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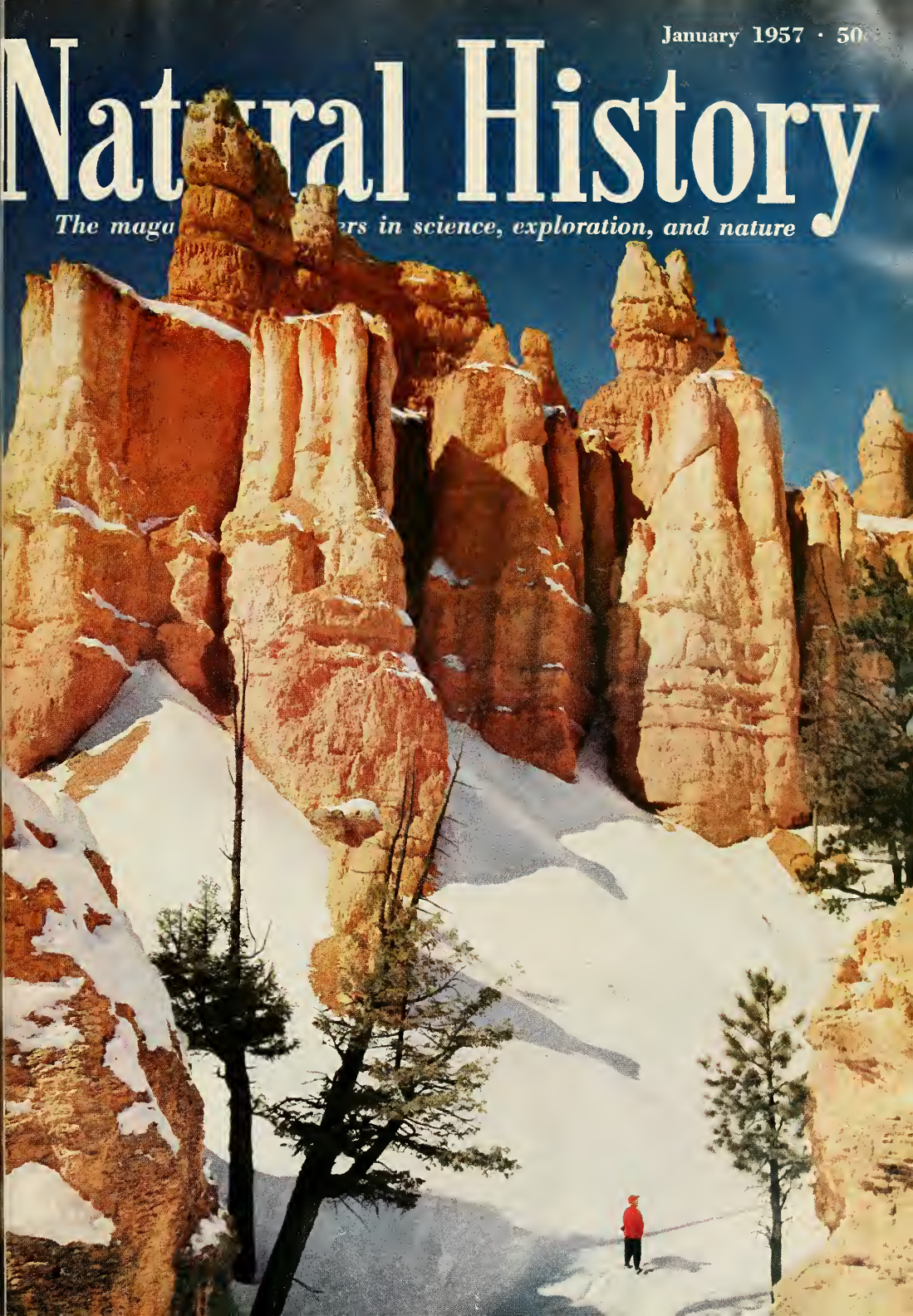
Natural History

The maga[illegible]ers in science, exploration, and nature



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Letters

Sea Balls on this Continent?

SIRS:

I have just read with interest Elsie A. Parry's article in the November issue of NATURAL HISTORY. Are these sea balls only found around the Mediterranean?

Last summer I found a similar ball along the coast of North Carolina, just below Cape Lookout along Shackleford Banks. This ball was apparently larger than these illustrated, being about 6 inches in diameter. When I picked it up, it was fairly well weighted down with sand. When I shook out the sand the ball was very light. I was not aware that I had found a "beachcomber's treasure," although I had never before seen such a ball. I thought it was just one of those freaks, which I imagined had been formed by wave and wind action upon a mass of sea plants.

At the time I was taking movies of a driftwood forest formed over the years as the sand encroached upon a cedar grove. The sea ball provided a little action as I photographed it rolling ahead of the breeze into the dead forest.

I was delighted to see the article on these balls, because I've often wondered just what to say about this movie scene. But now the question arises as to whether these are of very unusual occurrence along our shores. If so, how did this one get on our beach? It would seem that it would be more likely a product of the Gulf Stream, rather than the Mediterranean.

Any information you can supply will be greatly appreciated.

J. W. E. JOYNER
Rocky Mount, North Carolina

P.S. Not realizing I had stumbled upon a "treasure," I permitted my sea ball to roll merrily along.

Once again we have turned to our botanist Jack McCormick for help. He offers the following information:

Vegetation balls are formed when long, narrow leaves or other flexible plant parts are caught in the rhythmic swirl of waves along a beach. They have been found on the shores of all but the polar lands and on the shores of many islands. But the conditions for the formation of vegetation balls exists not only on the edge of the sea, but also along the shores of lakes. Early in this century a great many reports were published citing the discovery of vegetable balls along American and European lakes and presenting detailed analysis of their contents. As the occurrence of the botanical curiosities became well-documented, scientific interest in them dwindled. But vegetation balls are rare enough to be unfamiliar to most of us. There is still the reward of accomplishment in finding one of these "beachcombers' treasures."

Leaf-Cutter Ants

SIRS:

It was with great interest that I read Ross E. Hutchins' article "Ants that Grow Mushrooms" in the November issue of NATURAL HISTORY.

At the Royal Victoria Institute Museum we have under observation a nest of Leaf-cutting Ants, which are called *bachacs* in Trinidad. Every morning we supply a quantity of leaves and flowers which are "planted" in a container at the far end of their garden. Our particular group of bachacs seem to prefer (at the moment) hibiscus flowers and I am pleased with this arrangement since the ants seem to be more spectacular when carrying "red" flags to their nest than the usual common green leaves. Their garden is contained within a glass house, so it is possible to see the fungus garden and our many visitors spend countless hours watching the parading ants and all their activities. I might add that from 12 to 20 hibiscus blooms are completely devastated in a matter of a few hours.

All of our captive ants are confined in a glass case and moated arrangement to prevent the escape of our bachacs. I understand that years ago there was another

bachac observaion nest in the museum—not so escape proof. These ants invaded a horticultural show that was in progress on the second floor of the building and made short shrift of the floral display! Outside the museum we have plenty of wild bachacs in our gardens. I have taken workers from a strange group and placed them with our museum bachacs. The work immediately stopped and the invaders were promptly annihilated.

I can appreciate Mr. Hutchins' problems in trying to get a captive colony started. We dug up and installed perhaps as many as 25 groups before our colony really got started and now it has been running for several years. The secret, I believe, is to get a "queen" for without this most regal and central character, the nest will not thrive. I have seen observation bachac nests successfully kept in battery jars, provided a queen was present.

continued on page 56

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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January, 1957 Volume LXVI, No. 1

Bryce Canyon ..... Cover Design
From a color transparency by Josef Muench

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What You Should Know about Antarctica ..... Walter Sullivan 8
An exciting round-up of information about the least-known continent, at the outset of the greatest program of scientific exploration in history

Banana Animals ..... Walker Van Riper 16
Scientists have long recognized fruit shipments from tropical lands as a source of strange and interesting animals

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It is lighter than wood, harder than steel, and it serves many uses for our comfort and safety

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One of our most common butterflies has an unusual life cycle

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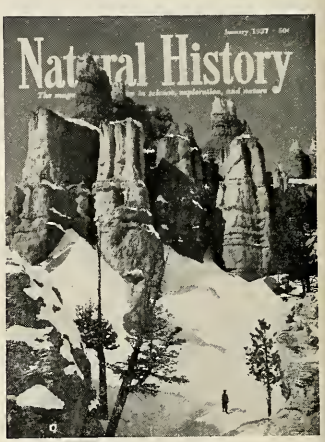

THE COVER THIS MONTH

Few of the many who visit Bryce Canyon National Park each year see it under snow, as shown in this color photograph by Josef Muench. Its spectacular pink and orange cliffs are unsurpassed among the wonders of the world as an illustration of the bizarre sculpturing power of rain, frost, and wind.

One of the finest views is that from Sunrise Point, near the park museum and information office. But those who would see the full variety of Bryce's beauties must explore the extensive trails on foot or horseback. Sunlight on the spires and turrets seems sometimes to light them from within, and the rich blue of the desert sky appears even more intense behind the flame-colored formations.

The rocks were laid down as sediments under the sea many millions of years ago, but the erosion that sculptured them is a much more recent geologic event and is still going on.

The Park is open throughout the year, but visitor facilities are closed from November 1 to May 10.

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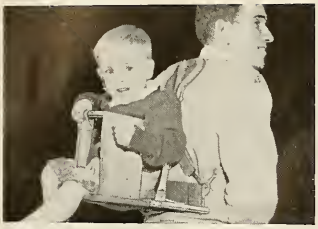

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CHALLENGE OF THE ANDES; THE CONQUEST OF MOUNT HUANTSAN

- - - - - - - - by C. G. Egeler and T. de Booy

Translated from the Dutch by
W. E. James
David McKay, $4.50
203 pp., illus.

Reviewed by ROBERT BATES

SINCE World War II, stories of expeditions to climb Everest, Kanchenjunga, Nanga Parbat, Annapurna and other giants of the Himalaya and Karakoram have thrilled thousands of mountaineers and armchair explorers. Yet relatively few Americans have shared in the stories of the conquests of the great snow peaks of South America, such as Salcantay, Yerupaja, Huagaruncha, Huascarán, or Huantsán.

Virgin peaks are still abundant in South America. Only a few months ago English, French, Dutch, and American expeditions were all in Peru together, seeking with ice axes and crampons to force routes up gleaming ice slopes where man had never been before. Among these climbers were Egeler and de Booy from the Netherlands. With them once more was Lionel Terray, the daring Chamonix guide who in 1952 led them to the top of Huantsán.

In 1952 these two Dutch geologists were not veteran climbers. Their expedition to 20,981-foot Huantsán, then the highest unclimbed peak in the Cordillera Blanca, was their first outside the Alps, and they then measured everything by Alpine standards. The tale, told almost entirely by Egeler, is without "side." It is a human book, which admits inexperience and mistakes and differences of opinion. Egeler and de Booy's previous training had not prepared them for what they encountered: porter trouble, rock bulges covered with *verglas*, 30-foot cornices, a bivouac at 18,000 feet and a 65-degree ice slope. Their first attempt on Huantsán ended in the dark when de Booy fell *300 feet* down a rock and ice cliff, his crampons striking off a shower of sparks.

"Terray and I clung, petrified to the face. Black despair for our comrade choked us. I saw no reason to call out. De Booy could hardly have escaped being killed."

But miraculously de Booy suffered only a skinned nose and a sore back! Undismayed by the fall and the icy bivouac, the trio tried a different route. Again they were halted—this time by a three-day storm. Once more they regrouped, and now, thanks to the courage of all three and Terray's magnificent leads, this time they climbed a steep arête and reached the summit of the south peak. That night they camped at about 20,000 feet, and next day reached "the proud, inviolate summit of the Huantsán."

Challenge of the Andes was planned during the blizzard on Huantsán; its first outline was scribbled with mittened hands on the back of a gingerbread carton. It holds one's interest. In addition to the suspense of the climb, the characters of all three protagonists, especially Terray, emerge in the pages of the book and add to its appeal. The volatility, brilliant technique, and magnificent self-assurance of Terray is a dominating note. Whether he is cutting an ice or snow mushroom for a long rappel, swearing at a deserting porter, or standing on a snow slope and chewing Egeler's frozen big toe to try to prevent serious frostbite, he is peculiarly Terray:

the most successful expedition guide of our generation.

Surely we will read of other victories by this colorful triumvirate.

The reviewer is himself a veteran mountaineer. He was a member of the American expedition to K² and an expedition to the Andes which sought in the summer of 1956 to determine the highest mountain in South America.

THE DRUNKEN FOREST

- - - - - - - - - - By Gerald Durrell

Viking, $3.75
238 pp., illus.

Reviewed by ARCHIE CARR

LIKE Gerald Durrell's earlier books, *The Drunken Forest* tells of the joys of catching animals for zoos. This time, Mr. Durrell took his wife Jacquie with him; and I might remark right here that I think he was very lucky to have found such a girl as Jacquie. Not many young women would put up with the sort of harrowing capers he inflicts on a wife.

The action of this frolicsome book takes place in South America, part of it on the pampas near Buenos Aires but most of it away out in a backwoods section of the Chaco in Paraguay (not in Uruguay, as the flap of the jacket says), where the Durrells set up housekeeping with an extroverted cook named Paula and a fast-growing set of animal boarders.

Most people who write for the general reader about collecting animals fill out lulls in the action with data from the manuals on the life histories or classification or distribution of the critters they are after; and this is all right. But with Mr. Durrell there aren't any lulls. If a lull seems imminent, he quickly has an accident; and while some of these are pretty hard on him—and worse on his sweet wife Jacquie—he proceeds to relate them with the greatest fluency and relish. Some of these many situations just happen; but others Mr. Durrell plainly walks into, as when he playfully rolls a balled-up orange armadillo into bed with his sleeping wife, or sticks his thumb into the mouth of a man-eating toad, or tries to stare down an enraged tiger bittern and gets its ghastly beak shoved up his right nostril. When you've got that kind of a talent, the only possible antidote is a light heart, and Mr. Durrell certainly has that, too.

And he writes well. He would write even better if he gave up some cherished English colloquialisms and used less hyperbole. But there is a piece on a sunset seen from a tumbledown dock by the Paraguay River that is lovely, and most of the hilarious incidents in the book are told with a fine sense of situation and timing. He shows you the people he meets, too—Paula is as good as a character in good fiction, — but most of all he has a way with animals and a way of writing about them that leaves you certain that you know them personally.

A few may complain that he is anthropomorphic in his relations with animals. I am pretty certain he'd answer that by saying, sure, that's the only way to get along with them. As near as I can make out, his reporting of the antics of his charges is accurate and honest; and if they turn out to act like people, it must be that they *are* like people. There is a school that is so afraid of reading into animal behavior something manlike that is not there, that it won't let you use any of the regular names for emotions you note in the non-human creatures. Well, Durrell doesn't belong to this school. If an animal gets sad or jealous, Durrell says so — and goes ahead and treats the symptoms of sadness or jealousy, and the animal gets well. Some of the personal names he gives his wards are a little eccentric—I spot Dracula, Pooh, Eggbert and Flap-arse as random samples — and the generally relaxed atmosphere and intimate collector-specimen relations will offend a crotchety minority. But everybody else will stay in stitches.

The title of the book refers to the Chaco Parkland, a savanna-forest country in which the most conspicuous tree is the curious *palo borracho* (drunkwood: an even more potbellied relative of the Caribbean ceiba and African beobab), which "stood about with their bulging, beer-drinkers' stomachs, tilted at unbalanced angles."

Ralph Thompson's jacket design and black-and-white illustrations are extraordinarily fetching.

The reviewer has also written of his adventures as a naturalist in Latin America, his latest book being The Windward Road *(1956).*

EVOLUTION:
The Ages and Tomorrow

- - - - - by G. Murray McKinley

Ronald Press, $4.00, 275 pages

Reviewed by JULIAN HUXLEY

PROFESSOR Murray McKinley has accomplished the feat of producing a work which is simultaneously good and bad. Almost all the detailed facts and ideas in it are good, and so is the orderly and comprehensive way in which he has brought them together. But its central thesis of evolution as purposive, of "nature" striving towards a goal, of the evolutionary process "seeking" increased awareness and intelligence, is muddled and bad.

Let me first stress its good features. The book summarizes, clearly and accurately, recent advances in our knowledge of most aspects of the evolutionary pro-

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cess—theories of cosmology; the origin of life and its prerequisites; the gene-concept; the time-scale of biological and human evolution; the main advances registered in biological organization during evolutionary time, together with their limitations; the origins of "mind," the evolution of instinct, intelligence, and conceptual thought; the development of social organization and communication; the peculiar and unique characteristics of man as an organism; the facts concerning human races, intelligence, population, and resources; a brief summary of the civilizations of man; and sections on semantics, ethics and evolution, and on the future.

I found his summaries of the behavior of social insects and higher primates particularly valuable, as also his chapter on the threat of overpopulation. Again, his treatment of the prerequisites for each step in evolutionary advance, and of the increasing difficulty of realizing each new advance, is unusually penetrating. But there is one serious gap—he gives us no adequate treatment of natural selection, its operation and results.

Speaking generally, the author's very proper desire to emphasize the continuities of evolution has led him to play down or neglect its discontinuities. When we look at evolution as a whole,—or what comes to the same thing, when we learn to see the whole of phenomenal reality as an evolutionary process—we find two major discontinuities, or, as I prefer to call them, critical points. After each critical point, the method, the nature, the tempo, and the results of the evolutionary process become radically different. The first critical point, of course, is the one between "not-life" and "life," between the inorganic and the organic or biological. It is characterized by the self-reproduction and the self-variation of matter, which immediately made natural selection operative. The second critical point is that between all subhuman organisms and man, between the organic or biological and the human or psychosocial. It is characterized by the self-reproduction (by cumulative transmission of experience) and the self-variation (by intelligence and imagination) of mind or awareness, and it immediately relegated natural selection to a back seat and switched man into the new path of cultural evolution. These facts, especially those concerning my second critical point, are implicit in much of what Professor McKinley writes; but they should have been rendered more explicit.

However, my main criticism concerns the book's main thesis—the thesis that "nature" (let us at least be thankful that he does not spell it with a capital letter) or evolution is purposive, and is "seeking" or "striving" for greater awareness, intelligence, and consciousness. Lest I be misunderstood, I will quote Professor McKinley's own words (p. 176):—"there is but one over-all trend and direction to all phenomena—that of the eternal striving of cosmic energy towards greater conscious understanding. All else is subsidiary and incidental." This remarkable statement omits all reference to the Second Law of Thermo-dynamics, which operates in a completely opposite direction. But even if the statement was intended to apply only in the field of biological evolution, it would still be wrong and misleading.

