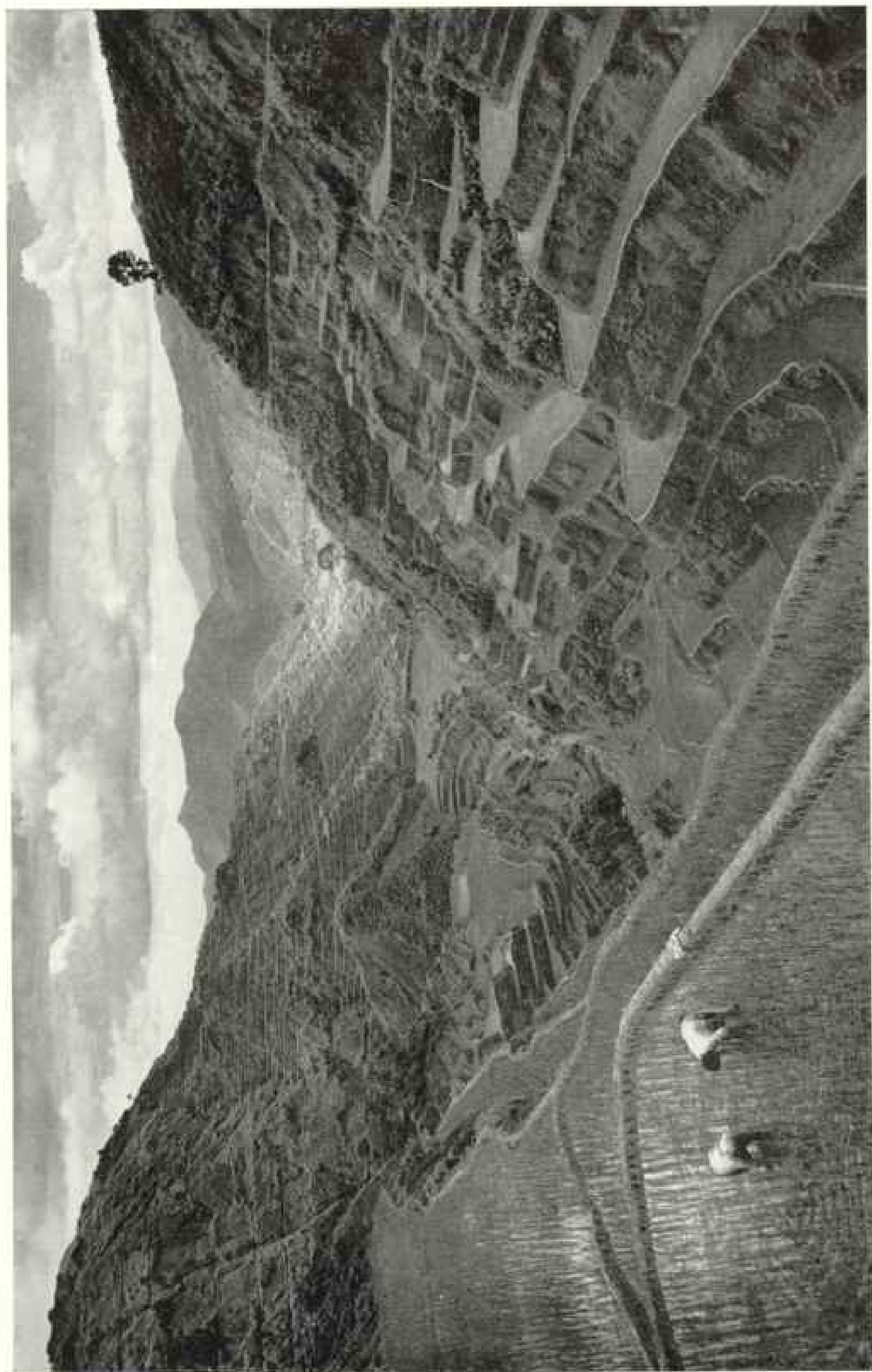
Sugar cane grows mostly on Negros, Luzon, Panay, and Cebu. The Government-owned Manila Railroad earns 33½ per cent of its income derived from freight from hauling cane and sugar, and sugar is the leading export of the islands.

#### Sea Roads to the Philippines

Sea routes that link us with the Philippines are vital, not only to our welfare in peace times, but now to our national defense. Were certain essential raw materials cut off by lack of steamers to the East, our Nation's continued existence might be in jeopardy.

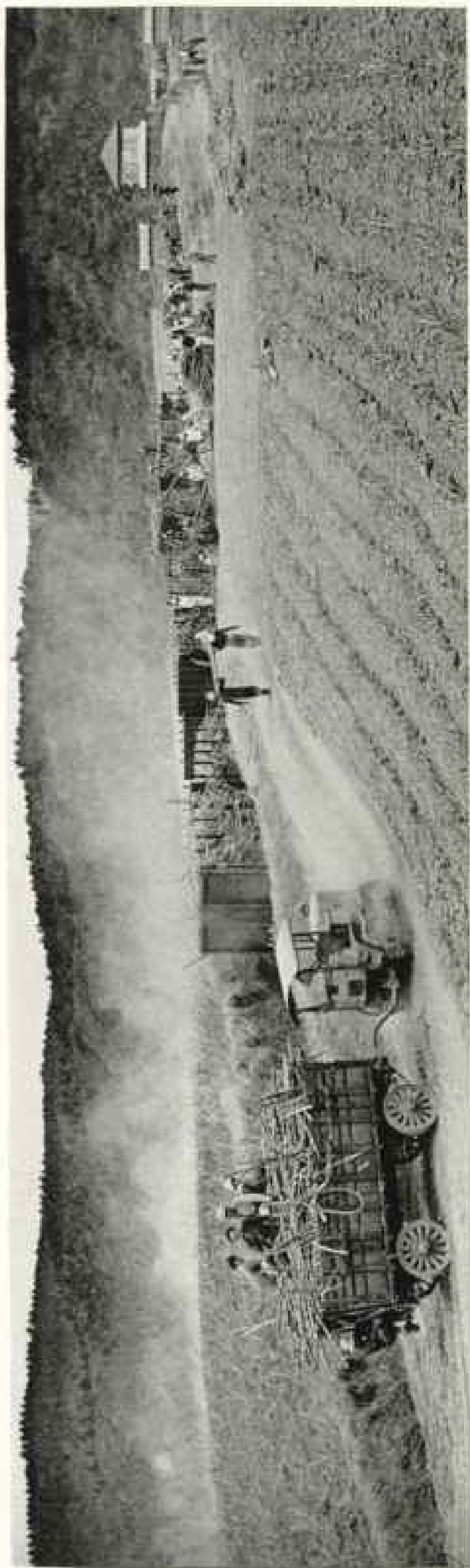
From the Philippines we import much hemp, chromite, coconut oil, sugar, and some manganese. Rubber, tin, and quinine may reach us from Singapore and Java by way of Manila.

You can think of Manila as the hub of our Pacific transportation wheel. To the islands, directly, we send canned milk, cigarettes, steel, oil, machinery, flour, meat, and many supplies for our Army and Navy based there. To a degree, also, in normal times, Manila is our distributing center for many other Far East markets.



**Who Built These Astonishing Examples of Irrigation Skill on Luzon? When and How? Nobody Knows!**

Pagan hill folk, with back-breaking effort, began the monumental work perhaps 20 or 30 centuries ago. Why were terraced rice paddies built way up here at Banaua? One theory is that lowland peoples fought the hill tribes and held them in the mountains. To get food, they evolved this ingenious agriculture. Miles and miles of dikes hold water on the level patches, floods being carried off in cleverly built spillways and tunnels.



**With Annual Crops of 1,000,000 Tons of Sugar, the Philippines Help Satisfy World's Hunger for Sweets**

New crops are grown from cut joints (foreground), not from seed. Tractors are much used here on a Calamba estate, Luzon, for plowing and hauling cane.



**Near the Sunken Hulks of Spanish Ships Destroyed by Dewey Rests a 74-passenger Pan American Clipper from San Francisco**

Lying at the left, at Cavite, is one of the many small sailing craft which trade in live pigs, poultry, fruit, straw mats, and firewood among coastal towns.



From Photo from These Days

**Fine, Shining, Whitch Hemp Being Sorted at Davao, Mindanao, Looks Not Unlike Long Tresses of Human Hair.**

All over the world, rope made of Manila hemp is in demand. Hemp now, for our Navy and merchant marine, is one of the strategic materials we need from the Philippines (page 190). Other necessities from the Far East include tin, rubber, quinine, tung oil from the Chinese tung tree, chrome, and manganese.



An Interisland Steamer Loads Lumber at Port Holland, Basilan Island, South of Zamboanga, Mindanao

Port Holland is just a sawmill (upper left). A small Constabulary post protects the mill hands. Hardwood logs, seen in foreground lashed together with rattan and other vines, are floated down a river, at whose mouth the mill stands. With workers, in nipa shacks, live also a few fishermen.





#### Going "Up the Pole" to Get a Drink!

Wooden bucket on shoulder, Juan climbs up to gather sweet sap from coconut blossoms. By fermenting the juice, the Filipinos make a delicious drink known as *tuba*. Bamboo poles, lashed like scaffolding from tree to tree, permit the workman to go from one sap-gathering job to another without climbing up and down every tree.

The Philippines, in fact, is our fifth best overseas customer.

Each normal year hundreds of shiploads of our goods go to the Philippines; for return cargo these boats seek to fill up with Philippine products—sugar, hemp, hardwoods, coconut oil, etc. Thus Manila is a kind of terminus, or turn-around place, in ocean trade.

Docks out there now are piled high with things we badly need. But ships are scarce; and, for obvious reasons, all merchant ships are slowing down.

Even before this war started, more freight lay waiting us in Far East ports than our ships could promptly carry. But despite war, our U. S. Maritime Commission is making every possible effort to keep vital freights moving between America and the Philippines.

#### Manila and Its Defenses

At the mouth of the Pasig River stands Manila, facing the wide, shallow Manila Bay.

At the South China Sea entrance to this bay rises rocky, heavily fortified Corregidor Island. Like Gibraltar, this great rock is bored through and through with man-made tunnels and vast underground chambers that hold guns, ammunition, food, water, lights, soldiers' quarters, hospitals, kitchens, signal devices, etc.

Guns elsewhere about the harbor entrance—there are three other island forts besides Corregidor—further defend it.

But, as American military men have long insisted, since you can't move this rock around like a battleship, it is useless except for shooting at any enemy ship foolish enough to try to pass it. Wars have changed, since Spain first fortified this rock to guard Manila against attacks from the sea. In this war, just as predicted, our enemies at first ignored Corregidor and attacked by air and overland.

Cavite, headquarters of the U. S. 16th Naval District, lies less than 10 miles south of Manila and likewise on the east shore of the bay. Our Asiatic fleet normally rendezvous here from December to May. Here the American admiral commanding lives in the same old stone fort which sheltered the Spanish *Almirantes* of long ago.

Repair shops for the Navy are here, Cañacao naval hospital, marine barracks, a base for seaplanes, and a powerful



**Dizzy Driving on the Crooked, One-at-a-time Motor Road Between Bagnio and Bontoc**  
 Blasted and cut from steep, rocky mountainsides, this highway reaches an elevation of 7,800 feet. Curves and sharp V-shaped turns average more than 40 per mile. Block signals control one-way traffic.



**Travel Is Never a Pleasure for Philippine Pigs!**

You see them tied to a rear bumper in Bagnio. Often they're slung feet up on a pole and carried between two men, or dumped, feet tied, on a jolting bull cart. Always they protest, with grunts and squeals.

ALFRED T. PUGH

radio station. A beautiful palm-fringed beach drive of 22 miles connects Cavite with Manila.

Olongapo, which has been bombed repeatedly, lies on Subic Bay on Luzon's west coast, about 35 miles north of the entrance to Manila Bay. Here the Navy has another base, with repair yards, and dry docks big enough to accommodate good-sized ships.

Manila itself was formerly well defended by Forts Abad, Santiago, and its own cannon-covered walls, until such defenses became obsolete. Ordinarily Fort Santiago, with all its drawbridges, parapets, and moss-grown bastions, at the mouth of the Pasig, is headquarters for General Douglas MacArthur and his staff. Generals Funston, Hines, Wood, Pershing, Liggett—all have passed this way. Here, for decades, has been stationed the 31st U. S. Infantry, "Manila's Own."

Quickest mobile defense for Manila was the fleet of Army planes based at near-by Nichols Field, and, of course, Navy planes at Cavite. Fort William McKinley, a few miles southeast of Manila and on the Pasig River, is a permanent Army post with facilities for many thousands of men.

Fort Stotsenburg, another old Army post 60 miles north, lies just off the main railway line running to Lingayen Gulf on the west coast of Luzon.

However, largest by far of all military forces is the Filipino Army itself. Ever since American occupation, Filipinos have taken readily to the American way of training soldiers. No native troops anywhere ever excelled the famous Philippine Scouts and Philippine Constabulary in pluck, tenacity, and first-class fighting qualities.

Today's trained Filipino Army, including reserves, numbers about 160,000. It has been organized, drilled, and equipped, during the last six years, by General MacArthur. The Filipinos gave him the rank of Field Marshal. Now this Filipino Army has been made a part of the American Army, and President Roosevelt has made MacArthur commander of all our armed forces in the Far East.

#### America Never Exploited These Islands

Since the day when Governor General Taft announced it, Uncle Sam's consistent policy here has been "The Philippines for the Filipinos." Aware that the islands were reverting bag-and-baggage to the Filipinos, American capital never ventured in on any big scale.

Contractors came, to build railways, street-car lines, power and light plants; cordage firms came, seeking hemp; soap makers looked for steady sources of coconut oil, and a few other

homeland industries sent agents, making small, cautious investments here and there.

But compared with Dutch business operations in Java and Sumatra, for example, or with those of Britain in her colonies, American companies domiciled in the States have made few land, mine, or factory investments.

Among the handful of American civilians left now in the islands—not over 8,000—are a very, very few who have grown rich from gold mines; some few others have prospered in hemp, sugar, and coconut culture, in laundries, lumbering, machinery, automobiles, etc., and in law and journalism.

Almost no Americans have migrated here in recent years, except the mining boom crowd and the few going out to take jobs as salesmen, engineers and bosses, or office workers for such firms as the Pan American Airways, the branches of New York banks, steamship companies, etc.

During the reconstruction period, say some 30 years after 1902, thousands of American civil service clerks and provincial officials were on duty here. But by the time the last American governor general quit Malacañan Palace to become High Commissioner, and the Filipinos chose their first President and Senate, many of this force had come home, while others retired there on pensions.

Hence, though we sell the Filipinos lots of goods and buy a lot of their exports, we've had little to do, from here at home, with development of their islands. But for gold mining, then, and some lumbering, it seems we've left the Filipinos to develop their own industries, which still lag pathetically behind the enormous possibilities of this rich archipelago.

It is even possible that the Japanese, with their hemp research laboratories and scientific plantation methods, have done more to increase Philippine production than American business men have done in any other one line.

#### English Is Becoming the Universal Tongue

But in education and public health work, unselfish American achievement here is probably without parallel in the history of colonial administration.

It was the American schoolteacher, thoughtful Filipinos have told me, who did most for these islanders.

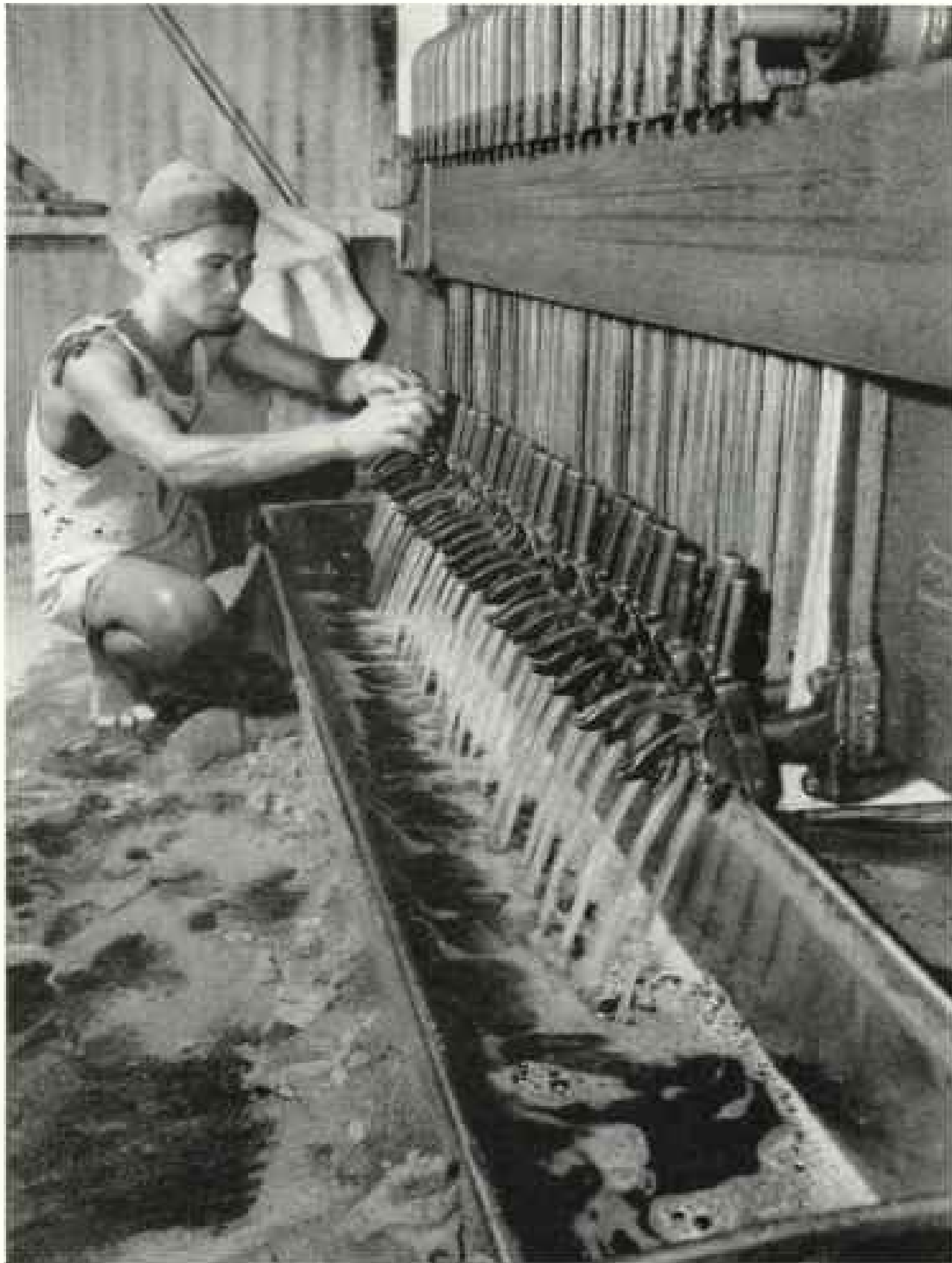
I do not mean Filipinos were largely illiterate when we came. It was only that schools were scarce. We scattered them into every nook and cranny of the archipelago, from the mountain Igorot country down to wild Moro land, and imported American men and women teachers by the hundreds. Often



*Fishes Vented from Black Star*

### Hold Your Nose When You Land on Sitankai, Where Drying Fish Smell to Heaven

Island fishermen, "gypsies of the sea," live aboard their own boats, trading dried fish and sting rays to small merchants. On Sitankai, in the Sulu group, 35 miles from Borneo, all members of a family are buried in one grave, which is part of a huge community burial mound.



Filtering Coconut Oil, Mostly Used to Make Toilet Soaps and Cosmetics

This mill stands on Mactan Island, where Magellan was slain by natives. Copra, or dried coconut meat, is about 64 percent oil, mostly used in soap; glycerin, by-product of the soap-making process, is used in making certain explosives. After cooking, copra is subjected to pressure, 4,000 pounds per square inch, to squeeze out the oil, which is priced according to color and acid content.

the teacher was the only white person for miles around his lonely *barrio*.

Spanish, when we came, was the official language. "Now if children wish to learn Spanish," President Manuel Quezon told me, "they have to hire private teachers. English is becoming the universal tongue. Your pioneer American teachers first taught it; then their pupils became teachers and passed it on to millions of others."

Native tongues are still spoken, of course; they probably will be, for generations to come. Filipino talkies are made in Tagalog for box office reasons. English is the official language

in the Legislature; yet members, whether Tagalog, Visayan, Igorot, or Moro, may argue in their own tribal tongues if they wish.

But leading Philippine newspapers and magazines are all printed in English, and every Filipino seeks to learn it.

For years past almost one-third of the insular budget has been spent on education, with emphasis in public schools on trades for boys and homemaking for girls.

Thousands of Filipino public schoolgirls now learn to cook, sew, keep house, and care for children (p. 188).

Latest estimate is that 1,940,792 pupils attend 12,083 public schools.

In 1611, or 25 years "B. H."—before Harvard—the University of Santo Tomás was founded in Manila. Today there are eight universities in these islands. Most important is the State-supported University of the Philippines at Manila; with its branches at Baguio and Cebu, its 6,500 annual enrollment exerts a profound

cultural influence on all the archipelago.

To give vocational and citizenship training to older people, the Office of Adult Education was set up in 1936. It teaches gardening, homemaking, sanitation, etc., to improve the social condition of the people.

#### Half the Filipinos Read and Write

Today, about one-half of all Filipinos, including the non-Christian tribes, can read and write.

Best of all, the Filipino is learning the dignity of labor.

Read what Professor J. B. Panganiban, of



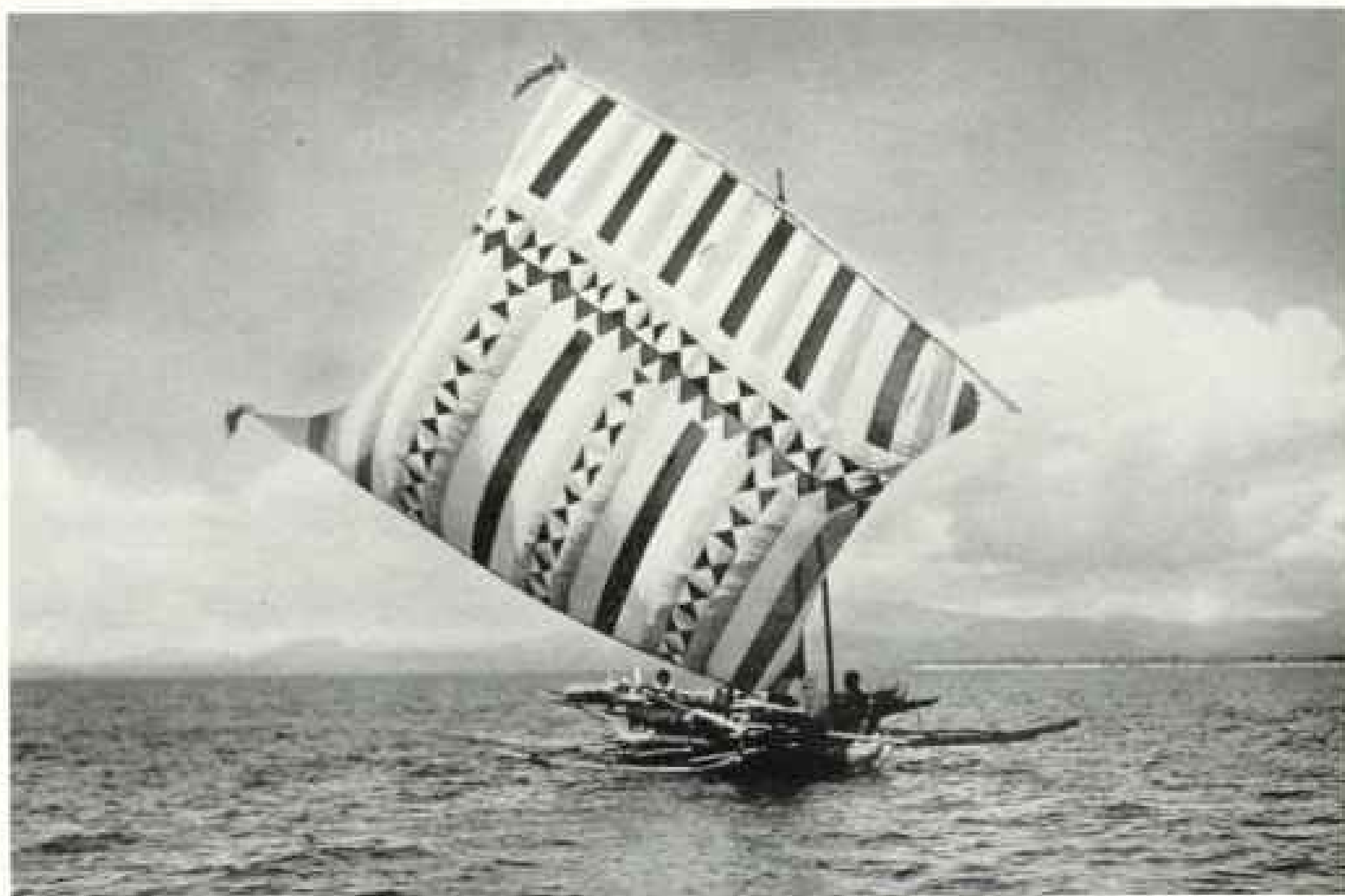
### Vast Fortunes in Gold Come from Philippine Mines

It took \$534 in stamps to send these 20 bars, worth \$175,000, by registered mail from Baguio to San Francisco. This gold comes from fabulously rich Balatoc Mine, which normally makes a shipment every 10 days. Practically all these mines were known, and worked in a small way, in Spanish times.



### Good-looking Girls of Binakayan "Sit on a Cushion and Sew a Fine Seam"

Recruited near Cavite, they do piecework for garmentmakers and shippers. Slippers are taken off to avoid soiling the cloth they handle on a bamboo floor. Married girls are identified by pinned-up "hair-do."



Maj. Gen. Frank Parker, U.S.A. (ret.)

### On Feast Days Speedy Moro *Vintas* Unfurl Sails of Striking Patterns

Yacht designers would probably starve in Mindanao, where every Moro builds his own boat. These narrow dugout canoes are speedy and fairly dry in rough seas. When used for passengers and night fishing, boards are often laid in the outriggers to make more deck room. Straw mats cover sleeping quarters and are raised for shelter from rain. A fleet of *vintas* running before a stiff breeze on a day of bright sun and blue water makes a thrilling spectacle.

the University of Santo Tomás, has said: "When the Americans came, education became free to everyone." . . . But, "clerical posts, soft-collar jobs, became preferred to farm labor. Students aspired to a long string of degrees after their names. For a time, they were the gods of the country.

"But, when the depression came, academic degrees lost their meaning. It became 'What can you do?' and not 'What degrees do you have?' . . . There were too many lawyers in peanut jobs, too many physicians without practice. Students began to flock to trade and farm schools. Now the dignity of labor has come to be recognized."

#### A Stronger and Healthier People

With book learning, with more knowledge of arts and crafts, came also aroused enthusiasm for outdoor games, for boxing, baseball, tennis, basketball. Teams from here now go in peacetime to play against athletes in other oriental lands.

"No effect of American occupation," General MacArthur told me, "is more noticeable to me, as an Army man interested in soldier physique, than the improved physical condition and even the increased stature of the Filipino recruits."

Many insist today's town-dwelling Filipino is an inch taller than he was a generation ago.

How American doctors cleaned up Manila, purified its drinking water, and stamped out epidemics of plague, cholera, smallpox, and other deadly diseases is a well-known story. Now Filipino medical men and sanitary experts carry on this work.

Moderate, Americans have certainly been, in their industrial exploitation of these rich islands. But in this legacy of wide education, better health, and physical form, it may be that in his 40 years of rule Uncle Sam has best fitted his Filipino wards to fight gallantly now in this common struggle against an alien foe.

# New Map Shows Immense Pacific Battleground

**T**HE vast Pacific theater of war—the most far-flung battleground the world has ever seen—is revealed in its entirety in a new ten-color map sent to the 1,165,000 members of the National Geographic Society as a supplement with this issue of their NATIONAL GEOGRAPHIC MAGAZINE.\*

This lucid map of the world's largest ocean and its myriad islands includes the shores of the four great continents which look out upon that embattled sea. Within its scope are most of North America, including all of continental United States; the whole west coast of South America, much of Asia, all of Australia, New Zealand, and the Netherlands Indies.