It is a curious fact that today, on the eve of the centenary of the appearance of the *Origin of Species*, so many thinkers, even among biologists, refuse to draw the full conclusion from Darwin's epoch-making work. For, once the idea of natural selection is grasped, it becomes obvious that the apparent purposefulness of evolution is apparent only.

Professor McKinley is trying to make the best of both worlds: of scientific method and of idealistic philosophy; but he only contrives to get into the awkward position of being astraddle both sides of a very uncomfortable barbed wire fence. He repeatedly proclaims that he is not a teleologist, though his central concept of nature seeking a goal or striving for an end, even a receding goal and a never fully attainable end, is the very essence of teleology. He seeks to protect himself further by the naive semantic device of calling the purpose he claims to find in evolution "non-anthropomorphic." This is a gallant, or perhaps a desperate attempt to have his cake and eat it. Unfortunately the simultaneous having and eating of cakes, whether culinary or intellectual, is just as much an impossibility as is the construction of a perpetual motion machine. The real marvel and mystery of evolution is that a blind and purposeless mechanism has generated mental vision and comprehension and eventually, in the person of man, true conscious purpose.

I hope that eventually Professor McKinley will accept this view, and will write a revised edition of his book from this standpoint. If so, it would be in the running for the best semi-popular book on evolution.

The reviewer is the well-known world authority on evolution and biology.

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THE ANATOMY OF NATURE

- - - - - - - By Andreas Feininger

Crown, $5.95
168 pp., 175 photographs

Reviewed by ROGER CROSSGROVE

IN the best book of its kind by a dedicated, sensitive artist, *Life* photographer Andreas Feininger has assembled the most strikingly beautiful nature photographs ever made. An artist, architect, engineer, and designer, he believes that

▲ THE SKELETON of an African Hero Shrew.

"a good photograph shows the observer *more* than he would have noticed in reality." A collector's item (not merely a picture book aimed to show that nature is beautiful), it is a superb visual presentation of the belief that beauty is "the resultant form of definite purpose." The book makes clear the unity, similarity, and interdependence of natural things—rocks, plants, and animals. A particularly fascinating, absorbing section is that devoted to the bones and skeletons of vertebrates and their structural design. This section alone, to say nothing of the invaluable, illustrated descriptive information and guidance on special techniques in nature photography, is worth the nominal cost of the book.

The reviewer, an art instructor, specializes in the teaching of Nature Structure at Pratt Institute.

RATTLESNAKES: Their Habits, Life Histories, and Influence on Man

- - - - - By Laurence M. Klauber

University of California, $17.50
1476 pp., illus.

Reviewed by CLIFFORD H. POPE

THIS book can best be described as stupendous: it is practically an encyclopedia on rattlesnakes. Further, because the work of a single brilliant mind, it has a uniformity found in few encyclopedias. The wonder of it is all the greater when we read that its inception dates back only to 1945.

The author has made more contributions to the scientific study of rattlesnakes than has any other investigator. He was one of the pioneers in revolutionizing herpetological method by the statistical approach. And he has never been satisfied to study his snakes only in his basement, (he has 7,500 preserved specimens!) but has observed them also in a wild state.

Calling it an encyclopedia gives an idea of its wide scope. Laurence M. Klauber has not considered lightly the last three words of the title. Amerindians and rattlesnakes are the subject of an invaluable chapter. In addition to devoting a seventh of the text exclusively to man's relationship to rattlesnakes, he has given the historical background of the subject which, therefore, includes a lot that clears up erroneous ideas and beliefs.

Some subjects are inherently technical and must be discussed in language difficult for the layman. This book is, however, clearly written and is never more technical than is absolutely necessary. The going becomes progressively easier and winds up with chapters everyone will enjoy. Despite the abundant detailed, technical information, interested laymen will browse through both volumes with fascination.

Some 260 illustrations are excellent: there are half-tone photographs of all but 4 of the 30 species and of the great majority of the 65 subspecies. The many line drawings give, among other things, details of structure. Sixty-six of them placed in the keys greatly simplify identification. Each of the two volumes has a beautiful frontispiece in full color.

The reviewer is a leading authority and writer on reptiles and amphibians.

THE RIVER OF LIFE

- - - - - - - - By Rutherford Platt

Simon and Schuster, $5.00
309 pp., illus.

Reviewed by JOSEPH WOOD KRUTCH

IN the eighteenth century they called it "The Great Chain of Being." The author of this book calls it *The River of Life*. But whatever you call it, we now see, not a fixed chain, but a continuing evolution. Yet the wonder grows instead of diminishing.

The purpose of the present work is to describe a great many of the wonders, all of which could not be covered in many volumes, much less in one. But Mr. Platt manages to cover an amazing amount of ground. Instead of beginning with the simplest forms of life, he opens with an admirable account of the honey bee, and the choice is a good one. The bee is one of the most remarkable creatures, although its world seems remote from that of another remarkable creature, — man. Mr. Platt then goes back to the beginning and presents an almost encyclopedic survey of the principal types of animal life. A great virtue of his book is that it includes so much without seeming either cluttered or unpleasantly sketchy.

Everywhere the stress is upon the unity underlying diversity. Nature seems to have hit upon every possible way of using a limited number of capacities to achieve similar ends. The most obvious end or purpose is, of course, survival of the individual and the species. The capacities are those inherent in protoplasm's ability to react, and include the five senses as well as instinct and (perhaps) intelligence. These capacities are used in countless ways and any one of them is relied upon to many different degrees.

But both life and the processes of living are obviously one thing. Ultimate questions concerning why and how, the author leaves open. He describes what occurs but plumps neither for mechanism nor any of its alternatives. Apparently he would agree with William Morton Wheeler, who said that though we know a good deal about what animals are and something about the steps by which they came to be just that, we have no idea *why* they are *what* they are.

Mr. Platt, an advertising executive by profession, is one of those amateurs who is by no means also a tyro. He has accompanied more than one scientific expe-

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What You Should Kno

An exciting round-u
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of scientific exploratio
in histo

By

WALTER SULLIV

Correspondent of the New York Ti

Bernard Kalb, New York Times

▲ HIGH CLIFFS of ice fringing much of Antarctica have protected its secrets.

About Antarctica

AT the bottom of the world lies a mighty continent still wrapped in the Ice Age and, until recent times, unknown to man. It is a great land mass criss-crossed by mountain ranges, whose extent and elevation are still uncertain. Much of the continent is a complete blank on our maps. A 1,000-mile stretch of the coastline has never been reached by any ship. Man has explored, on foot, less than one per cent of its area.

Antarctica differs fundamentally from the arctic regions. The arctic is an ocean, covered with drifting pack ice and hemmed in by the land masses of Europe, Asia, and North America. The antarctic presents the reverse situation. It is a continent almost as large as Europe and Australia combined, centered roughly on the South Pole and surrounded by the most unobstructed water areas of the world—the Atlantic, Pacific, and Indian Oceans.

The continental ice sheet is over two miles high in its center and refrigerates the air over the bottom of the earth far more than occurs over the arctic. This cold air cascades off the land with such force that it makes the nearby seas the stormiest in the world and renders unlivable those regions whose counterparts at the opposite end of the globe are inhabited. Thus more than a million persons live within 2,000 miles of the North Pole in an area that includes most of Alaska, Siberia, and Scandinavia, a region rich in forest and mining industries. Within the same distance of the South Pole there is not a single tree, industry, or settlement, apart from a handful of weather stations.

While it is certain that no place in the world is as cold as the mountain-ringed South Polar Plateau, no one knows how cold it really gets during the six-month winter night, for no one has been there then. Unlike the vicinity of the North Pole, where men have camped for many months, only two parties of explorers have ever set foot at the South Pole—both of them during the southern summer of 1911-1912. No one has been there since except to fly over in aircraft, although the United States is placing an outpost there for the International Geophysical Year of 1957-1958.

Condensed from a portion of the forthcoming book, Quest for a Continent *(McGraw-Hill).*

Historic Explorations in Antarctica

WHEN Captain James Cook encircled Antarctica in 1772-4, no one knew that there was an Antarctic Continent. In 1819-21, F. G. Bellingshausen of Russia discovered Peter I and Alexander I Islands (① and ② on adjacent map), but Nathan Brown Palmer of the United States is credited with having discovered the continent itself, when he reached Palmer Peninsula ③.

In 1823, the British explorer James Weddell sailed into the sea now bearing his name ④. The British explorers John Biscoe, Peter Kemp, and John Balleny made significant discoveries in the 1830's. The existence of an Antarctic Continent was actually announced for the first time by Charles Wilkes, in command of the first U. S. Naval Exploring Expedition. In 1840, he found land in 158°E. ⑤ and skirted the coast westward for 1,500 miles. In the same year, Dumon D'Urville of France discovered Adélie Land ⑥.

In 1841-2 James Clark Ross discovered the Ross Ice Barrier or Shelf ⑦ and sailed farther south than anyone previously (78°10'.) An expedition under C. E. Borchgrevink of Britain in 1899-1900 was the first party to winter on the Antarctic Continent ⑧, and a new record of 78°50'S. was established.

In 1902-4, the British explorer Robert F. Scott discovered King Edward VII Land and sledged south to 82°17' ⑨. In 1908-9, his fellow countryman Ernest Shackleton reached 88°23' ⑩, and others of his party reached the region of the South Magnetic Pole ⑪.

In 1911, Roald Amundsen made the famous sledge journey ⑫ that won for Norway the discovery of the South Pole. Thirty-four days later, Robert F. Scott also reached the Pole but died with all his companions on the return journey.

In 1912, Wilhelm Filchner of Germany discovered Luitpold Coast ⑬.

In 1912 and 1913, Douglas Mawson of Australia established bases in Adélie Land ⑭ and 1,400 miles to the west in newly-discovered Queen Mary Coast ⑮, charting large sections by sledge.

In 1928, Hubert Wilkins used the airplane for the first time in antarctic exploration and flew the length of Palmer Peninsula.

Richard E. Byrd established his famous base in Little America ⑯ in 1929. He flew over the South Pole on November 29th and made an aerial survey of Marie Byrd Land ⑰.

Douglas Mawson's explorations that year and the next, took him by plane over MacRobertson Coast ⑱. Also in 1929 and 1930, Riiser-Larsen of Norway discovered Queen Maud Land ⑲ and Princess Martha Coast ⑳ in flights from the *Norvegia*. About a year later he discovered Princess Ragnhild Land ㉑, on an expedition that took the *Norvegia* around the continent.

Admiral Byrd's second expedition (1934-5) explored 450,000 square miles, and Byrd himself wintered alone at an advanced station ㉒.

In 1935 Lincoln Ellsworth flew across the Antarctic Continent from the region of Palmer Peninsula to Little America ㉓, making four landings. Four years later Alfred Ritscher of Germany mapped 135,000 square miles in the vicinity of the Greenwich Meridian from the air. A year later, Richard E. Byrd charted most of the coast between Ross Sea and Palmer Peninsula.

In 1946-7, Admiral Byrd led the U. S. Navy Antarctic Expedition, popularly known as *Operation Highjump*, the largest ever organized for polar work. It included 13 ships and 4,000 men. A total of 64 flights photomapped most of the continent's coastline.

A long-term base that the French had established at Port Martin on Adélie Land was burned in 1952, but seven men remained to continue the work.

In 1946-48, Commander Finn Ronne of the United States determined that the Antarctic Continent was a single mass with no strait between Weddell Sea and Ross Sea. His airplane flights produced 14,000 aerial photographs with ground-control points, embracing an area of 450,000 square miles.

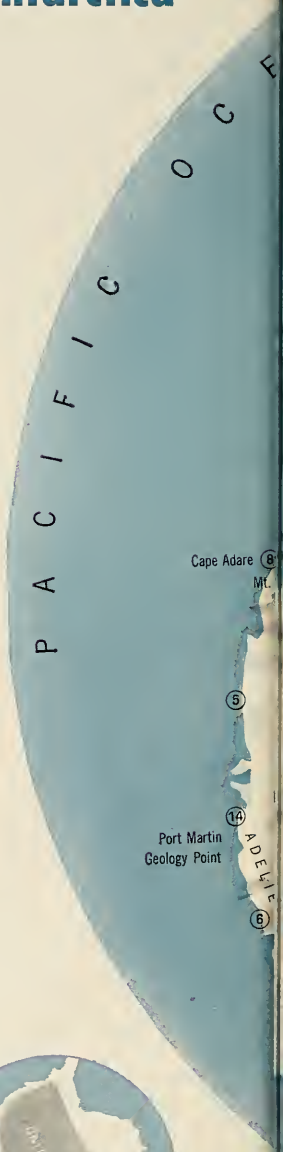
Between 1950-52 the British-Scandinavian Antarctic Expedition under Captain John Giaever conducted extensive aerial surveys from a base at Maudheim ㉔ in Queen Maud Land.

Continuous scientific work has been carried on by the Australian Government since 1947 at stations on Heard (53°6'S.—72°31'E.) and Macquarie Islands (54°49'S. and 159°49'E.).

The habitation nearest the South Pole is the scientific station established in February, 1954, and named Mawson ㉕ for Sir Douglas Mawson, the Australian explorer.

This brings us up to the vast program of international cooperation under which the antarctic continent is being subjected to extensive scientific research as part of the International Geophysical Year.

The Editors



Peter I Island
1
Charcot Island
BELLINGSHAUSEN SEA
2
Alexander I Island
AMUNDSEN SEA
PALMER PENINSULA
3
Mt. Siple
MARIE BYRD LAND
ELLSWORTH HIGHLAND
Gardner Bay
WEDDELL SEA
4
ATLANTIC OCEAN
23
17
EDITH RONNE LAND
General Belgrano
Vahsel Bay
LUITPOLO COAST
13
COATS LAND
Cape Norvegia
24
Maudheim
"Atka Bay"
berger Bay
Colbeck
nerica V
n Bay)
16
22
Inlet
ROSS
ICE SHELF
7
12
PRINCESS MARTHA COAST
20
QUEEN MAUD LAND
"Admiral Byrd Bay"
Beardmore Glacier
9
SOUTH
POLE
Mount Markham
10
19
POLE
OF
INACCESSIBILITY
PRINCESS RAGNHILD LAND
21
AMERICAN
HIGHLAND
LAND
MacROBERTSON COAST
25
Mawson
18
Vestfold Hills
KNOX COAST
15
Vincennes Bay
QUEEN MARY COAST
Haswell Island
INDIAN OCEAN

▲ THE SKUA is seen closer to the South Pole than any other bird.

U.S. Navy

▲ STRANGELY ENOUGH, an active volcano, Mt. Erebus, is found in this land of snow and ice.

Nearer the coast, where men have wintered, temperatures have been registered as low as −80°. In summer, on the other hand, when the sun shines brightly on a protected place, a man may strip to his waist. The seasons in Antarctica follow the pattern of the southern hemisphere. Summer begins in November and winter starts in June. The summer days and the winter nights become longer as one approaches the continent until, once the Antarctic Circle has been crossed, there is a period of continuous daylight in midsummer and of unbroken darkness in midwinter. If one keeps on moving toward the South Pole these periods lengthen until at the Pole itself there is only one "day" a year, with six months of daylight and six months of twilight and darkness. Here all directions are north and all time zones converge.

Until the moon or other planets are attained, Antarctica will remain the most unearthly region within the reach of man. The landscape is so alien that a completely specialized vocabulary is needed to describe it. Nunataks, the tips of mountain peaks, poke their heads above the ice sheet. Winds, pressures, tensions of almost inexpressible violence mold the ice and the granular snow, or névé, into countless strange shapes—sastrugi, bergschrunds, barrancas, dongas, hummocks, seracs. Even volcanoes thrust their fiery heads through the antarctic ice — how many no one knows. Mount Erebus continuously trails a plume of steam. And an erupting volcano so heats Zavodovsky Island that much of it is snow-free in a region of eternal snows.

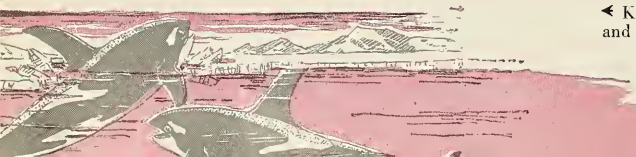
The great mass of the continent is buried under a moving ice sheet. Just as other continents shed water, Antarctica sheds ice. Snow falls on the ice sheet, adding constantly to its bulk, and then the ice flows, sometimes over 1,000 miles, to the sea. Rivers of fast-flowing ice or glaciers, cut through the plains of more stagnant ice to the ocean. Some, like the Beardmore Glacier, a dozen miles wide and a hundred miles long, flow majestically down mountain valleys, their surfaces marked by symmetrical patterns of crevasses. These clefts in the ice may be narrow and bridged with snow or large enough to hold the Washington Monument. In the steep valleys there are ice "rapids," broken into a chaos of crevasses. While they display no visible movement, they thunder with a sound of continuous artillery fire.

Much Ice is Sea-borne

The ice sheet does not pour into the sea at certain places only, as is the case with watersheds. It pushes out in virtually all directions. Icebergs break off, or "calve," from the ice front along almost the entire coastline.

Where the ice sheet has pushed out over the sea and is afloat, though still attached to the continent, it is known as ice shelf. The largest example of it covers a mighty gulf on the Pacific coast of Antarctica. Known as the Ross Ice Shelf, it is roughly the size of France, with a seaward front of 400 miles. At its maximum it extends out 500 miles from the mountainous coast to the south. This ice shelf produces the flat-topped "tabular" icebergs typical of Antarctica—great wafers of ice about 800 feet thick and sometimes 100 miles long.

Though several thousand miles of antarctic coastline have not been reached by ship, it is evident from what we have seen that much of the shore consists of ice cliffs roughly 80 feet above the water. This is the "front" of the continental ice sheet where it has pushed out from one to several hundred miles over the sea. Of all the sights that greet the newcomer to Antarc-



◀ KILLER WHALES, "the wolves of the sea," hunt in packs and are the worst threat to other creatures of the sea.

Wide World

↑ BEARDMORE GLACIER. It is formed by ice that pushes its way down between mountain peaks from the polar plateau.

tica, the uniformity of these ice cliffs is the most impressive.

Actual Shorelines Unknown

Because the ice sheet completely buries much of the shoreline, we do not know the true shape of Antarctica or where its coast would be if there were no ice. The "coast" as we see it on our maps generally marks the façade of the ice cliffs, which changes from year to year as icebergs break off. In some sectors mountains drop sheer into the water or divert the flow of ice so that there is an "oasis" of bare land along the coast, but these are exceptional.

The material from which the great antarctic ice sheet has been built is the lowly snowflake. By wind action or compression, the flakes become sandlike grains, and as they settle deeper under the weight of new snows they merge into larger and larger grains which finally congeal into true ice. Imprisoned bubbles of air are compressed as the entire structure sinks deeper. If you make a tall drink with the deeper glacier ice, no soda is needed, for the air escaping as the ice melts is under pressure and effervesces.

What does Antarctica "look like" under its icy shroud? Echo soundings in Queen Maud Land have revealed that beneath the smooth white plateau is land as rugged as the Norwegian coast. Mountains rise 4,200 feet, just poking their tips above the snow, alongside fiords that are more than 2,500 feet below sea level. There are islands and channels of sea water below the floating part of the ice sheet along the coast. The explorers who were measuring the ice had to travel over 130 miles inland before they detected ground that was above sea level. In places the ice sheet was 7,800 feet thick.

The buried fiords had been carved out by glaciers at an earlier time when the ice sheet of Antarctica was forming and beginning to fight its way to the sea – just as it did in Norway. If the ice of Antarctica retreats, the fiords will reappear.

In addition to the ice of the continent, Antarctica produces "sea

Bernard Kalb, New York Times

← FROM THE AIR, one can see that this bridged-over crevasse would be dangerous to cross by snow tractor.

Bernard Kalb, New York Times

▲ ANTARCTICA is the home of the dignified Emperor penguin. A killer whale is glimpsed in the water.

U.S. Navy

▲ ALSO NATIVE to the area, the Adélie penguin lays two eggs a season, but skuas carry off the weaker chicks.

ice" — the material of which the "pack" is made. The pack is a belt of drifting ice which girdles Antarctica. It is what kept the continent inviolate until the twentieth century. The seas around the coast freeze during periods of the winter, and under buffeting of the first violent storm, this sea ice breaks up into floes which wander with the prevailing winds, usually from east to west. The pack is often 600 miles wide, but thins in some sectors and at some seasons to only 20 or 30 miles. Explorers in recent decades have found that in a few places it may disappear altogether in late summer, allowing ships to sail right up to the ice and rock-bound coasts.

The pack is the focal point of life in Antarctica, for here is "earth's richest pasture," providing the plant food that is absent on the mainland. So cold are the waters in the pack that a man without waterproof clothing becomes unconscious within ten minutes and dies soon thereafter. Yet so dense is this water with tiny living creatures that it resembles a murky soup. The opaqueness is due to plankton — a drifting cloud of little one-celled plants and tiny animals that feed on them. There is said to be more living matter per acre in these waters than anywhere on the globe, either on sea or land. When the sea freezes, layers of this plant life are caught in the ice. Thus the slush created when an icebreaker batters its way through is often greenish-brown.

The plants in the sea are eaten by tiny creatures, who in turn are swallowed by larger fish and by birds and mammals. Even the largest of all animals, the blue whale, depends for its food on the little shrimplike krill of antarctic waters.

The chief enemies of these giants are the killer whales, the "wolves of the sea," who hunt in packs and are the most vicious and sinister of the animals in Antarctica. They run to 30 feet in length and are easily recognized by a tremendous sharklike dorsal fin that rises about 5 feet out of the water as they

Walter Sullivan, New York Times

▲ A MEMBER of the American expedition on the *Atka* in 1955 provokes a seal and gets a definite response.

break the surface. The killers are the nemesis of the blue whale. Once they have killed their prey and eaten his tongue, they may abandon the rest of the gigantic carcass. In the pack they swim under the ice in groups of from 2 to 40, and when they sight a shadow overhead, they know it means a potential dinner. They swim deep, developing tremendous momentum, and strike the ice with their backs, shattering it and spilling their prey into the water to be torn apart. They then stick their heads six or eight feet out of the water and hang there for a few moments while they look around on the ice for more seals or penguins.

Too Close to Killers

Ponting, the photographer on Scott's last expedition, saw killer whales skirting the ice that covered part of McMurdo Sound and ran toward the edge with his camera, but the killers vanished.

"I had got to within six feet of the edge of the ice – which was about a yard thick [he wrote] – when, to my consternation, it suddenly heaved up under my feet and split into fragments around me; whilst the eight whales, lined up side by side and almost touching each other, burst from under the ice and 'spouted.'

"The head of one was within two yards of me. I saw its nostrils open, and at such close quarters the release of its pent-up breath was like a blast from an air compressor. I was enveloped in the warm vapour of the nearest 'spout,' which had a strong fishy smell. . . . It was all I could do to keep my feet as I leapt from piece to piece of the rocking ice, with the whales a few yards behind me, snorting and blowing among the ice-blocks. . . . I recollect distinctly thinking, if they did get me, how very unpleasant the first bite would feel, but that it would not matter much about the second."

He leaped across the last patch of open water to safety and then looked back to see a huge black and tawny head rise out and rest on the ice, looking at him with its evil little eyes and displaying a fearsome array of teeth.

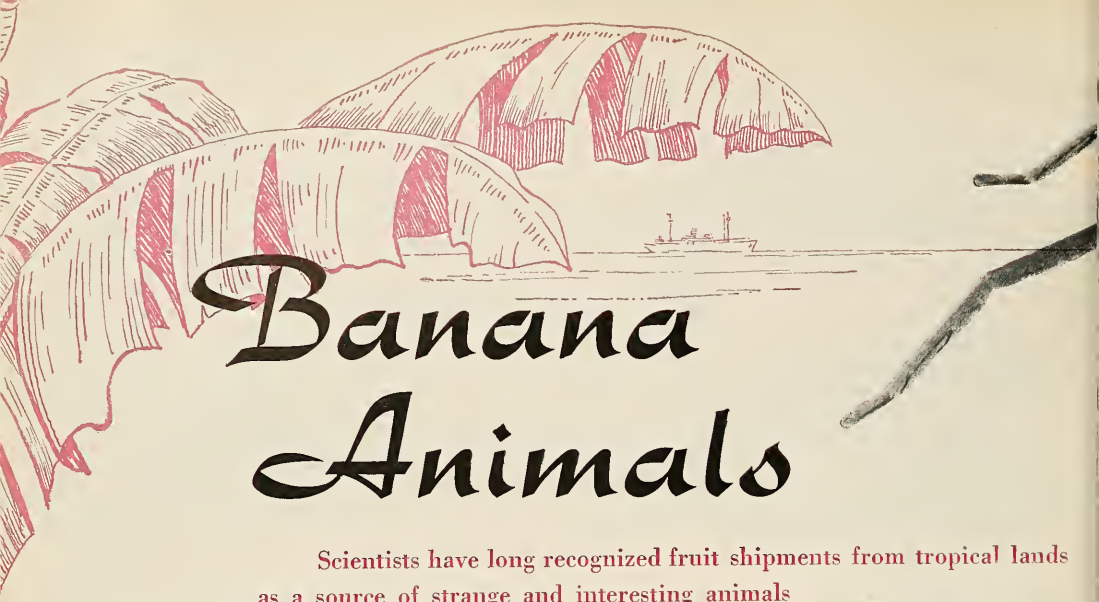
The pack abounds in seals, but none of them are of great commercial value. The fur seal was the first economic attraction in Antarctica. These animals were so decimated that they became almost extinct, but now they are reappearing at their old breeding grounds.

The antarctic pack is dominated by the crabeater seal, yet little is known of its life. Less than half a dozen crabeater pups have been seen, in all cases on the drifting floes of the pack. In the summer these great beasts – they weigh about 500 pounds – migrate to the shores of the continent, but when it comes time for breeding they return to the pack and disappear.

The crabeater is so named because crustaceans form the bulk of his diet. He dives to the bottom and scoops up both sand and crabs. His teeth are so arranged that he can use them as a sieve. He ejects the water and sand but keeps the crustaceans and a few stones that help his stomach break up the shrimp and crab shells.

The Weddell seal is considerably bigger, even, than the crabeater, for he may weigh 900 pounds and is roughly ten feet long. His life centers on the ice that covers the bays and inlets along the coast, especially where pressure has wrinkled the sea ice into ridges, creating havens out of the wind and lines of weakness in the ice where the seals can gnaw air holes. These holes enable the seals to take refuge from the terribly low temperatures that descend on the coast during the winter night. The water under the ice never gets be-

continued on page 51

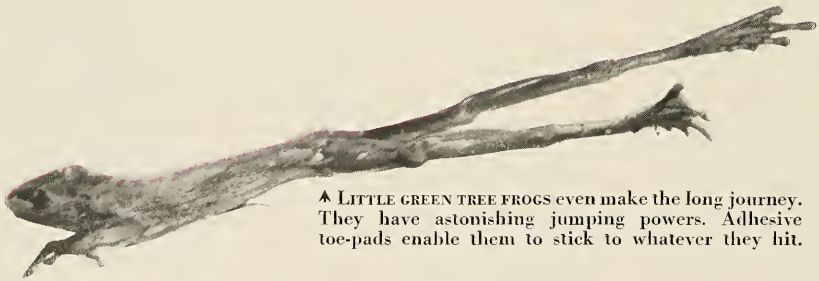


Banana Animals

Scientists have long recognized fruit shipments from tropical lands as a source of strange and interesting animals

By Walker Van Riper
Denver Museum of Natural History

All photographs by the author, with high-speed equipment designed by Dr. H. E. Edgerton



↑ Little green tree frogs even make the long journey. They have astonishing jumping powers. Adhesive toe-pads enable them to stick to whatever they hit.

When you think of the hazards of a journey on a bunch of bananas, it seems almost unbelievable that so many animals could come to this country in that way. The accompanying photographs show only a few of the creatures that have traveled to Denver clear from the plantations in the tropics. They were all turned over to me by banana handlers.

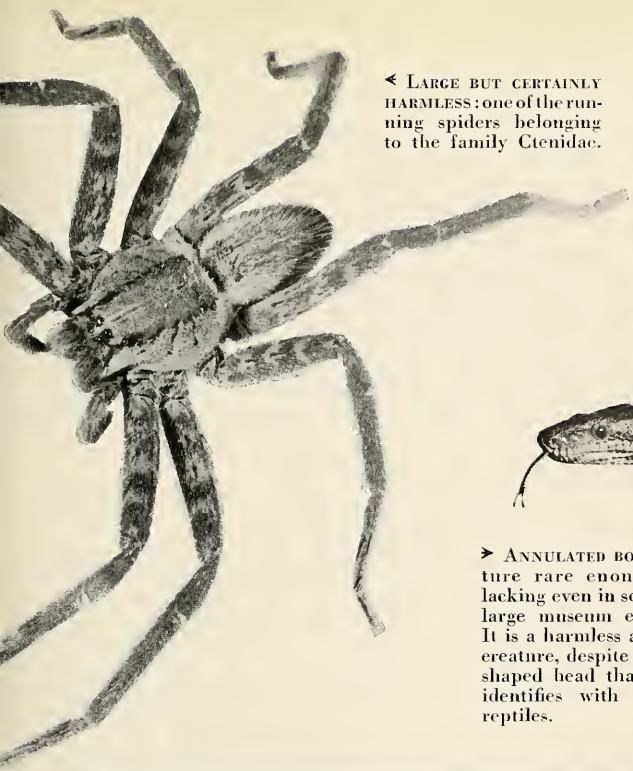
In the plantations, the banana trees are sprayed heavily to control pests. Then, after cutting, the bunches are dipped in vats containing a muriatic acid solution to wash off the poisonous sprays. Finally, they are subjected to refrigeration on the long sea voyage.

My banana menagerie has necessarily included only animals large enough to attract the interest of the banana handlers, who mainly want to know whether a thing is poisonous or not. Over the years, I have had about a dozen kinds of spiders, various tarantulas being the most common. I have also had half a dozen species of snakes, three lizards including a large iguana, tree frogs, scorpions, a giant millepede, a brushtailed mouse, and a cockroach "big enough to put a saddle on and ride," as one of my friends said.

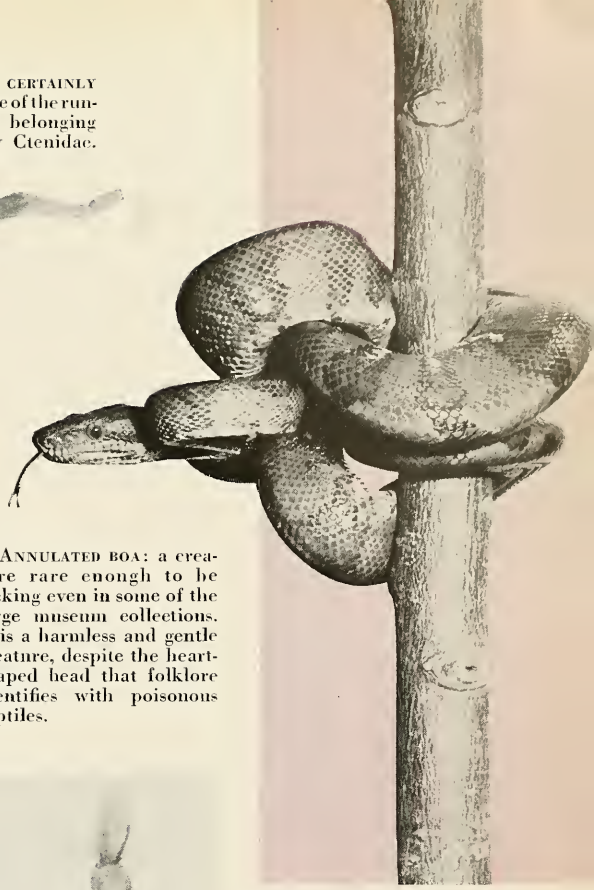
I have a long way to go to compete with one German scientist, Dr. G. Schmidt by name, who collected no fewer than 120 different species of spiders alone on bananas arriving in the port of Hamburg.

All of my snakes have been harmless kinds. However, there is a so-called "Green Snake" that has an evil reputation in the banana trade. I have been told that when one of these snakes is seen but not caught, a warning notice is supposed to accompany the shipment.

My best acquisitions came when bananas were being imported to Denver by truck from southern Mexico. Present-day shipments from more distant lands are not so productive. But one of my best specimens, the big iguana, arrived just the other day.



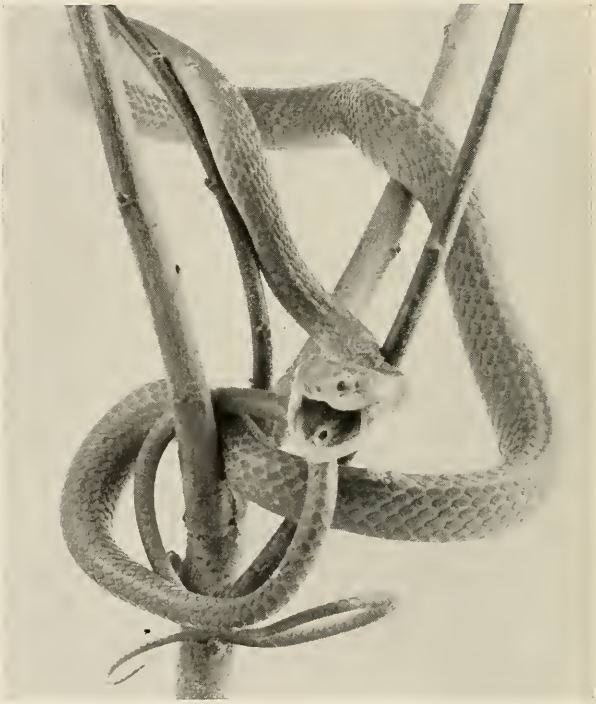
◄ LARGE BUT CERTAINLY HARMLESS: one of the running spiders belonging to the family Ctenidae.



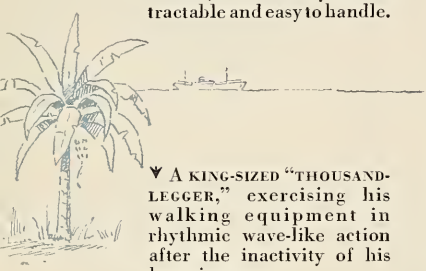
► ANNULATED BOA: a creature rare enough to be lacking even in some of the large museum collections. It is a harmless and gentle creature, despite the heart-shaped head that folklore identifies with poisonous reptiles.

◄ WITH FANGS as large as a good-sized rattlesnake's, this tarantula arrived with her egg sac and was ready to defend it with vigor. Despite their bad reputation, few of these spiders are known to have venom toxic to human beings. A banana handler in Denver needlessly chopped off his finger when bitten by a tarantula!

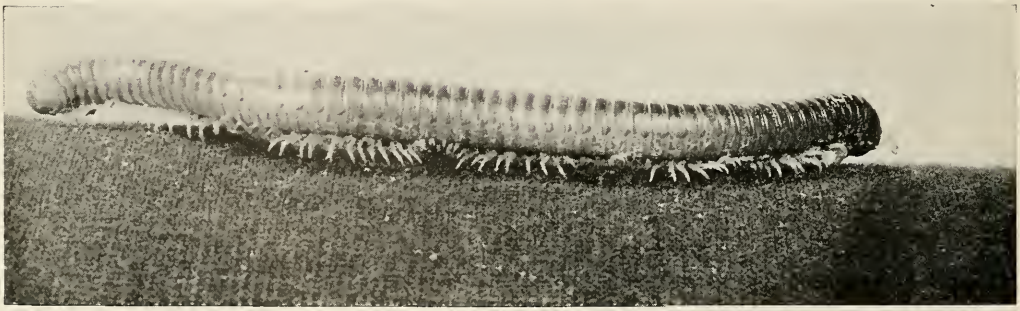
↑ THIS HARMLESS LITTLE Spotted Night Snake, possibly better known as the Cat-eyed Snake, is one of the most frequent banana travelers. If you keep two as pets, use separate cages, or you may end up with one.



→ THIS GREEN TREE SNAKE *(Leptophis ahaetulla)* opened its jaws wide and hissed loudly when disturbed, but actually it was tractable and easy to handle.