From the Burma Road to Bermuda and from Calcutta to Cape Cod—such is the tremendous span of this map. It covers a total east-west distance of some 13,800 miles, more than half the circumference of the earth. Thus such distant places as Sumatra and Singapore may be seen at once in terms of their direction and approximate distance from Seattle or San Diego, or even from inland cities such as Syracuse, New York, or Charlotte, North Carolina.

To all members following the progress of American and allied arms in the Pacific, to students and strategists, to soldiers, sailors, and the families of men fighting far away, the map is a timely aid. Your Editors began its preparation months ago, as skies over the Pacific grew ever darker. Measuring 20½ by 26½ inches, the supplement is designed for ease of handling and for ready reference.

## Table Gives 861 Distances

"How far away is Manila?"

"What's the distance from Vladivostok to Tokyo?"

To help in answering such questions the map carries a table which gives, in statute miles, 861 different airline distances between important points. It shows immediately, for example, that Manila is 6,965 miles from San Francisco and that Tokyo and Vladivostok are only 665 miles apart.

Principal steamship routes are indicated on this Mercator Projection map by blue lines with distances in nautical miles.

Listeners to radio news reports from the Far East and readers of newspaper dispatches will be able to visualize, with the aid of this map, the time of day at the point where the news is originating. White lines mark the time zones, and dials show the time in any given zone when clocks in Greenwich, England, are striking midnight.

United States islands in the Pacific are more

numerous than most persons realize. Many bear witness to the far-ranging voyages of Yankee whalers and clippers in the days of sail. Now the needs of ocean-spanning aircraft bring almost forgotten bits of land into prominence again.

Besides Hawaii and the Philippines, United States Pacific islands are: Guam, the Aleutians, Wake, Johnston, Kingman Reef, Palmyra, Howland, Baker, Jarvis, Eastern Samoa, and Swains. Midway is in the Hawaiian group.

The map also shows United States claims to Christmas, Malden, Starbuck, Vostok, Caroline, Flint, Danger Islands, Tongareva, Rakahanga, and Manihiki, in the Line Islands; to Nukulaelae, Nukufetau, and Funafuti, in the Ellice Islands; to Canton, Enderbury, McKean, Birnie, Hull, Gardner, Phoenix, and Sydney, in the Phoenix Islands; and to the Tokelau or Union group—Atafu, Nukunono, Fakaofu.

Almost in the center of the map lie the Hawaiian Islands, chief American bulwark in the Pacific, where the Japanese attacked the base at Pearl Harbor while their diplomats talked peace at Washington and Tokyo. Other important bases are Dutch Harbor in the Aleutian Islands, which jut out even farther toward Asia; and Pago Pago, in Samoa.

Pago Pago, with its carefree, brown-skinned natives, lies in the midst of the South Sea Isles, glamour land of story and song. But today, with war ranging the Pacific in steel ships and bombing planes, few indeed may escape its touch. The very name "Pacific" now seems ironical.

In the western Pacific lie the islands of Micronesia ("small islands") scattered like stars over a distance about equal to the total coast-to-coast width of the United States.

## Secret Japanese Bases in Micronesia

Most of these isles are of coral formation, built up through the centuries by tiny living coral polyps which lived, died, and left their limestone skeletons for others to build upon. And here the Japanese for years have been as ceaselessly busy as the coral creatures themselves—preparing for war. They hold the Marianas, Caroline, and Marshall Islands, three of the four chief Micronesian groups; Britain owns the Gilbert Islands.

\* Members wishing additional copies of the map, "Theater of War in the Pacific Ocean," may obtain them by writing the National Geographic Society, Washington, D. C. Prices, in United States and Possessions, 50¢ on paper (unfolded); 75¢ mounted on linen; Index, 25¢. Outside of United States and Possessions, 75¢ on paper; \$1 on linen; Index, 50¢—all remittances payable in U. S. funds. Postage prepaid.



Before the first World War the Marianas, Carolines, and Marshalls belonged to Germany, but in the post-war settlement the League of Nations entrusted the islands to Japan under mandate with the express provision that they were not to be fortified. The Japanese promptly and secretly began their fortification.

The fall of unfortified Guam early in the present war is easily understood when it is seen that it lies in the very heart of these mandated islands, with powerful enemy bases at Rota and Saipan, only 37 and 115 miles away, respectively.

For many years the Japanese mandated islands have been forbidden territory. Rarely has an American been admitted, and then only under strictest surveillance.

Among the most interesting of the islands is Yap, in the Carolines. On Yap the native money is made of stone—large circular disks with a hole in the center.\*

Marshall Island natives in early times were wonderful navigators and pioneered in the use of sailing charts which they made from strips of palm.

Of recent years the native population in all of these islands has declined, while their Japanese population has rapidly increased.

#### Pacific Area Yields Important Products

From the isles and shores of the Pacific come many highly important products. Among them are several which our Government long ago listed as "strategic" or "critical" and began stockpiling for an emergency.

Besides producing, with British Malaya, most of the world's rubber and tin, the rich Netherlands Indies are also the chief source of cinchona bark for fever-combating quinine, and of the vegetable down known as kapok for use in life preservers.

China and Burma are normally the leading producers of tungsten, vital steel-hardening and machine-tool metal; and the French South Sea island of New Caledonia ranks second to Canada as a source of nickel, used in alloy steels for armor plate, gun barrels, and projectiles. British India produces 75 per cent of the world's mica, employed in electrical equipment.

The varied lands which form a mighty frame around the earth's greatest ocean are sometimes seared by volcanic eruptions or wracked

by earthquakes. Japan has often been hard hit.†

Many Pacific islanders literally "live on volcanoes."‡

Across the top of the map Alaska and Siberia reach toward each other like two hands almost touching. In Bering Strait, at the northern limit of the map, outlying islands of the United States and the U. S. S. R. lie almost within a stone's throw of each other. Thus United States planes can fly to Asia without crossing any ocean, by-passing the whole Pacific.

Following are some of the many articles on the Pacific, its lands and islands, which have appeared in the NATIONAL GEOGRAPHIC MAGAZINE in the last several years. Many others of older date may be located in The Cumulative Index to the NATIONAL GEOGRAPHIC MAGAZINE.

- "Java Assignment," by Dee Bredin, January, 1942.
- "Westward Bound in the *Yankee* (Caribbean, Panama, and Pacific Islands)," by Irving and Elocta Johnson, January, 1942.
- "Life Grows Grim in Singapore," by H. Gordon Minnigerode, November, 1941.
- "Ancient Temples and Modern Guns in Thailand," 10 illustrations, November, 1941.
- "Panama, Bridge of the World," by Luis Marden, November, 1941.
- "Cruise of the *Kinkajou* (Baja California)," by Alfred M. Bailey, September, 1941.
- "Samoa—South Sea Outpost of the U. S. Navy," 10 illustrations, May, 1941.
- "Aeroplanes Come to the Isles of Spice," by Maynard Owen Williams, May, 1941.
- "Unknown New Guinea," by Richard Archbold, March, 1941.
- "Turning Back Time in the South Seas (Fatu-Hiva Island, Marquesas)," by Thor Heyerdahl, January, 1941.
- "Burma Road, Back Door to China," by Frank Outram and G. E. Fane, November, 1940.
- "Our Air Frontier in Alaska," by Major General H. H. Arnold, October, 1940.
- "Behind the News in Singapore," by Frederick Simpich, July, 1940.
- "Celebes: New Man's Land of the Indies," by Maynard Owen Williams, July, 1940.
- "Where Nature Runs Riot: On Australia's Great Barrier Reef," by T. C. Roughley, June, 1940.
- "1940 Paradox in Hong Kong," by Frederick Simpich, April, 1940.
- "At Home on the Oceans," by Edith Bauer Strout, July, 1939.
- "Bali and Points East," by Maynard Owen Williams, March, 1939.
- "Hawaii, Then and Now," by William R. Castle, October, 1938.
- "Guam—Perch of the China Clippers," by Margaret M. Higgins, July, 1938.
- "Canton Island," by Capt. J. F. Hellweg and S. A. Mitchell, September, 1937, and I. C. Gardner, June, 1938.
- "Flying the Pacific," by William Burke Miller, December, 1936.
- "Capital Cities of Australia," by W. Robert Moore, December, 1935.

\* See "Mysterious Micronesia," by Willard Price, NATIONAL GEOGRAPHIC MAGAZINE, April, 1936.

† See "Sakurajima, Japan's Greatest Volcanic Eruption," by Thomas A. Jaggar, NATIONAL GEOGRAPHIC MAGAZINE, April, 1924.

‡ See "Living on a Volcano," by Thomas A. Jaggar, NATIONAL GEOGRAPHIC MAGAZINE, July, 1935.

# Taming "Flood Dragons" Along China's Hwang Ho

BY OLIVER J. TODD

*With Illustrations from Photographs by the Author*

OVER the good earth of China's Great Plain there rolls periodically a tawny tide. The mighty Hwang Ho, or Yellow River, is on a new rampage.

To sense the full, blood-chilling menace of such an overwhelming force as the Yellow River in flood, one must stand on the banks, as I have many times, while swift waters are undercutting vast sections of land as if they were brown sugar.

One must see fear-crazed villagers gathering their few possessions before they and their homes are swept into the maelstrom. One must witness excited attempts of the "river police" and drafted farmers to close new breaks in the dikes as the mad waters toss aside huge stones, piling, and plugs of kaoliang stalks tied with hemp ropes (pp. 211-213).

It is a one-sided, and often futile, battle. When river demons are on the loose they frustrate all efforts of man to check them. Farmers in their path must flee. The Great Plain has little high ground and a cross-country flood soon cuts off escape in all directions.

Even those with boats may not always survive. Rapid deposit of silt leaves a vast slimy sea of liquid mud through which only the hardiest can swim or wade to safety.

Victims of Yellow River floods are bewildered and terrified by these sinister waters. Little wonder that, to the simple people of the plains, turtles, serpents, dragons, and demons of every sort seem lurking in the opaque depths.

## "China's Sorrow" Checks Japanese

Countless times through the centuries the Yellow River has been China's sorrow. I first saw the river's tragic work some twenty years ago and spent most of those two decades as an engineer fighting the flood dragons.

Today, by strange irony, "China's sorrow" is also one of the chief defenses of that beleaguered land. The river, dragons and all, has been enlisted to fight the Japanese. Thrown out of its course by the Chinese, this muddy moat holds back the invaders along a front of hundreds of miles (map, page 207).

The river would still be flowing across the Great Plain in a northeasterly direction, as it had for the previous 85 years, had not military emergency intervened in June, 1938.

Japanese forces had taken Honan's capital, Kaifeng, and were about to move westward to capture the important railway center of Chenghsien, a few miles south of the railway bridge over the Yellow River. To break the south dike east of this bridge and to send the muddy flow of the great river between Chenghsien and the advancing enemy was good military strategy. The river soon spread its yellow flow over the country in a path a mile wide and ultimately sought out an old, long abandoned course.

The muddy fields with one to three feet of water flowing over them could not be traversed by Japan's auto transport. The Japanese were definitely bogged down and were not able to take Chenghsien. "Face" was lost by Japan in this sector, for her military leaders were laughed at, a fact which, in the Orient, can be almost as annihilating as machine-gun bullets.

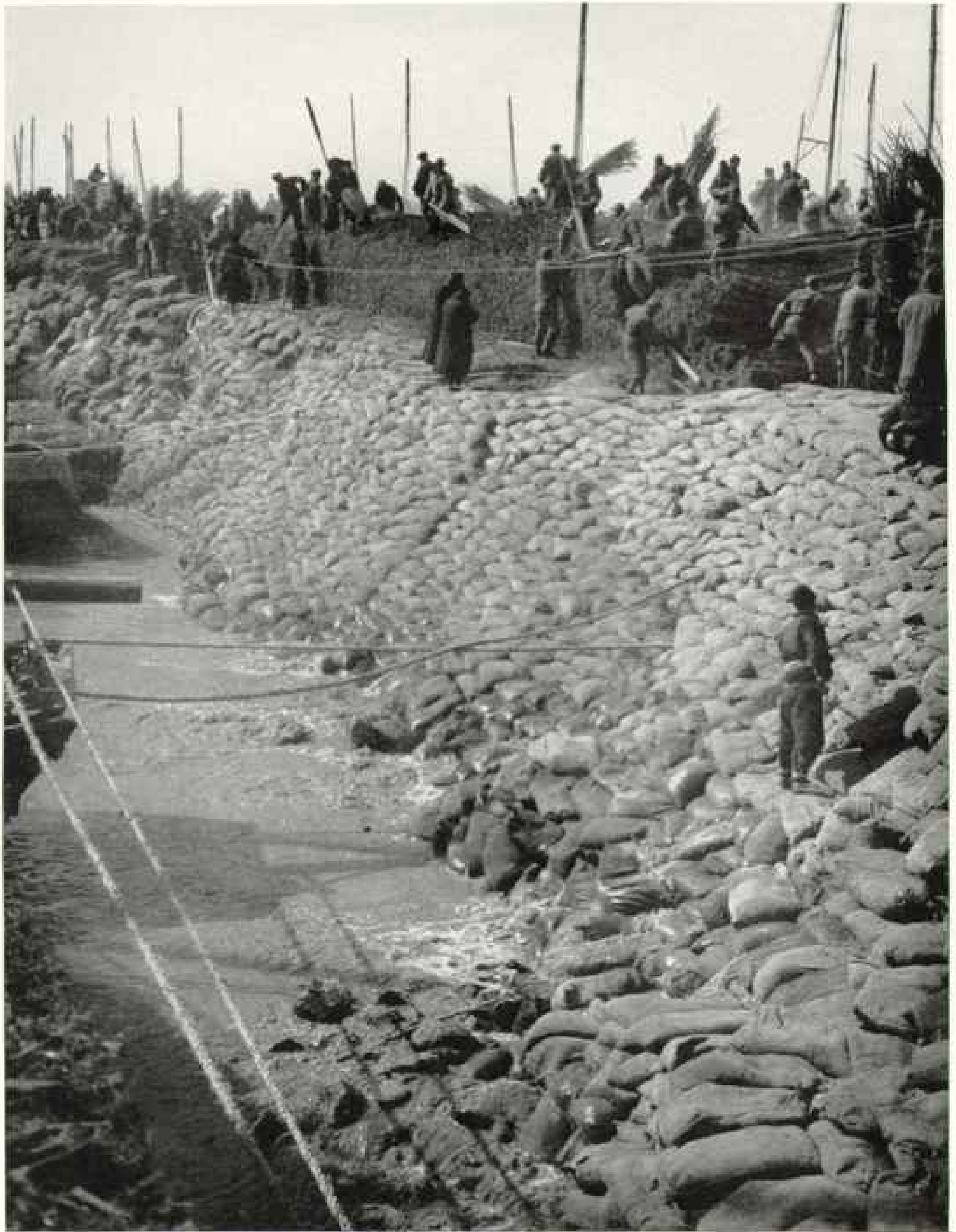
As this is written, the dislocated river still forms an effective barrier against the armies of Japan. In addition, the activities of the Japanese in North China are hampered by the fact that a mere trickle of water flows through the former channel—not enough to permit navigation.

## Giant Often Runs Amuck

Somehow the unruly Yellow River captivates everyone who sees it. One of the world's largest and mightiest rivers, it is little known to the outside world. Scenically monotonous, it is not sought by visitors. Mud bars make it useless for steam navigation, and junk traffic is seasonal and unimportant. Yet it is the throbbing artery attached to the heart of North China, and by its vitalizing waters 50,000,000 human beings live.

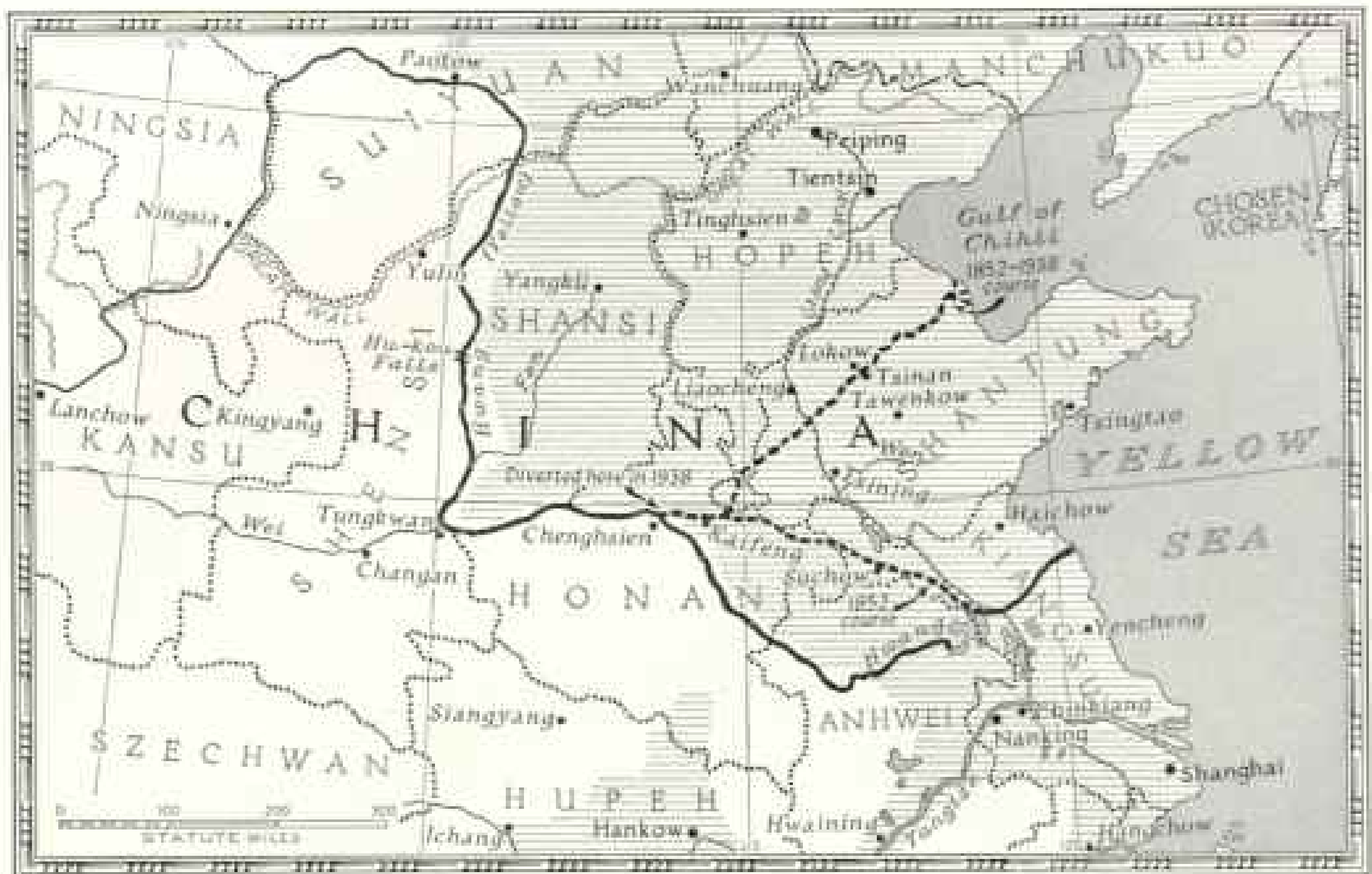
I first went to China, long before the present conflict, to study the rehabilitation of the Grand Canal, the world's longest man-made waterway. But fate and heavy rains soon thrust upon me more vital problems. I stayed to tussle with a giant run amuck.

That "dragon carrier" which the Chinese call Hwang Ho was living up to its evil reputation as one of the great killers of mankind. A terrible drought famine had scarcely ended its scourge of Shantung when rising waters were drowning thousands of persons and livestock, washing away whole towns, and laying



#### Bags of Earth Heighten an Old Dike to Keep Pace with the Rising Riverbed

The barricade will be faced with stone and stalks of kaoliang, a grain sorghum. Through China's Great Plain the bed of the Hwang Ho rises, on the average, about three feet a century. At many points the increase is much more. Some 20- or 30-mile stretches of dikes must be built up five or six feet each year to combat the enormous deposits of silt. Unlike the Mississippi, the lower Yellow River has no important tributaries in which flood-control systems can be set up.



### Hwang Ho, or Yellow River—Source of Flood and Famine for Millions in China.

Challenge to the world's best engineering minds is the 2,500-mile stream which rises in northern Tibet and empties into the Yellow Sea. The last lap of its journey lies across the Great Plain of North China. Periodically cutting new outlets to the sea, the river has moved its mouth roughly 700 miles up and down the coast in the last century. Broken lines mark the principal abandoned channels. Shaded area shows the region now occupied by Japan. In June and July, 1938, the river was diverted to flood 800 square miles in Honan Province, forcing a motorized Japanese army into hasty retreat by rafts and boats.

waste densely populated regions. A quarter of a million men, women, and children were forced to flee to higher ground.

From Tientsin, headquarters of the Government river and canal commissions, I hurried off for Shantung, where survey parties had preceded me.

#### "May I Set Up My Cot?"

My train dropped me at the little station of Tawenkow at 3 o'clock on a chilly autumn morning. My two Chinese "survey coolies" were as strange to the place as I was. The train moved out, and the stationmaster disappeared into his office, where his kerosene lamp burned low to save expense.

Half a mile away the town lay silent within mud walls. I could hear the sentry's challenge to vegetable venders approaching the gates and in the starlight see the silhouettes of soldiers' heads and rifles as they paraded slowly along the ramparts.

It seemed wise not to attempt to enter the town now. "*Hsien sheng*" (literally "first born," here meaning "Honorable sir"), I called through the door to the stationmaster, "may I set up my cot under the roof

on the platform and rest until daylight?"

He understood little English and spoke less. His brief reply was "Not allowed!" He faded from sight and turned his light still lower. On his hard office bed he doubtless wondered what new kind of "foreign devil" had dropped off the train at such a time of night without official escort or friend to meet him.

With this strange introduction to the countryside I began my flood-control work. Along the Wen Ho and along the Hwang Ho itself I carried on for a year and a half. I soon learned that restoration of the Grand Canal would be too costly, practically impossible. This once popular inland waterway had outlived its usefulness in North China.\* The Yellow River was its conqueror.

#### Floods Worse than Mississippi's

On the Great Plain, immediately upriver from where the Yellow River intersects the Grand Canal in Shantung Province, lies the greatest outdoor laboratory in the world for flood control. A few hundred miles farther

\* See "Grand Canal Panorama," by Willard Price, in the NATIONAL GEOGRAPHIC MAGAZINE (of April, 1937).



**"Flood Dragons" of the Hwang Ho Buried This Temple to the Eaves in Silt**

When the dike broke, raging torrents engulfed the building. Now the waters have receded, leaving behind a thick layer of sediment. In flood time, 40 per cent of the river flow, by weight, may be silt (page 227).

upriver there is an extensive field for the student of soil erosion.

To the engineer this is a land of promise even more challenging than the Mississippi Valley, for the problems of flood control are more complex.\*

While the Mississippi in its main lower course lies to some extent in a groove with large feeders pouring into it, the lower Yellow River has no important branches. For 500 miles it flows in a raised bed built up by its own loads of silt. Flood waters swirl along well above the surrounding flat country. When the dikes break, it is with difficulty that the flow is returned.

From the treeless, loess-covered hills of Kansu,† Shensi, and western Shansi, avalanches of liquid mud each summer descend onto the Great Plain, choking channels.

When the river overflows its banks, farmers on the plains pay with their growing crops, their homes, domestic animals, and often their lives. The heavy hand of tragedy has repeatedly left its mark on more than 55,000,000 acres of rich farmland.

Beside this river lies the cradle of Chinese civilization. To the west and north of Tung-kwan, along two main tributaries of the Yellow—the Wei Ho and the Fen Ho—powerful Chinese rulers dwelt and raised grain to feed their armies more than 20 centuries ago.

The almost legendary engineer, Yü, who afterwards became Yü the Great, Emperor

\*See "Men Against the Rivers," by Frederick Simpich, in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1937.

†See "Where the Mountains Walked," by Upton Close and Elsie McCormick, in the NATIONAL GEOGRAPHIC MAGAZINE for May, 1922.



**Man, Wife, and Donkey, Teamed Together, Pull the Drill for Spring Planting**

They are sowing grain in a new bed of silt, on reclaimed land from which flood waters have receded. Most of their livestock was drowned. The new covering of sediment acts as a fertilizer and is rich soil. If the river stays away from their fields for a few years, they will recover their losses (pages 227, 228).

of China, sought for years to find a way to control floods on China's eastern plains. He is said to have solved the problem by dividing the flow and keeping channel beds below the surface of the plain. This was some 22 centuries before Christ.

To curb the Yellow River's floods and to channel these waters to the sea has been deemed by Chinese scholars and sages China's leading physical problem. In forty centuries of shuttling back and forth over the plain the river has constantly terrorized village dwellers.

Famine often takes heavier toll than the oncoming flow; yet the silt washed from the hills acts as a fertilizer. So the farmer of Honan, Hopeh, Shantung, and Kiangsu takes his chances and maintains an abiding faith that benevolent dragons will favor his lands.

He hopes that if drought or flood or grasshoppers come they will just miss him; then there will be a good local demand for his wheat and corn. If he dwells close to the river, he may raise some hemp for native rope, or some tamarisk and willow to be made into baskets for repairing dikes.

His kaoliang stalks are carefully stacked with roots on, after the leaves have been stripped off for cattle feed and the tops taken to the threshing floor. This tall stalk, a grain sorghum somewhat resembling sugar cane, can stand considerable water and does not die quickly, as does corn after temporary flooding. A patch of sweet potatoes furnishes cheap and wholesome food for all his family, although it is spurned as "coolie food" by wealthier countrymen in Peiping and Tientsin.

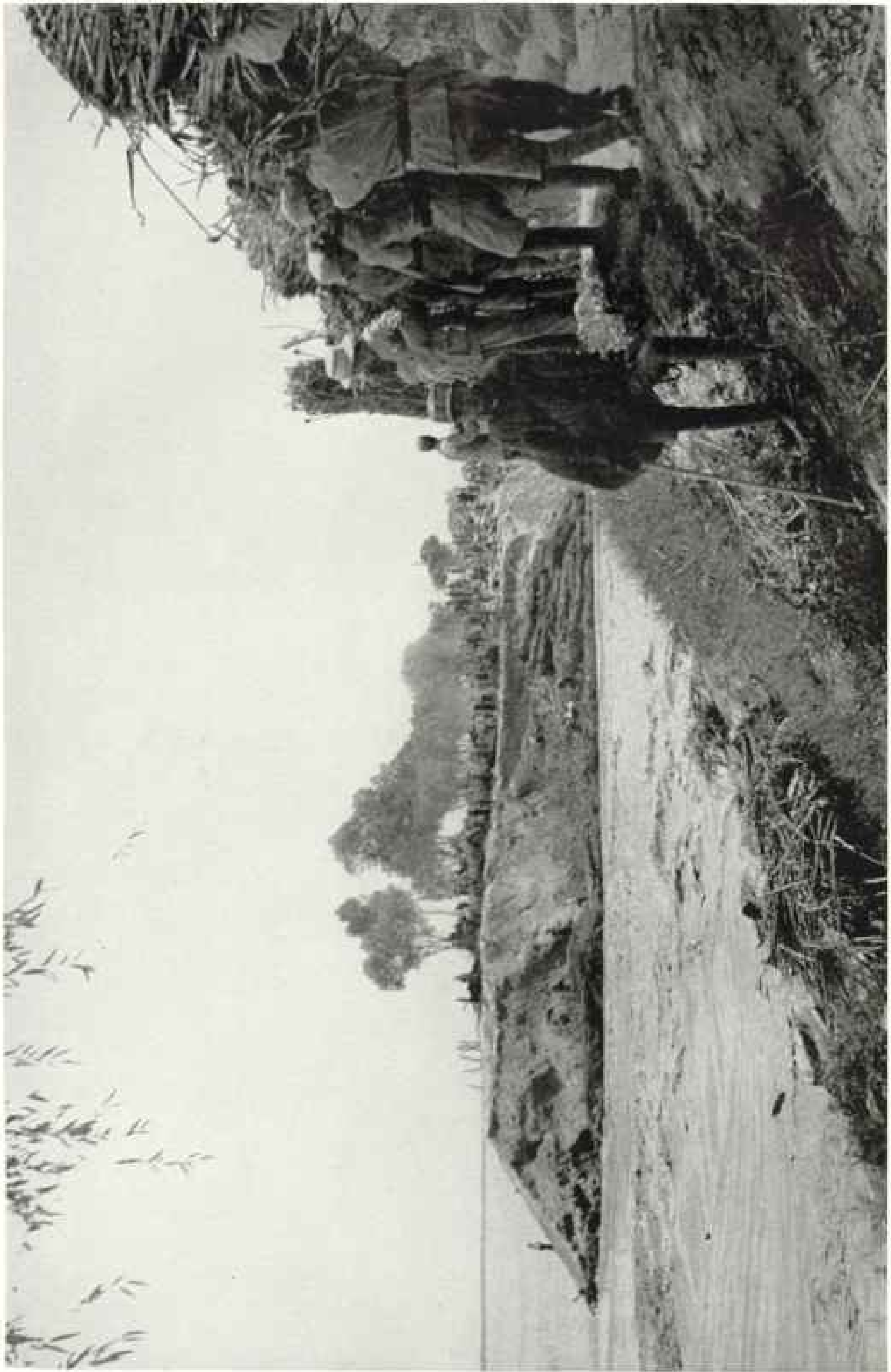


**August Floods Turn Hundreds of Square Miles of Western Shantung into Lakes**

Here, four months later, farmers have become fishermen on their own lands, still under water. Famine takes heavy toll of lives in such outbreaks.