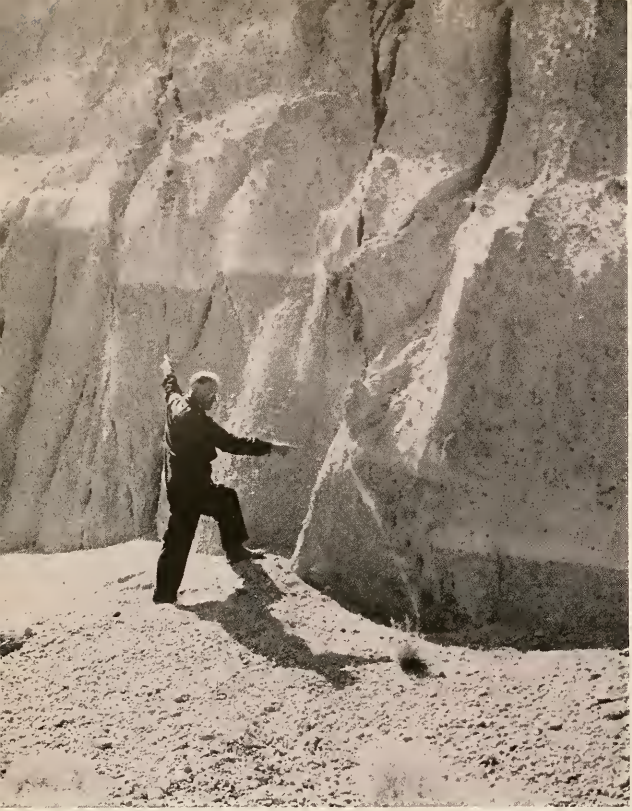


↓ A KING-SIZED "THOUSAND-LEGGER," exercising his walking equipment in rhythmic wave-like action after the inactivity of his long journey.



➤ Some days after arriving in the United States, this four-inch scorpion presented the author with the litter of babies seen riding on its back.

A Spiny-tailed Iguana a oot and a half long *(Ctenoaura)*. It reached Denver n a bunch of bananas hose origin was probably Honduras.



◄ A PUMICE PIT near Bend, Oregon, one of the richest regions in this commercially valuable oddity. Notice that the white band is at two levels here, owing to the fact that one section slipped about ten feet past the other in what is known to geologists as a fault.

▼ SWIMMERS near pumice deposits sometimes play with stone "lifebuoys."

The STONE that Floats

It is lighter than wood, harder than steel, and it serves many uses for our comfort and safety

By HOWARD E. JACKSON

As a glass, pumice is an odd sort of stone!

That may sound like double-talk, but it isn't. Webster defines pumice as a variety of volcanic glass, full of minute cavities. It is very light in weight and is used, especially in powdered form, for polishing.

You and I think of it as a stone—the kind we cleaned our hands with when we were kids. And we've heard tell that pumice is a rock that can float. A floating stone! While it would take a superman to raise a fair-sized boulder off the ground, an ordinary person can lift an equal-sized pumice stone to chest height.

In addition to being a lightweight glass rock that floats, it also has the rather unusual characteristic of being a hard substance that readily breaks and crumbles away. It's about the hardest rock there is besides quartz. That's why it's such a fine abrasive. It is used in industry on buffing wheels, in restaurants as grill cleaning blocks, and in dental laboratories for polishing teeth. Yet it is so brittle that a child can pulverize a piece the size of a cobblestone in less than five minutes with a toy hammer.

Durable? Many of the 1500-year-old aqueducts and buildings of old Rome were constructed of pumice blocks. Its durability perhaps exceeds that of any present-day concrete.

The sterling qualities of this prodigal son from the stone family are little appreciated by the average man. Even construction engineers could afford to know it better. Builders in Italy and Germany use pumice oftener than we do in the construction of houses and other buildings. Some U. S. contractors, however, are now using concrete masonry units with pumice as the aggregate, chiefly to reduce weight in construction.

In addition to being a great weight reducer, this lightweight material is an excellent insulator. It keeps a house warm in winter, cool in summer. Ceiling insulation is made of crushed pumice. It is

▼ Note how small the evergreen trees look in this view of pumice cliffs above an oxbow in the Rogue River near Union Creek, Oregon.

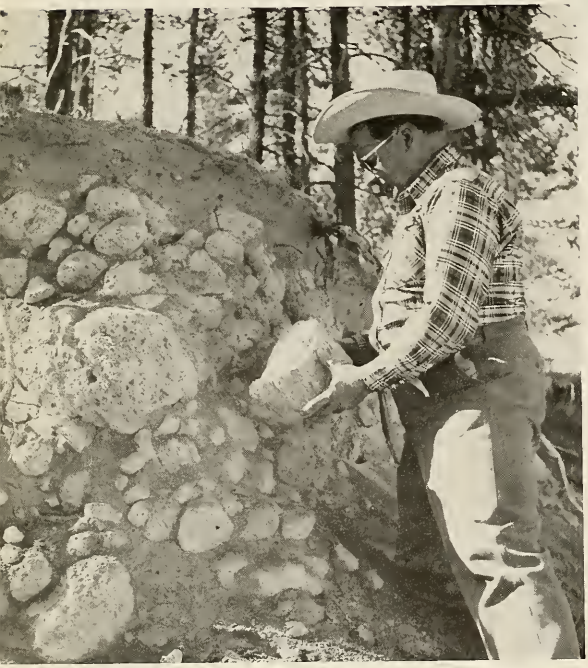
Lloyd A. Williamson

also good as acoustic material, absorptive packing material, and a carrier for catalysts in chemical industries.

Larger pieces of pumice are put to many unusual uses. Since they hold water so readily, they are employed as flowerpots for cacti and rubber plants. Soaked with fuel oil, they make excellent torches for burning brush in the woods.

America is blessed with an abundance of pumice. Central Oregon has some of the finest and largest deposits of pumice to be found anywhere in the world. The entire stretch from Crater Lake to Bend is undermined with it. In one area it is estimated that about 2400 square miles of the stuff lie beneath the

↑ A STEAM SHOVEL loading a truck with pumice. The material is so light that the bucket was enlarged by 65%.



CHUNKS OF THE LIGHTWEIGHT STONE are sometimes imbedded in the ground close to the surface as shown here. Mine owner Denver Parkes playfully tosses a large piece of pumice into the air at right.

surface, unseen, untouched. You drive on roads on top of it for about 60 miles in a north-south direction, yet would never know it is there except that some road cuts have been made through it. Since rain goes right through it, some roadbeds are made of pumice with red cinders on top.

Melting snows quickly disappear where the ground is pumice. Therefore there are no floods, and in the spring you can take off across the desert free of any worry about being mired down in mud. Natives report that almost anything will grow in pumice, if the crop gets water, but the land must be soaked overnight every two days. They also say that their houses shake when a truck or train goes by on pumice ground, but the vibrations do no damage.

Railroad engineers in pumice country had quite a time with their water supply in the old days. Well water would begin to taste rank. When a man was sent down the well, he would come up with drowned chipmunks. The little animals had bored right through the light material and fallen into the water. After that the railroad men had to haul pure water from springs where it flowed out of the porous rock.

Two Kinds

Roughly, there are two kinds of pumice. The fine kind lies in beds, as far down as 30 feet, covered by an overburden of volcanic or pink ash that is softer than pumice. The dazzling white beds of pumice vary in thickness up to 20 feet. The pumice in these beds is pea-size or slightly larger. You can hold a dozen little lumps of it in one hand. It is mined from pits by steam shovels. When sorted, graded, and sized, it constitutes the bulk of pumice used commercially.

The second kind is the lump pumice, generally found only a few feet beneath the surface. The majority of lumps are about the size of a bowling ball, but some are as big as a bathtub. They are rooted out of the ground by means of a bull-dozer. Many a 'dozer blade has

↑ Even a girl can lift a good-sized piece of pumice. The stone's porosity makes it useful for insulating and sound-deadening.

been "cut" by the stones it unearths!

And where did all that pumice come from? If you are a cook, you can picture it as something like the bubbly fluff atop a pot of boiling applesauce. If you want to make like a volcano and see how the stuff got splattered all over the landscape, put the fluffy applesauce in a funnel and blow a stream of air up through it. A good jet of air will blow the foam off the applesauce and leave the bulk of the mass behind.

That's about the way it happens in volcanoes, only on a much bigger scale. The highly cellular, fragmental volcanic rock is formed in the craters of erupting volcanoes when water vapor and other gases are being released from the viscous lava. When expanding gases reach the surface of the molten rock, they create froth, which solidifies and breaks into pieces. During an explosive eruption, these pieces are expelled from the crater as pumice. While some of the expanded glassy material is blown only a short distance from the crater, the force of the explosion may be great enough to send quantities of it many miles. A supercolossal popcorn machine!

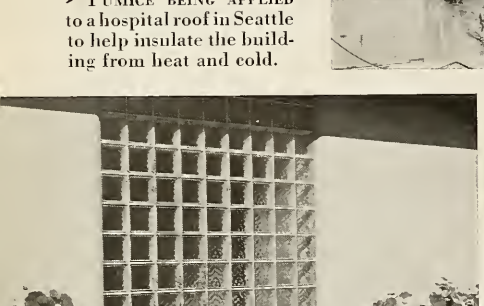
Pumice deposits occur as original beds, laid down as described above, or they may result from the reworking of such beds by wind and water.

Oddly enough, only certain volcanoes produce pumice. In Washington State, for instance, only Mt. St. Helens and Glacier Peak were pumice parents. Famed Mt. Ranier, Mt. Baker, Mt. Adams, and Mt. Tumac spewed none of the frothy stuff. This may not seem to make sense, but perhaps we can't expect every volcano to produce such a pixie as pumice!

↑ PUMICE is so hard that it scores a bulldozer blade. In powdered form, it is a favored abrasive and polisher.

Howard Staples & Associates

➤ PUMICE BEING APPLIED to a hospital roof in Seattle to help insulate the building from heat and cold.



Acme Commercial Studio

← AN EXTERIOR WALL of pumice blocks, with glass blocks between. Pumice is gaining favor as a building material. It can be painted or left natural.

Monarch of the Skies

One of our mos common butterflies ha an unusual life cycl

By

JOSEPH WOOD KRUTC

AT the beginning of the fi chapter of *Alice in Wond land,* Alice has an important conv sation with a caterpillar. Thinki of her own recent experiences, s complains that it is very confusi to change size and shape. The c erpillar—brusque as all Wonderla creatures are—replies: "It isn't."

"Well, perhaps you haven't fou it so yet," said Alice, "but wh you have to turn into a chrysali you will some day, you know—a then after that into a butterfly should think you'll feel a little que won't you?"

"Not a bit," said the Caterpil

"Well, perhaps your feelings n be different," said Alice; "Al know is, it would feel very qu to *me.*"

"You!" said the Caterpillar c temptuously, "Who are *you?*"

Having reached this impasse, t

Edwin Way Teale

↑ A VERY PRETTY BUTTERFLY, the red-brown and black Monarch is even glimpsed in the depths of the city.

proceed to explore several others that do not concern us. But this one does.

The two bodies and two lives of a vast number of living things on this earth are taken as a matter of course. Yet in very many cases neither the two bodies nor the two lives resemble one another in any way whatsoever.

Suppose we select for observation one of the most familiar and widespread of American butterflies—the large red-brown and black Monarch *(Danaüs archippus)* which few dwellers even in the depths of cities have missed seeing. It ranges over the entire United States and in recent years has migrated, perhaps on American ships, to England, to Australia, and the Philippines. Country dwellers sometimes see Monarchs gathered into large flocks in late summer, ready to begin a southward migration very surprising for a butterfly. Most other butterflies perish, leaving only eggs or chrysalises behind, though some species hide the winter out almost motionless in some shelter.

During the summer, each female Monarch has sought out some member of the milkweed family and glued to its leaves a number of tiny eggs. Seen under a hand lens, they are distinctly pretty – greenish in color, conical in shape, and neatly ribbed—, but they are also too small to be noticed often except by those who look for them. Presently the egg hatches into a tiny caterpillar, which immediately begins the only business of its young life—immoderate eating. If the pasture holds out, it never leaves the plant upon which it was hatched and does nothing besides eat, except on the several occasions when it pauses briefly to shed the skin grown too tight to be longer endured.

Presently it reaches full growth, and it is then that the casual country walker usually notices it first. It is fat, soft, and to most people repulsive. But it continues to eat ravenously, so that sections of the leaf disappear visibly as the creature moves its head up and down the edge, taking great bites as it goes. Cylindrical feces almost as big around as the caterpillar itself fall to the ground one after another in rapid succession and do not miti-

THE CATERPILLAR attaches itself to the button of silk preparatory to the chrysalis stage.

John H. Gerard from National Audubon Society

HANGING BY THE BUTTON OF SILK, the butterfly has now become a pale, leaf-green chrysalis.

A MONARCH BUTTERFLY makes an ungraceful debut from its chrysalis.

Louis Quitt from National Audubon Society

CREASED AND RUMPLED, a Monarch butterfly at this stage is a sorry sight

gate the general impression of grossness. Moreover, the caterpillar has made itself as conspicuous as possible by ringing the green of its body with black and yellow stripes. Monarch larvae have a bitter taste detested by birds; any inexperienced bird that tries one should not find it difficult to remember what a Monarch larva looks like.

Pick him up and you will see that, crowded together near the front end, are the six normal-looking legs that all butterfly larvae have, corresponding to the obligatory six legs of all adult insects. But there is nothing else about him remotely suggesting a butterfly or indeed an insect of any kind. These six close-together legs are not sufficient for his length, and yet there is an absolute rule of nature that no butterfly can have even in the larval state more than six. You will therefore see at the hind end a double row of fleshy little stumps (five pairs in all) called prolegs, which clasp the leaf upon which the creature is feeding and serve as substitutes for legs.

If you decide to raise him in captivity for purposes of observation, and should this be your first experience, you will presently be filled with despair. Your caterpillar seems sick. He has grown very sluggish and, incredibly, his incredible appetite fails, no matter how fresh the leaves of his favorite — in fact his only—food you may provide for him. But do not be alarmed. Your caterpillar is about to lose his life in order that he may gain it. Beneath his skin, invisible to any observer, drastic changes have been going on. He no longer eats, because he could no longer digest if he did. Moreover, a tough membrane enclosing his whole body is forming just beneath the skin and is making him so stiff that he can no longer move freely.

Soon he will take up a position either on a twig of the food plant or perhaps upon some other nearby support, natural or man-made. From a special gland in his head a little gluey substance is secreted, and as it hardens, he attaches the tip of his body firmly to this support. No butterfly caterpillar spins enough silk to wrap himself, as many moths do, within a cocoon; but the Monarch glue is liquid silk. Soon after he is firmly attached, he will let go with all his legs and hang head downward from this button of silk. This is the last step before the caterpillar becomes a chrysalis.

The transformation from sick caterpillar to quiescent chrysalis is less often observed than the emergence of the adult, because it happens so quickly. As a matter of fact, there isn't much to see. Everything except the one final event takes place beneath the outwardly unchanged skin. Suddenly this skin splits down the back. The creature works its way out, clinging to the castoff skin

until it can attach itself to the button of silk. Lashing its body around it, it dislodges itself completely from the castoff skin. Its body then shrinks into an oval form. Where a moment ago there was only a worm, there is now the mysterious chrysalis. But the Monarch was a good choice for observation because its chrysalis is the prettiest of any American butterfly.

The color is a pale, luminous, leaf-green; the shape somewhat ovoid but broken gracefully into two sections differently curved. Probably it follows "the laws of dynamic symmetry" (if there are any such things). It is chastely ornamented with a row of small gilded dots raised slightly above the surface where they half encircle the chrysalis, just at the line where the curvature changes.

"A green coffin with golden nails" someone once called it, and the phrase is accurate as such pretty phrases usually are not. The dots really are not yellow but precisely the color of gold leaf. If they serve any practical function, I have never heard it suggested what that function might be. They can hardly be explained by any of the methods commonly used to reduce the beautiful in nature to the merely utilitarian. There is no "sexual selection" to be made at that phase of the Monarch's life cycle. They are certainly not conspicuous enough to serve, like the caterpillar's stripes, as the warning "I taste bad." Nor can the gilding be explained away as the necessary mechanical result of structure as the beautiful designs on the invisible diatom sometimes are. Possibly some substance necessary to the caterpillar but no longer usable just happens to be golden and just happens to be excreted along the line so gracefully placed in relation to the design of the whole. At least we will let it go at that.

Keep the green coffin under observation for a while and presently the yellow-brown of the developing wings will be seen through the thin transparent outer skin. Then one day the skin will rupture and a rather sorry-looking creature, rumpled and feeble, will somehow catch hold of a support with its six legs and rest motionless for several hours. Its abdomen is disproportionately fat, its wings crumpled into little disorderly packets like the not-yet-unfolded petals of a filmy poppy. Gradually they expand and pass from shapelessness to shape. As they do so, the fat body grows slenderer, because the fluid that once distended it has been forced through the veins of the wings to expand and stiffen them.

As they grow, the whole insect begins to gain in strength and confidence. An hour ago it had been almost as helpless as a premature baby and hardly able to cling to its support. In an hour more the wings will begin to flutter and the Monarch will sail away—not to the very brief life of many moths, but perhaps to flit until the end of summer. Then, with crowds of companions, it may start the migration that will carry it hundreds of miles away to some southern clime.

Next spring a few with battered wings will make their way north again. Are these northward bound individuals retracing their previous journey, or are they members of a generation begot by those who went south? The question has been long in dispute. Butterflies cannot be banded as easily as birds!

John H. Gerard from National Audubon Society

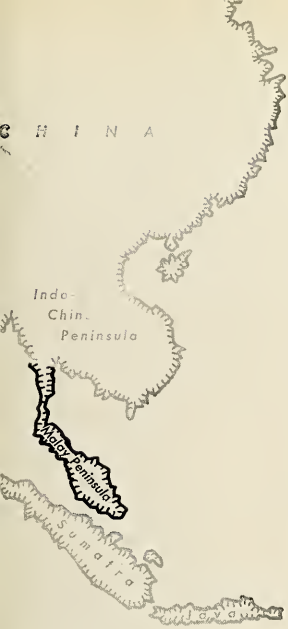
↑ It is weak and rests for several hours while gradually expanding and drying its wings.