**Stone Roller and Plodding Hoofs Work Out the Grain on a Threshing Floor of Sun-baked Clay—North China**

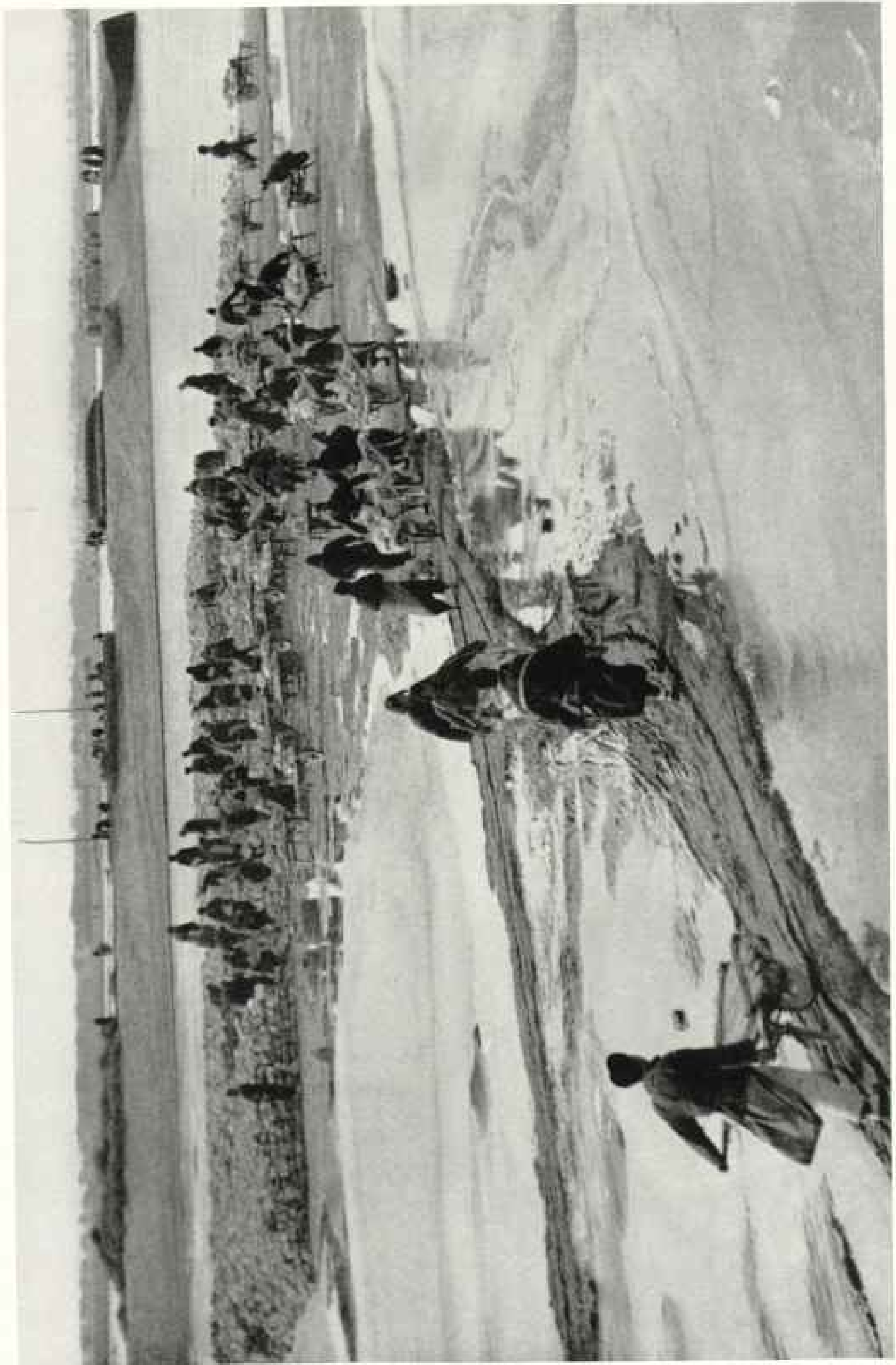


AP from Press Asia's

**Coolies and Soldiers Work Side by Side to Close a Flood Break in the Dikes of China's Rampant Hwang Ho**

They toss thousands of bundles of kaoling stalks into the gap in a mighty effort to keep the stream in its channel. When dikes break, millions of acres are flooded.





**By Wheelbarrow, Tons of Stone Go to Reinforce Dikes Threatened by Ice Jams in Winter**

The huge stock pile of stone was built up for emergency use along the banks of the Hwang Ho (page 223). Heavy ice may overtop the dikes and break them down. Sometimes the river cooperates in closing such breaches by depositing heavy loads of silt in the opening.



**Rocks Are Rushed to the Dike Break by Manpower in a Valiant Effort to Curb the Unruly Hwang Ho**

When work of closing a gap extends into swift water, vast quantities of stone must be dumped upstream to prevent the river from cutting under the new fill of kanliang pack. Coolies push their heavy wheelbarrows right to the water's edge.



#### Into a Dike Breach Near Liaocheng Goes a Giant Bale of Kaoliang

When it is in place, a foot of earth will be placed on top to make it settle deeper into the mud at the bottom of the Hwang Ho. This breach occurred during the disastrous flood of 1935, when 6,000 square miles of western Shantung farmland were inundated.

The sweet potato vines are turned after the rains so the leaves will not rot and drop off, for these are precious winter fodder for goats and cattle. Where conditions permit, a patch of indigo is grown for the family dyeing.

Ranging the Shantung countryside in my fight against the river, I saw how people live in the face of potential disaster. Setting out at daybreak by mule cart, I found blue-trousered farmers already hoeing long rows of wheat in closely abutting fields that extended in every direction, a green carpet so broad that I could not see its borders.

Here and there, by the thatched roofs of a village, the fresh boughs of willows or elms in full leaf hung like decorative curtains.

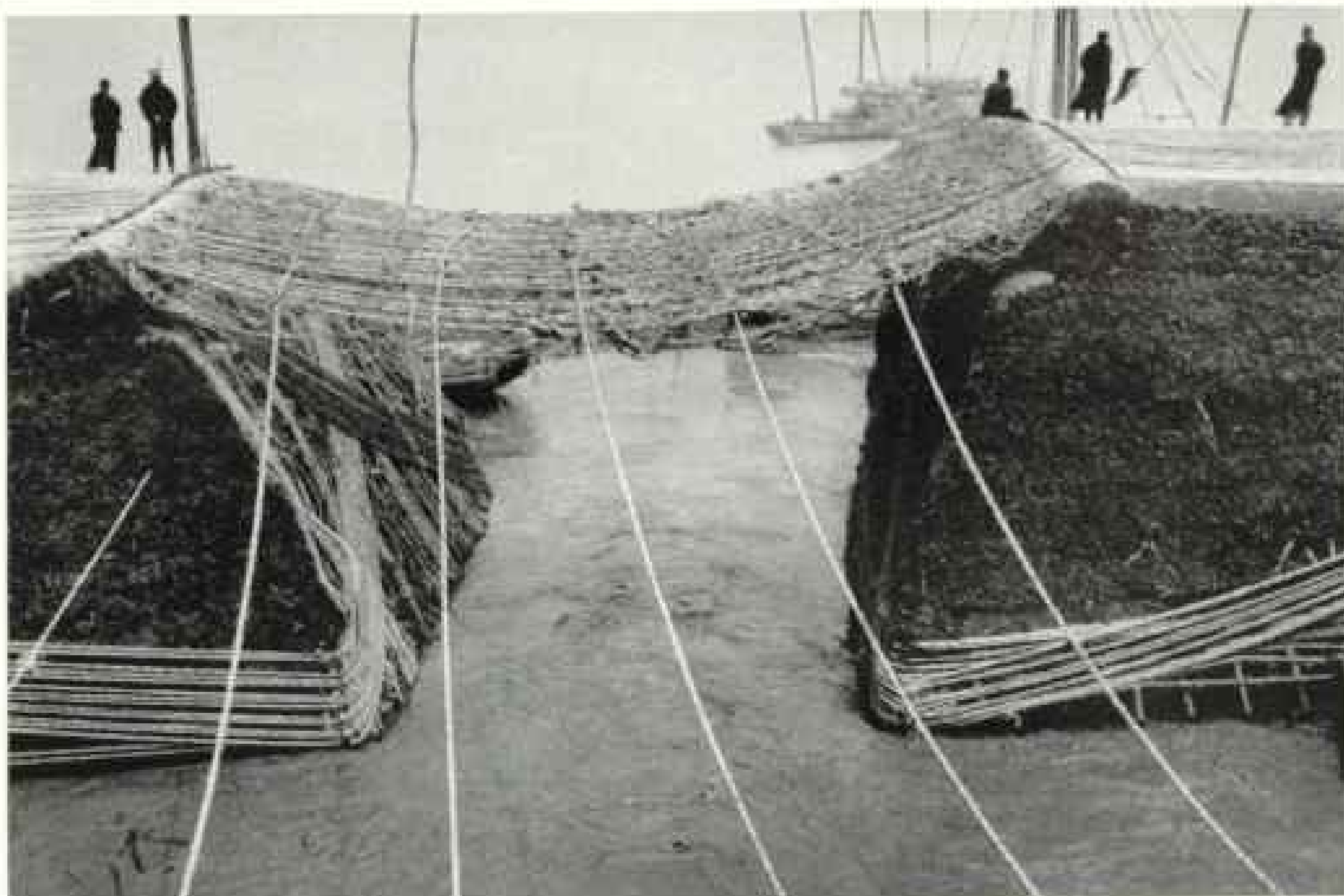
#### Hark, the Lark—and Singing Cicada!

Close by the roadside the aged owner of a field set down a bird cage containing his favorite Mongolian lark. In a small patch of broom he hoed weeds as he listened to the lark's

morning song, for he was too old to keep the pace of his sons and others who diligently cultivated the wheat with their heavy hoes until sundown. His grandson was with him, carrying a small gourd that housed a singing cicada, or, more likely, one trained to fight against others of its breed.

Here the fields are level, the soil fertile, and the crops good when rains are regular. This is the "good earth" to which the Chinese farmer clings as long as Nature is kind and the tax gatherer is not too rapacious.

In the wheat harvest, where the short sickle does the cutting and the straw is bound by hand, the entire family takes part and every spear and head is saved. Sometimes I would stop my mule cart along the roadside, take a handful of newly cut wheat straw in my left hand, splitting it with my right, with forefinger extended, and make it into a band to tie a bundle, as I did on my father's farm in Michigan 50 years ago.



**Dike Builders Stretch a "Dragon Net" to Make Both Ends Meet**

Hemp ropes, tightly entwined, cover the narrowed gap. Soon the net will be filled with bags of earth and kaoliang stalks, then lowered into the water (see below).



**Slowly the Heavy-laden "Dragon Net" Slides into the Gap**

Workmen gradually release the ropes, which are fastened to stakes. This is a secondary barricade, built to cut off leakage from a main dike.



#### With a Grooved Block, He Twists Hemp Strands into Rope

The rope will tie up bundles of kaoliang stalks, to be packed into dike breaches along the Hwang Ho. Kaoliang, abundant on China's Great Plain, is a grain sorghum somewhat similar to sugar cane (page 209).

Halting work and staring, the farmers would break out laughing as if to say, "Who ever saw a 'foreign devil' who could tie a bundle of wheat straw as we do along the Yellow River?"

"You see," I would explain, "I also was a farmer and worked in the harvest fields before I studied engineering."

"Good," said the patriarch of the group as he sized me up and down from head to toe.

"Very good," added his grown son with a broad grin and an upturned thumb as all of the group laughed again. I had made friends.

As I jumped into my cart, the Chinese engineer with me remarked, "You foreigners can do such things without loss of face, but I cannot. What a foolish thing this matter of face is, after all!"

"I hope these farmers will keep on considering us engineers 'queer folks,' who are willing to turn their hands to anything, even to running wheelbarrows and using picks and shovels." I said as we drove on. Engineers, like doctors, must be on friendly terms with countryfolk.

All up and down the Great Plain, after the main crop is taken to the threshing floor, girls and women spend their spare time weaving straw into long strings of hat braid. Their brothers raise big radishes, cucumbers, and onions, which they eat with relish through the summer months.

#### Melon Seeds for Appetizers

Everywhere melon seeds are saved and dried for winter use. Some are sold to restaurants where they are served as appetizers, or to theaters where they are eaten throughout the performance. The hulls are pushed over the balcony rail or dropped on the floor.

I saw wheelbarrow loads of garlic, braided together in long, heavy strings, go to market. This vegetable is considered both a flavoring and a tonic. From small round beans resembling peas come bean sprouts, bean milk for children, and bean curd for everybody. Northern Chinese depend far more on beans and wheat than on rice as staples of diet.

Early in my river studies I found that of next importance to the provincial armies in Shantung, Hopeh, and Honan was the Yellow River Bureau, with its organization of chiefs, captains, and "river police." In each province the river was divided into sections, with headquarters where chiefs remained in charge the year round.

Between calamities river police planted wil-

lows to protect dikes, operated quarries up-river, and hauled stone down to bends where banks were eroded. Kaoliang stalks were stacked in cubes of about 14 feet on each side. Piles of these were placed on or near the dikes at danger points.

I first saw this organization swing into action in the autumn of 1921, following a serious dike break 75 miles above the mouth of the river. But valiant efforts to fill the breach with sandbags, kaoliang stalk groins, and stone failed. The River Bureau was defeated, and 250,000 people in the flooded area were made homeless and destitute. A colony of famished refugees built a dike village stringing out for miles and grimly awaited help or starvation.

Accompanied by a missionary doctor, I left Tsinan in a small boat for the scene of the disaster. China's New Year was almost at hand, and we found the old family system of celebrating holidays a stumbling block. Drifting downriver at sundown amid floating ice, we hoped to get beyond Lokow before our boatman should change his mind and suddenly become "ill." "It is not wise to begin a journey on the Hwang Ho in the evening, no matter what the emergency," our boatman solemnly informed us. "Evil spirits in the dark waters never like it."

"Have you paper cash to burn on the bow of your boat in case of unfavorable winds?" my companion inquired. He shook his head.

"Then go ashore at once and get a *catty* (1.3 pounds) and be quick, for we must be off," I ordered.

We waited an hour, shivering, for his return. At last he came with a handful of gilded cash



#### He Claims Confucius for an Ancestor

H. Y. Kung, chief engineer of the Hwang Ho flood-control project on which the author acted as consultant, bears the family name of the ancient Chinese sage (page 224).

and a small kitchen god of clay wrapped in a cloth. But even thus fortified he was not happy. We shoved off, somewhat cheered by a bright moon that reflected its light from chunks of ice which brushed the sides of our boat. All of us rowed to aid the flapping sail and to keep warm.

#### More "Foreign Madness"

It was an adventure for the doctor and me, but like a death-sentence for the boatman.

"Such foreign madness," he seemed to be saying aloud.

"Such callousness!" we thought as we pondered the fate of the 250,000 starving flood victims perched on the dikes 70 to 80 miles downstream.



Coolies on a Work Barge String a Rope "Cradle" to Hold Packs of Kaoliang Stalks

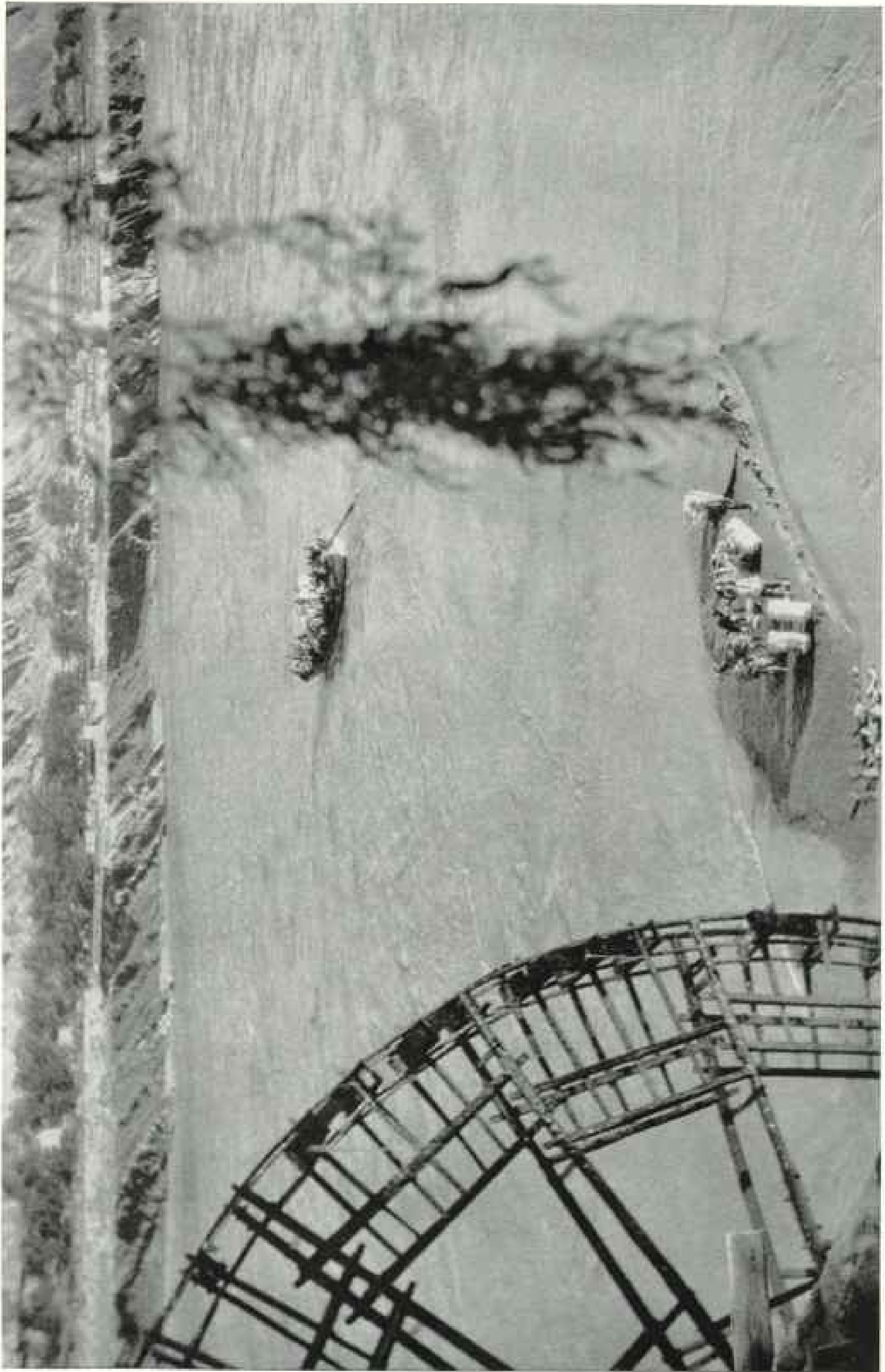
When the section is completed and filled, it will be moved to deep water and sunk to close a gap in the dike. Concrete revetments are impossible along the Hwang Ho. No sand is available within a reasonable distance. Kaoliang, willow stakes, hemp rope, and stone are China's traditional weapons against flood.



**One Lusty Heave, and into the Dike Gap Plunges a 50-foot Stone "Sausage"**

Chinese builders wrap willow sticks around a long series of "one-man-size" stones, and tie them firmly together with hemp rope. Many hands push the unwieldy roll up to, and then over, the embankment (page 223). Most Hwang Ho dikes are from 15 to 30 feet wide at the top.

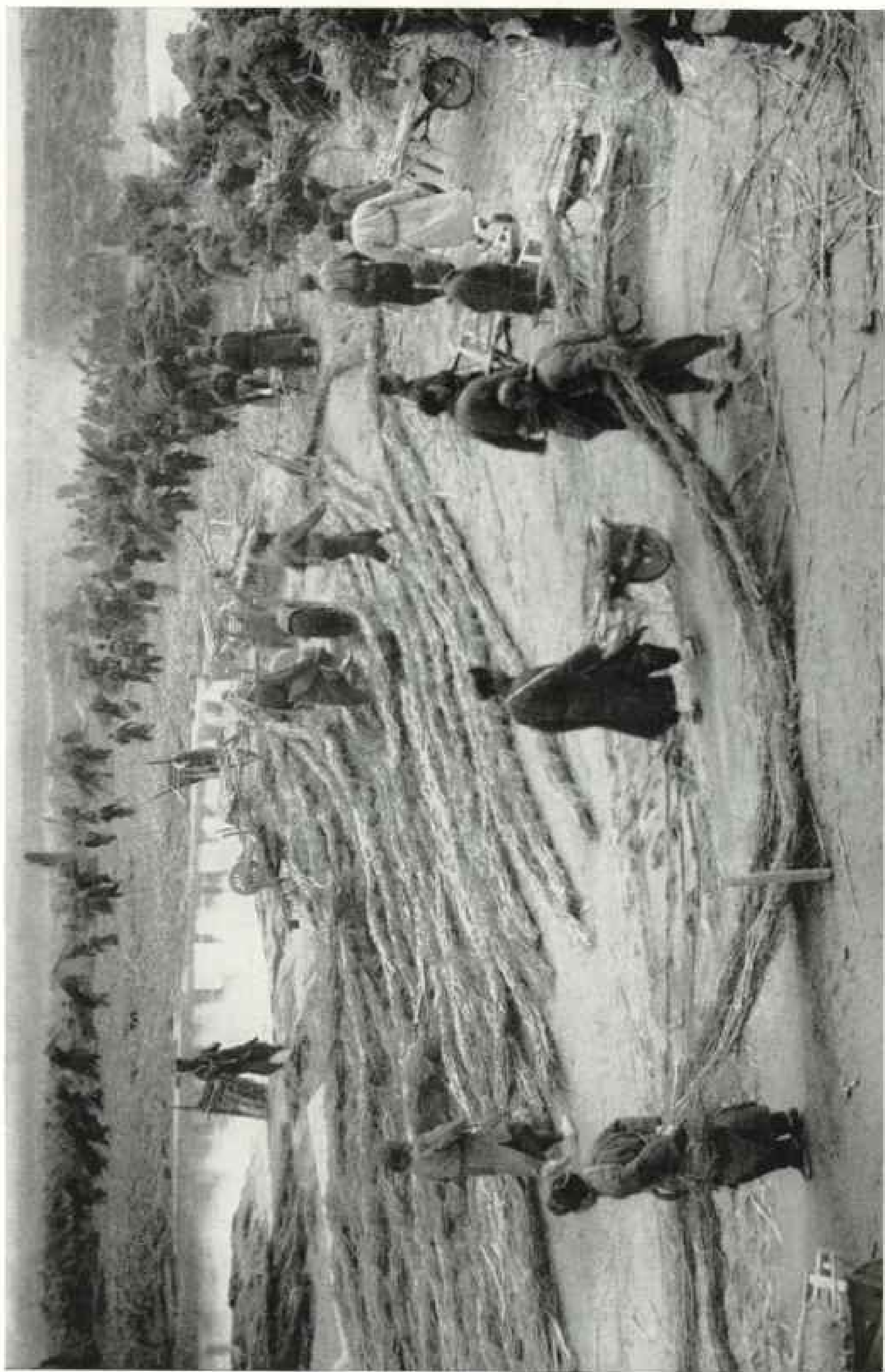




Water wheel

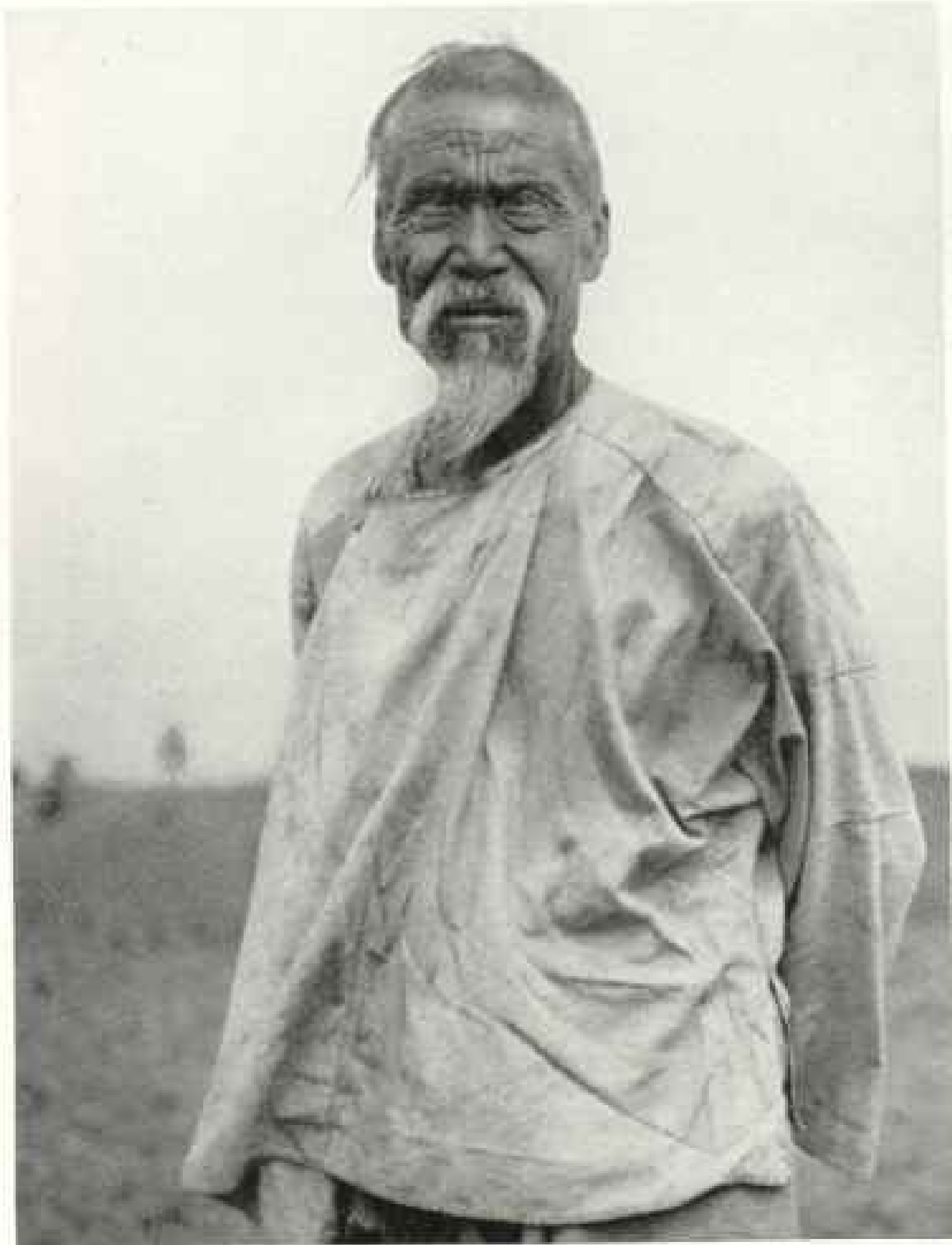
### Far Inland, Traders from Tibet Ferry Across the Turbulent Hwang Ho to Chinese Markets

Here, above Lanchow, the stream runs through rocky gorges. The irrigation wheel (left) lifts water from the river and sluices it onto near-by farmland. Rapids and numerous mud bars prevent steam navigation. Only a few junks, rafts, and ferris ply the waters of the Hwang Ho (pages 205, 224).



Swarming Along the River Bank Like Ants, Coolies Drag Long Strands of Woven Willow Sticks to the Dike

Others carry packs of hauling stalks to the water's edge. Both materials rot in the water after a few years. Then new stacks are placed on top of the old, forcing the decayed mass into the mud on the river bottom. Often the entire construction is destroyed when the current scours out the rotted foundation.



### He Knows Why the Hwang Ho Is "China's Sorrow"

A Shantung farmer, head of his family, surveys barren fields in a year of famine. Crops have been destroyed by raging floods.

But that was not the boatman's concern. He lived three counties away. They did not belong to his family, and he did not know even one of them. Next morning he would move no farther. A cold wind had sprung up in the night, presaging more ice.

We spent the forenoon in quest of a cow-drawn cart that again started us on our journey along the dike, but slowed our speed to three miles an hour. We walked to keep warm. Our carter had ample time to ponder and by night realized how close we were to New Year. He insisted that he must return home next morning.

There were other carts in the inn, but none of the drivers was interested. Our pleas that many thousands were freezing in the adjoining county met deaf ears.

During the New Year period, they explained, countryfolk lay aside all cares for two to three weeks, pay and collect debts, visit friends and relatives, and paste on each side of their front doors red banners covered with sentiments of good will for the coming year. Only crazy foreigners would attempt to move far from home now. We were breaking custom.

But we made our investigation, walking most of the time. We "ate our share of bitterness," as the Chinese put it, and returned to the provincial capital with our report—and much wiser.

We saw how the Yellow River produces a spirit of fatalism among the people and noted how poverty and the family system make men in one village callous toward the misfortune and misery of those a few miles away.

Twenty years have elapsed since my first cold trip to a distressed region. Since then schools have introduced Western ways into even the most isolated and neglected districts. I have seen many changes for the better. Even before the current Far Eastern conflict more and more young Chinese from the cities were going to the country with new ideas.

### Oregon Fir Fights Chinese Floods

The Shantung Government failed to raise the funds necessary to close the dike breaks the next spring, and the following summer's flood widened the opening to more than a mile. The River Bureau was still helpless. Next winter I had the job of organizing the work that closed this breach, forcing the river back to its channel.

To build the pile trestle for a rock-fill dam,

I cleaned the lumberyards of China out of nearly all their big timbers. To these I added a shipload of fir piles from Oregon. Some 25,000 workmen were employed at the rush period of channel excavation.

The diversion dam that solved the problem was built by dumping 40,000 cubic yards of "one-man-size" stone onto a matting of wire mesh from a timber trestle 800 feet long.

China did not have enough wire mesh. It had to be brought from Japan. But stone transport was the most critical item (pp. 212, 213). For many weeks a fleet of 300 river junks hauled stone from upriver quarries, an average of 100 miles away, to prepare for rapid dam construction in late April and early May.

When the following summer's flood passed through the channel, and the work held, that greatly coveted asset to life in China, "face," was the reward of my associates and myself. Reputation for successful struggles with the Yellow River sets one apart and in high esteem in China. By grapevine telegraph the word spread up and down the Plain and served as a talisman for travel into remote places.

Twelve years later, when the river broke through the dikes at the western border of Shantung, I was asked to assist on a similar job as consultant. This time I saw work go forward much as it had ages ago, without piles or pile driver but with many local materials—kaoliang stalks, willow stakes and branches, hemp rope, and stone. It was a primitive struggle of men against the river. Hand labor did it all, for it seemed economical at 15¢ (U. S.) per day.

The old "contraction method" was used and



Madonna and Child of China's Great Plain

They rest in a wheat field, where they have been gleaning. Floods have ruined the crop. Hours of toil bring only a small harvest.

the breach closed by the end of March to the symphony of thousands of squeaking wheelbarrows, just ahead of the "Peach Blossom," or early spring flood. The full force of river police of Shantung, Hopeh, and Honan was assisted by an army of farmers drafted from a dozen counties. The latter were sent by their magistrates to work for nominal pay (their food) and told to stay on the job until the immense task of earth moving was completed.

Long willow fascines, encasing stone cores, were built up with considerable skill and tied together firmly with twisted hemp ropes, making "stone sausages." With these the breach was made smaller each day (page 219).

Attempts to close the last water gap of 30 feet by sinking a heavy barge filled with rock

all but succeeded, and might have if so much time had not been wasted with religious rites and incantations.

It was 10 o'clock on a clear moonlit night, and a picked crew had worked all day for this moment. The last small bundle of brush, tied with a ribbon and properly sprinkled with incense, had been laid on the deck of this Chinese reincarnation of Hobson's *Merrimac*.

The bugles sounded and the river police stood at attention, except for the men who steered the barge into position. The chief officials moved up to the water's edge and, with bared hands, mumbled the prayer of the Tibetan lamas. But this delay proved disastrous. The river dragons became annoyed, picked up the boat, and stood it on end, scattering its stone load in all directions.

The rushing water swept the empty barge downstream through the gap as the crowd fell back in chagrin. Slowly and without a word all retreated to camp and went to bed. Next morning the routine of putting in more stone sausages was resumed. Blunders were soon buried and forgotten as the work went forward to a successful conclusion.

#### Engineer Descended from Confucius

Chief engineer H. Y. Kung told me he was a direct descendant of Confucius.\* (In Chinese the name of Confucius was Kung Fu-tze, the family name always being given first.) This representative of a distinguished line worked early and late, was autocratic in the use of his authority, understood his countrymen, and never wavered in his faith that he could make the mighty river bend to his will, especially in low-water periods (page 217).

Our American way adapted to China's conditions succeeded in 1923; this improved Chinese way succeeded in 1936. Either will solve again the problem of getting this stubborn river—dragons, turtles, and all—back into the bed from which it was diverted just east of the Peiping-Hankow Railway bridge in June, 1938, as a part of military strategy.

But today shifting armies and guerrilla bands prevent repairs. So the river must continue to wander off to the southeast, drowning fertile fields that normally grow grain, cotton, and beans.

At present, as in times of natural calamities when dikes break by overtopping, river traffic is blocked. The Yellow River, however, has

\* See "Shantung—China's Holy Land," by Charles K. Edmunds, in the NATIONAL GEOGRAPHIC MAGAZINE for September, 1919.

† See "Raft Life on the Hwang Ho," by W. Robert Moore, in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1932.

never been a dependable waterway for commerce. On it in normal times glide small picturesque junks and high-riding cotton boats. The latter, 20 feet wide and mere shells, are often torn apart and sold for lumber at the end of a journey.

Upstream, because of the rapids near Lanchow, cargo is carried on inflated cowhide and goatskin rafts† that are dismantled at Pao-tow, terminus of the Peiping-Suiyuan Railway. The river is too shallow for powerboats, such as are common on the Yangtze.

The laws of conservation of energy rule boatmen, who drift with the current downstream and wait for favoring winds upstream. Only in emergencies do they climb out into the muddy water and pull the towrope, for it is easier to sit on the boat and whistle for winds to fill the sails. The shrill call is almost identical with that I used on a Michigan farm half a century ago to lure horses from the pasture. Sometimes it works!

At sundown a pan of paper cash burned on the foredeck may appease the gods and bring favoring winds. In Shantung I have seen boats traveling in opposite directions, each with its pan of paper cash being burned to attract a breeze to its sails. It would seem fairer to favor the upstream-bound boat.

Worship of family gods is not forgotten in the captain's quarters. Many old rivermen would not trade their ways and superstitions for anything. To them, the bronze cow, made natural size and set in front of a temple along a dangerous section of dike, belongs there and has earned her original cost many times over. To riverfolk and to farm dwellers on the Great Plain these bronze images are symbols of vigilance and appeasement.

#### No "Squeeze," No Work

Once I employed a camp cook for a big reversion job on the lower Yellow River. After six weeks he begged to be let off to go to Tientsin to have his teeth fixed. He said they ached. I knew it was an old Chinese dodge to escape a situation or get to go somewhere for personal reasons. So I had my best Chinese engineer talk to him. He soon obtained a frank statement.

"Yes, I am paid my wages as agreed, but my 'total monthly income' is too small here," was his explanation. He meant he was deprived of the prerogative of acting as purchasing agent.

All supplies for the foreign mess came from Tsinan, 150 miles away. Even eggs and local vegetables were bought by a foreigner in charge of supplies. The stocks were locked up and issued to him daily as needed. He did



© Capt. Hans Koester

**High Walls Protect an Upstream Village on the Hwang Ho from Robbers**

Grain grows in the fields along the river's edge. Although terraces check soil erosion, the stream constantly scours out its banks, acquiring more silt to be carried down to China's Great Plain. Here, near Lanchow, the channel cuts through gorges, and floods are not a serious menace.



#### Anchor Boats Hold Work Barges Steady Across a Dike Breach

Engineers have tried for centuries to keep the Hwang Ho within its channel. In some years they have been successful. Adapting American ways to Chinese conditions, the author and his associates first closed dike breaks in the winter of 1922-23 (page 222). Chinese engineers, under American tutelage, have succeeded occasionally since, but the unruly river still goes on rampages. Serious floods occurred in 1935 and 1938.

not have a chance to "squeeze." So he wished to resign.

"For shame!" exclaimed Mr. Tan, the engineer. "You are admitting your dishonesty before these foreign engineers." But to the cook this was merely a part of life, and foreign management had upset custom.

When the high-water season was on in late July, 1936, I drifted down the Yellow River almost the length of Shantung. I went in the smallest junk that carries a sail—a three-man boat—where one of the crew does the cooking and sleeps, while the other two handle the oars, rudder, and sail.

I took my turn at the oars, when not photographing caving banks and undermined villages. Buildings were being rapidly dismantled to save the woodwork just before the mud walls dropped into the swirling waters.

I was inspecting dikes and some cutoff work that had just been completed in an attempt to straighten flood channels. Waves caused by shifting sands on the riverbed often alarmed the captain of our boat. By sighting high waves far ahead he kept away from the worst rapids. But, as we cut across the less violent ones, great skill had to be used to prevent the boat from being capsized.

#### Not Pirates, Just the Tax Collector

"Bang!" went a gun along the shore, and our captain turned with a look of apprehension. He saw a flag waved and said he must stop and go ashore. A man in new uniform was halting us. We hoped we were not being held up by river pirates.

But the man with the flag and gun proved to be only another tax collector. He wished to see my passport, and I explained my mission. He informed me there was a transit tax and that all boats passing his station must pay according to the cargo they carried. In our case a dollar would do, for we had no freight. Now our boatman felt better. He would be able to return past this post without having his boat seized.

In summer one gladly leaves the hot plains to be in the rougher country of the middle or upper stretches of the river. Following the channel from its great elbow at Tungkwan, Shensi, for 125 miles north along the boundary of Shensi and Shansi, the Western engineer is thrilled by the sight and site of Hu-kou Falls.

Here the water, which in winter carries rocks embedded in ice, has cut a long slot in the limestone bed. In low-water periods, water tumbles 65 feet in a single drop, plus 45 feet of rapids in the next mile.

This break in navigation is a nuisance to boatmen, who must unload and portage their

cargoes. But with patience they have chiseled out a channel in the rock floor of the valley that carries no flow except at high water.

Some day engineers will harness these falls for hydroelectric energy—50,000 to 100,000 horsepower most of the year. Few but native boatmen, shepherds, occasional military patrols, and exploring engineers have passed this way. Difficult trails lead in from the nearest town, a full day's travel distant.

#### Bamboo Wheels for Irrigation

Famished as North China often is, the Yellow River is drawn upon only moderately for irrigation. At Lanchow, far up the river in Kansu, I have seen huge bamboo wheels with alternating buckets and paddles propelled by the flowing stream. Water is raised 40 or 50 feet, caught in a trough parallel to the plane of the wheel, and tapped from this to a long trough running to adjacent fields.

Near Ningsia the river feeds canals that irrigate bottom lands around this walled city, capital of Ningsia Province. Crops are watered by primitive irrigation works dating from the Han Dynasty. The surrounding country is dry, with yearly rainfall at times no more than six inches. Droughts cause widespread misery in this part of China.

The silt load of the Yellow River at times runs to 40 per cent (by weight) of the stream's flow in the main river and 50 per cent on at least two of its feeders (pages 208, 230). Some of it goes to replenish worn lands on the Great Plain. Most of it goes to sea—an average of 15 million cubic feet annually.

Silt piles up close to the mouth of the river to extend the delta or mixes with the water of the Gulf of Chihli to be deposited on its bed far from shore. Much of this is fertile topsoil washed from the loess-covered hillsides and plateaus of Kansu, Shensi, and Shansi. The underlying clay is not equally good for agriculture.

On this watershed erosion has accelerated in recent centuries, and China's northwest is becoming gradually less desirable as a habitat for the human race. Modern soil-erosion control is needed here. The attempts of the farmers to protect their lands by earth and sod terraces have proved inadequate. A Yellow River Valley Authority probably will be required to deal with this phase, along with flood control, when the time comes for national action.

Meanwhile these people plod on and seem never to give up hope. When erosion or flood ruins them, they merely remark in a fatalistic manner, "There is no way to avoid it." Months after a flood has passed over one of





#### Flood Victims Return to a Village Buried in Six Feet of Silt

They fled from their homes, two miles from the Hwang Ho, when the rampant river broke the dikes in August. For six months they were refugees. Now they have come back to dig out whatever may be salvaged from the engulfing sediment and prepare for a new spring planting in their silt-topped fields (page 227).

their villages, burying it under six or eight feet of silt, they will be seen digging out their homes, rescuing the bricks and timbers, and again erecting houses on the same sites, but a few feet higher than before.

Good nature, patience, and sturdiness are characteristics of dwellers along this river valley. They accept defeat with stoicism, but always hope for better things tomorrow or next week or next year. When famine comes, they tighten their belts, sell their chattels gradually, rarely take poison to end their misery, but go on foot hundreds of miles in search of work or food.

At such times they eat ground corncobs, peanut shells, seeds from various weeds, bark from elm and willow trees, and in some provinces temporarily keep alive by eating locusts or clay and drinking water.

#### Cave Dwellers and Paper Panes

Many of the mud huts of Honan and Shantung seem scarcely good enough for domestic animals, to say nothing of using them as dwellings for humans. We would hesitate to house army mules in such structures. But where in this barren Yellow River region is there lumber with which to build dwellings? Scarcely

enough is grown for the posts, wall plates, and purlines.

Bricks may be made of the fine silt along the river, and sun-dried bricks are used by the poorer villagers. But to make burned bricks costs much more. These become luxuries only for the wealthy farmer, the merchant, the high-ranking official, and for temples.

In the upper Yellow River country, particularly in Shensi and Kansu, as well as in western Honan and Shansi, caves in the hill-sides are the commonest dwellings outside the river villages. Millions of North China farmers live in these caves in the loess hills and house their domestic animals in similar quarters. Windows are few and without glass. A thin translucent paper is pasted over the frame. This substitute for glass is generally in use among those who man the plows, hoes, and sickles.

Their ancestors of 1,000 to 2,000 years ago used bronze mirrors in their homes or none at all, but in modern times glass has replaced these as being less costly. Glass cannot compete with paper in price, however, and paper windows remain a part of Chinese rural economy.

These people, where holdings are small, depend on the spade to turn their fields and use the hoe to cultivate the growing rows of wheat and corn, kaoliang and beans, millet and cotton. They thresh on sun-baked floors of clay, using cattle, horses, or donkeys to pull the stone roller (18 inches in diameter and two feet in length) over the ripe heads of grain and beans. Rarely is the flail seen along the Yellow River, although it is common along the Yangtze and farther south.

Nowhere in this region is there a mowing machine or a binder. Men and women often pull the native seed drill and sometimes the plow after floods have drowned their last donkey or cow (page 209). They still use the carrying pole and wheelbarrow for transport.

I spent several days touring the region south and east of the great dike break of 1935, studying the partly buried villages, the sanded lands, and the ruins of temples and mud huts where floodwaters had worked havoc. Passing a village far from the river, I noted unusual signs of precaution.

"Why are so many large rowboats lying here at this distance from the river?" I asked my Chinese assistant.

"Who knows where the dikes will fail the next time?" he replied. "In case of a serious break, all low-lying villages are in danger, and there is little time to get to higher ground. A boat may be the only means of escape. It may also become a temporary home. Even though the river cannot be seen from here, it is an ever-present menace."

So those who can afford this kind of insurance provide themselves with boats, which lie bottom-up near their homes. With these, in time of sudden flood, they can move their chattels to a dike and there erect a hut with timbers saved from their home. Once established on these dikes, the farmers of Shantung prefer to remain there and go out to their fields to plow, cultivate, and harvest until dike breaks are thoroughly repaired.

#### Serpents in Silk-lined Boxes

Priests of the temples keep superstition deeply rooted in the mass of the Yellow River peasants. Wind and water towers or images are still erected to keep devils or evil spirits from going in straight courses from cemeteries to the homes of fearful folk.

Live serpents, representing spirits of leaders drowned while trying to combat floods, are kept in silk-lined boxes in temples near the scene of large dike repairs. High Chinese officials of the old school kneel in obeisance to these influences, even in our time.

In 1936, at the completion of a dike closure

in western Shantung, members of the Chinese staff were compelled by their chief to attend a quaint snake-worshipping ceremony. He said it would have a satisfying effect on the peasant worker and the river police. Needless to say, Chinese engineers with Western training attended only under compulsion and then laughed among themselves afterward.

Children shed their clothes in May and run naked until autumn. Men at work in the fields strip to the waist except when it rains. Along the river, in summer, clothes are deemed a nuisance by men handling boats or working in wet places.

Sickness is rare among these outdoor folk in normal times. But let famine come, and malnutrition makes them ready victims for pneumonia and other diseases. Lack of sanitary measures spreads such epidemics as typhoid, typhus, cholera, and smallpox. Then people die by the thousands and families are wiped out in a few days.

#### Banditry in the Wake of Famine

In times of want following prolonged drought, bandit gangs, often destitute coolies under daring leaders, spring up. Merchants and others keep within locked doors and always seek a walled town at night. Former soldiers join these roving groups, which sometimes grow into small armies living by loot taken from captured towns of moderate size over a wide territory.

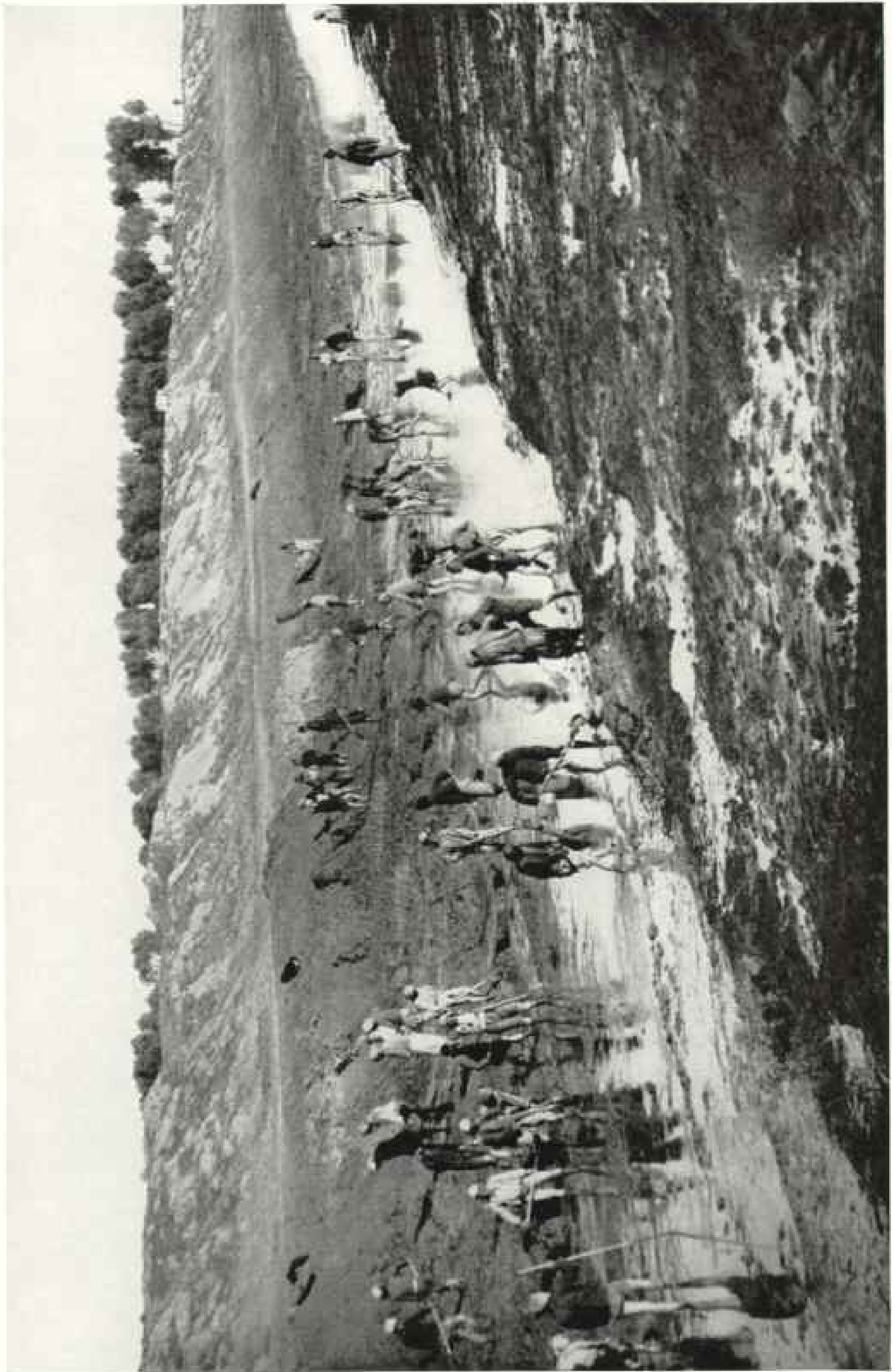
Prisoners are seized for ransom, provincial troops are sent out to "exterminate" them, and compromises are often made whereby bandit armies are taken into provincial forces. Robbers who remain in one place have their guilds, as do beggars.

The coming of the railway 30 years ago did much to modernize this Yellow River region. More sons and daughters have been able to get to school, and even to college. Modern equipment and supplies have been brought into market towns.

But still the two-wheeled cart drawn by one or two mules is the standard vehicle of the country road. This is the springless "Peking cart," known all over the Great Plain and far into the hills of the northwest.

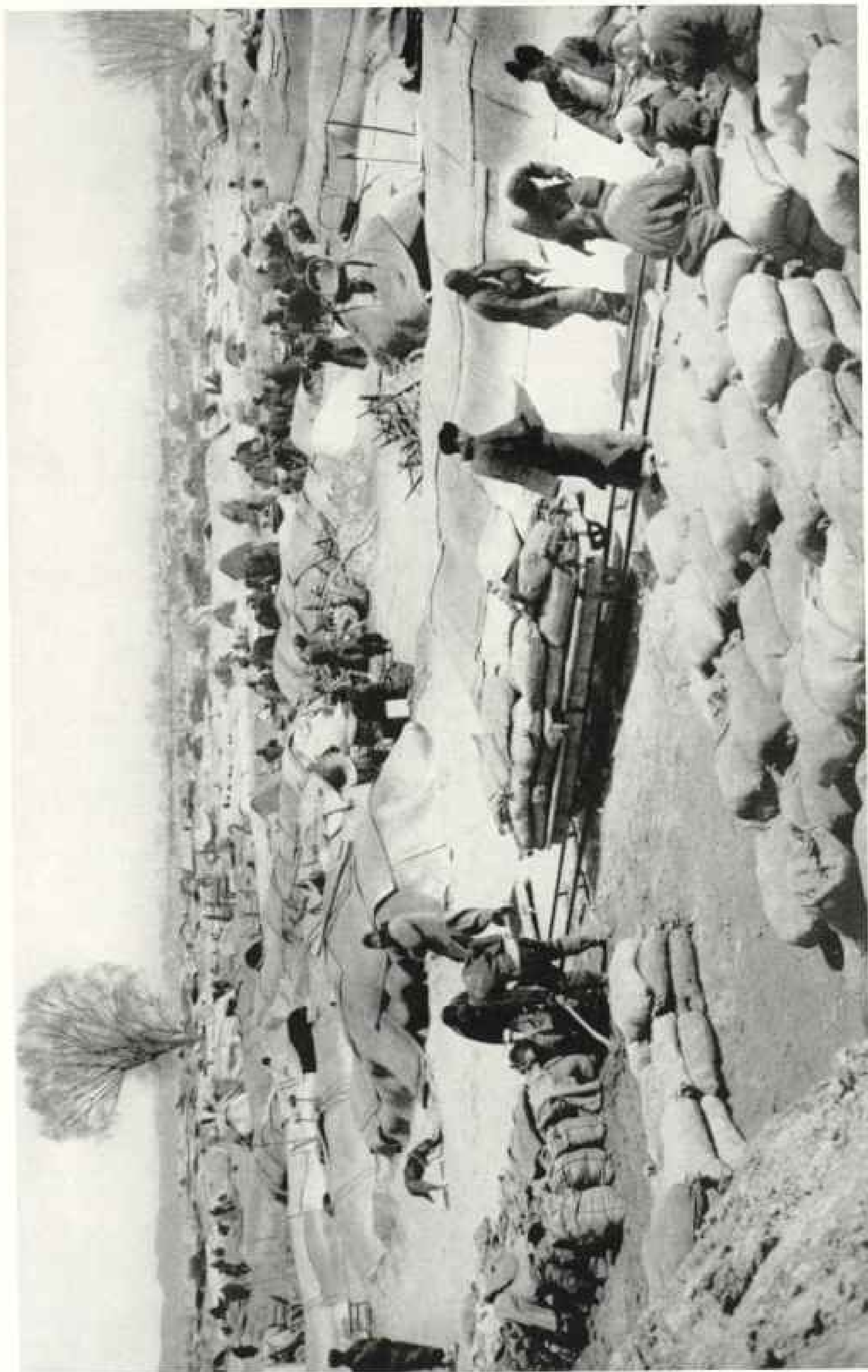
The similar but heavier luggage cart is used for hauling produce, earth, or fertilizer, or to take an entire family to the village fair. Motive power is three or four animals—rarely all mules, and often made up of mules, donkeys, and oxen hitched together.

Now come the ricksha and the automobile to travel dirt motor roads built in the past 10 to 15 years. In summer road superintendents may close highways for several days



**Strong Hands and Long Shovels Remove Tons of Silt from an Irrigation Canal on the Mongolian Border.**

The Hwang Ho picks up its tremendous load of sediment in the loess country of North China. Vanished forests and intensive cultivation for centuries have speeded up erosion at an alarming rate. The loose earth of crumbling mountains and hills is carried into the river from all sides during rainy seasons (page 227).



Acres of Mat Sheds House an Army of Hwang Ho Flood-control Workers

Tens of thousands of human hands take the place of steam shovels, cranes, and modern machinery, little of which is available on China's Great Plain. Hands wield spades, entwine stalks, twist rope, and carry stone in the battle against the unruly river. Here coolies in the foreground fill bags with clay to weight down huge plugs of kaoliang stalks lowered in dike breaches (page 215).

to prevent their being unduly rutted. But countryfolk do not care to move around much in these times and are not clamoring for metaled roads. They stay on their farms or wait for China's New Year to do any traveling that takes them farther than they can walk.

#### Man-power Carts with Rubber Tires

On cross-country roads, such as that connecting Kaifeng with Tsining on the Grand Canal, a new two-wheeled cart has been devised for moving freight. A light frame about ten feet long is balanced on an axle carrying a pair of ricksha wheels. These wheels with light steel spokes and pneumatic tires are reinforced by extra spokes. One man pulling and one pushing such a cart can move a half-ton load 25 to 30 miles in a day.

This means of transport challenges the wheelbarrow. It carries a somewhat heavier load than the ordinary ricksha used on the new graded motor roads, where 700 pounds of kerosene, flour, or baled cotton is a maximum load. But the ricksha is pulled by one man without an assistant to push, although, traveling in groups, these men help each other over rough places in the road.

In this region, too, a gradual change is evident, so it is not quite so difficult to get replies to questions concerning distances or locations.

Twenty years ago, during some Grand Canal studies, we were at a loss to know why our Mr. Yuan would not ask questions or even let the natives know that we were not familiar with the region. There seemed to him an implication of inferiority on the part of the one asking his way, and he could not afford to lose face by showing that ignorance. But we soon learned to ask travelers and villagers ourselves.

#### Chinese Distances Are Elastic

"How far is it to Ershihlipu?" we would ask, and the reply would come, "A distance of 18 li."