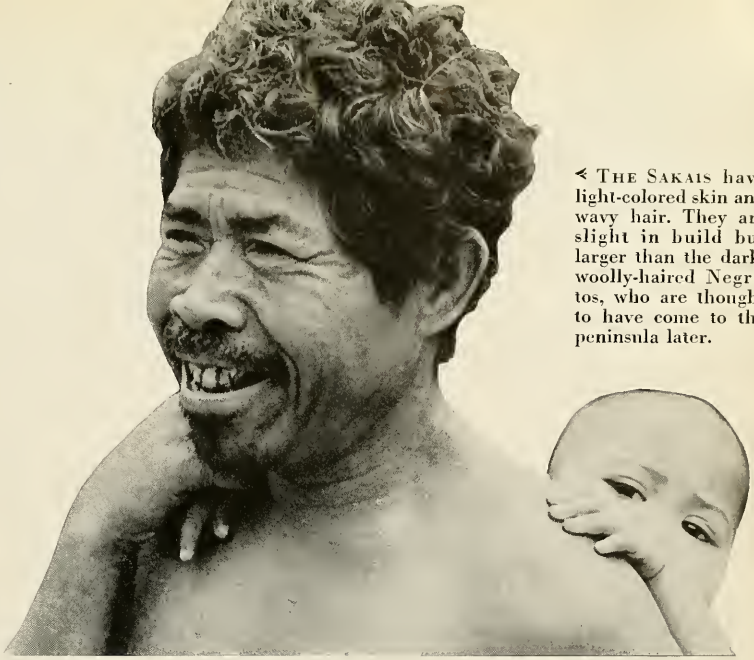
Edwin Way Teale

➤ Most butterflies perish at the end of summer or during the winter. The Monarch migrates south seeking warmer skies!

From the author's forthcoming book, *The Great Chain of Life*

▲ SHY TOWARD STRANGERS, the Sakais wear simple clothing and decorate themselves with beads, rings, and jewelry.





< THE SAKAIS have light-colored skin and wavy hair. They are slight in build but larger than the dark, woolly-haired Negritos, who are thought to have come to the peninsula later.

THE SAKAIS OF MALAYA

Glimpses of a people of back-country Malaya who occupy a strategic position in the struggle against Communism in southeastern Asia

By HARRISON FORMAN

FIRST the Communists and now the British have undertaken to win over the Sakais. They are one of three major racial groups in the Malay Peninsula. The other two are the Semang (Negritos) and the Malays proper.

The Sakais are generally small in size and quite timid toward strangers. Usually they keep to the densest part of the jungle, sometimes wandering from place to place as the local supply of roots, tubers, and fruit becomes exhausted. Though most plentiful in the widest part of the peninsula, some Sakais are found in other parts of the country. Those closer to the coast have changed their customs in contact with the Malays and can scarcely be regarded as typical.

The Sakais of the interior have attained a higher culture than the Semang. They plant rice, tapioca, and other crops. Originally they wore only loin cloths made from the bark of the *trap* and *ipoh* trees. Their traditional hunting weapon is the blowgun. Their art is simple, but they have a respectable musical culture and instumentation, including a nose-flute and a bamboo lute.

The Sakais have borrowed metal tools from the Malays, but the names they give them closely resemble the names they have apparently always given to the stone implements of considerable antiquity that are found on the Malay peninsula. It has therefore been suggested that they represent a closer link with the Stone Age than do some of the neighboring tribes.

The Communists, realizing that without assistance from the aborigines they could not exist for long in the jungle, assigned picked workers to contact and organize these men. The natives were given poultry, pigs, seeds, and tools, and were taught improved methods of farming. The Communists encouraged them to settle in advantageous locations. Their ailments were treated, and the women were showered with bangles and beads. In a short time, the Communists were apparently able to mobilize a veritable army of Sakai auxiliaries.

More recently the British said: "Let us win over the aborigines, and we shall win this war."

So the British undertook to construct a string of forts — "jungle oases" — deep in the interior. Some of these have handkerchief airstrips near by. Others must rely wholly upon helicopters. From these, contact with the aborigines is being slowly and patiently established. Some 5,000 natives are said already to have been won over.

▲ THE FACE PAINTING shown here and the multiple-strand necklaces are typical adornment among the Sakais.

◀ THE SAKAIS live in communal longhouses, raised on poles. Crude steps or notched poles lead to a single unpartitioned living room, with a springy floor made of latticed bamboo. In the larger houses, a dozen or more families eat and sleep together in harmony. Cooking is done on an open fire based in a heap of ashes in the center of the living room.

↑ DENSE JUNGLE blankets much of the land in interior Malaya, making travel difficult.

↑ PRO-BRITISH SAKAIS armed with shotguns for use in guerrilla warfare against the Communists in Malaya.

→ A YOUNG SAKAI BELLE. Though they once used bark cloth, the women now wear a sarong made of cheap textile.

The Pineapple

PERCHED on a table across th kitchen, a pineapple may seem just a reddish-yellow shape with tuft of sharp green leaves on top But look before you cut it. Notic the "eyes." Each was once a littl separate fruit—as many as 110 t 180 of them in one common variety Altogether the pineapple is a mos remarkable fruit.

Columbus thought so when o his second voyage he and his ad venturers tasted pineapple for th first time—the first time any Euro peans had eaten this fruit.

➤ PINEAPPLE CONTOUR PLANTING: the largest soi conservation project eve undertaken by private en terprise. Terraced field minimize wash-off.

Hawaiian Pineapple Company, Ltd.

Fruit of Royalty

By Jennie Harris

Since the day when Europeans first learned of it from Columbus, it has been vastly improved by science and has become an important item in world commerce

On the steep bright island of Guadalupe, the explorers had marveled at a great waterfall, its white rush of water seemingly pouring from the skies. They had glimpsed parrots "numerous as sparrows." Then they tasted this strange new fruit. It hung not from a branch overhead but grew up from the ground, on a stalk almost waist-high; and it amazed and delighted them.

"What is it?" they asked.

Of all the fruits Columbus and his men were to discover in this unbelievable world, the pineapple with its exotic flavor pleased them most.

"*Anana,*" Indians called it, which means "excellent fruit." "*Piña de Indes,*" Spaniards named it. "See, shaped like a pine cone."

It came originally from Brazil, where the Indians had cultivated and improved the wild variety. They carried the fruit with them on their travels; thus it was spread through northern South America, Mexico, and the West Indies. They seemed to sense its health values. Oviedo was to write later in his history of the Indies, "It restores appetite, induces them [the Indians] to try to eat, restoring enjoyment."

By the time its fame and some of its fruit had traveled with sailors back to Europe, it was called *King Pine,* fruit of royalty. Only the rich could afford it after such laborious transportation; besides, here was fruit royal in itself. "Have you tasted king pine? Tastes a little like melon." "More like quince to me."

Dole

▲ THIRTY-INCH STRIPS of mulch paper are laid on the field by three-row machines. Similar to tar roofing paper, mulch paper discourages weed growth, holds moisture and heat in the soil. Two discs cover edges of paper with soil to hold it down.

▲ EACH PLANTER carries a narrow tr with which he pierces the mulch p for each pineapple slip he plants. A 17,500 slips are planted to the acre.

Sir John Evelyn wrote in his diary in London on August 19, 1668, "Standing by his Majesty at dinner in his presence, there was of that rare fruit called the king pine, growing in Barbadoes and the West Indies; the first of them I had ever seen. His Majesty having cut it up was pleased to give me a piece off his own plate to taste of . . . It has yet a grateful acidity."

To forestall thirst, Portuguese sailors took pineapples with them on their voyages—and unwittingly furthered the propagation of the plant. When they yanked off the crowns and tossed them overboard, some of them may have washed ashore on Africa, Madagascar, and elsewhere. Other plantings were deliberate. Pineapples in time were thriving in the Philippines and Java.

A wealthy merchant in the Netherlands grew a pineapple plant in his greenhouse, picked himself a big ripe fruit, and started a flurry of imitators in France and England. A most engaging hobby, this growing of pineapples under glass. How-to-do-it pamphlets appeared. The fruit was now called *pineapple,* probably because people found that if the tough rind were removed, you could eat it like an apple, uncooked.

For 300 years, European nobles and others of wealth practiced hothouse culture of pineapples. Then planters took some of their cultivated pineapples to Australia and various islands in the South Pacific. Shouldn't a tropical fruit like this fare even better under open skies?

Today, greenhouse pineapples are a chief export of the Azores, mostly for European tables. But the pineapples most of us see are field-ripened. About 85 per cent of ours in the United States come from Hawaii, largely in cans.

Origin of Hawaiian Pineapple

Hawaii's varied plants have many origins. Some may have been brought by birds, or winds, or ocean currents. Others were introduced by the Polynesian voyagers who settled there. And then explorers and whalers, who used to stop at the sun-blessed isles for fresh water, may have left pineapple-starts. The Hawaiian name for pineapple, *halakahiki,* means "fruit from a foreign land."

In 1882, Akerman and Muller in North Kona, Hawaii, started a small cannery for native pineapple. Then Captain John Kidwell arrived to make history. He wanted better pineapples than Hawaii yet grew. He searched over other islands and in 1886 imported from Jamaica 1,000 pineapple plants of 31 varieties. His testing ground was in the Manoa Valley, near the site of the University of Hawaii. In all tests, Smooth Cayenne proved best. For 50 years, it had been favored by greenhouse-growers in Europe and by plantation-growers in Australia and the West Indies.

To be at their sweetest, pineapples must be picked when peak-ripe, and ripe pineapples perish quickly. Transportation to San Francisco, Kidwell's chief market, was long and rough, and the delicate fruit suffered in transit. Kidwell realized he must can his pineapples to save them. He joined with a plumber, John Emmeluth, and opened a cannery in 1892, but the venture failed. Then in 1899, young James D. Dole came to Hawaii from Harvard and planted a dozen homestead acres on Oahu.

Few people believed in Dole or his dream. However, he managed to exchange shares of stock for freight charges, and he raised $20,000 locally and in Boston and San Francisco to form the Hawaiian Pineapple Company. People were impressed when he shipped 1,800 cases of pineapples in a year. Before long, he was averaging 25,000 cases.

All photos by Dole

▲ THE PLANTS are sprayed with an iron solution at intervals throughout growth. Another spray is used to destroy insects. Specially fitted trucks deliver the sprays over a wide area.

But there was more to the problem than growing and canning pineapples. People had to be educated about pineapples. Dole increased his advertising. In 1922, he was able to expand and bought a whole island. "Doesn't he know Lanai's a dust bowl?" people asked. "How can he grow pineapples there?"

Withstand Dryness

Lanai, though one of the cooler places in Hawaii, *is* dry. When Dole took it over, it was desolate and largely overrun by cactus. But pineapple plants are a little like cactus in their ability to store up moisture. They hold it in the thickened bases of the leaf blades. And on Lanai the pineapple thrived. Today, 14,000 acres – 22 square miles—are planted with pineapples there. Homes, schools, churches, playgrounds have been built. Workers and their families—2,500 men, women, and children – live happily on this island, once "not good for anything." Lanai City is located at an elevation of about 1,800 feet and is heavily planted with Norfolk pines.

In 1906, three things happened. A. W. Eames, Sr. established his cannery for pineapples (now the California Packing Corporation) at

▲ HARVESTERS select the fully ripe fruit, remove the crown, and place the pineapples on a conveyor belt. The moving belt carries the fruit to the harvester, and an elevator conveyor lifts it into the bin. When the truck is full, it drives out and a new one with an empty bin comes in to take its place.

Wahiawa; W. P. Thomas also built one in the same place (the beginning of Libby, McNeill, and Libby); and the Kauai Pineapple Company opened at Kauai. Other companies organized.

Today there are eight companies, twelve plantations, and nine canneries. In the 1952-53 pack year, they produced a hundred million dollars worth of pineapples. Most of the industry is located on five of the eight islands: Oahu, Maui, Molakai, Lanai, and Kauai.

The companies, through their own research and through the Pineapple Research Institute, spend an estimated million dollars a year on pineapple study. They maintain 150 acres on Oahu exclusively for scientific purposes.

Treated like a Prodigy

To the eating world, Hawaii means pineapples, and to the agricultural world, pineapples mean latest scientific methods. The pineapple is so strange a fruit, almost a law unto itself, that special chemicals, hormones, and protective agents are used to care for it through every stage of production and have made it the great golden fruit we enjoy today.

Believe it or not, the pineapple is akin to Spanish moss, which festoons live oaks in the South. In fruit structure, the pineapple is a little like the strawberry. Its fruit is a group of fruitlets fused.

At the time of planting, a Hawaiian pineapple plantation looks striped in red and black. The red is the soil. The black is the mulch paper that is laid down so that the plants may later be planted through it. It is impregnated with asphalt to conserve moisture. It keeps down weeds till the plants are large enough to fight weeds themselves, and by then the mulch paper has rotted. Moreover, by raising the temperature around the plants, the mulch paper makes them grow faster.

Before the mulch paper is laid down, the fields, in blocks 100 to 120 feet wide, must be prepared. This means knocking down and stump-cutting the tough fibrous material left from a former pineapple harvest. Heavy disc-plows loosen and granulate the soil over and over. Other equipment pulverizes it.

Then a special machine for pineapple cultivation fumigates the soil and covers it with the long strips of black mulch paper, 32 to 36 inches wide. At the same time, the machine may lay fertilizer down under the paper.

Men with sharp knives gouge holes in the mulch and insert a pineapple plant in each hole—15,000 to 18,000 plants to the acre. These so-called "seeds" are either crowns from the ripe fruits, slips from just below the fruit, or suckers from the lower part of the plant's main stem.

Just selecting this plant material takes care and skill. Slips and suckers from outstanding mother plants are grown separately for several years, and selections from these are used to develop superior strains. Thus, in time, the quality of the entire plantation is improved.

A tiny wasp was imported from Brazil to destroy mealy bugs, which suck pineapple leaf juices and transmit wilt. But mostly the plants are protected with insecticides, fumigants, and weed-killers. Plant nutrients are supplied regularly.

The machines are odd-looking. One type has a 50-foot arm that sprays half of a 100-foot wide block in a single journey. A mealy bug sprayer has nozzles that attack the bugs sucking at the center of the plants and also hit the undersides of the leaves where they like to gather. A fertilizer machine has a flange that pushes aside the leaves and drops fertilizer at the base of the plant.

Once workmen had to walk down the fields with a hand spray to feed the plants their needed iron. Now a tower-spray outfit sends out a fine mist under high pressure.

No less fantastic than the machines are the names of some of the chemicals. A worker may tell his wife, "We sprayed pentachlorophenate today." "What's that for? Oh, I know. So you won't be bothered with weeds." Developed by the Dow Chemical Company of Midland, Michigan, this is standard against weeds in pineapple fields.

Hawaiian scientists, constantly in touch with research departments

and laboratories all over the world, make tests and adopt any procedures that help pineapples. There is much outside assistance as well. The chemical industry has even influenced the shape of the pineapple. Hormones plus careful breeding make it a big smooth, barrel-shaped fruit instead of the pinelike cone that gave it its name.

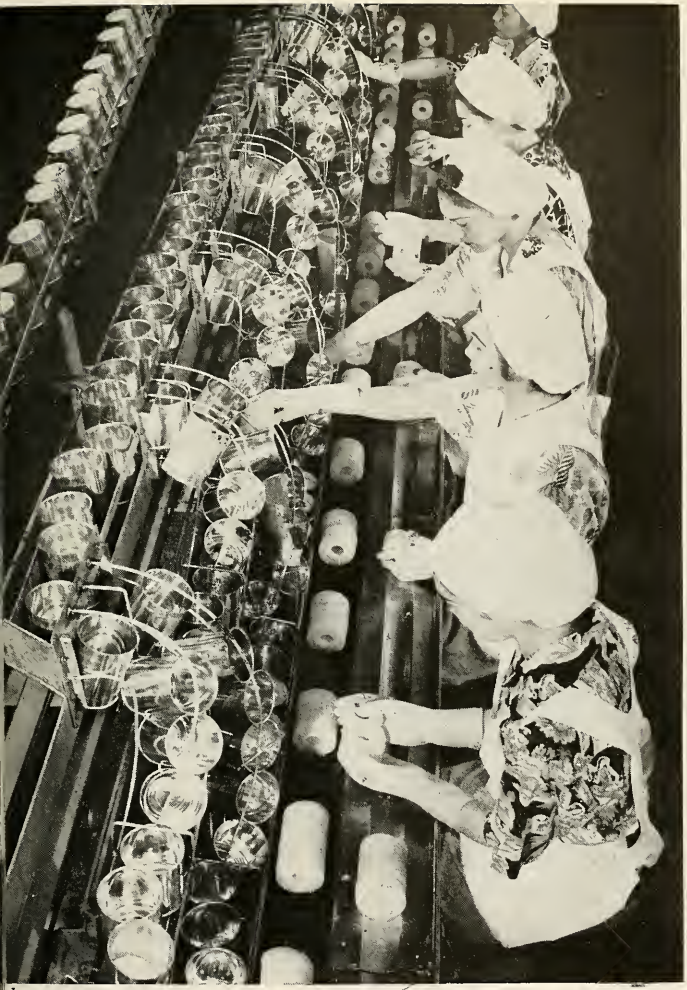
From Bud to Fruit

As the young plant matures, its leaf blades become 30 or 40 inches long and 2½ inches wide. They are swordlike, with tapering, thorny edges spiraling up around the short main stalk. They furnish this central stalk with starch.

In a little over a year's time, a tiny bud appears at the tip of the stalk and enlarges. Then, about 16 months after planting and at 8 or 9 o'clock in the morning, the first flowers bloom. They are like a signal to the leaves, telling them to stop growing.

The next day, more flowers will open, and so on for three weeks until the final blooms (the ones at the apex of the bud) have had their little day.

Now what happens? The ovary of each flower thickens, fleshens, becomes a little fruit attached to the central core, and fuses with a



hotos

'HE PINEAPPLES are into the Ginaca ma- ne, which removes shell and core and off the ends, leaving fruit in cylindrical m. The machines cess fruit at the rate 0 to 105 pineapples a ute.

↑ PACKERS carefully inspect and grade the slices and place them in the appropriate cans.

Hawaiian Pineapple Co., Ltd.

fruitlet near it. The sepals and bract of the flower also thicken, touch, and merge with the thickened sepals and bract of an adjacent flower. The connection becomes spiral in that slow, patient whorling around the core. Six months of this enlarging and connecting, and we have the composite single fruit with a complete rind of partially flattened bumps.

The fruit weighs perhaps five pounds and may be seven inches tall, with a crown of stiff pointed leaves, borne erect on a four-foot stalk.

The tough rind yellows; and the flesh inside turns pale yellow. The fruit awaits its final gift: a rush of sugar from the supporting stalk to all its flesh and juice. Starch in the stalk turns to sugar. The ripening happens so rapidly that harvest hands must be ready to pick fast to hit the peak of sweetness and ripeness. This usually comes 15 months from the time a sucker was planted, 18 to 20 months from a slip, 22 months from a crown.

The busiest months are July, August, and September. Harvesting calls for 12,000 more employees than the year-round 6,000 fieldworkers and the intermittent 4,000 cannery workers. Luckily students, home by the thousands for vacation, work eagerly to pay for further schooling. Housewives put in spare time. Races work happily side by side — Filipinos, Chinese, Japanese, Hawaiians. Hawaiian pay is the highest year-round agricultural wage in the world — from $1.20 an hour for a tray boy or $1.35½ an hour for a planter, to $2.09 for a head carpenter or a leading machinist, with paid vacations and holidays, medical protection, sick pay benefits, retirement pay, group insurance. Romantic settings and sparkling beaches add to the lure of employment.