Then we would ask, "Is the li large or small?" Usually the reply would be, "Not the large li." The farmer knew we were tired and wished to make us feel happy by telling us these were small li (about three to the mile).

Often in flat country the li is long compared with those in hilly regions. Time consumed in travel affects the designation of distances covered, for precise measurements are lacking.

Although villages may be named Shihlipu, Ershihlipu, and Sanshahlipu, these may not be just 10, 20, and 30 li from the large city to which they are tied by these measurements.

There is much "Distance not much" in giving distances on the Great Plain, as elsewhere in China. Good-natured people do not like to be brutally accurate.

In port cities and among embassy groups, the custom of "saving a servant's face" by sending him to see relatives instead of summarily dismissing him for a misdemeanor is sometimes practiced.

There is always a "No. 1 Boy" who speaks English and who employs the other servants. He handles accounts, holds up peddlers and makes them pay a "squeeze" to be admitted, divides profits with the other servants (retaining for himself the largest percentage), and is responsible for keeping the household running smoothly. Usually he answers the doorbell, waits on table, and acts as intermediary between employer and other help.

Missionaries, however, cannot afford this expense and place their main trust in the cook, who hires the less obtrusive houseboy and coolie. With them an English-speaking servant is not required, and pay is lower.

#### "Travel Boy" Makes All Paths Smooth

There is nothing so important to a field engineer in China as a faithful "travel boy." Tai Feng Chi acted in that capacity for me for 16 years, until his death in 1935.

I never had the heart to employ another. He looked after my baggage, arranged my quarters after locating a place for spending the night when we were on the march, and cooked my meals, always getting a hot supper no matter what hour we reached camp.

Early next morning he was up ahead of me and had my breakfast prepared so we could start without delay. Every night he boiled the drinking water and put it in quart bottles to cool for use the following day.

Once I was walking ahead of our caravan. At a village I stopped before the gate of the first dwelling to ask directions, but my unshaven face and hot-weather attire caused the dog to view me with suspicion. The owner of the premises also entertained doubts about me and forgot to instruct his dog to behave.

The next instant the brute made a dive at my legs and his sharp teeth went through my canvas trousers. But soon Tai was on the spot, having noted a commotion.

"You are worse than a turtle!" he said to the owner of the dog and proceeded to upbraid him further, boxed his ears, and received an apology all within a minute.

"How can you allow your dog to bite my master, who is traveling through your village on important work under instructions from



**To a Rhythmic Chant, This 90-pound Stone "Flapper" Flies Up and Down**

When the primitive tamper falls with a thud, it compresses loose earth shoveled into a dike under construction along the Hwang Ho. Fluttering red cloth tags on the ropes guide the eyes of workmen, helping them to keep the continual tossing steady and even.

the Governor of Shansi?" he asked. "Tell the people of this village what a chief engineer is and teach them to show him due respect when they see him pass along the road."

Tai Feng-Chi basked in the sunshine of his master's glory and always fought for my safety and my "face." In turn, I defended him against all comers and any who would dare accuse him of squeeze! Those who said he was being overpaid, because of salary advances, simply did not know the value of a good Chinese servant like Tai.

**Influence of the "Christian General"**

With all the age-old, deep-rooted traditions and superstitions of a rural civilization that seems to lag behind that of the West, especially in mechanical things, school systems, health service, and broad national sympathies, this Yellow River Valley, including almost the whole of the Great Plain, has felt the touch of modernism. The work of the noted

Chinese educator and Yale graduate, James Y. C. Yen, at Tinghsien, Hopeh, has improved living conditions and broadened the outlook of all these folk.

The school for training magistrates, established at Kaifeng a few years ago by the "Christian General," Feng Yü-hsiang, had an important influence while it lasted. There, for the first time in this region, if not in all China, young women had an opportunity to train. Though separated from men students, the seven women enrolled when I visited this institution were taking the same course as the men.

The general's wife had been before her marriage a leading Y. W. C. A. worker in Peiping and was a powerful influence in promoting the movement for the emancipation of women. Since then Madame Chiang Kai-shek has been a leader in the same movement.

Many young women with superior education and ability are getting into country places



#### Patiently a Five-year-old Plants Beans in His "Good Earth"

His father, a Shantung farmer, digs the holes in fields from which flood waters have just receded.

and helping to make the rural population of China more conscious of civic or communal duties.

Bound feet are not nearly so common as twenty years ago, even in rural districts where conservatism has its stronghold. Not all marriages are arranged by the parents, as in years gone by. Boys and girls are freer to leave the farm and go to the city to school, learn a trade, or even study for a profession.

#### Young Chinese Engineers Learn to Wrestle the River Dragons

The best assistant I have had in recent years was a young Chinese from a farm in western Hopeh. He went to Tientsin to study engineering against the wishes of his family, who hoped he might take up law and become an official with little to do.

Instead, he entered into his engineering duties with all the enthusiasm and intelli-

gence that his father had shown on the farm. He knew it took hard work and long hours to make an engineer. I arranged to put him on active construction work under my observation in a bandit-infested region, and he grew up with me on this and similar jobs.

Now, with several years of experience and much travel into the back country, he is fitted to play a leading part with his country in the work of improving waterways and highways in Szechwan, Kweichow, and Yunnan. Along with scores of others with similar histories, he is helping to build the China of tomorrow.

The old homes of these young men were on the farms of the Great Plain of China. Their new ones will be where duty and fortune may carry them. Like Engineer Yü of forty-two centuries ago, today's young Chinese engineers are wrestling with, and making tractable, the "dragons" that have been frightening rural China all these centuries.

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#### INDEX FOR JULY-DECEMBER, 1941, VOLUME READY

Index for Volume LXXX (July-December, 1941) of the NATIONAL GEOGRAPHIC MAGAZINE will be mailed upon request to members who bind their copies as works of reference.

# Life with an Indian Prince

As Guests of a Maharaja's Brother, Two Young American Naturalists  
Study Age-old Methods of Hunting with Trained Falcons and  
Cheetahs and Savor the Pomp of Royal India

BY JOHN AND FRANK CRAIGHEAD

*With Illustrations from Photographs by the Authors*

**H**IS Highness Maharaja Sir Krishnakumarsinhji of Bhavnagar turned to his two American guests at the huge round banquet table.

"Do you fly peregrines in America?" he asked politely.

"Yeah, sure," we answered, and, encouraged by the interest and friendliness of His Highness, we talked on about hawks and falconry. Unconsciously, "I mean's," "You see's," "Uh huh's" and more "Yeah's" crept into our conversation. All the Indian state officials at the table were silent.

"Do you shoot in your country?" the Maharaja continued.

"Yeah," said Frank, and I noticed an exchange of glances go the round of the table.

What was the trouble? Were we eating too slowly? Should we have stopped attacking our quail when the Maharaja finished his? Had we taken too big a helping of curry? Were we supposed to use every one of those forks and spoons? Or had we said something we should not have said?

I glanced over at Bapa, our friend. Even he looked uncomfortable; and then I realized what was wrong. In our enthusiasm we had completely forgotten to address the Maharaja correctly.

"Yes, Your Highness"

Before dinner Bapa had instructed us in this custom of his country, and we had practiced saying, "Yes, Your Highness," and "No, Your Highness," in the privacy of our room. How strange it had sounded! But now I was determined to make good on the next question addressed to me.

My chance came.

"Did you come by way of the Pacific?"

"Yes, Your Highness."

At last I had gotten that mouthful out. It sounded like a strange language. I looked all around, yet no one else seemed to think it sounded queer; and naturally so, for we were in India as guests of the Maharaja and his youngest brother Bapa.

A long story leads up to that first banquet with Indian royalty. It begins just seven years

ago when with halting steps and anxious glances Frank and I entered the National Geographic Society building in Washington with a manuscript and a stack of pictures under our arms illustrating our experiments in training hawks and falcons to hunt for us.\*

"We can use it," we had been told.

That meant the NATIONAL GEOGRAPHIC would publish our article. How much more it meant we could never have dreamed. Certainly we could not have foreseen the first letter postmarked "India" that dropped through the mail slot.

That letter began, "I have just read your article in the National Geographic," and concluded with, "God willing, you must visit my country sometime and see how we fly falcons. Sincerely, K. S. Dharmakumarsinhji, P. S. Don't let the name scare you. . . . Call me Bapa for short." That postscript firmly established our friendship.

For several years letters arrived from far-away India. From them we learned that Bapa was a Rajput and a prince, that his people had come down from the north and fought for the land they now ruled.

Bapa described hunting lions, wild boars, and gazelles. He mentioned running trained cheetahs at black buck and flying saker falcons at kites. Each letter stirred our imagination, and each one ended with, "Sometime you must come and see all this for yourselves."

We in turn told Bapa about America and invited him here. It never occurred to us that Bapa would be the first to accept, but one day we learned he was on his way to America.

How were we to entertain a prince? What would he look like? How would he act? A thousand other questions came to mind. But when Bapa arrived he soon answered them all, for Bapa was in any language a regular guy!

**Prince Sips "Cokes," Rides Roller Coaster**

In two short weeks we tried to show Bapa how young Americans live. We went fishing, canoeing, swimming, and hunting. He did them all well. We drank Coca-Colas and milk

\* See "Adventures with Birds of Prey," NATIONAL GEOGRAPHIC MAGAZINE, July, 1937.





### Falconers Three—the Craighead Twins and Their Princely Host

Frank (left) and John are holding sakers, birds which resemble the American prairie falcon. Bapa carries his prize lugzar, a large Asiatic falcon with dull brown plumage. Usually the twins wore Indian garb in Bhavnagar (page 260). An army officer taught them how to wrap and tie their turbans.

shakes, rode roller coasters, played baseball, and danced to jazz music.

Before Bapa left, he had visited us at home in Washington, D. C., and at Penn State College. He had participated in college "bull sessions"; he had admired the campus coeds; and he had decided with us that America was a pretty swell place.

As the train pulled out, we called, "So long, Bapa; we'll be seeing you in India." Back drifted the answer, a hundred per cent American, "O. K., Frank and John."

Two years of schoolwork rolled by, and India was pigeonholed in the routine of college life, but not forgotten. With each new letter from Bapa, India became more alluring and more clothed in excitement and adventure.

What an experience it would be to live the life of an Indian prince! We would do it! Hadn't Bapa given us his O. K.?

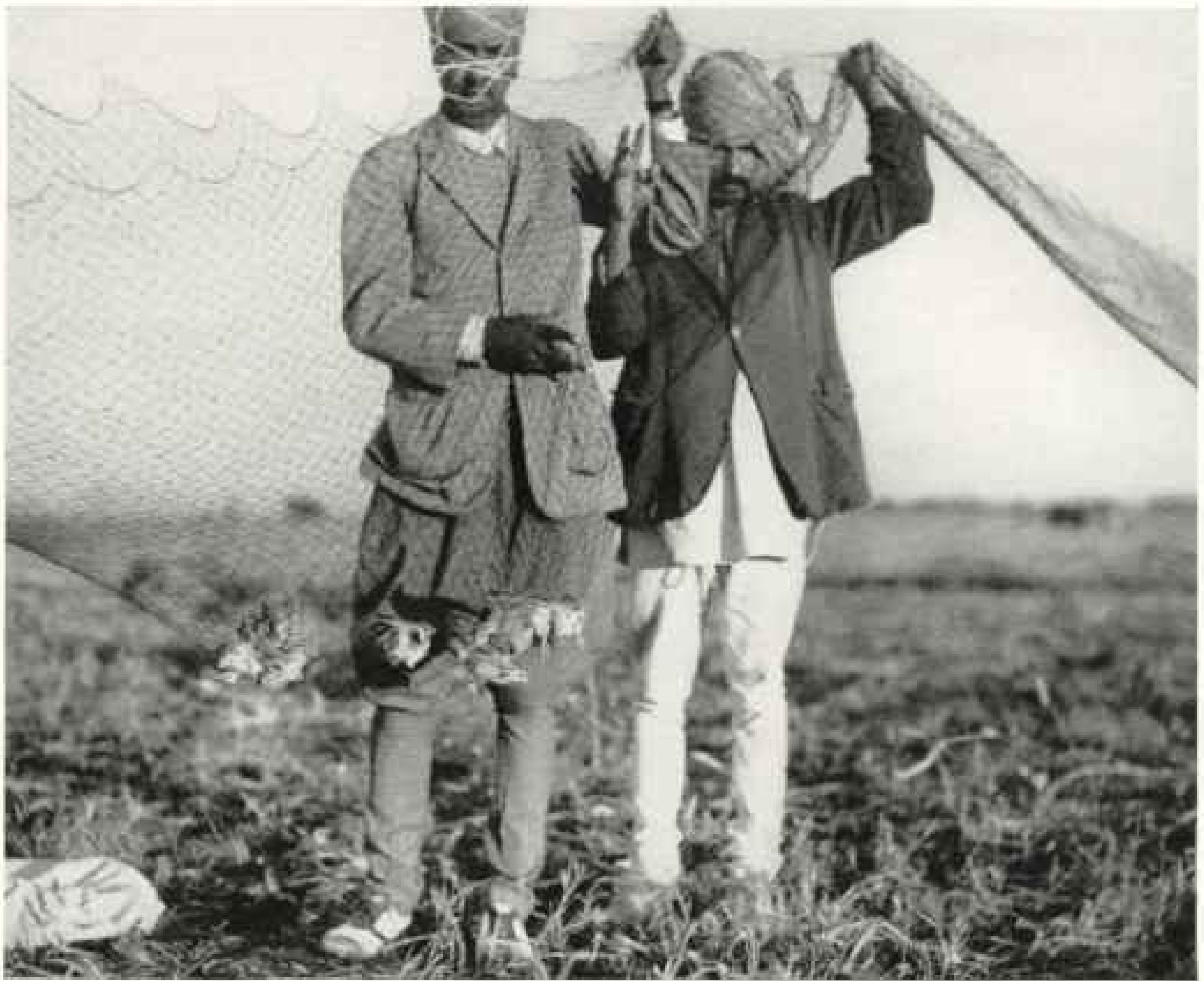
But first we must finish our university studies. Then we must figure how to get half-

way around the world. That problem was solved when the Editor of the NATIONAL GEOGRAPHIC MAGAZINE gave us an assignment and grant. When summer arrived, we were off to India, sailing the long Pacific route because war had closed the Mediterranean.

### Returning the Prince's Visit

At Bombay we met Bapa and traveled with him in a special train to Bhavnagar, one of the most modern and progressive of the many Indian States. It lies in western India on the shore of the Arabian Sea (map, page 238).

We were keenly interested in this little State of almost 3,000 square miles that had lured us half around the earth. Our narrow-gauge train rolled through miles and miles of flat, semidesert country similar to parts of Texas and Arizona. The land was dotted with hundreds of small cotton and *jowar* (millet) fields walled in by acacia trees or high euphorbia hedges, and birds were in abundance.



#### Migrating Quail Ensnared Themselves at Dawn in This Long, Vertical Net

The Craighrads saw 3,000 birds trapped in this way within three weeks to provide food for the palace table. The quail are fed and fattened, then eaten when desired.

Each mud-walled village had its water tank or pond, for in Bapa's country water is as precious as gold. With water, Bhavnagar is a land of plenty; without water—death and famine. So it was with pride that the Maharaja pointed out the big modern dams he had constructed to catch and hold the monsoon run-off.

#### Life in an Indian Royal Family

His Highness, and intelligent rulers who preceded him, had introduced many Western ideas. There was a mingling of the old and the new.

A modern hospital, university, dairy farms, cotton factories, roads; clean, sanitary suburban areas; automobiles, trucks, and trains indicated the way of the future. Mud villages, rumbling bullock carts, crowded bazaars, primitive cultivators, and wandering goat-herds bared to us the heart of ancient Bhavnagar. Our life with Bapa fluctuated between these two worlds,

In some royal Indian families the Maharaja and his wife or wives, and the younger brothers or princes with their wives and children, live together in a single huge palace. It is often one big complex family, usually made more complicated by the difficulties of the harem and purdah system.

If a ruler believes in keeping the women in purdah (seclusion), the rest of his court usually follows suit. The women are then allowed to meet and talk only with their husbands or close relatives. They are carefully hidden from the eyes of other men. They observe all state festivities from behind screens, and if they must appear in public their faces and often their entire bodies are hidden. They ride in cars whose curtained windows hide them from the public's gaze.

In Bapa's State this system was outmoded. The present Maharaja is an educated, cultured ruler with liberal views. He neither believed in keeping the women in purdah nor approved of harems. His wife accompanied



### Falconers' Paradise—The Indian State of Bhavnagar

This little State of 3,000 square miles borders on the Arabian Sea, north of Bombay. Here, where hawking has been a sport of royalty for centuries, John and Frank Craighead, youthful falconers and ornithologists, were guests for three months. Their host was Prince K. S. Dharmakumarsinhji (Bapa for short), brother of the Maharaja. An ardent falconer, he struck up a long-distance friendship with the Craighead twins after reading an article by them in the NATIONAL GEOGRAPHIC MAGAZINE (page 235).

him in his travels, and her presence added a touch of feminine charm to his court.

Among other things, the Maharani was interested in gardening, but most of her energies were devoted to rearing and training her two small boys for the heavy responsibilities that will later be theirs. We watched the boys laugh and joke as they built sand palaces on the beach or spun tops, just like young American boys. Even at this juvenile age, however, they had learned to assume a princely dignity when occasion demanded.

This royal family did not live together in one palace, but each brother had built a magnificent home of his own. Bapa's house was a modernistic cantilevered building whose massiveness and horizontal lines harmonized with the country's level topography and the dwarfed vegetation of a semiarid land (p. 239).

The furnishings were luxurious and extremely modern. Rare paintings of falcons, sketches of ducks, snipe, and geese, and mounted heads of leopards, gazelles, and black buck looked down from the dining-room walls. The up-to-date living room included a radio, and Bapa had a collection of books on falconry that the largest libraries in the world would envy.

One room in the house, the music room, was entirely Indian. It contained no chairs, and the guests sat cross-legged on gorgeously embroidered mats and cushions. Here we would sit and listen to Bapa play stringed instruments, sometimes alone and sometimes accompanied by Mrs. Bapa with drums.

Now and then the state musicians entertained and thus introduced us to different forms of Indian music. Afterward servants brought us sliced sugar cane to chew, coconut milk to drink, or an orangeade.

In our walks through the gardens we stopped at the aviaries and listened to the call of Bapa's green barbet or slowed down to see if the fruit pigeons were still fighting over their food. We talked to Philip, Bapa's parrot, who learned to say "John" but not "Frank." One day he startled us by imitating the police whistle of the officers who escorted the Viceroy of India on a visit to the State.

In the heat of the day we swam in the blue water of Bapa's pool and dived from the tier of diving boards. Here Bapa had taught his wife to swim, an unusual accomplishment for a royal Indian lady. Mrs. Bapa knitted us each a sweater, of which we are very proud, for every stitch was done by an Indian princess.

It was among such people that we found ourselves when we arrived in Bhavnagar.

### Spicy Indian Foods on Silver Plates

We soon learned that Bapa and his brothers (His Highness and Prince Nanabhai) never did anything halfway. We were given a suite of rooms in the guest hotel with all the modern conveniences we could desire. Room boys were placed at our service, and our meals were excellently prepared.

Menus were a combination of Indian and European food. If we were so inclined, we could order an Indian meal of *roti* (bread), chutney, curry, and sweets. Such a meal was served on large silver plates, and it was good manners to eat with the fingers.

Rice and *roti* were piled high in the center of the plate, and small bowls on the rim were filled with hot spicy foods, curries, and sweets. Everything was gradually mixed in the central rice pile and tasted. Some dishes were so spicy and hot that they made our eyes water and mouths burn.

A driver and touring car were at our disposal day and night, and Bapa devoted all his time to doing and showing us the things he knew we would like.

Falconry was of special interest to all of us. Bapa had anticipated our desires and



**In Bapa's Modernistic Home, the Craighead Twins Led the Life of a Prince**

Swimming pool and tier of diving boards, right, were popular during the intense midday heat. Turbaned hunters in the cars are waiting for the Prince and his guests to start out for a day of hawking.



**Baz Brings Down a Hare with Unerring Skill**

In India the female goshawk is called a *baz*; the male, a *jerra*. In general appearance they are similar to the American species. Usually the larger female is flown at hare, the smaller male at partridge.



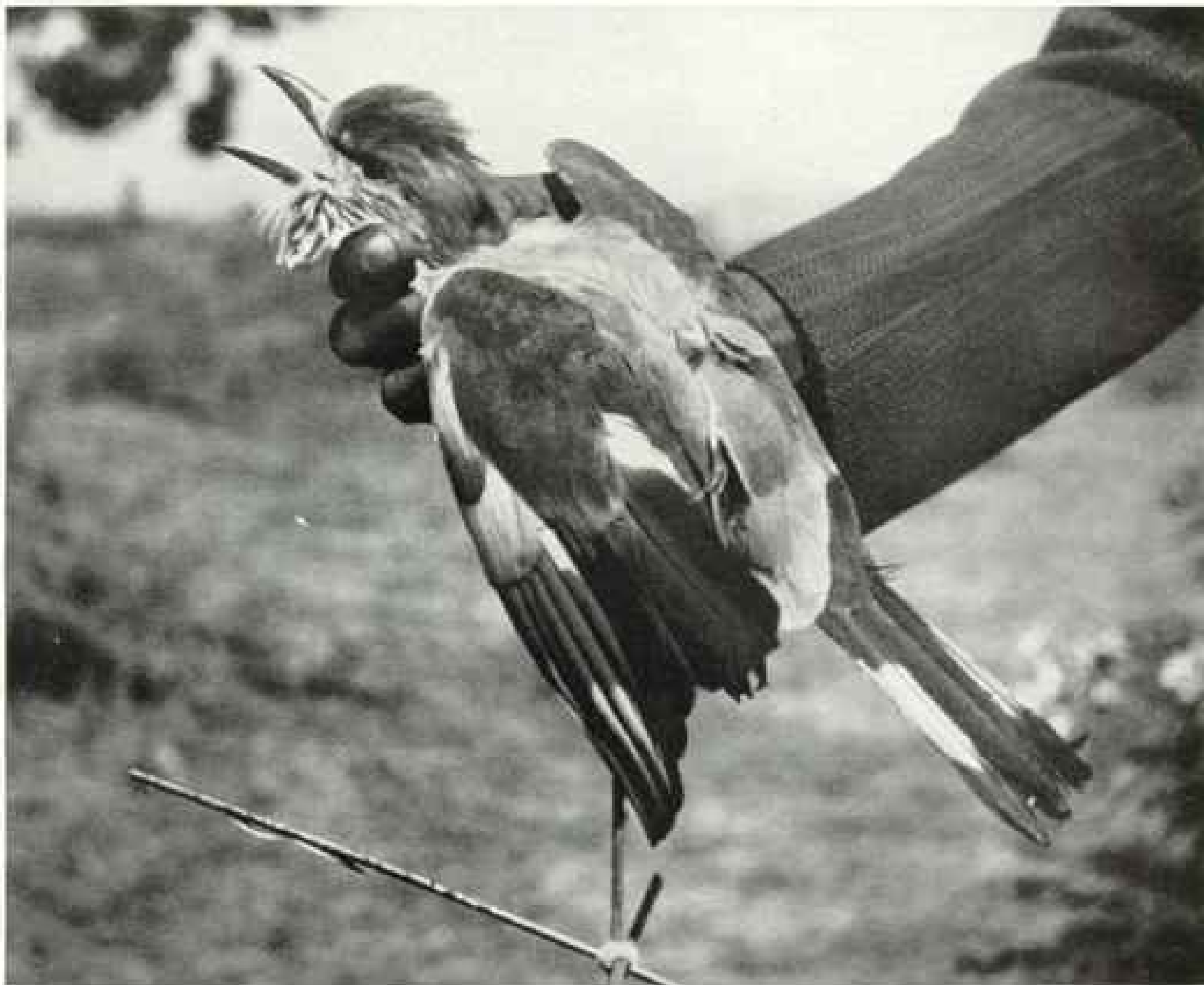
**Indian Harvesters Toss Their Jowar to the Wind in Bhavnagar**

First the stalks are trampled; then women hand the jowar heads up to the men. Threshing is simple, for the breeze blows away the chaff and the grain falls in a heap at the workers' feet. *Jowar* is the Indian name for millet, grown in the United States and Europe as forage and in Asia and Africa as a food crop.



**The Hunters Come to Hatawab, the Prince's Summer Home Near Bhavnagar, to Trap Their Own Falcons**

Bapa is at the wheel of the right-hand-drive car in which the dusty journey was made (page 243). Frank Craighead is beside him. The turbaned hawk men carry partially trained birds. Along the seashore, the boys trapped peregrines; in the back country, eagles and buzzards.



#### All Stuck Up with Birdlime, This Indian Roller Was an Easy Capture

The sticky substance, made from roots, bark, and sap, was smeared on three small wands. These were arranged as a tripod and placed over a mole cricket. When the bird flew down and reached under the sticks for the bait, its wings became entangled in the glue. The more the victim thrashed about, the tighter the wands adhered to its feathers, until it was unable to fly. Rollers are so called because in the breeding season they perform loops and rolls in flight like tumbler pigeons.

had plans for a wonderful falconry season that was just beginning when we arrived in Bhavnagar. The hot weather was drawing to a close, and harvest season was at hand. It was time to think of getting hawks—not one or two hawks, as American falconers might plan, but scores of hawks of all species.

His Highness had ordered Bapa to send men off to the distant hawk markets of the Punjab. Already his best falconers were bargaining with the shrewd northern trappers and would soon return with sakers, goshawks, sparrow hawks, and shahins.

In the meantime we set out to do some trapping of our own. The peregrine falcon, the finest bird for training in India as well as in America, migrates along the coast of Bhavnagar. The luggar, a desert falcon, is a common resident in the State. Peregrines were expensive and trapping was fun, so why

buy all our hawks if we could get some ourselves? Bapa had already made plans for doing this.

His Highness was an enthusiastic sportsman, and among his shikaris and trappers were men from all parts of India. Whenever he found a man who was an expert in a special trapping technique, he offered him a job in his State. These men then traded their knowledge for specialized training in some other field. Thus a quail trapper from the Punjab might learn to train falcons or hunting leopards while imparting his knowledge of quail-catching to some of the Bhavnagar trappers. In this way a sporting tradition had grown with the years, and an accumulated knowledge was passed on from generation to generation.

Bapa had absorbed all this and added a bit from his reading and experimenting. Now

he was going to impart this knowledge to his two American friends. We would learn as he and his forefathers had learned—by doing, by receiving our instruction directly from an expert.

Had Bapa told us of his trapping techniques and of the things we were to see in the days to come, we should not have believed him. In fact, some things we found hard to believe even when we saw them with our own eyes.

Bapa and his men could trap any bird at all, even while flying. They had perfected numerous trapping methods each designed to fit in perfectly with the habits of the bird to be trapped. If a hawk was hungry, they could catch him a few minutes after seeing him. They used nooses, nets, birdlime, decoy birds, etc., but it was the technique and efficiency of the methods that brought results.

Bapa was eager to show us how he trapped hawks, and perhaps a bit anxious to get off alone with us in the country until he could see how his American friends were going to fit into the customs of Indian life. Nothing could have suited us better than his plan to spend a few weeks at Hatavab, his summer home on the coast near Bhavnagar. Bapa's servants went ahead to prepare for us, and we followed more leisurely with traps, guns, hawk men, and trappers (page 241).

In an open car we drove along dusty roads lined with impenetrable euphorbia hedges, forded streams where women were washing clothes and where ebonylike water buffalo were wallowing with only their heads and massive horns uncovered. Reef and pond herons fished unconcernedly as we splashed through the water, and red-wattled lapwings ran along the shore. We raced through the mudhouse villages, scattering dogs and cattle in every direction and eliciting respectful salutes from the villagers.

#### Happy Hunting Ground for Hawks

Hatavab was built by Bapa's father. It was screened by spreading banyan trees, from whose shadowy recesses came the screams of peacocks, the calls of noisy parakeets, or the whistle of the koel and the mellow "took" of the coppersmith.

The open-air bungalows looked out over the bay at high tide and mud flats at low. It was a winter congregating place for shore birds—curlews, storks, spoonbills, plover, ruffs, oyster catchers, and flamingos. The call of kingfishers vied with those of stone curlews. White and brown Brahmany kites sailed by, while far above circled the ever-present vultures.

No wonder Bapa loved this cottage and no wonder the peregrines sought its mud flats,

where they could race up and down in search of tasty shore birds.

Every morning a turbaned Hindu awakened us with a few softly spoken words. He approached so quietly in his bare feet that he seemed to materialize out of the dark like Aladdin's servant, and to hover for an instant beside our mosquito nets. We would then join Bapa on the terrace for tea and watch Venus fade away in the east as the sun rose.

Down the beach among the sand dunes Bapa demonstrated the use of the innocent-looking *phai*, a circle of nooses placed upright around a tethered pigeon and designed primarily for catching the peregrines.

In the days that followed we caught old haggards and young immature falcons making their first migration. The latter were our greatest prizes, being young, enthusiastic, and with practically no limit to their capabilities. Such hawks would be trained on the largest and most difficult quarry. Later they would be given their freedom, for Bapa frees all of his hawks after three months of falconry.

Using sticks coated with *lasa*, or birdlime, we caught mature peregrines to train on ducks, and with a small vertical net, or *doguzza*, we caught luggars and numerous eagles (p. 261).

#### Wild Falcon Caught in Five Minutes

In the fields extending back from the beach we saw our first luggar falcon perched on a high mudbank. Bapa immediately stopped the car. Grabbing the *doguzza* and a decoy bird, he set the net in the flood plain of a small stream and staked down the bird behind the nearly invisible mesh (page 244). This required about three minutes, and in the meantime the luggar's mate, known as a *jugger*, had joined her.

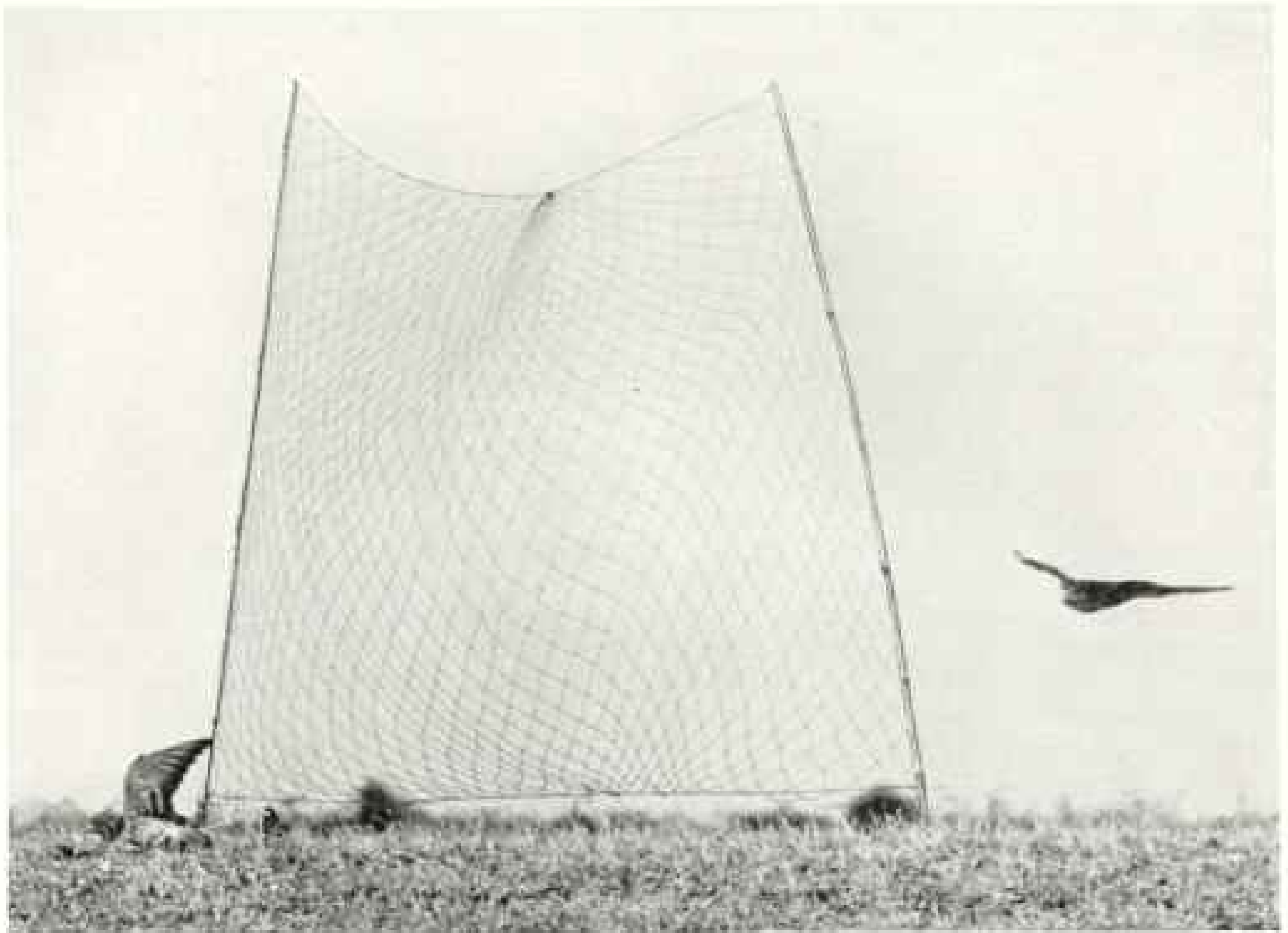
Simultaneously the two hawks left their perches and raced for the net. It is customary for these falcons to hunt in pairs, and together they stooped back and forth trying to hit the tethered bird from the side, for they saw the net and were wary. Each time they stooped they would swing above or to one side of the *doguzza*.

Suddenly the *jugger* abandoned his caution and swung in straight at the net. Perhaps he was a little hungrier than his partner, perhaps a little more daring. He plunged into the yielding net, the vertical side poles collapsed inward, and a wild hawk was hopelessly entangled. It had taken us less than five minutes to catch a desert falcon.

#### Eyes Sealed with Needle and Thread

The *jugger* was securely bound in a handkerchief and its eyes sealed. While a man held





#### Betrayed by Its Own Greed, a Luggar Swoops into the Net

When Bapa saw the falcon on a mudbank, he fastened a fat pigeon to a stake as decoy and then erected this net. Intent on a pigeon dinner, the falcon plunged into the meshes and, as the poles collapsed, was hopelessly entangled. The entire episode lasted only five minutes (page 243).

the hawk, Bapa slipped a needle through the lower edge of the eyelid, pulled the thread over the head, pushed the needle through the other eyelid, and tied the string over the top of the head. The bird did not give evidence of pain (page 253).

In this manner the Eastern falconers seal the eyes of all their birds. It keeps them quiet for the first days of training and prevents them from becoming excited and scared.

One eventful day followed another as more hawks were trapped and new techniques unveiled. It seemed incredible that we could walk into an open plain with not a bird in sight and, by using a decoy falcon, could soon have a huge eagle in our hands, one that only a few minutes before had been soaring out of sight above us.

#### Luring an Eagle from the Blue

On one occasion we drove to a great open plain where the horizon was a shimmering straight line and where the reflected light from earth and sky was of equal brilliancy. I scanned the heavens, from the light blue of the horizon up through the turquoise blue of

the zenith. A single eagle was in sight, soaring on rising air currents. Except for this one moving speck, the colored dome above us was devoid of all life, so far as human eyes could see.

Here in this seemingly deserted region we released a luggar barack. A barack is a decoy hawk whose primaries are tied so it can fly no more than a few hundred yards. A ball of feathers containing horsehair nooses is fastened to its talons to make it represent a hawk with food, and thus it arouses the robbing instincts of larger birds of prey (page 271).

After a laboring flight of several hundred yards, our barack landed on a large anthill. We waited half a minute, then a minute, and suddenly the sky was no longer a cover to a lifeless world. A speck hurtled earthwards with closed wings and resolved into a luggar. Two more feathered spearheads shot toward the barack—toward what appeared to be a bird with a kill. The sky robbers were after an easy unearned meal. A long-legged buzzard and a white-eyed buzzard followed by a harrier came speeding in.

But now a huge imperial eagle took pre-



John Craighead Trains His Shahin on the Balcony of Bapa's Guest House

cedence over all the rest. He dropped like a plummet and plowed into the barack, which had reared back on its tail and extended its talons in defense.

#### A Would-be Robber Handcuffs Himself

The huge eagle's talons closed on the ball of feathers tied beneath the luggar's claws and a tiny, innocent-looking noose of hair tightened around his toe. We saw that he was caught and ran after him as he flew off dragging the luggar beneath him. The luggar spread its wings and impeded his flight.

The eagle dropped to earth and again and again tried to escape, but succeeded merely in dragging the luggar across the field. We overtook him and pounced on him, just as he had done on the barack. With a small falcon we had trapped a huge eagle boasting a wing-spread well over seven feet.

Bapa's trapping methods, evolved through generations of experimenting, filled us with amazement at the ingenuity of the people who had produced them.

In the evenings we would sit on the terrace while Bapa's trappers approached and stood quietly by until spoken to. In Gujarati they would tell Bapa, their master, of the day's

trapping, of their trek along the beach, of the falcon that they almost caught; or they would proudly produce a hawk for Bapa's approval and leave with a smile on their faces from a word of praise.

Bapa translated the conversations in the darkness while we looked over the sea and listened to the surf roll in or retreat. While the stone curlews called and the huge fruit bats and flighty nightjars flew past, we talked of falconry, of bird habits and behavior, of astronomy, war, politics, religion, and often we carried on whole conversations in metaphor, just as we used to do with our roommates at college.

One morning His Highness and family came for a visit, and two days later the Dewan, or prime minister, stopped in. All wanted to know when Bapa was returning. Perhaps they thought the country was no place for him to entertain guests who supposedly were accustomed to the fast pace and excitement of American life.

"I wonder why they all want me to return home," Bapa said. "With hints and suggestions of all the things going on in town, they have tried to lure us back. They can't understand what we see in this life.



#### Captive "Call Birds" Lure Other Quail to the Hunters' Nets

At dusk their cages are placed near long vertical nets stretched across a field (page 237). Throughout the night, the imprisoned birds call out. Small migratory quail (*Coturnix*), which travel in huge groups, move in toward the calls. At dawn they rise, fly toward the decoys, strike the nets and are caught.

"We cleverly eluded their snares," he chuckled. "It isn't so easy to catch hawk trappers; we know all the tricks."

#### Racketeers in the Hawk Trade

We left Hatavab when Bapa's men returned from the hawk markets with their purchases—thirty birds which included peregrines, saker falcons, sparrow hawks, goshawks, shahins, and luggar falcons. All were wild-caught birds valued at twenty to forty U. S. dollars apiece.

Buying a hawk is like buying a horse. The purchaser must know his business, for the trade is full of racketeers. Color phases, markings, shape and size of beak and middle toe, spirit, age, size, and weight are a few points that must be considered (page 249).

Bapa compared falcon-buying with purchasing a pack of cigarettes in America. You would never buy these if the seals were broken, and likewise an Indian falconer would not buy a falcon whose eyes had been unsealed. Sealed eyes were an indication that the hawk had not been tampered with or spoiled.

His Highness paid all expenses, and it was

Bapa's job to make trained performers of these fierce, untamed hawks. Bapa presented Frank and me each with a beautiful shahin, a type of peregrine falcon (pages 245 and 252), and then assigned one bird to each of his men.

Mass-production training was now under way. For four or five days the hawks never left the gloved hand, day or night, for only by handling them constantly, speaking softly, and stroking them gently could these wild birds be tamed.

#### Hawk Trainees Even Go to the Movies!

Everywhere we went men were carrying falcons. From early in the morning to late at night, in the fields, the bazaars, along the roads, and chatting on the street corners, were brightly turbaned men stroking and hooding their charges (page 248).

The day shift even attended the village movie with hawks in hand. When the show was over they gathered up the papers they had spread on the floor, handed over their birds to the night shift, and the stroking and carrying continued.



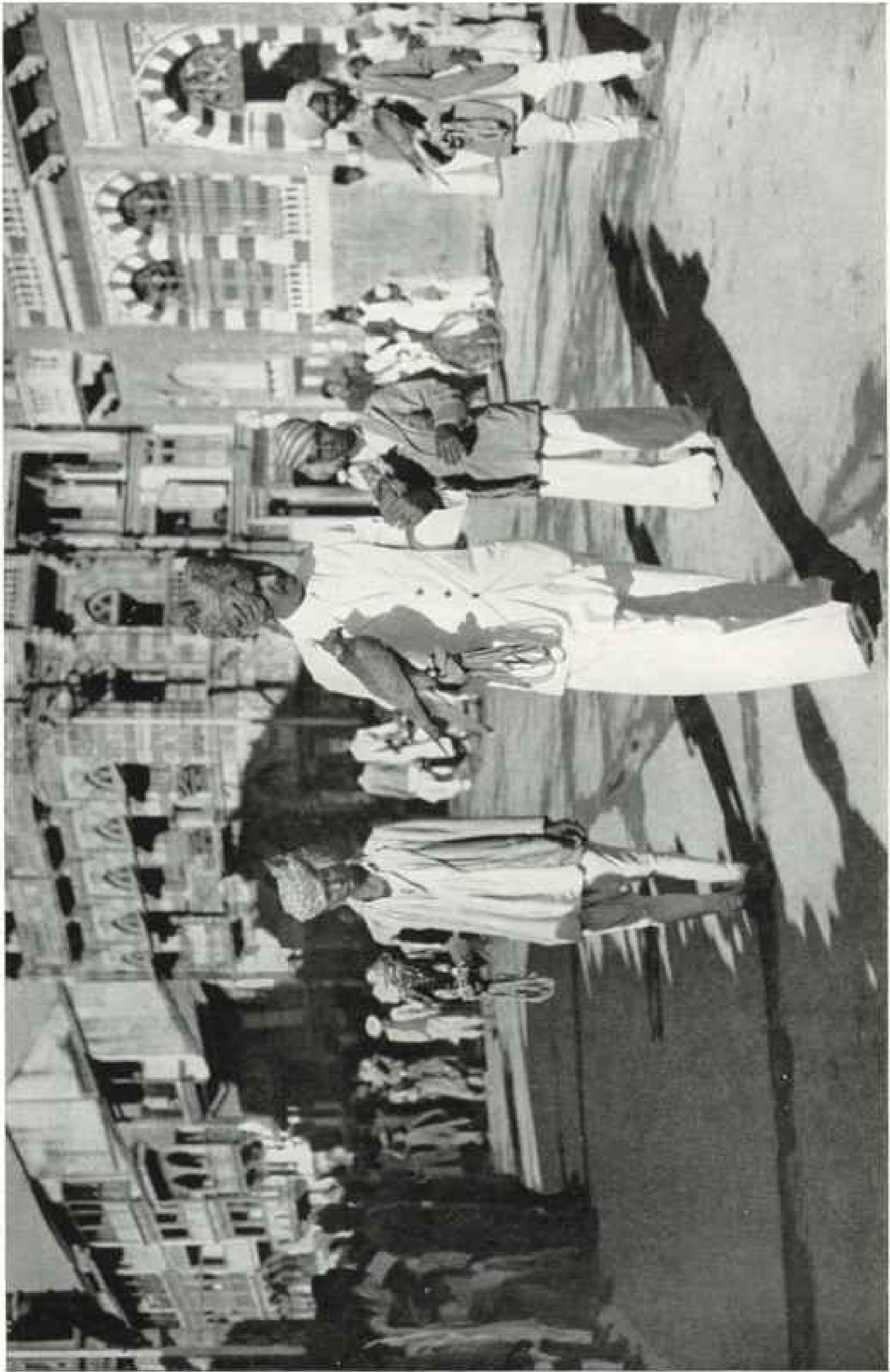
#### An Indian Pied Piper, in Brahman Garb, Entices Crows to Their Doom

The Brahmans, a priestly caste, share their food with birds and animals, so the wily crows do not fear them. Murmuring prayers and offering scraps of food, the disguised trapper lures the crows to this field, where he has concealed his net. When his quarry has gathered, he pulls a string, flipping the net over them. A few minutes after the photograph was made, he caught 25 at one time.



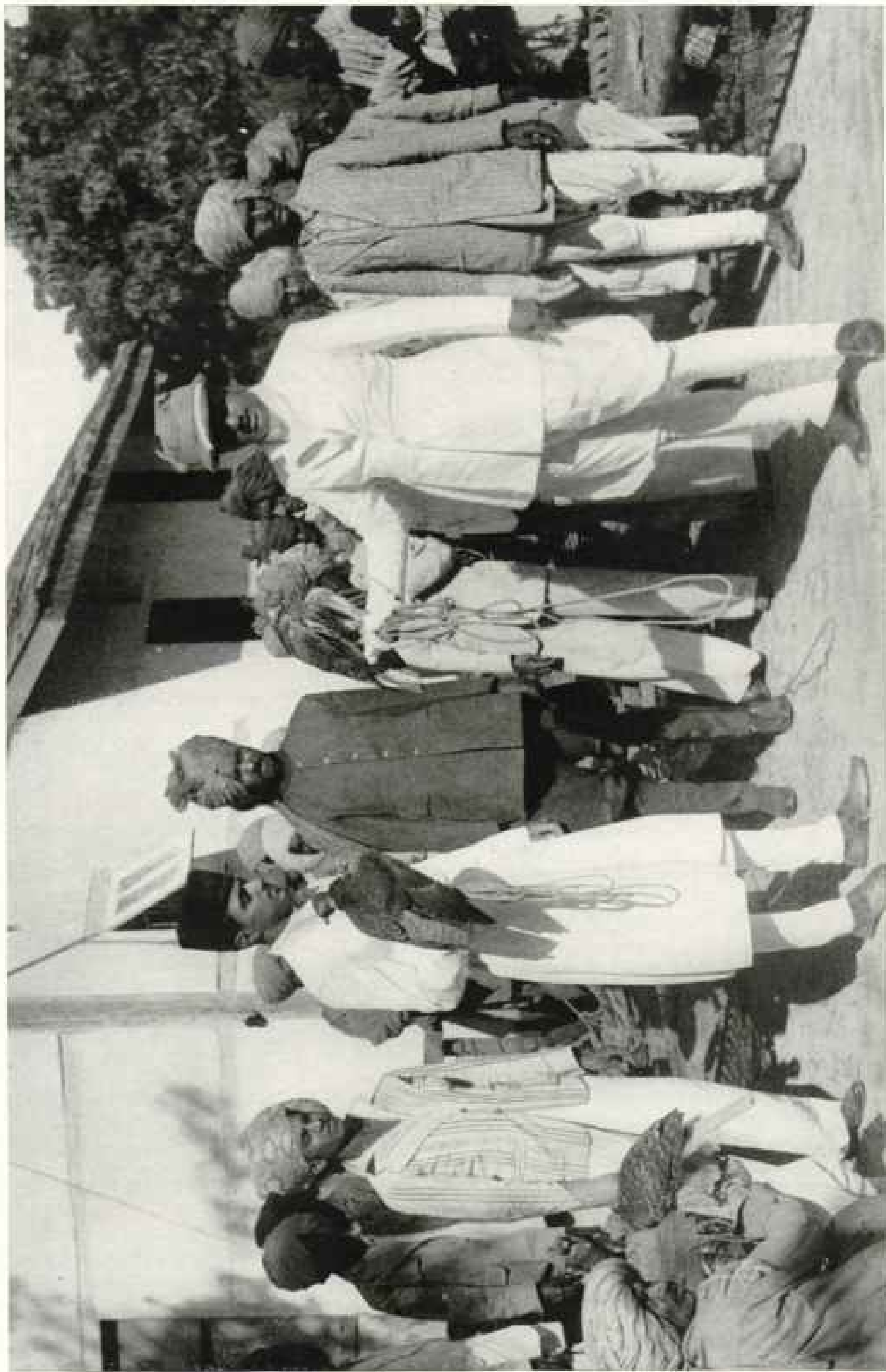
#### There's Many a Slipknot 'twixt This Shikra and His Dinner

The bird is snared in a *bal-chatri*, an Indian trap especially designed for short-winged hawks. A partridge is placed within the framework of netting and canes. Then thin nooses are spread over the netting. The shikra, trying to get the partridge, entangles its talons in the nooses.



**Not a Parade—Just Casual Strollers with Their Hawks in a Bhavnagar Street**

So numerous are falcon trainers in this city that pedestrians do not give them a passing glance. It is hawk-training season and each man keeps his bird with him constantly. When a falconer goes to an Indian movie, he takes his charge along into the theater (page 246). In foreground is Bapa's head falconer.



Shrewd as Yankee Horse Traders Are Indian Hawk Buyers and Sellers in Bhavnagar's Market.

Bapa, left center in black hat, and his brother, Nanabhai, right, hold wild birds they have just purchased for training (page 245).

As soon as the hawks lost their fear and became docile, their eyes were unsealed and flight training began (opposite page).

It was a wonderful sight to see dozens of birds responding to their trainers. Time after time they flew to the fist for food, and again and again they were turned loose and made to stoop at the moving lure, not one bird or two birds, but thirty or more.

We were actually watching trained falcons being turned off the assembly line in mass production, and at the head of the organization was Bapa. With the keen observation of a born naturalist he noted the qualities of each hawk as it performed, then prescribed special handling to suit its particular abilities and temperament.

In a few weeks a legion of wild hawks became a squadron of highly instructed aerial fighters trained to do men's bidding.

#### Hawks Help Keep the Larder Filled

It was not for sport alone that the natural habits and instincts of these hawks were channeled so that they did their work for Bapa instead of flying free over the land. In a country where meat cannot be kept in cold storage and bought in every corner store, falcons were almost a necessity. In the Punjab, some families depend on their goshawks for most of the food they eat. Bapa and his Rajput people lived on game. Hawking is a sporting method of keeping the larder filled.

For many centuries falconry has been practiced in India. Bapa learned the art from the best men in his country, supplemented this with extensive reading, and then proceeded to develop a brand of falconry that probably has no equal in the world today.

Leaf back 400 years of history and you can relive a day of sport with medieval royalty, but if you should visit Bapa as we did, you can experience at first hand the preparation, the excitement, and the color of a day of falconry with an Indian prince.

#### Birds Given a Mystic Potion

When all our hawks were trained and flying well, Bapa arranged a falconry meet between his men and his brother Nanabhai's men, so that His Highness could see all the hawks perform.

The evening before the contest, in the privacy of his study, Bapa prepared small potions of strange Indian spices and drugs. A potion was administered to each hawk to stimulate it to exert its utmost powers of speed, endurance, and courage on the morrow. There was an air of secrecy and mysticism about this rite.

A procession of two cars and two army lorries left the royal palace before daybreak and tore along the dirt roads, churning up a cloud of choking dust behind us. Leaving the cars, we started walking through the fields. The hawk men lined up on either side of His Highness, Bapa's men strung out on one side and Nanabhai's on the other. We formed a line of 35 or 40 men with almost as many hawks.

From the start there was keen competition about the whole affair, and it increased throughout the day, reaching its peak at sunset.

#### The Maharaja Opens the Meet

When we arrived, some partridges had already been located and men were stationed to watch the covey. Then His Highness advanced to a heavily overgrown fence row with a keen, fierce-eyed goshawk. The Maharaja was starting the meet (page 255).

From the alert way the hawk turned his head to watch every movement of the beaters, and from his erect, eager stance, it was apparent that the game was an old one to him and he knew exactly what to expect. A whir of wings in the brush, a shout from a beater, a tinkling of the bell as the hawk shoved off, and the race was on.

The partridge and hawk sped low along the fence; then both hawk and quarry zoomed up over the thorny hedge as if tied together by a string and disappeared on the far side. The partridge had dodged into the thorns and escaped.

A morsel of food was offered, the goshawk jumped to the glove, and we were off after another bird. Again a whir of wings, a shout, and the hawk was catapulted after her quarry.

At once realizing her danger, the partridge dived into the thorny acacia bushes. I held my breath and my muscles tightened as the hawk struck the deadly thorns while going full tilt in pursuit. Often goshawks are killed in this way. Fortunately our bird was uninjured, but his quarry had once more eluded him.

Before the hawk could be retrieved, another partridge flushed, and with the aid of the *jangoli*, a leather neck strap, Bapa hurled his male goshawk, or *jerra*, into the air. After a 50-yard chase the hawk zoomed up and caught her quarry forty feet aloft.

"*Shabash!*" (bravo) shouted the men, as feathers seemed to explode in the air and the hawk glided to earth with the first partridge of the day.

Meanwhile, Nanabhai's men had jumped a hare, which was immediately caught by a powerful female goshawk.



### Bapa Calls His Tereel to the Lure

He swings a lure at the end of a short stick. The tereel, or male peregrine, stoops, but the bait is jerked away before the bird can strike. After 40 or 50 attempts, the tereel is permitted to strike and bring the lure to the ground. This ends the lesson, and the falcon is hooded and fed (opposite page).

Soon it was Bapa's turn, and as his men routed out a hare two saker falcons were released. The sakers stooped, struck, and rose; first one attacked and then the other as the scared hare twisted and dodged amid the thorny cover. Again and again the sakers struck at the hare, but he finally reached safety behind the mud walls of a village.

This had been a long chase; the men were scattered and all of us were tired from running. A wave of the hand from His Highness sent a man off across the fields and soon our cars raced across country to meet us. Beneath the shade of mango trees we had breakfast.

Curious but respectful cultivators gathered to watch us. Shyly the hard-working subjects paid their respects to His Highness while he questioned them about their farming problems.

The score now stood: Bapa, seven partridges, one hare; Nanabhai, three hares. The goshawks were fed, their hunting over, for now Bapa's prize luggar falcon was to be flown.

Until Bapa's time no one succeeded in flying the sluggish luggar falcon at partridge. But the drugs administered the night before worked miracles on this desert falcon that normally preys on lizards, mice, and small birds (page 259).

Up she "rung" (*i.e.*, rose spirally) and for 25 minutes circled above Bapa's head as if controlled by Indian magic. This type of flight is termed "waiting on," for the bird flies above her master waiting for game to be sprung. Although hundreds of feet above us, she never strayed and never "checked" after other game while we beat the bushes for partridge.

### A Sky Robber Crashes the Party

When a partridge flushed, the luggar banked into a vertical stoop, dropped like a bomb, and struck her fleeing quarry a terrific blow. Her wings open, the luggar zoomed upward to check her speed.





#### Nature's Pursuit Plane—a Speedy Shahin

Faster than a peregrine falcon on short flights, it tires on a long chase. The hooded bird, closely related to the duck hawk or peregrine, was a gift from Bapa to Frank (pages 245, 246).

At that instant came a warning shout from the men. We looked up, and there, following our falcon down like a shadow, plunged a huge tawny eagle. The bold sky robber had sighted an easy meal.

Our whole party was galvanized into action. Two men rushed to protect the falcon; another raced for the shotgun, while still another man at Bapa's command unrolled his net and deftly set up the doguzza (page 261) with a pigeon as decoy. A man remained with the falcon, the eagle sailed close above him, and we moved off to watch the fun.

Suddenly the pigeon flapped, the hungry sky raider nose-dived earthward, and an enemy bomber was helplessly enfolded in a gill net.

The early-morning hawking now came to

a close. The goshawks and sakers had been fed, and we had bagged the dinner that would be served us at the palace when the day's sport was over.

The peregrines' turn was next, and we drove off cross-country in search of black ibis, cranes, and herons. These birds would afford ringing flights for the bold, high-flying peregrines. In Europe similar flights once made falconry the sport of kings.

Before long we sighted some ibis flying at a great height. Nanabhai released his favorite peregrine, and she mounted till she shrank to a tiny speck. Far away the falcon "bound" to her prey (*i.e.*, seized it in air and clung to it) and dropped to the ground.

We had followed the flight in cars and arrived on the scene to find both falcon and ibis at the bottom of an open well. The ibis, a larger bird, had freed itself on the ground and then plunged to safety down the near-by hole. The peregrine had followed.

A trainer was lowered in the well bucket and rescued both victor and vanquished.

"That was a good flight, wasn't it?" Nanabhai asked, and Bapa had to agree that it was.

"It's your turn now, Bapa," Nanabhai said with a twinkle in his eye.

At a near-by tank, Bapa, against his better judgment, flew one of his peregrines at ducks. But the falcon had been reclaimed from the wild for only a week and behaved poorly.

"You don't keep your hawks properly," Nanabhai chided. "My men can do better. That was a very poor show, I must say. Another thing, you shouldn't have tired her by calling her upwind."

Nanabhai chuckled to himself and made some more pertinent remarks in Gujarati.

Bapa could say nothing, but later in the day his favorite peregrine climbed up, up, and up after a heron twice her size. After an exhausting chase in which the falcon exerted all of her speed, endurance, and courage, she bound to her big sharp-billed prey and both birds dropped to earth like a stone. I could hear the impact as they hit the ground, with the hawk on top.