Only skilled eyes and hands can select the pineapples that are ready to be picked. Harvesters wearing heavy gloves and heavy clothing against the sharpness of pineapple leaves, go down the rows, breaking off "pines" and striking off their crowns. They walk behind a moving belt on which they place the fruit. The pineapples are transported to a truck, and when the truck is full, it moves to the cannery and another truck comes in to take its place.

Only one pineapple from one plant after two years of care! But a year later, a second crop will be harvested, the so-called ratoon crop, borne on a sucker or two left on the original plant. The first harvest may yield about 32 tons of pineapples to the acre, the ratoon 20 to 25 tons.

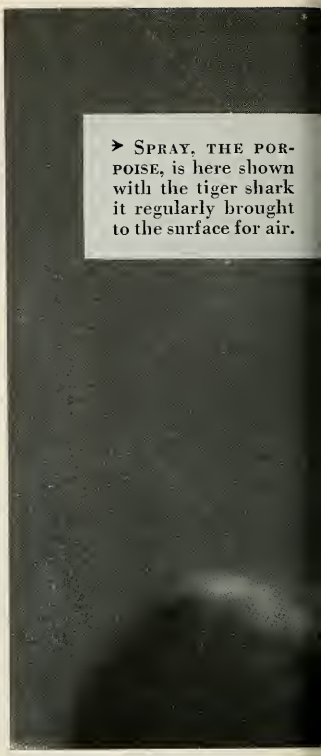
Soon after the first harvest, the men collect the best planting material. After the ratoon crop is taken, they knock down the plants, plow them under, and make ready for an entirely fresh planting.

The fruit must be canned within 4 to 24 hours after picking. Each pineapple company cans its own fruit. At the cannery, the truck with its movable floor discharges pines into a storage conveyor. Barges also bring to the canneries thousands of tons of ripe pineapples from the islands of Molokai and Lanai. These, too, go into mechanical conveyors and thence to the graders.

Big fruits, graded as to size, pass under strong streams of clear water for a thorough washing. They then pass to a sort of wonder-machine, the ginaca, invented by Henry Ginaca in 1913. This shells, cores, and trims off ends of fruit, all in one operation. What's more, as the fruit shell falls, the machine retrieves any flesh left clinging to it. Forty of these ginaca machines may operate in a single cannery—odd-looking automata, their movements fast, efficient. Remnants of skin left on a trimmed cylinder are removed by hand. Other workers watch for blemishes, off-sizes.

The fragrant, cored cylinders move in a fast, even stream to the trimmers. Here, workers remove frayed ends, internal blemishes, and pieces of shell not removed by the ginaca. Next the fruit goes to the slicing machine, where it is sliced, diced, or chunked. Again it

continued on page 55



➤ SPRAY, THE PORPOISE, is here shown with the tiger shark it regularly brought to the surface for air.

The Porpoise with a Purpose

By CHARLOTTE B. NORI

A porpoise at an oceanarium tries to mother a tiger shark with fateful consequences!

LATE IN July, 1956, a female bottle-nosed dolphin named Spray reversed the mood of the legend that says dolphins and porpoises will befriend a drowning person. This one methodically and thoroughly unsaved the life of a 20-pound leopard shark. The shark was one of her finny neighbors in the giant, four-story tank of sea water at California's Marineland of the Pacific.

Apparently, Spray considered the shark too pale about the gills; and, reacting in accordance with her species, she decided that, like herself, he needed a whiff of air. So she took an uncompromising grip on his head and surfaced. Then, still holding the squirming fish over her nose, she dived low in the tank, rolled over in a leisurely way, and repeated the performance.

Periodically, day and night, porpoises have to come up for air, and by this treatment, Spray seemingly undertook to teach the shark the art of gracious living. As the days went by, she failed to realize that her protégé was weakening. In fact, she continued her Ferris wheel routine long after her victim had been gathered to his fathers.

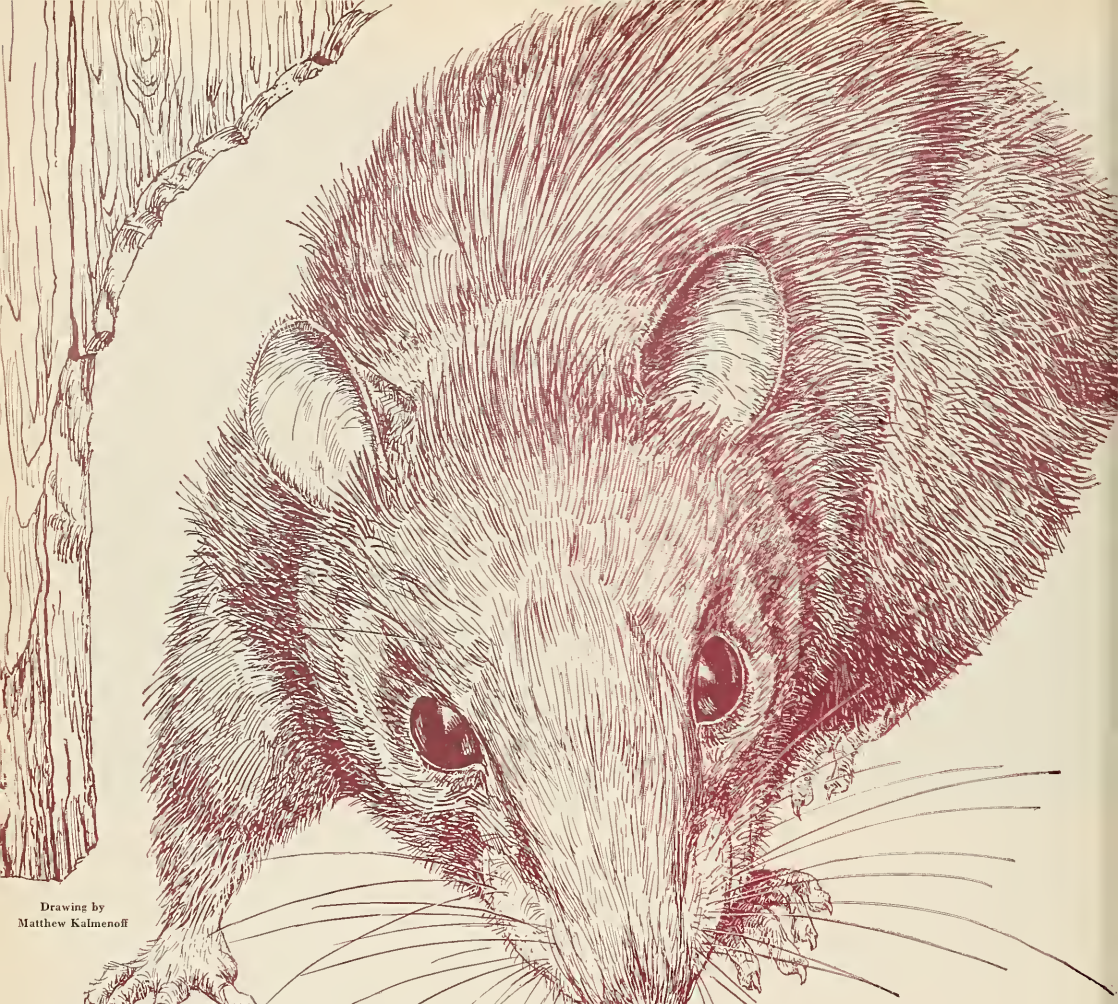
During the eight-day interval, this dedicated dolphin did not eat, sleep, play ball, nor race with other porpoises. She simply continued to swim monotonously up and down, up and down. As many as three divers at a time tried to take the demised fish from her; but being capable of projecting herself through the water at a speed of 20 miles an hour, she continued to elude them.

Mother porpoises have been observed to support an ailing young one at the surface. We don't know whether Spray had ever had any family responsibilities. But Marine Aquarist David H. Brown observed her minutely, clinically, and shook his head in a puzzled manner. "Spray has certainly developed a fixation," he said. "She is treating that shark much as she would her own young, taking him topside to teach him to breathe."

At the end of the eighth day, hunger triumphed over devotion. During one of the feeding periods, Spray dropped the fish for a moment to obtain food, and an alert diver retrieved it.

With an audible sigh of relief, David Brown commented, "Just why that dolphin lavished so much attention on her cold-blooded neighbor is really not known. A good guess would be that the silly old thing actually imagined the shark to be a baby porpoise. Who knows?"

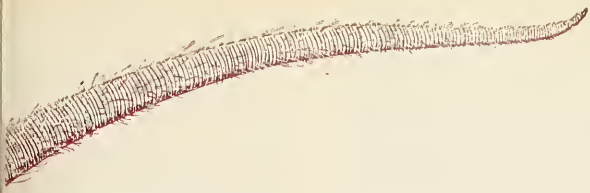
However, if the shark had been permitted the last word, he'd doubtless have stated bitterly, "The old superstition about bottle-nosed dolphins bringing fair weather to seafaring men is pure hokum, for this one brought only a falling barometer to me!"



Drawing by
Matthew Kalmenoff

The Destructive

RAT– *Strange I*



All the wars and revolutions in history

haven't taken as many lives as the common rat

has during the last ten centuries

roduct of Civilization

By Gary Webster

MEASURED by almost any standard, the rat is the most important four-legged foe of modern man. A twelve-ounce engine of destruction with built-in disease-carrying features, he easily surpasses all the others in numbers, cost, and menace.

But we've brought it on ourselves. True, rare and scattered clues suggest that rats have been around for many thousands of years. Bones have even been found in association with relics from men of the Stone Age. But the rat has had a very brief career as a major villain. He has played this role for less than a thousand years—a mere instant of biological time.

The literature of classical Greece and Rome abounds in reference to animals, large and small. There are several allusions to mice, but not so much as a single word about rats. This factor, plus the absence of their bones from excavated sites, indicates they were rare if not altogether missing from ancient cities. Not until late in the twelfth century did any writer make a clear reference to the rat.

Theory has it that wild rats of the Arabian deserts found that they could fare better in villages than among sand dunes. So they moved to town, became dependent on mankind, and gradually spread into more densely settled regions. If this view is correct, they were numerous but not especially important by the time of the Crusades. When Christian warriors returned to Europe, African rats stowed away on their ships and soon established outposts in the new land.

The rat of this era is now known to zoologists as *Rattus rattus*. A skilled and graceful climber, he can easily run along pipes, wires, and ropes. His tail—which is slightly longer than his head and body together—serves as a balance so effective that he can jump from one perch to another almost as nimbly as a squirrel.

Early efforts at control were scattered and ineffective. In some cities, various kinds of bounty were offered. For instance, in the fifteenth-century, Jews in Frankfort, Germany, received special privileges in return for annual tribute in the form of 5,000 rat tails. Professional rat-catchers became so numerous that they were organized into guilds. In Shakespeare's time, a good rat-killer might enjoy considerable honor in his town.

In spite of attacks by professionals and amateurs, the so-called black rat had a field day. Europe was literally over-run. Damage to food and other commodities shot upward at an alarming rate. People grumbled, tried new traps and poisons, passed laws.

They did not even realize that the rat's role as a vandal is the smallest part of its menace. Only in recent centuries have people understood that the epidemics of typhus and bubonic plague in Europe were linked with the invasion of the rat.

Though plague must have existed much earlier, it did not become epidemic until modern times. Plague is transmitted to man by fleas from rats. In the five or six generations before Columbus' voyage, more than 34 million persons died of it. Europe's population was reduced by one-fourth. Spanish armies in Granada lost six men from plague to

Seventeenth-century rat-catcher.

Bettmann Archive

Philip Gendreau

every man felled by arrows of the Moors. It hit London in 1665; before it subsided, there were 100,000 casualties.

Many persons regard the rat-borne disease as "medieval," of historical interest only. It is true that there have been no major epidemics in the western hemisphere in nearly three centuries. Health authorities have checked it quickly in each U.S. outbreak: San Francisco, 1907; New Orleans, 1914; Galveston, 1920.

Lacking money and equipment, doctors of India have not matched that record. In the quarter-century after 1898, plague killed as many natives of India as there are people in Chicago, Philadelphia, Atlanta, Dallas, Miami, and Los Angeles, combined.

And that's only one facet of the story.

Rats transmit murine typhus through the agency of the lice they harbor. During the four centuries this disease has been epidemic it has claimed millions. Historians generally write the records of nations in terms of kings and generals. As Hans Zinsser has pointed out in his famous book, *Rats, Lice, and History*, rat-spread typhus has influenced western civilization far more than any great man whose name

Loss of stored crops keeps the farmer constantly on the warpath against the rat.

Three Lions photos

➤ CALCIUM CYANIDE is sprayed into suspected places.

▲ POISONED PELLETS must not endanger desirable animals.

◄ VERTICAL TRAPS sometimes fool wary rats.

➤ SCREENING VENTS helps where original construction was not rat-proof.

appears in all the history books.

It would be guesswork to estimate the total impact of rat-linked disease and death. Rats rank so high among global killers that most authorities are content with a general statement. In less than ten centuries, experts agree, diseases involving rats as agents have taken more human lives than all the wars and revolutions ever fought.

Plague and typhus do not exhaust the list. A rat is a living freighter whose design is just right for transporting a cargo of bacteria. He can digest almost anything; and after a meal in the garbage dump, he may slip into a building for dessert. With feet still wet from a jaunt through his favorite sewer, he will prowl casually over the stock of the corner grocery. His blood stream and stomach harbor disease-producing organisms ranging from those of amoebic dysentery and infectious jaundice to rabies and tularemia.

So far, all attempts to exterminate the rat have failed miserably. Hundreds of inventors have perfected traps—but none are more than moderately effective. Dogs, cats, ferrets, and even weasels are still employed to hunt them, but they seldom do more than thin the ranks temporarily.

Poisons

Long-used natural poisons have about seen their day. Powerful new synthetic compounds of several types have been used with considerable success. One of them, 1080, is so deadly to humans and livestock that only experts are permitted to use it. Another, ANTU, is fatal to brown rats but comparatively harmless to many other mammals. Warfarin, most publicized of new poisons, prevents blood from clotting and causes rats to die from internal bleeding.

A few optimists have predicted that these and other chemical weapons can reduce the rat to negligible importance. Others consider such a view to be wishful thinking. In the known history of rats, they point out, there has been only one instance of a really decisive victory.

It was won, not by man, but by rats. The two main types of rats that live with man are *climbing* rats (such as *Rattus rattus alexandrinus)* and *burrowing* rats *(Rattus norvegicus* and its varieties). The burrowing rats are sometimes called brown rats, though both brown and black occur in the two main types, and brown is actually predominant in both. History's strangest conquest is believed to have been launched shortly before 1727. In that year, hordes of the unfamiliar "brown" kind were seen scurrying through Russia. When they came to the Volga, the army of migrants plunged into the river. Thousands drowned, but great numbers crossed to the western bank.

Some authorities think this fierce rodent came from Chinese Mongolia. Others believe its original home was somewhere near the Caspian Sea. At any rate, it was unknown in Europe before the eighteenth century.

Once it penetrated new regions, however, the brown rat's advance was sure and rapid. A few specimens reached England in 1728. Popular belief linked the new marauder with timber ships from Norway. Hence it is now almost universally known as the Norway rat.

The newcomer was short-tailed and blunt-nosed by comparison with the black rat and proved much more fierce. Attacking its well-established cousin, the brown rat won a series of smashing victories. Blacks are still dominant in tropical and subtropical areas throughout the world. But almost everywhere else except in seaports, browns have exterminated their slender foes.

Brown invaders reached North America some time just before or after the Revolution. They spread up and down the Atlantic seaboard within a decade. When miners made their epic dash to California, rats went with them. Working inland from both coasts, they were soon established throughout temperate North America.

Meanwhile, other immigrating rats moved eastward from Europe and set up successful colonies wherever they stopped. Hence they are now firmly entrenched in regions that make up about half the world's land surface. At the mid-point of the twentieth century, no other mammal except man holds equal territory. The brown rats of the world probably outnumber their hosts; if so, they are the most numerous mammals on earth.

Bettmann Archive

▲ THE PIED PIPER charming rats out of town.

Willingness to eat just about anything has been a major factor in the rat's world conquest. Adults eat about 50 pounds of food a year. Their menu: almost anything they can cut. They've been known to gorge on paint, shoe leather, soap, and rubber insulation from electric wires. Enterprising colonies have cut into the bellies of swine, dug turnips from the ground, even feasted on the oil-rich toenails of sleeping elephants.

No one knows how many rats

there are in the world. In the U. S. alone, there are thought to be some 175 million, give or take a few million. This estimate rests on data from many campaigns. In Baltimore, one year of activity by civic forces led to some 460,000 casualties among the city's rats. U. S. Department of Agriculture workers killed 7½ million in a single three-state operation; it took 400,000 traps, carloads of poisoned grain, and about one million pounds of little sausages treated with poison.

According to the best guess of the U. S. Fish and Wildlife Service, direct rat damage in this country ranges somewhere near $200 million a year. World totals soar far into the billions, precisely how far, there is no way to determine.

Actual eating by rats is perhaps the smallest part of their drain on civilization. They destroy many times as much as they cram into their bellies. It is generally believed that their toll exceeds that of all other animal pests combined.

Bettmann Archive

A TOWN CRIER calling "Bring out your dead," during the London Plague of 1665. The cart in the background is removing the corpses.

Keep Gnawing or Die

Part of this wholesale destruction rests on a biological base. The incisor teeth of the rat appear eight or ten days after birth. Both lowers and uppers keep growing throughout the animal's life. The incisors advance at the rate of about four inches a year. If one is lost from the rat's upper jaw or is knocked out of line, the one below may push up so high that it pierces the brain cavity and causes death.

Total growth of upper and lower cutting teeth in the normal rat's three-year life amounts to about 29.5 inches. Obviously, if the rodent didn't work constantly at the job of wearing down his teeth, they'd soon become so long he'd go around with his mouth permanently propped open.

This factor may account, at least in part, for persistent life-long gnawing and chewing. Observation suggests that the typical individual uses his teeth at least half his waking hours. When he isn't actually eating, he's ripping and cutting—sometimes, it seems, for the sheer fun of it.

Given a few hours in a warehouse, a single rat may tear holes in dozens of sacks of flour, grain, feed, coffee, or even fertilizer. Instead of dining on two whole potatoes or apples, a hungry fellow is likely to take random bites from a score of them. Rats are said to have slaughtered as many as 1500 baby chicks and 325 broilers in a single foray.