Bapa was again in high spirits and Nanabhai rather subdued. His Highness was grinning broadly, thoroughly enjoying the flights and the good-natured competition.

"All my hawks performed well, Bapa," said Nanabhai. "Only 95 per cent of yours did. So far the meet is in my favor."

Bapa smiled.

"I have flown twice as many hawks this morning," he said. "It is more difficult to train and fly a lot of hawks and have them do well than only a few."

We agreed with Bapa, but the afternoon might settle the argument, for the program was to fly the saker falcons at kites (page 259). Nanabhai's head trainer was admittedly the best authority on kite hawking, so Nanabhai was not worried at Bapa's slight edge in the morning performances.

Nanabhai released the first saker, and after a 20-minute aerial dog fight that taxed the falcon and strained our eyes to follow the tiny specks in the blue, the falcon outclimbed and outmaneuvered the kite, drove it earthward in a series of stoops, bound to it, and dropped to earth victorious, her quarry a bird of prey much larger than herself.

At sunset one saker falcon had been lost, two had failed, and three had been successful. Nanabhai was one up on Bapa, and, realizing that it was too late to do much, he turned



**Eyes Sealed, a Newly Caught Luggar Becomes Quiet and Docile**

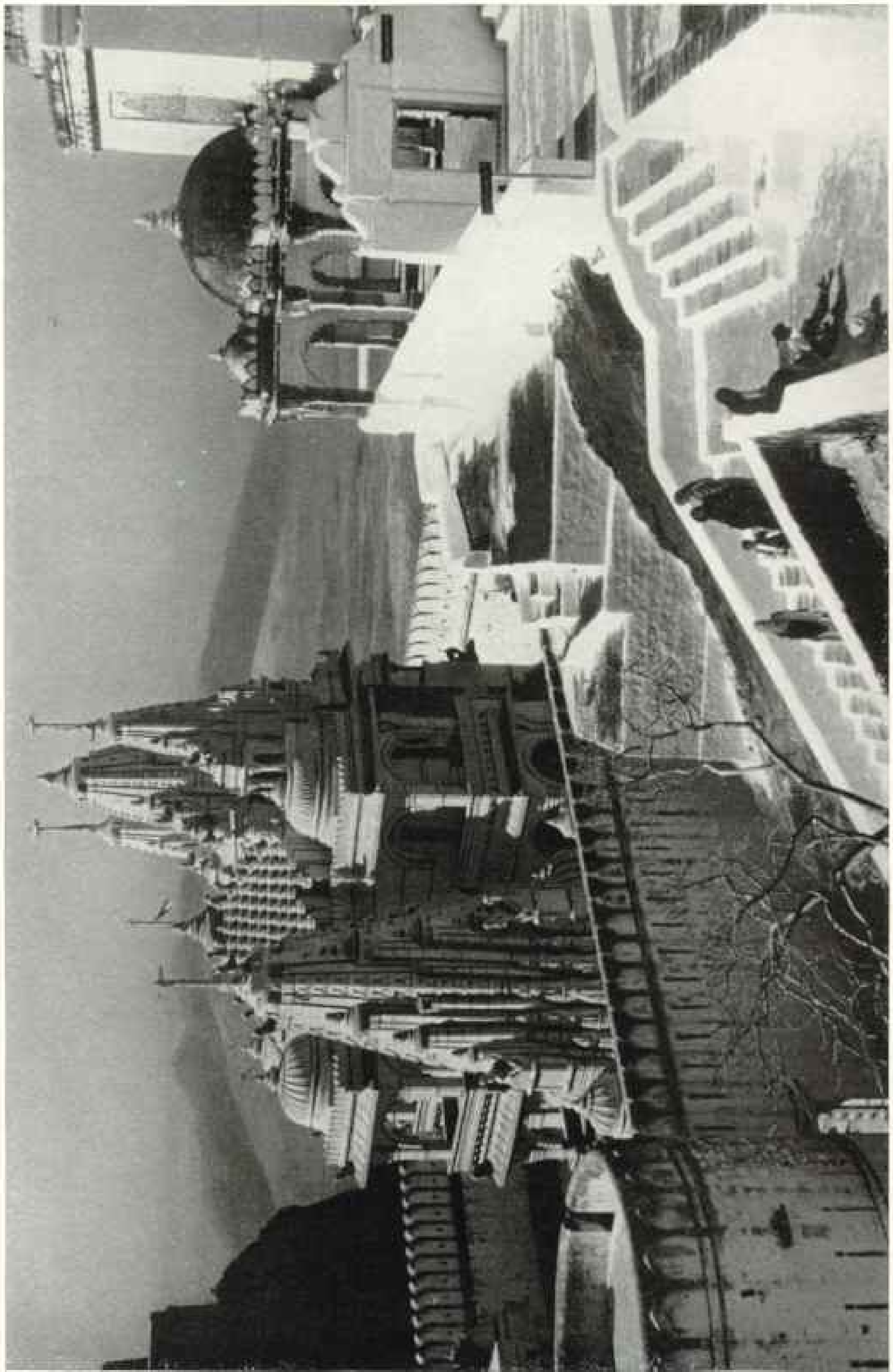
Bapa employed a trainer for every hawk he kept (pages 246, 250). When this one became accustomed to its handler, it was taught to catch crows. Luggars are trained in pairs to hunt rabbits.

to his younger brother and said, "It's your turn, if you want to win."

Bapa answered this challenge by releasing his remaining saker at a group of kites hundreds of feet above us. These kites had learned the game and started climbing immediately. The saker falcon mounted, then appeared to give up, and flew steadily away until visible only with field glasses.

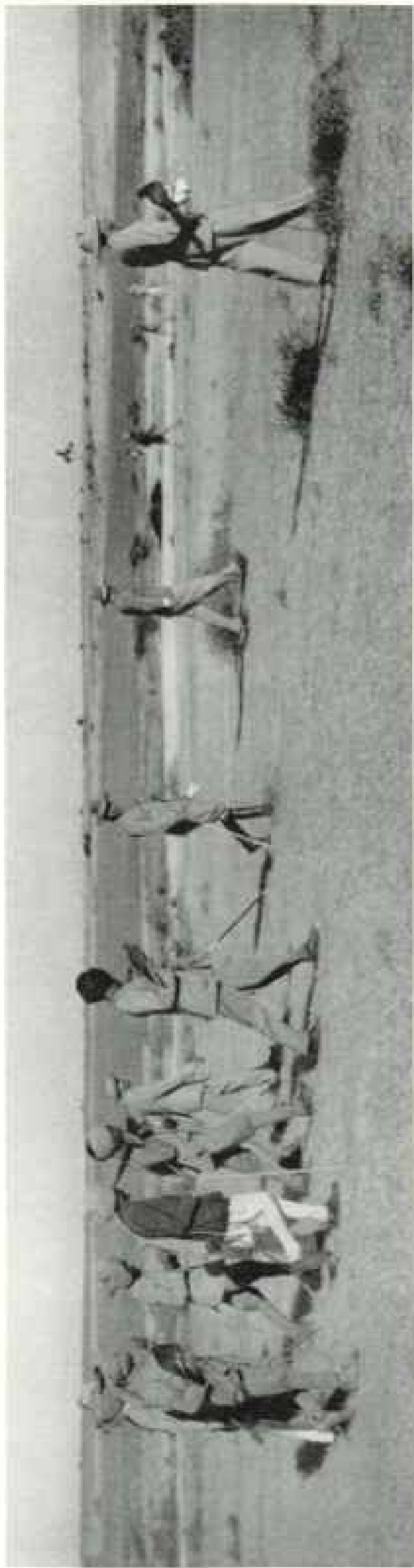
Several kites followed, for the falcon often uses this ruse to get above its quarry; having gained altitude, it returns to the attack. Bapa's saker, however, seemed to have no thought of returning.

Nanabhai was chuckling when suddenly Bapa yelled. His saker was attacking the kites in the distance. We couldn't see, but



**Mecca for Jain Pilgrims from All India Are These Snow-white Temples Atop Satrunjaya, or Holy Mountain, near Bhavnagar**

The sect has about a million and a half members, most of whom are traders in Indian cities; many are extremely wealthy. Their religion, related to Brahmanism and Buddhism, is nearly five centuries older than Christianity (page 258). This temple city is very tidy; alicence prevails.

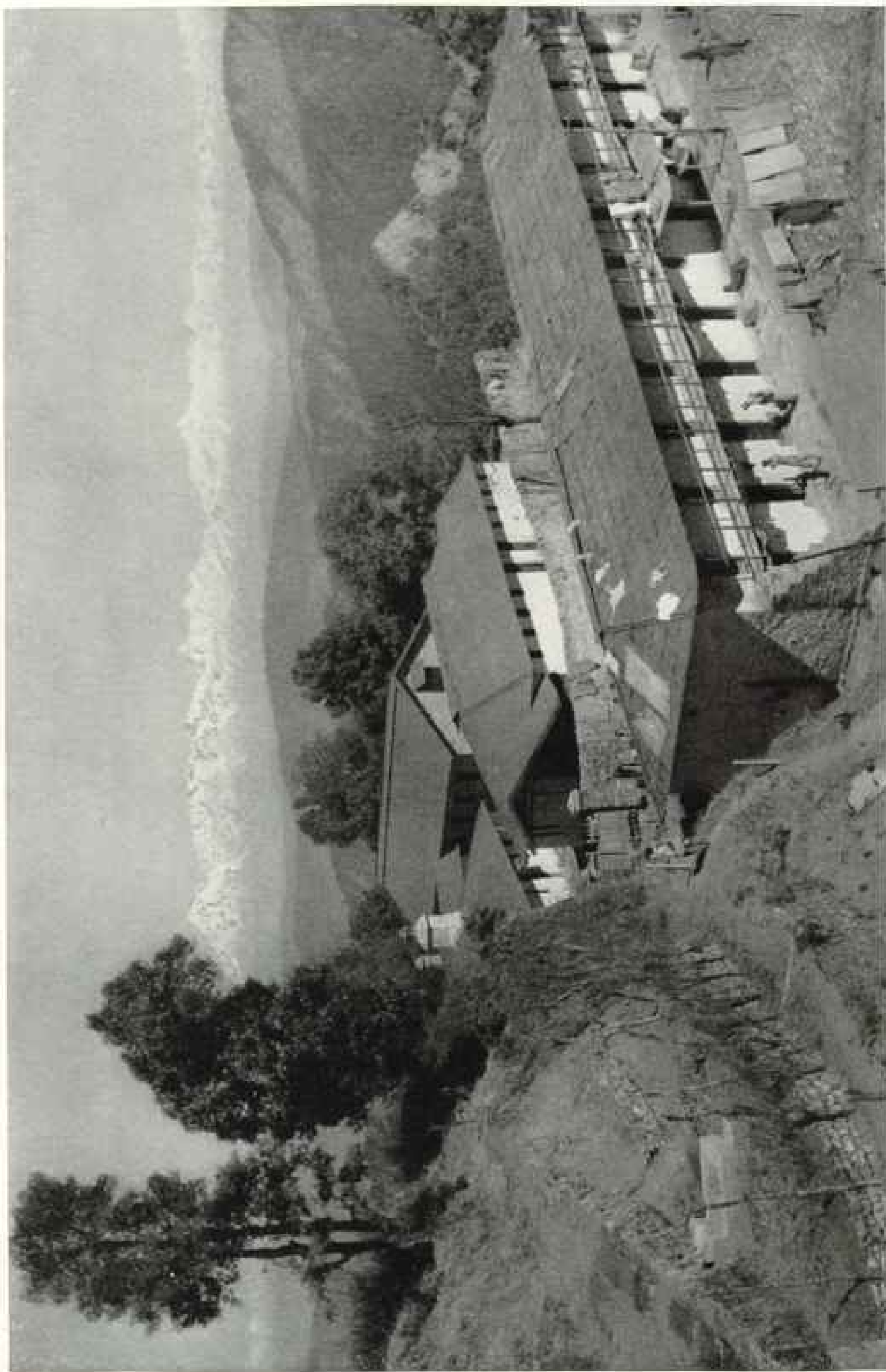


**Bapa, Carrying a Goshawk, Leads the Hunters Across a Plain in Search of Partridge and Rabbits**

Nanabhai and the Maharaja are next in line (center). Turbanned hawk men bring up the rear.

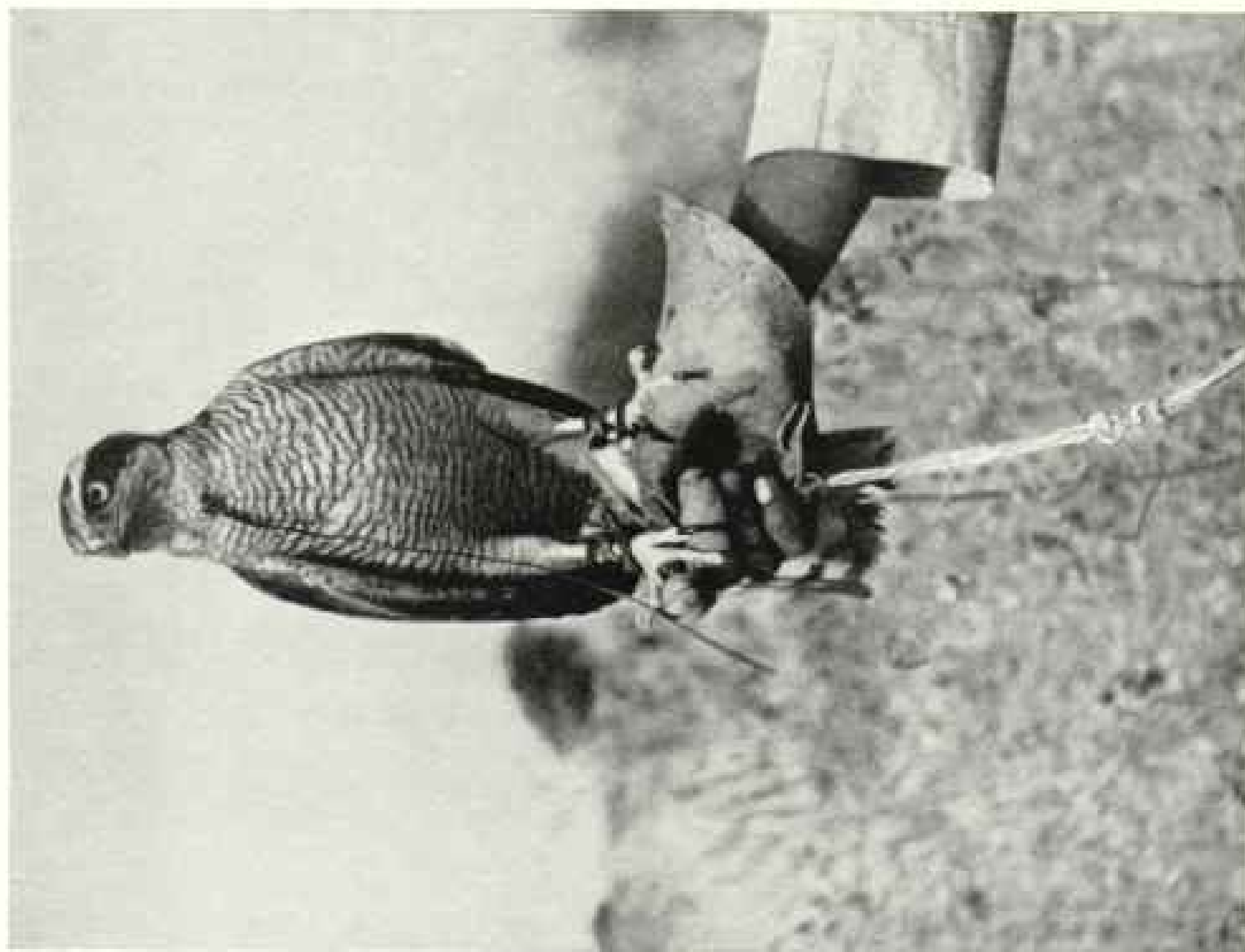


**His Highness the Maharaja Opens the Meet by Catapulting a Goshawk at a Gray Partridge (page 250)**



*Above the Village of Naini Tal, the Craighead Twins Caught This Glimpse of 5-mile-high Nanda Devi*

*The summit, 25,645 feet above sea level, is one of the highest peaks in the Himalayas, which stretch across northern India. Mount Everest, the world's highest mountain, lies 450 miles to the southeast, across the Nepal-Tibet border. It soars more than 3,000 feet above Nanda Devi.*



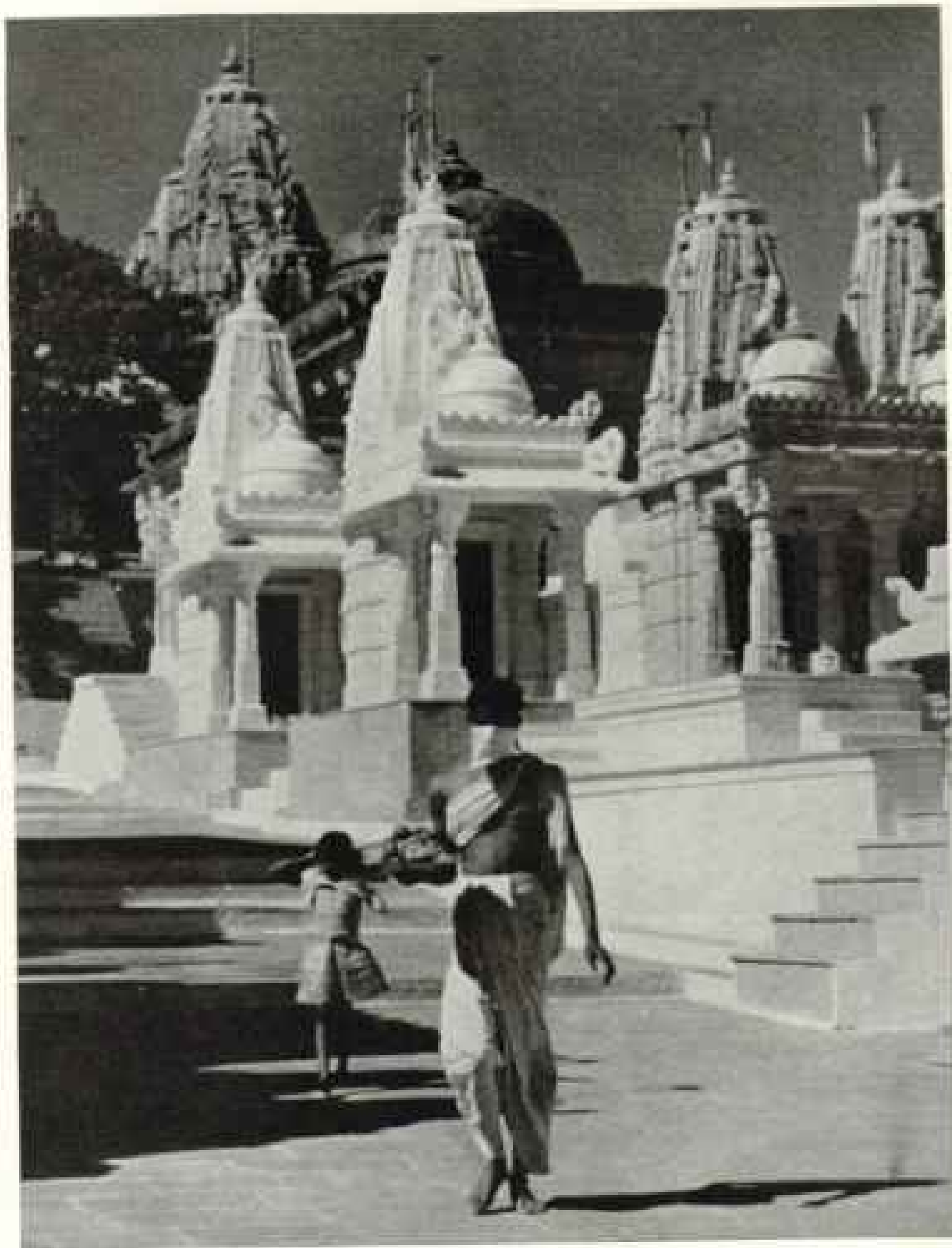
**"Show Me a Partridge—I'm Ready"**

When the falconer suspects a partridge is about to flush, he grasps the neck and leg straps and pulls the goshawk to a horizontal position. When the game rises, the falconer throws the hawk forward as an athlete hurls a discus (page 255). The push helps the falcon overtake its quarry.



**From This Indian Sage, Bapa Learned the Falconer's Art**

Seventy years old, the veteran trainer could still tramp all day with a goshawk on his wrist. The Maharaja's trappers and shikaris come from all parts of India. Each exchanged his special knowledge of hunting or trapping for training in another branch of the sport.



#### Extremely Humane, This Jain Wouldn't Even Kill a Fly

He wears the cloth across his nose to keep from breathing in and annihilating microscopic forms of life. The Jain religion, an old Hindu faith, teaches that all life should be preserved. Here the man is leaving one of his sect's temples in the Indian State of Paltana, bordering Bhavnagar.

Bapa shouted, "She got one!" He dropped his glasses; we jumped into the car and raced away to the scene. Nanabhai called after us, "I'll meet you at the palace."

It was almost dark when we found the victorious falcon. On the way back we slowed down to call out the good news to Bapa's men. They gave a hearty shout that was partly drowned by the acceleration of our engine. We passed Nanabhai's men, who cheered less enthusiastically at the news of "She got it."

At the palace Bapa could hardly restrain himself. Nanabhai purposely asked no questions, so only after a long silence did Bapa casually turn to him and say, "Of course, you

know we got that last kite."

"Uh!" said Nanabhai, and the tournament was over.

Sport is the life of an Indian prince, and we were experiencing it in all its phases, including quail trapping, wild boar and Asiatic lion shoots, days of stalking black buck, gazelle, and nilgai, as well as hunts in which we bagged duck, crane, partridge, sand grouse, and quail.

#### A Typical Day

Sunrise usually found us up for early-morning falconry. Eagles were so numerous that they often interfered with our experiments by dive-bombing on one of our falcons. Some of our birds were killed in this way. We retaliated by netting the eagles and training them as decoys to help us catch more.

This session ended about 9 o'clock, and after breakfast there was more falconry, with perhaps an hour or two of hawk trapping. Then came a swim in Bapa's pool.

Lunch, at about 1 o'clock, was followed

by an hour's siesta period. But we were never sleepy at that time, so we spent it in writing notes and letters. In the afternoon we hunted wild boar, buck, or crane, or looked for eagles' nests. Driving through the park just before sundown, we spotted jackals, jungle cats, wild boar, and civet cats in the beam of the headlights.

After supper we developed negatives, filled slides, amplified our notes, and were off to bed at 10 o'clock. It was a quiet, luxurious life. Sometimes we wished for a wrestling mat or a good-sized mountain to climb.

With Bapa we studied the native wild creatures and collected and identified eagles for his museum of skins.



#### Triumph in Falconry—Bapa's Prize Luggar Downs a Teal

This slow desert falcon, in its wild state, would not normally pursue a fast-flying duck. Indian trainers usually disregard the luggar as a hunter, but Bapa taught this one to capture teal and partridges (page 251).



#### After a Hard Flight, a Saker Falcon Downs a Fast-climbing, Short-eared Owl

Indian falconers reach their highest goal when they can induce hawks to capture larger and fiercer birds of prey, such as the kite, or to bring down big herons, cranes, or the black ibis. Rigorous training is necessary to teach the little fighters how to chase such quarry. The hawks are often drugged just before the attack to key them up (page 250).





#### Bapa Adds a Giant Indian Bustard to His Bird Collection

Frank and John help him hold up the prize, which weighed 19 pounds. Wary and difficult to approach, these big birds frequent open plains, always keeping a weather eye out for danger. Bustards are related to the cranes.

In India there is an open field for wild-life research, and Bapa was keenly interested in studying the habits of the birds and mammals in his State. He had already made progress on a scientific collection of bird eggs, and in his aviary he kept and studied various species.

On our trips he showed us new and interesting birds—hoopoes, rollers (page 242), night-jars, bustard, button quail, coursers, thick-knees, jaçanas, drongos, bee eaters, lapwings, and a host of others. The setup for carrying on scientific work was perfect. Bapa did the planning and studying and taught his men to do the routine work.

#### American "Princes" Go to a Wedding

Some days we visited temples. Other days we wandered in the crowded bazaars, or listened to the music of strange stringed instruments that gradually grew more and more attractive to our ears. We attended dinners at the palace and banquets at the guest house. But it was the marriage of Nanabhai, Bapa's elder brother, that gave us our first look at the lavish state ceremonies that are an integral part of royal life.

We felt highly honored at being invited to

attend this wedding, for all other guests were Indian state officials and neighboring maharajas or princes. The few resident Europeans envied us our good luck.

For some time we had been wearing the dress of an Indian prince and had received the respectful salutes of the Bhavnagar folk. No doubt many of them regarded us as American princes!

It was novel indeed to be regarded as a prince, and slightly different from our life in America! Now, thanks to the generosity of His Highness and Nanabhai, and to Bapa's desire to show his friends all he could of life in India, we found ourselves on a special train making a 2,500-mile trip across India, from the arid country of Bhavnagar to Agartala, in the luxuriant jungle country of Tripura in Bengal.

The wedding party was composed entirely of men, with whom we made friends as we rolled along in our separate compartments or gathered to eat in the private saloon. The old colonel, a veteran of many World War experiences, was a favorite. He taught us to tie our turbans, tried to persuade us to marry Indian girls and live in Bhavnagar, and was always ready with a smile and a bright word.



#### Frightened from Its Roost in a Well, a Pigeon Flutters into the Net

The hunter strikes a stick on the ground or tosses a pebble down the well to rout the bird. His helper stands near, *dogurra* outstretched. The startled pigeon usually flies directly into the almost invisible meshes and is ensnared. Pigeons are used as hawk food and bait.

To pass the time we played cards, swapped stories, or engaged in earnest conversation with the state officials and the maharajas. We wanted to know more about India, and they were keenly interested in America.

His Highness asked about our national parks, our great industries, and our educational system. He constantly praised the friendliness and unconventionality of Americans, and always we returned to the subject of New York, for that city and its bustling life had fascinated him most.

Our special train made its own schedule in crossing India. Occasionally the train was halted so that we could all take a stroll or see some unusual sight. Once His Highness stopped his train to look at some gray hornbills, and on another occasion when things were dull he invited us to accompany him to the engine while he drove the train for a while.

#### Wedding Lasts Three Days and Nights

Bapa told us that when we arrived we must not expect to get any sleep, for the ceremonies would continue for three days and nights. He was right. From the time we watched the gorgeously dressed maharajas step from the train and walk along a red carpet to their

waiting Rolls-Royce, until we left three nights later, we lived in a fantastic world of splendor where time was of no concern and sleep unthought of.

Early in the morning before our train arrived at Agartala, the capital of Tripura, we were awakened by Bapa's man, and amid sleeping bags, shoes, clothes, and suitcases we did our best to dress for our arrival. For the formal reception we thought it well to wear American clothes rather than masquerade in our Indian finery.

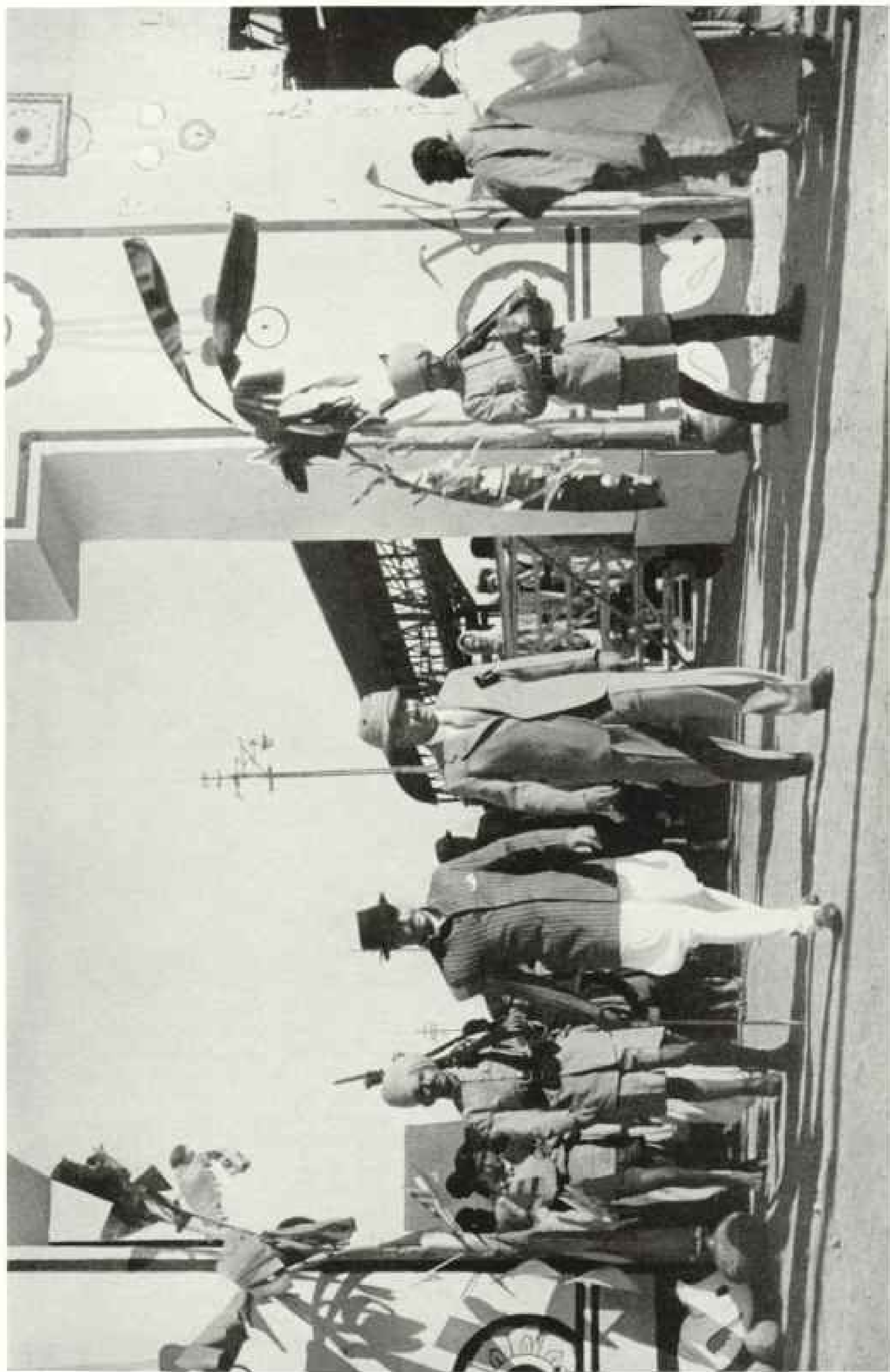
Bapa's preparations fascinated us. A special barber, taken along for the occasion, shaved him while his valet spread out his Indian clothes of colorful silver and gold embroidery. Bapa selected diamond-studded buttons for his long coat, adjusted a diamond ring on his finger, chose an orange turban, tied a sash around his sword, and was then ready to have his man help him put on his breeches and lace his shoes. In his splendid dress he looked every inch a prince. We hardly recognized him as the Bapa with whom we had lately been chatting.

Amid all this splendor John and I crawled out of our now coal-blackened bedrolls (even the best of Indian trains are sooty), shaved,



**Royal Elephants in Gorgeous Trappings Parade Before the Palace of the Maharaja of Tripura at the Wedding Ceremony**

Here the Craighhead twins were guests at the marriage of Namubhal, Bapa's brother, to the sister of Tripura's ruler (page 260). This Indian State lies in the heart of the Bengal jungle country. In Tripura the turbaned twins were often mistaken for Indians, because many Bengalese have fair complexions (page 265).



The Maharaja of Bhavnagar (Right) and His Bridegroom Brother, Nanabhai, Leave Agartala After the Royal Wedding.

They are about to board a river steamer for the 90-mile ride up the Ganges, on the return trip to their own State. The bride, in seclusion, was carried aboard the boat in a howdah. The Craighields did not see her until weeks later.



#### Up to the Glove Flies the Saker Falcon for a Morsel of Food

Twenty to thirty times a day the trainer calls the bird, on a leash, to his hand. Soon it learns to respond instantly to the summons. All around Bapa's home, mass production of trained falcons was carried on in preparation for the hunting season (page 250).

picked out our only clean American suit left to wear, and were soon dressed.

For another half hour we rolled along in the train, uncomfortably doing our best to keep clean. Then followed the official welcome and a series of elaborate processions with elephants, soldiers, maharajas, and hundreds of variously dressed tribesmen. Each procession was a moving rainbow of color placed in a jungle of green and set off by the blue of the sky and the pure white of the palace buildings.

The parades were like a rotating colored disk. There were so many moving forms and colors that my lasting impression will not be the silver carriages, the trays of silks and jewels that were presented to the bride, or the gorgeously dressed groom, but it will be an image of a great color splash, as if a bubbling spring of color had overflowed at our guest palace on the hill and trickled down as a long quilted ribbon to the new palace by the lake. Even the visiting maharajas were overwhelmed

by the beauty, cost, and lavishness of the ceremonies (page 262).

#### A Wedding Procession without a Bride

The final wedding procession, perhaps because it occurred at night, still remains fairly detailed in my mind. In this public ceremony the bride takes no part, being kept in strict seclusion.

At the guest house we spent hours sipping drinks while waiting for the bridegroom to appear. It was fashionable to be late and, as Nanabhai said, this was one time when he could keep even the maharajas waiting.

At last the bridegroom appeared, bedecked in pearls and dressed in gold. He took his seat in a silver throne strapped to the broad back of a tusker, and the procession started off from the old palace on the hill to the new palace on the lake.

A hundred elephants preceded the bridegroom, and the maharajas followed closely in



#### Cloth Wrappings Protect Wings and Tails of Asiatic Sparrow Hawks

Without this covering the tethered birds might injure themselves in attempts at flight. Here the small hawks pose quietly under the watchful eyes of Bapa's head trainer.

the rear. Behind them trailed countless on-lookers colorfully dressed for the occasion and all carrying sputtering torches. The mile-long road to the palace was lined with torchbearers, and thousands of curious spectators formed a solid wall on both sides.

John and I, dressed in our Indian garb, pushed through the throngs to the head of the parade and took flashlight pictures in color while the torchlighted procession wormed past.

As the bridegroom rode along, the natives emitted a cry of joy that sounded like the distant call of a loon. This wail, started by the first spectators, traveled like an electric current down both sides of the road, keeping pace with Nanabhai's elephant.

Frightened by the glare of the torches and the weird wails, many of the elephants grew unruly. The one bearing Nanabhai became balky and could not be made to kneel at the palace steps. A docile female elephant was brought alongside and the bridegroom climbed over to its back before dismounting.

Inside the palace the guests wandered from one huge room to another while Bengalese servants with slant eyes constantly trotted silently about, serving drinks and smokes. Hired nautch girls danced and sang, but no other women took part in the celebrations. They were all kept in strict purdah. It was a men's party from beginning to end.

#### Americans Mistaken for Bengalese

On our first night at the palace some of the younger rajas had introduced us as princes from a distant State, but explained that we had lived in Europe and America so long that we had almost forgotten our native language.

Many of the guests were completely fooled, for, as one surprised prince said, "You look just like the fair type of Bengalese, and the turbans completely hide your hair. I would never have known the difference if you had not told me you were Americans." He in turn enjoyed introducing us as his friends from a still larger and better-known Indian State.



### Homeward Bound! Last Chapter in the Adventure of a Lifetime

The Craighead identical twins, John (left) and Frank, return to the United States aboard the American cargo boat *Exemplar*.

I often had a hard time locating John in the crowd, and when one English guest finally found us he said, "No wonder I couldn't find you. I've been looking for Americans for two nights now."

We were having an experience such as we had never dreamed of before. Banquets that were scheduled for nine came off at twelve, but no one seemed worried.

At these affairs more than a hundred guests were seated at a long table decorated with flowers and silver candlesticks. The centerpiece was a long pool of water from which fountains rose and in which lotus flowers were growing and fish swimming. We were served Indian food—hot spicy dishes, fish, curry, and vegetables.

The rice was covered with pure gold and silver leaf. We were told to eat this, as it was good for the heart. We couldn't help but think as it went down that it might be good for the heart, but that the stomach wouldn't appreciate it.

Servants poured us rose water and wine. Others continually brought us platters of Indian breads.

Our huge silver plates were filled with small bowls containing sweetbreads, chutney, sauces, and vegetables. Each one seemed to be hotter

or sweeter than the last, and soon we were unable to distinguish one taste from another. We found out later that even our Bhavnagar friends had difficulty with the hot spicy foods of the Bengalese.

### Dancing Girls Sing Love Songs

Our meal was kept lively by the dancing girls who walked about the huge table singing love songs to the guests.

The things they sang to us in Bengali would make you blush anywhere, even in the company of Indian princes and maharajas, who take it all for granted.

The girls peered out from under their saris and raised and lowered their eyebrows to add expression to their words. The princes urged us to wink back and laughed as they translated the songs to us. One girl sang, "I love you. Just touch me, and you will know the greatest happiness."

A night of fireworks, sword dancing, and singing ended the enchantment. At an auspicious moment determined by the stars, the groom left the palace with his bride and the ceremonies were over (page 263).

On our return journey up the Ganges next morning, Bapa said, "I'll be glad to get back to my falcons."



#### Dancing Girls Who Helped Keep the Wedding Feast Lively

They moved around the huge banquet table, singing love songs to the guests (opposite page). Their long silken saris reached from head to waist. Dots on foreheads are caste marks.

"Yeah," Frank said. "It was fun for a while, but already I am wondering what the luggar and tercel caught while we were away."

I was writing notes at our quarters in the guest hotel when the room boy brought a message from Bapa: "We're running the cheetahs in the morning. Nanabhai wishes you to be at my bungalow at six."

#### Hunting with Cheetahs, Swiftest Cats

Nanabhai had charge of all the cheetahs, or hunting leopards, saw that his men trained them well, and purchased new ones when necessary. The cheetahs are imported from Africa and are trapped full-grown—never taken as cubs. They cost about \$400 each, but once trained they can be kept and hunted for many years and are used to secure venison for the table (pages 268-270).

The cheetah is the fastest of the cat tribe—and, in fact, of all mammals in a short spurt. Its small, rounded head, narrow body, and long legs are adaptations for speed. Centuries ago its abilities were recognized, and this animal, no bigger than a large dog, has long been trained for hunting by the princes of India.

Bapa's father, the former ruler of Bhavnagar, had as many as thirty cheetahs at one

time. His favorite ones he kept with him in his palace, just as we keep dogs.

In Bapa's State the cheetahs are run at black buck, a true antelope which inhabits the dry, level plains. The doe and young are fawn-colored, but the bucks commence to turn black when about three years old. They usually live in herds and depend upon their keen sight and fleetness to escape danger. They were indeed a fit opponent for the cheetah, and it was a race between these two animals that we were to witness tomorrow. For the black buck, the outcome meant life or death.

We were up and away at daybreak. Bapa and his brother were riding in the front seat of a Ford truck, and John and I were huddled in the back.

It was actually cold and I could feel my jaw muscles tense in the wind. Our hands were in our pockets and we were packed against each other for warmth. A station wagon with several men and a cheetah followed us. Behind them came our car with cameras, guns, men, and another cheetah.

After driving for almost an hour along dusty roads, we stopped at the edge of a wide coastal plain. An army truck was already there with three more cheetahs and their trainers.

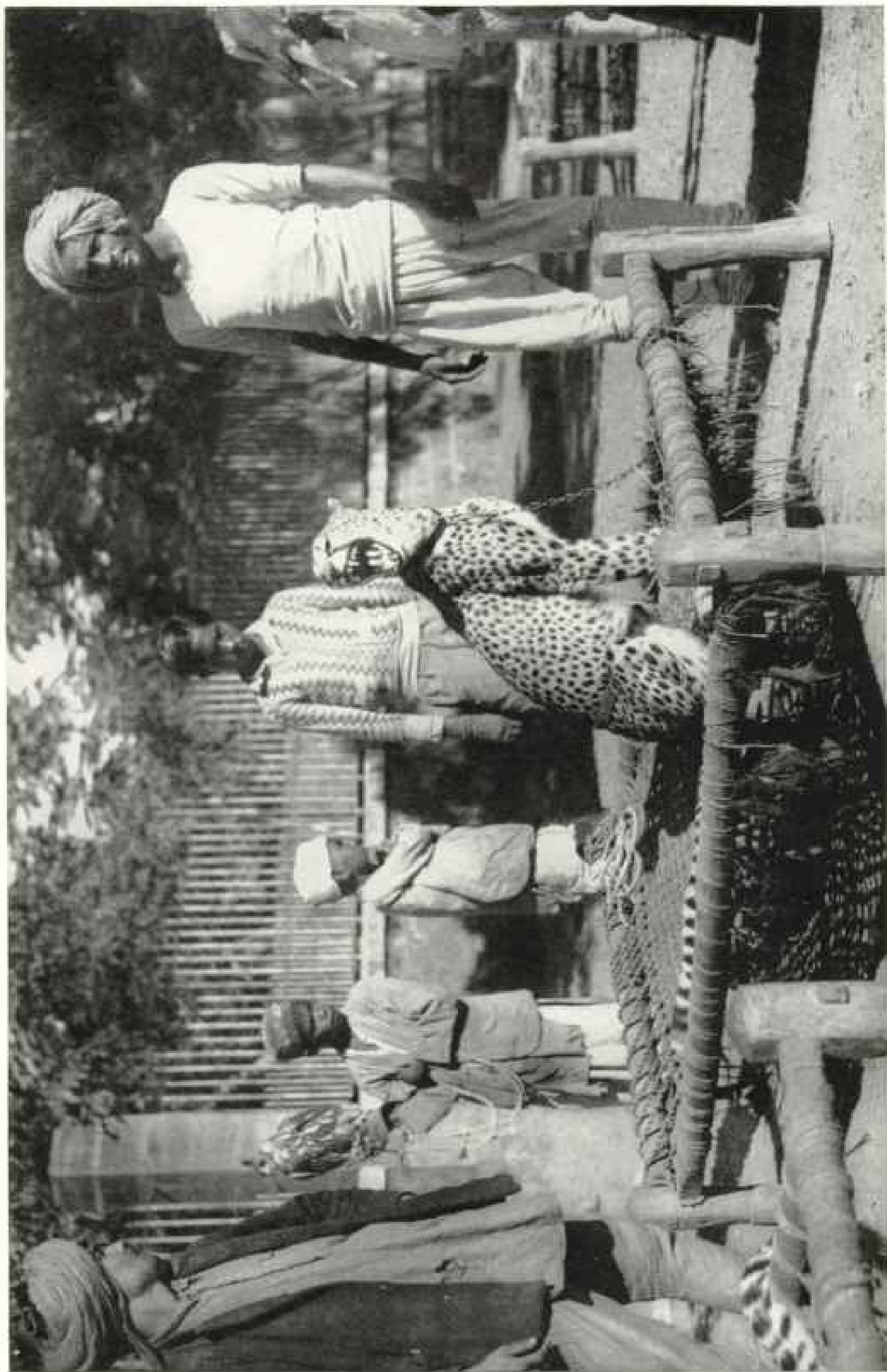
A few orders were given; a cheetah was





**Off for the Hunt—Cheetah and Spectators Ride in Bullock Carts to Grazing Fields of Antelope Herds**

They will dismount the fawn-colored does and young, looking only for fleet black bucks. The hunters work their way close to a desired buck, before they release their hunting leopard. The cheetah attains 70 miles per hour, but only on a dash of a few hundred yards. On long runs, bucks almost always escape (page 267).



**Pet of an Indian Prince—a Tame Cheetah Camouflages Its Friendliness with a Snarl**

When the fleet animal is not hunting, it is kept in the palace gardens on a rope netting stretched across a wooden frame. Bapa's father once had a pack of 30 cheetahs. His favorite leopards lived in the palace, as would house dogs.



#### Into an Army Truck Goes a Hooded Cheetah, Bound for the Hunting Plains

Trapped full-grown in Africa, the animal was trained by Nanabhai, Bapa's brother. These fast cats cost about \$400 apiece. They keep the palace table supplied with venison (page 267).

placed in the back seat of our open car with Bapa; John and I moved to the front; and we streaked out across the plain.

In some places the ground was as level and flat as an old lake bottom, but suddenly this smooth terrain would end in a series of deep erosion gullies or hummocks of earth and grass. In some places there was treacherous sand and in others boggy mud or cultivated fields.

Before long we sighted a herd of black buck, and the accelerator started down. Twice we got almost near enough to slip the hooded cheetah free, but each time our dash slowed down in rough or sandy ground. On the third attempt we seemed headed for success. There was nothing but level plain and hazy horizon ahead.

#### A Mile-a-minute Chase

Nanabhai pushed down on the gas. Our car gathered speed until we were doing sixty. The black buck were just in front, their spiraled spiked horns angled back over their

rippling shoulder muscles. All eyes were riveted on them.

Suddenly a deep gully loomed in front of us and then seemed to rush right under our car. My head jerked back and forth. I left the seat several times and grabbed the top of the windshield for support. The car lurched, the springs hit bottom, and we came to a stop astraddle some bumps on the brink of a deep gully. Three feet farther and we would have wrecked the car.

In a few seconds we had backed out and were seeking a better crossing. Again we were in the open and bearing down on the black buck.

Small bumps and ditches were ignored. It was a wonder to me that our car stayed together, but it had been specially built for this sport. We split a black buck away from the herd and overtook him with the speedometer bouncing above fifty.

When within fifty yards, Nanabhai jammed on the brakes and the excited cheetah sprang



#### Lure for an Eagle—A Luggar with Bound Wings

Indian hunters turn the swift bird into a barack, or decoy, by pinioning its wings so it can fly only a few hundred yards. A ball of feathers, which looks like food, is fastened to its talons, along with numerous hair nooses. When the eagle sees the feather ball it dives on the luggar and is caught in the nooses as it attempts to steal the "food." The luggar usually escapes injury.

from the car in pursuit. As he jumped, one paw struck John on the ear and cut a light gash.

The buck had been going fast, the car had been speeding, but all seemed slow in comparison with the burst of speed put on by the cheetah. He seemed to ripple across the plain like a wave rushing shoreward. I could hardly believe that an animal could move so fast and so smoothly. He started after a buck that was running at full tilt.

He had to start from scratch; yet he had overtaken the buck within 150 yards. It looked like a sure kill, but twice the buck dodged the cheetah as a front paw struck out to knock him down.

#### Cheetahs Taught Not to Chase a Doe

The run was over, the buck had escaped, and the cheetah sat down while his trainer walked out to him, fastened him by a leash,

and led him back to the car. The cheetahs seldom give chase for more than a few hundred yards. After an hour's rest he would run again.

It was hard to believe that an animal with paws no larger than his could ever knock down a black buck, but those soft round paws bore sharp claws. They were mean weapons in action.

We released a cheetah at another group, but he refused to run, as there were no buck. The cheetahs are never fed if they kill a doe or a young antelope, so they soon learn to chase only buck.

Once again we started off, and as we cruised along in this cross-country driving, Nanabhai told me how once he had suddenly run into a ditch and jammed the steering wheel into his stomach. The man sitting in my place had been thrown clear out of the car—a pleasant thought at such a time.

Dust rolled out in a column behind our car. Sand grouse flushed to the side of us and a few cranes passed overhead. The sun was now high, and heat waves were rising from the cracked plain.

In the distance I could make out the shimmering forms of running antelope, enlarged and distorted by the heat waves. The cheetah also was staring intently at them and likewise knew that those dancing blurs of black and white were his quarry.

As we sped along, we approached what looked like a lake. Some antelope were running along the "shore" while others seemed to be "splashing" across the smooth, glassy water.

I quickly glanced to each side and saw water. Something was wrong. I looked behind, over the terrain we had just crossed, and there also was a calm, glistening sea of water. Mirages on all sides!

#### A Race to the Death

I began to wonder whether the antelope were mirages as well, but soon they took form, and we could make out some black five-year-old buck.

We raced in pursuit of them. The speedometer rose higher and higher, the whole car skidded, and a shower of earth flew up behind us as we turned sharply to head the buck in the desired direction.

We were now close enough. Nanabhai jammed on the brakes and ordered the cheetah released.

The leopard sprang in pursuit, selected his buck (the largest and blackest one), and then slowly started gathering speed in a series of long, low, gliding leaps. He was timing his run, setting a pace, and gauging the distance. The buck, confident of his speed, was not yet going "all out."

The long leaps of the cheetah grew into a ripple, while the intervening distance quickly shortened. The buck was now alarmed and was putting all he had into a spurt, but the cheetah had timed his run, saved his wind, and counted on the spurt. He also went all out, and what had appeared like a speeding ripple was now a straight line hurtling toward the buck so fast that it appeared as if only one object were moving. The cheetah was doing close to 70, possibly 80 miles an hour, and looked like a blur of brown against a tan background.

The brown object and the black object came together. The cheetah's paw struck out; the buck dodged, and turned, and was now racing back directly toward us.

The buck was fast and powerful. Twice more he dodged the cheetah. Then, almost

in front of us, the pursuer struck again. The front paw with claws extended hit the buck's hind leg a side blow so that one back leg tripped over the other and the buck went down in a cloud of dust.

The cheetah turned a complete somersault but regained his feet first. He sprang, and his short, powerful jaws closed on the buck's neck. The trainers rushed in and with a Moham-medan prayer they finished the struggle.

The big buck and others bagged in the hunt were carted off to the palace, for this was meat for the table.

We enjoyed the life of an Indian prince, for life with Bapa was not a goal, it was not a purpose, nor was it a race or a struggle; it was something to be lived each day. All activity, from pure academic studies to sports, became an end in itself, never a means to an end. We did things for enjoyment and to satisfy the desire to learn. Life was charted by whims, not considerations, obligations, and necessities. There was no future, only a present.

The lack of hurry, servants to do the undesirable time-consuming work, freedom from worries, opportunity to talk, time to read and meditate, a chance to devote all our time and energies to learning, to doing the things we wanted to do, made indeed an unusual life.

Now and then Frank and I would look at each other and break into a laugh. We were thinking of the same thing. How had we ever chanced to fall into such an adventure? What a life!

#### From a Dream World Back to Earth

Seeing is believing in most parts of the world, but seeing and living the life of an Indian prince was hardly proof enough for two young skeptical American twins that the whole affair was not a dream.

The days with Bapa rolled by like the colored film in our movie camera when running 72 frames a second. When the time came for us to depart, we knew that we were leaving a true friend and a fine naturalist.

Our "So long," and Bapa's "Goodby," spoken as the train pulled out of Bhavnagar station, meant much more than the words implied. Bapa had come halfway around the world to meet us, and before we reached home we had encircled the globe in returning the visit.

For three months we had lived as brothers. We respected and understood one another. Words were not necessary to express what lay in our hearts.

"We'll be looking for you, Bapa. It's your turn next."

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In addition to the editorial and photographic surveys constantly being made, the Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, the Society's researchers solved secrets that had puzzled historians for three hundred years.

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The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,024 feet was attained.

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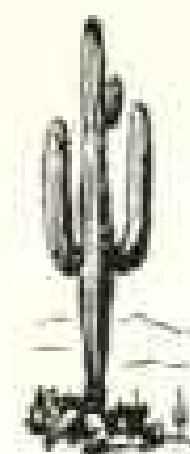


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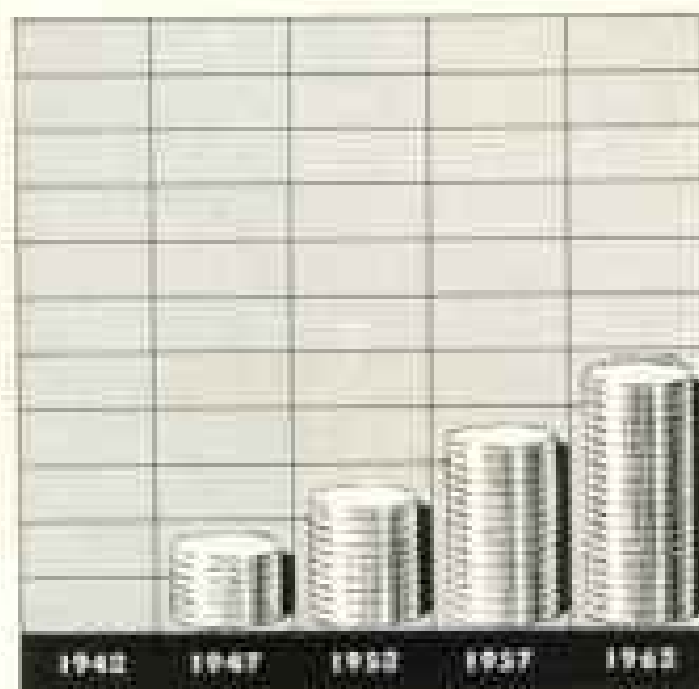
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\*Excerpt from the book, *THE SHADOW ON THE LAND*, by Dr. Parran.

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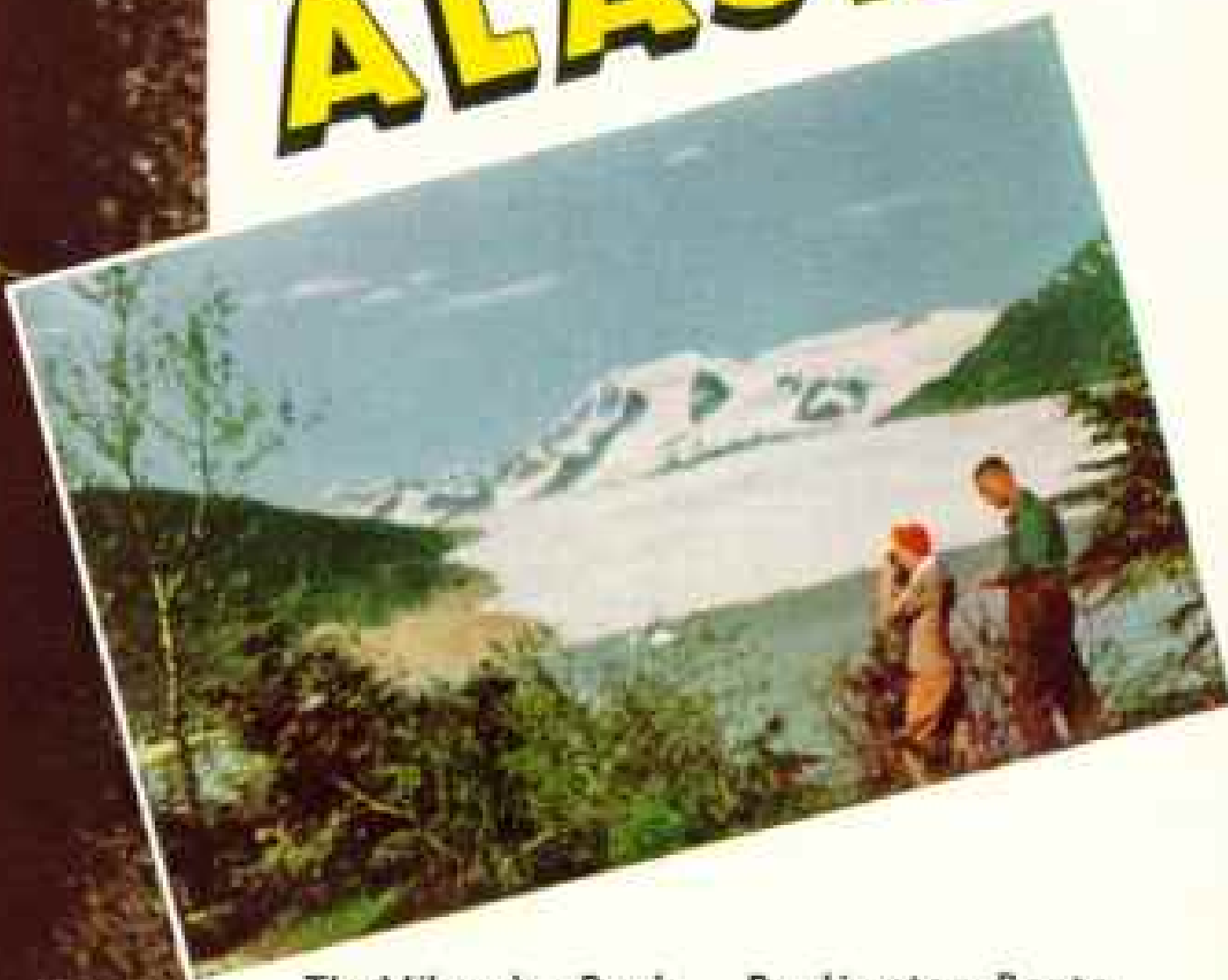
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