The cutting edges of their teeth are extremely hard. For no known reason except a remote possibility that water may be their objective, rats sometimes gnaw through lead pipes. Laboratory albinos — weaklings compared with their wild cousins—cut through two inches of foamglass in an eight-night test. Two nights less were required to gnaw a hole in an aluminum sheet a full half-inch thick. Wild rats have been known to cut through four inches of old concrete. They've gnawed holes in dams and started floods, and once threw much of New York into darkness by stripping insulation from wires to cause a major short-circuit.

Though ordinary rats are not such collectors as the notorious pack rat, they do steal small objects and carry

Gregor from Monkmeyer

THE WHITE RAT of laboratory fame, unlike its unwanted cousin, has helped save millions of lives. These young cannot yet see.

them to the nest. Exterminators digging into dens under a tenement have found keys, coins, a belt buckle, a lipstick tube, a shoe horn. Matches are often scattered through such piles of loot.

It is no myth, declare experts, that rats start fires both by cutting insulation from electric wires and by accidentally striking matches. Running to his nest with an ordinary friction match in his mouth, the rat drops it when it happens to strike. If it falls into a pile of litter, there may be another fire of undetermined origin.

Dr. Curt P. Richter, of Johns Hopkins, devoted five years to study of the rat's dietary choices. Given free access to separate containers of minerals, vitamins, carbohydrates, fats and proteins, laboratory animals selected each in proportions making for good health. That, insist some analysts, is more than many humans will do.

Rats can dig their own burrows, but they also are smart enough to take over the quarters of other creatures. They aren't fond of water, but swim when the situation demands it. Sailors have long vowed that rats can tell when a ship is in bad condition. The belief that they will desert a doomed vessel explains the almost universal practice of calling any kind of deserter or traitor a "rat." Bizarre as it sounds, the notion may not be completely unfounded. In old wooden ships, rats would be the first on board to know about new leaks—which may have prompted an exodus at the next port.

Many wild creatures languish in captivity, quickly die. Not the rat. He quickly adapts to almost any conditions in which life can be sustained. Producers making educational movies about rats found that the animals soon ignored intense light. Camera noise was a bigger problem. It was solved by running nonsense sounds continuously at a high volume, masking all minor noises. The four-footed actors went about their business, oblivious of both sounds and lights.

Most exterminators agree that an old veteran, whom they call a "Moby Dick," can master almost any kind of trap. He will kick it around until it goes off, then calmly eat the bait—unless he whiffs poison in it.

One expert vows he has known individual rats that liked music so well they clicked their teeth in applause. That story, which hasn't won general acceptance by scientists, may rank with others which tell of young ones leading the old and blind to safety in time of danger. And there are those who declare they've seen rats steal food by dipping their tails into bottles too small to admit a snout.

Perhaps the most fantastic rat story is the one that explains the way they steal eggs. Though some scoff at it, the tale has been current since the thirteenth century. According to it, rats organize for the purpose of plundering a nest or crate. One grabs an egg in his forepaws and rolls over on his back; another then catches his tail and drags him to their den. Whether that account is accurate or not, *somehow* rats do move eggs considerable distances and over obstacles. Eggs disappeared from one hatchery at the rate of 80 dozen a week. An assault on the dens of the rats revealed many eggs stockpiled in underground store rooms.

Intelligence of Rats

This much is absolutely clear: rats quickly beat every lethal device aimed at them. It is still too early to know whether new synthetic poisons will retain their effectiveness over a period of years. Rats may learn to recognize and avoid them. Albinos studied in the laboratory quickly learned to identify a magazine advertisement for ice cream—then selected it from half a dozen assorted ads. They also proved they could select one letter of the alphabet from a row of mixed ones, or pick a given ink-blot from

continued on page 55

THE AUTHOR formerly taught journalism and was in the publishing business. He now makes a successful living as a free-lance writer. His books and magazine articles are on a variety of subjects but the natural sciences are his chief interest. Writing is also a hobby. "I'd rather sit at a typewriter than play golf or watch a football game," he says.

He is also an ordained Methodist minister. He lives with his family in Nashville, Tennessee.

▲ After four or five days of drifting snow, icicles began to form below the eaves, sheltering the bird's supply of meat.

By
John Underwood

THE snow had fallen thickly for the past 36 hours; and now, as the first pale light shone in the east, we could hear the wind rising. It meant that we were to be snowed in again. Our cabin lay five twisting, drifted miles from the highway, but we had plenty of food and plenty of wood and coal, and there was no immediate worry. We settled down by the cast-iron stove with coffee and books.

A monotonous intermittent tapping at first failed to intrude on our reading. We had listened all summer to the sound of hammering from the people across the lake.

The sky was white, the sun still reluctant about showing itself, when —a dozen quick thuds, a pause, another group of thuds, then another pause. We hear sounds of many kinds during the winter, but now we realized that this was unfamiliar.

When we looked out the window at the porch, the cause was not hard to find. On the icebox, where some scanty-fleshed deer ribs had been placed, stood a Clark's nutcracker *(Nucifraga columbiana)*. He was thud-thud-thudding into the frozen meat with his long black bill, pulling off the jackhammered flesh, and eating it.

We thought he would fly away in a few minutes. But eight or nine *hours* later, as darkness closed down again, he still was busy on the ribs and paid little attention to our exits and entrances. He had flown away for brief intervals — too brief, we thought, when one of the cats appeared on the porch.

The following morning, to bring the visitor closer to us and farther from the cats, we hung the ribs under the wide eaves outside the kitchen window. After a few fruit-

Clark's Nutcracker

The hammering of the "camp-robbers" beak on a piece of frozen deer meat might not sound symphonic, but you would welcome his presence if you were snowbound for ten days

ess searching trips to the icebox and o all corners of the woodpile-rowded porch, he found them. The oft hammering began again. Acti-ities at the kitchen worktable in-ide the house disturbed him not a it. His beak, a trifle opened the etter to dig and push and twist at he frozen meat, miraculously howed no signs of wear. Nor did break off. His alert black eyes leamed against their background f white, a white which faded easily nto the pearl-gray plumage of the est of his head. The deer ribs were uffeted by gusts of wind, but the utcracker held on, flicking his lack-and-white tail up and down or balance.

The Clark's nutcracker shares ith the Canada jay, at least locally, e handy and suitable name of amp robber." He is anything but rarity in the Wyoming mountains. ampers almost always see him. He ill be watching them from spruce oughs above their heads, swooping ghtly down to pick up crumbs or clean the last traces of grease om a frying pan set aside to cool.

This bird is the only member of s genus in the Western Hemi-here, although another *Nucifraga* ith similar habits has been known nce the sixteenth century in north-n Europe, where its Latin name as later translated into the Eng-sh "nutcracker." The American ecies was first seen and described y Captain William Clark in Idaho uring the Lewis and Clark expedi-on in 1805. Since then, it has been permanent resident in all the west-n mountain country from Alaska Mexico, and as far east as the lack Hills. Almost exclusively a gh-country bird, it makes its nests twigs, pine needles, and bark-strips, in various evergreen trees. It lays three to five lightly spotted grayish-green eggs, often so early in the year that it must sit out the early spring snowstorms of the mountains.

Here at our lakeside cabin, 7,500 feet above sea level, one may see Clark's nutcrackers almost any month of the year, although most of the time they seem to prefer the timbered mountain slopes above us. But in late summer and early autumn we can be fairly certain that two or three of them will be around. As the limber pines bordering the lake lift their chunky, ripening cones into the air, a nutcracker can usually be seen balancing and swaying on a cone, right side up, upside down, uncaring which, pulling the ripe seeds from the cone. He carries away these and the nuts of other coniferous trees, and stores them in tree crotches, in rough ridges of bark, or other convenient holes high off the ground. As a member of the crow family (Corvidae), the Clark's nutcracker has numerous cousins sharing the trees about the lake, notably the ravens, the piñon jays, the magpies, and, less often, Steller's jays.

How our December visitor discovered the deer ribs remains a mystery. On the porch they were sufficiently under cover, and we had not noticed the bird about the cabin before. Perhaps it was just luck, his and ours. He stayed ten days, arriving each day before sunrise, staying until after sunset. The soft pounding of his beak was an accompaniment to all our activities.

For four or five days the snow drifted on icy winds, but warmer weather finally came. As the snow settled and thawed, the meat grew softer and disappeared more rapidly down the nutcracker's throat.

At last, on the eleventh morning, there was no hammering outside the window as we drank our morning coffee. All that day we watched for him. For several days we left the remnants of the ribs hanging. But he never returned. Perhaps he left to seek greener pastures—or, more likely, juicier ribs.

➤ BUILT like a small crow, it has a light-gray body.

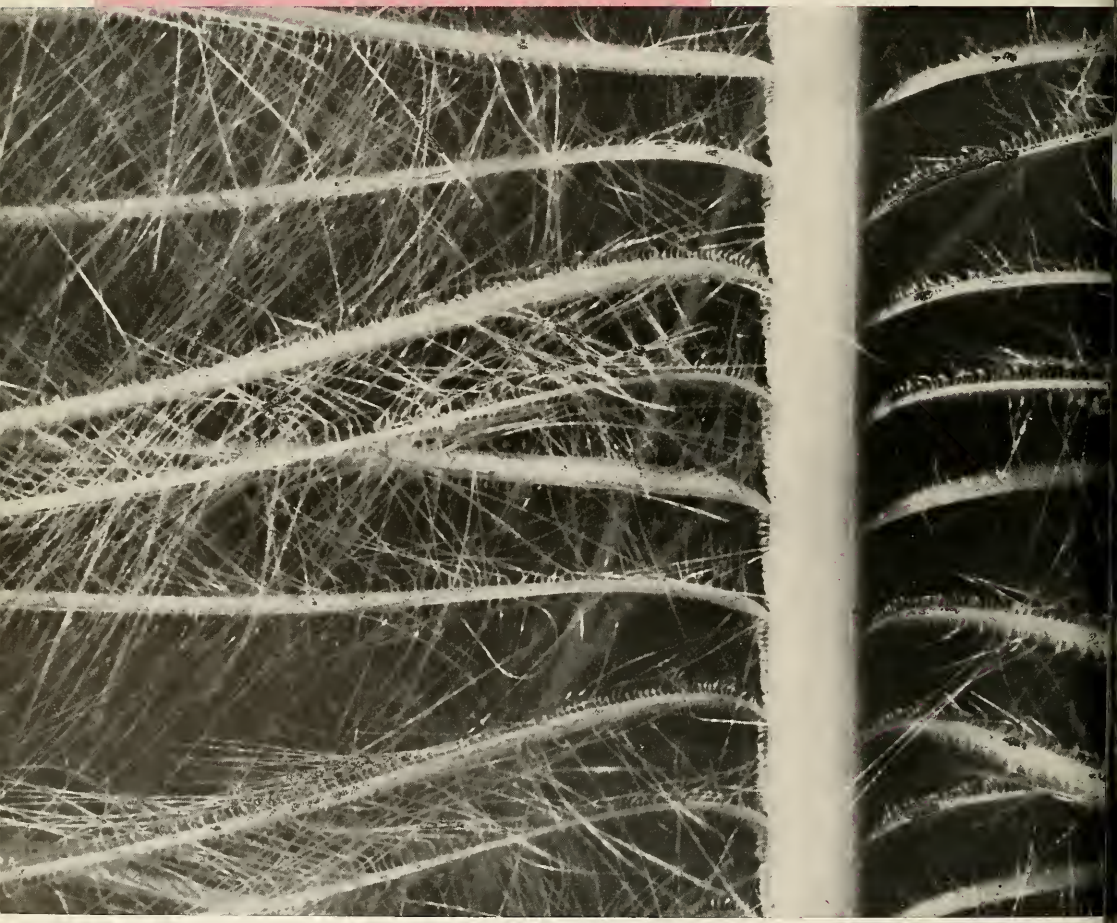
Hal H. Harrison from National Audubon Society

Some WHAT-ZIT Pictures

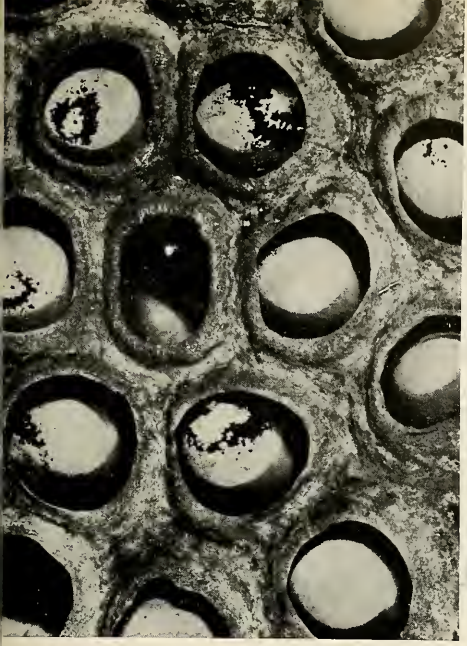
By John H. Gerard

The camera may not
be able to lie,
but when the photographer
goes on a size-juggling spree,
you may have trouble
recognizing some of his subjects
Can you guess
what these objects are?

(Correct answers on page 5

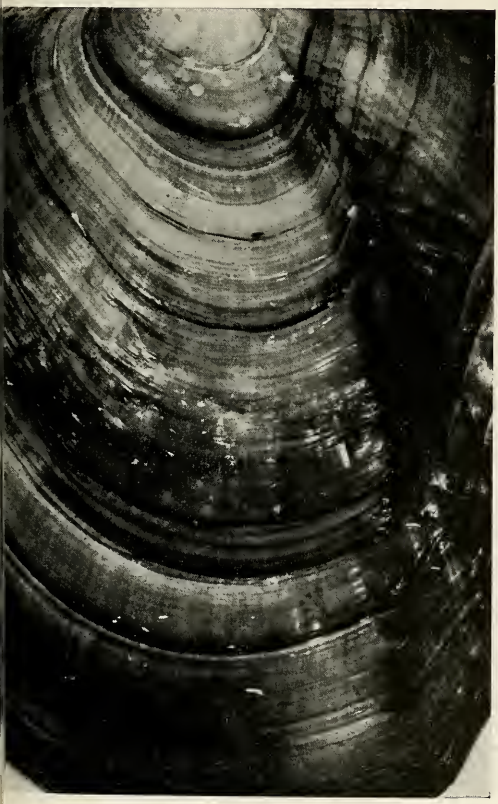


↑ A young evergreen tree? No, it's nothing so earthbound as that.



◄ MOST PEOPLE realize that this is more apt to be animal or vegetable than mineral. Perhaps it will help to tell you that you will find it in the water and that the round things are edible.

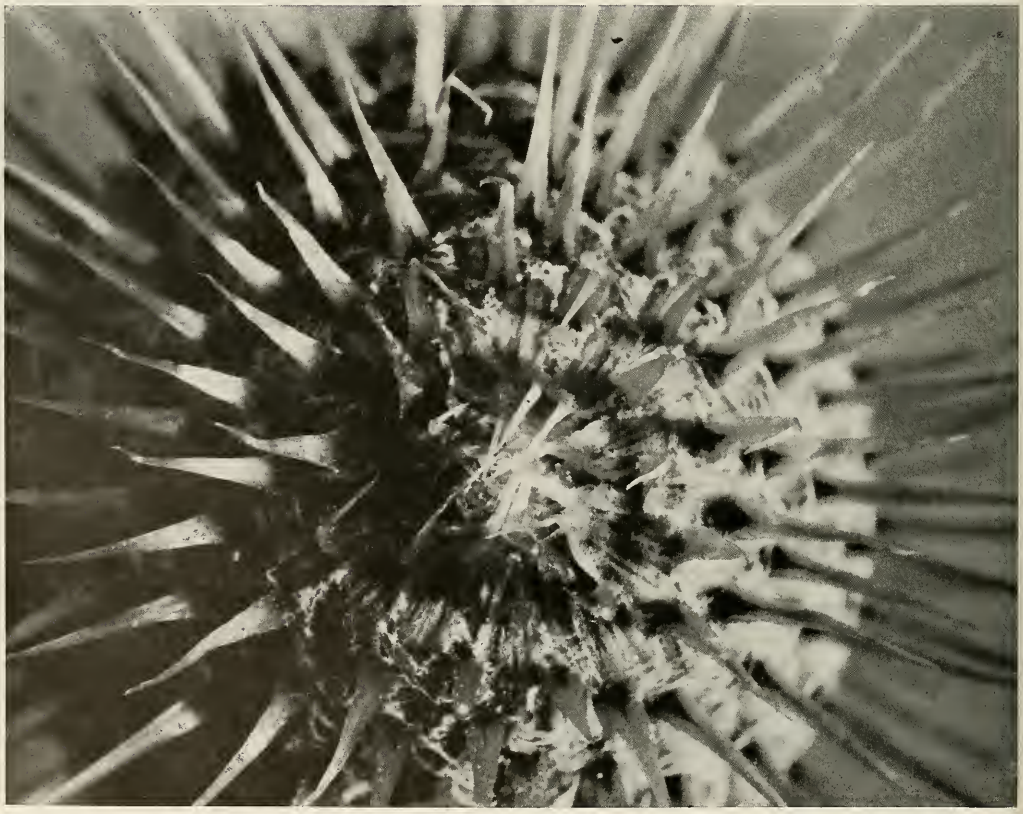
▲ IN ITS ADULT FORM, it uses the name of a bird, whereas here, at a younger stage, it has the name of a plant. But don't get the idea that this is the head end.



◄ THIS should be easy. But don't jump to the conclusion that these are the growth rings in a tree.

➤ WE'LL GIVE YOU A HINT: they're poisonous. But the creature owning them will not be able to run you down.

▼ IT MAY RESEMBLE some of the spiny undersea creatures, but it lives on land and produces one of the airiest things in nature.



low 28° above zero, whereas the air above drops to 75° below zero. By keeping their breathing holes open, the seals can stay under the ice almost constantly. Their colonies may be five miles or more from open water but they move along routes marked by "air filling stations" in the form of blowholes about every 180 yards. Every third hole, in general, is large enough to furnish an exit onto the surface. Weddell seals eat great quantities of fish and squid, and their stomachs are usually cluttered with cuttlefish beaks.

Rivaling the killer whale as the villain of Antarctica is the sea leopard, another member of the seal family. Not only is he a nimble swimmer but he has been seen to leap out and snatch penguins who were standing too close to the edge of a floe. He shakes the bird furiously, then bites off head and feet before swallowing it. A sea leopard has been known to eat a fully grown Emperor penguin, which itself is 3 feet long. The animal has often been seen chasing small boats. This has given him the reputation of being a maneater. Actually there is no authentic record of a sea leopard's attack on a man, and his pursuit of boats may only be inspired by curiosity — but no one has put the question to a test. It is not known how or where sea leopards give birth to their pups. Presumably it is somewhere in the vast reaches of the pack.

Bird Life

The birds of Antarctica have helped man in many ways during his perilous journeys into the pack. They have fed him, guided him, and the blubbery penguins have even provided emergency fuel for his steamships. The mariner who sees shags in a fog knows that danger is near, for these birds — a form of cormorant — rarely fly more than a few miles from the rocks where they live. When Shackleton made his memorable escape from the antarctic in an open boat, it was the shags who first told him that a haven was near. The sighting of snow petrels, on the other hand, is often the first warning that ice is close by.

The snow petrel is one of the most beautiful of all birds, resembling in flight a form of white swallow, but it is less than attractive when defending its nest. It resorts to what appears to be a form of projectile vomiting and can deliver a foul-smelling jet of oily, orange-colored liquid with deadly accuracy at a distance of four feet. When a French photographer sneaked up on a snow petrel nest in 1952 the mother bird hit his camera square in the lens.

The "vultures" of the antarctic are the skua gulls. They prey heavily on the Adélie penguin rookeries, swooping in to snatch the unprotected chicks. Most remarkable of all, the skua penetrates to the barren heart of Antarctica. Scott's party met them only 184 miles from the Pole itself, hundreds of miles from the nearest food.

The most characteristic creatures of Antarctica are the penguins. The Adélie penguin and Emperor penguin, like the antarctic skua, are found nowhere else. The Adélie stands about two feet high and most closely resembles the cartoonist's concept of the penguin. He is the clown of Antarctica. The Emperor penguin is as dignified in stature and demeanor as his name implies. He is perhaps the most remarkable animal relic of the Ice Age. Both the Emperor and the Adélie are excellent swimmers. Their wings have become flippers and they "fly" under water with sufficient speed to catch fish. The Adélies can dive into the water from a height of twelve feet and can leap onto ice floes five feet high. This they do by swimming deep and soaring out of the water at great speed, landing feet first on the ice. Like most antarctic creatures, they are so wild that they are tame. They have no natural enemies on the ice, and when they see a man will waddle eagerly over to have a better look.

The Adélie penguin becomes a kleptomaniac when, in the spring, he migrates from the pack and begins building his nest at one of the rock-strewn rookery sites. The nest of the Adélie is made of small stones and pebbles. Mario Marret, who spied on an Adélie rookery in 1952, described it thus:

"The whole Adélie population seems to be subject to a sort of collective madness. Individual birds hurry around with stones in their beaks and deposit them on their nest, but as soon as their backs are turned other birds steal the stones. The community is not divided into honest birds and bad birds: they're all thieves, and there is an incessant round of stolen stones from nest to nest."

Courtly Courtship

The collecting of stones is done by the male and is actually part of the courtship. The male comes up to the nest where his spouse is standing, bows low before her and then drops the stone at her feet. This is repeated over and over for many days.

The Adélies lay two eggs a season but the mortality is heavy — over 68 per cent in some cases — the weaker chicks being carried off by the skuas. The adults appear to be rather stupid and have been seen walking alone 60 and 70 miles inland, apparently lost.

The Emperor penguin is one of the largest of birds, for he weighs close to 90 pounds and stands 3 feet tall. He commutes in the opposite directions from the Adélie and all "normal" birds, for in the fall he heads south toward the Pole and the coldest weather, laying and hatching his single egg on ice during the winter night before heading north again into the pack and a less frigid climate. The egg is brooded in a snug corner between the tops of the penguin's feet and the rolls of fat on their lower abdomens. Here also the

young chick is held. Explorers have been impressed by the wild yearning of "childless" adults to nurse a chick in this manner. Actually, an unattended chick is in danger of being torn apart or smothered in the scramble of the big, clumsy birds to get hold of it. Dr. Edward A. Wilson of Scott's expedition tells how the chicks preferred to flee and starve rather than be nursed. He estimated that of the 77 per cent that die before they shed their down, quite half were killed by kindness.

When it came time for the birds of the rookery to return to their summer home in the pack, Wilson found that they had free transportation. Every day when there was a brisk south wind a contingent of birds would gather on the seaward edge of a nearby patch of frozen ocean. Before long this section of ice would break off and blow north toward the pack beyond the horizon. The big birds were like orderly passengers during the rush hour, with about 100 at a time marching out single file to wait for the next floe going north.

The only land animals in Antarctica are a few species of insects which eke out their existence among the rocks and mountains in the hinterland, in the penguin rookeries, or in the small rivulets of melt-water that run down rocky slopes here and there on the coast. The winds are so furious that the spiders spin no webs and the flies are wingless. These species spend almost their entire lives frozen solid. They thaw out for a few days each year and hurriedly carry out their life processes in order to keep the species going.

No Trees

Antarctica was once green with pine forests and jungles of tree-ferns, but today there is not a tree on the entire continent, and plants of any kind are so rare that explorers rejoice at finding even the lowliest moss or grass. The most widespread of the plants are the lichens—scaly, paperlike plants that cling to the rocks even on mountains bordering the South Polar Plateau—the coldest place on earth. Some of the lichens found on antarctic peaks, surrounded by hundreds of miles of barren ice sheet, display brilliant shades of red, yellow and orange.

Over a hundred kinds of lichen have been identified, more than fifty types of moss, and one or two species of coarse grass, but that is a desert vegetation compared to the flower-studded tundra of the arctic. The drifting plant life of the neighboring seas is always found in the fresh-water lakes that dot some of the snow-free valleys. This algae sinks to the bottom, creating peat-like deposits that may be three feet thick, but as a rule there is no visible soil in Antarctica. It has been ploughed into the sea by the glaciers or blown away by the furious winds.

The first clue that Antarctica was not always buried under an ice sheet was the discovery in the summer of 1892-1893 of what seemed to be part of a fossil pine tree on Seymour Island, near the tip of Palmer Peninsula. Sixteen years later, Shackleton and two companions, picking their way up Beardmore Glacier toward the South Pole, likewise found a petrified pine log and extensive seams of low-grade coal. When Scott's party passed along this same route, Wilson found a multitude of fossil leaves and twigs.

Thus it became known that the heart of Antarctica, now covered by its dense ice sheet, was once carpeted with waving swamp forests of palm and fern-lined trees.

Forests may have covered all of Antarctica 135 to 165 million years ago in Jurassic times, for petrified logs up to 18 inches in diameter have been found at Mount Weaver, close to the South Pole. During that period the world was dominated by the dinosaurs, but it seems probable that the forests, at least on Palmer Peninsula, continued up to the period when mammals and other modern animals began to emerge.

Who trod the dark jungles of Antarctica? So far no remains have been found of true land animals. Because of the continent's isolation, separated from its nearest neighbor, South America, by 600 miles of stormy seas, there may never have been four-footed creatures there. Nearby New Zealand, for example, has no native land mammals. Five genera of pre-historic penguins have been discovered in the Palmer Peninsula area, one of them a giant bird perhaps as tall as a small man. Some have suggested that these might have been the survivors of bird species that sacrificed their ability to fly in these untrod forests where there were no rivals or enemies. Then, with the coming of the ice, according to this hypothesis, the birds

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adapted themselves to aquatic life.[1]

Antarctica presents many unsolved problems of the most fundamental sort. The Permian trees and plants that grew 205 to 230 million years ago on the plateau near the South Pole are almost identical with those in the Permian deposits of South Africa, Australia, India, and South America—so much so, in fact, that geologists lump these scattered regions together under the name Gondwanaland. There have been various ingenious explanations for such close resemblance between such widely separated areas. One is the theory of continental drift, which supposes that the Gondwanaland continents were once a single land mass but broke up and drifted apart like huge ships floating on the plastic core of the earth. Others suspect that much of Gondwanaland has now subsided, leaving oceans in its place. Probably the most popular belief of today is in land bridges and island chains that bridged the gaps, following submarine ridges such as those which still connect Antarctica with South America, Australia, and New Zealand.

One of the American objectives in the International Geophysical Year is to test the theory of continental drift by seeking to determine the rock formations of Antarctica. If, in composition, they "fit" the formations of other Gondwanaland continents like pieces of a jigsaw puzzle, then the theory will tend to be confirmed.

Another of the basic questions confronting the scientists in Antarctica is the reason for the Ice Ages themselves. Here again many ideas have been discussed, including the suggestion that the poles themselves wander great distances across the face of the earth, carrying their frigid climate with them. Perhaps the most favored explanation is a cycle of changes in the volume of heat reaching the earth from the sun.

What does the future hold? Is the antarctic ice retreating? Will the fringe of that region become more habitable in the foreseeable future? These are questions that cannot be answered until we know more of Antarctica's past. New techniques have now been developed which should greatly aid in these studies.

One of the tasks of the International Geophysical Year will be to reconcile seemingly conflicting evidence as to whether the antarctic ice is in advance or retreat. Our interest in the question grows in the light of what seems to have been the influence of ice fluctuations in the past. In earlier stages of the earth's history the great periods of glaciation brought about radical changes in the development of the animal kingdom. Lesser fluctuations in climate occurring within the great cycles of advance and retreat can be of more immediate concern. Our information is far too meager to know where we stand at the beginning of this great scientific assault on Antarctica. However, even a relatively slight modification in climate and ice conditions might tend to make the coasts of Antarctica more accessible and bring some of its hidden—and as yet unknown—mineral resources closer to the rest of the world.

NEXT MONTH, another chapter will acquaint you with America's participation in the international program of research in Antarctica.

[1]The more favored theory depicts the ancestors of the penguins as living in a marine habitat rather than in forested country. It takes the view that there was an early flying ancestor, then loss of flight, and finally highly developed aquatic specialization. This would mean that the wings, for instance, evolved more or less directly into flippers during continuous association with the water, rather than that they degenerated into useless organs for a period of forest life and then returned to service as swimming organs.—Ed.

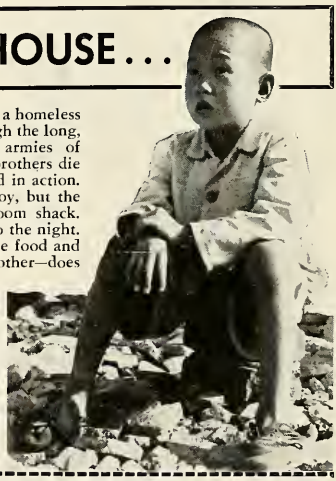
Answers to

Some WHAT-ZIT Pictures

on page 48.

1. A white chicken feather.
2. Sting spines of an Io moth caterpillar.
3. A fresh water clam (you know old *Lasmigona complanata*)
4. Seed pod of the American lotus.
5. The hind end of a tomato hornworm, the caterpillar of one of the hawk moths.
6. Seed pod of a thistle.

MAN OF THE HOUSE...



For almost nine years Won Hak has been a homeless wanderer. He and his mother lived through the long, terrifying flight from the communist armies of North Korea. He saw his three younger brothers die of cold and hunger. His father was killed in action.

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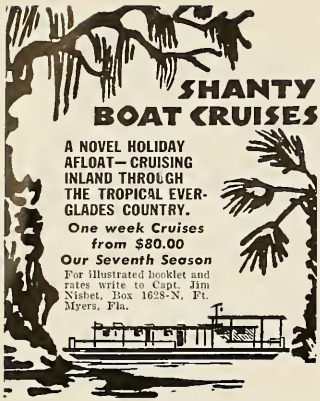

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dition, and he has read widely. This is an excellent addition to the "What you Ought to Know About —" books now being written for the layman.

Joseph Wood Krutch is the well-known author and critic who often writes and reviews in the field of natural history. His latest book in this field is The Great Chain of Life *which has just been published.*

THE EVOLUTION OF HUMAN NATURE

- - - - - - - by C. Judson Herrick

University of Texas Press, $7.50, 506 pages

Reviewed by ASHLEY MONTAGU

THE Evolution of Human Nature is divided into two parts. The first deals with the evolution of human behavior, the second with the evolution of the brain. The author has devoted a lifetime of thought and research to both subjects. The research has been primarily in the evolution and anatomy of the nervous system, and the thought has largely been devoted to bridging the gap between the knowledge thus gained and an understanding of human behavior. The present volume, which arrived on the very active author's desk on his eighty-eighth birthday, constitutes something of an account of the author's odyssey as well as of his findings.

Most readers will find the first part of the book, that which deals with the evolution of human behavior, the most interesting and valuable. This, indeed, may serve as a handbook on the subject, for its treatment of the development of human behavior is exceptionally sound, informative, and inspiring. Professor Herrick writes as a biologist, but in addition to that he also writes as a human being, ever aware of the fact that man is something more than an animal. And of this he makes his reader abundantly aware. He fully realizes the error into which some scientists fall in discussing higher levels of organization in terms of lower, and it is one of the great merits of this book that he puts the reader on guard against the possibility of his committing such an error, too.

From this book the reader will gain a knowledge of the methods of study used by the scientist in the field of human behavior; the nature of the world in which he lives will be discussed for him as well as the vital process itself. Not only is he made to see how human behavior evolved, but in the course of the exposition he will find himself exposed to a discussion of some of the fundamental and most pressing issues of our time. Frankly, I feel that no one can any longer be called an educated person unless he has familiarized himself with the exposition of the facts contained in the first half of this book. The discussion of levels of organization; trends in evolution; adaptation: means and ends; social factors in evolution, and especially the evolution of value is in each case a masterpiece of clarity which will be helpful to the general reader and the expert alike. The discussion of the evolution of the brain is remarkably clear and up-to-date, and may be highly recommended to all who desire to obtain a working understanding of this complicated subject.

This is a book that the reader will want to return to again and again—no greater compliment could be paid to its author than that.

The reviewer is the well-known social biologist and anthropologist, author of many books including the best seller, The Natural Superiority of Women (1953).

THE BIOLOGICAL BASES OF HUMAN FREEDOM

- - - - by Theodosius Dobzhansky

Columbia University, $2.95, 148 pages

Reviewed by HARRY L. SHAPIRO

IN these Page-Barbour Lectures, delivered at the University of Virginia in 1954, Professor Dobzhansky, one of the foremost geneticists of our time, has examined the bases of human evolution and the processes that have led to human freedom and ethics.

It is becoming more and more evident in recent books on human evolution that the appearance of culture must be recognized as the turning point in the long process of organic development that has led to man. All that is human in man arises from his adaptation to the new environment created by culture. Dobzhansky correctly points out that evolution has not ceased with the arrival at human status but continues, and must inevitably continue. Adaptation and selection are in no way diminished by the growth of culture however the direction may change.

But the nature of culture and man's adaptation to it enhances his freedom of choice, his adaptability and plasticity. Out of this and not from purely biological circumstances, emerges human ethics which inspires man with a sense of freedom and of right and wrong.

This stimulating book touches on many points, if briefly, and provides the reader with ample food for reflection.

The reviewer is Chairman of the Anthropology Department, and Curator of Physical Anthropology, at the American Museum of Natural History.

 continued from page 45

a display of several different ones.

Some psychologists assert that rats make better scores on five-way choices than on two-way ones. This, they think, is because any simple problem quickly bores them and they quit trying.

Intelligence alone would make the rat a worthy foe. In addition, he is fortified with a biological heritage that enables him to overcome almost any partial victory by his two-legged opponents. Given ideal conditions, a single female can produce ten litters in a year, each with about ten young. Potentially, one pair can have 350 million descendants in three years. Using every known weapon—including cyanide or other poison gas—professional exterminators seldom kill more than 95% of the rats in a region. The survivors can quickly bring the population back to the old levels.

Extermination on a global or even national level is not a real possibility in the foreseeable future. Control is a different matter. It requires three processes. First, use concrete and steel to rat-proof buildings. Second, eliminate open sources of food, such as garbage dumps and waste heaps. Third, wage a continuous war with traps and poison. All three measures must be used. Periodic killing alone is about as effective as treating leprosy with calamine lotion.

Civilization gives the rat abundant food on an all-year basis—plus protection from natural foes. Result: rats have increased greatly in the last few centuries.

Nature offers no rat-cafeterias that approximate the bakery, poultry shop, stable, distillery, feed mill, warehouse, food store, wharf, slaughterhouse, sewer, garbage dump—or even a home where food is constantly on hand. Nor does nature provide spacious shelters from which hereditary enemies are banished. Ferrets, weasels, and skunks consider the rat a choice tidbit, but neither householders nor businessmen encourage such rat-killers to hang around. Nor does man welcome his other allies in the rat war—snakes, owls, storks, herons, eagles, or vultures.

In effect, man has built special rat-havens, which he calls cities and farms. He stocks them with abundant food, which is on hand in wet weather or dry, hot or cold. These life-zones are just right for our planet's most troublesome four-footed pest. To overcome so well sheltered an enemy, it would be necessary to make a major change in some aspect of the man-rat complex. Thus far, only one really effective idea has been suggested: man should put the rat on his menu as a delicacy. Failing this or an equally radical change, it appears likely that "cousin rat" will continue to be man's guest for a long, long time.

The Pineapple – Fruit of Royalty

continued from page 38

must be graded. Then it is placed in cans and moved to machines to receive the syrup. The cans are sealed, sterilized, and labeled.

Though only about a fourth of Hawaii's cultivated land is given over to pineapples, the plantations, buildings, canneries, and roadways support numerous other businesses as well. Consider the tons of sugar—20,000 tons in the annual canned pack. Then there are all the needed cans (from the American Can Company of Hawaii) and the labels (by the Honolulu Lithograph Company). Stevedores load 29 million cases a year at Honolulu harbor and unload vast quantities of fertilizer, insecticides, and fumigants used in pineapple cultivation. Then there are the trucks, cars, machinery, service stations, and stores that keep the plantations busy and plantation homes happy.

Once pineapple juice ran down the drain and out to sea. In 1932, canned juice became an innovation. Now the juice is almost as much in demand as the fruit. Rather recent also are fresh-frozen chunks of pineapple—bite-size for fruit cups, roasts, cake decorations. So is fresh-frozen pineapple juice concentrate, which competes with fresh-frozen orange juice concentrate.

Like the pig with its famous squeal, every part of the pineapple is used. The cores are used for juice. The flesh trimmed from the shells, grated, and canned, enhances candies and cakes. Salvaged fruit shreds become syrup for the pineapple slices. Shells, finely chopped and sterilized against mold, go into pineapple bran used for cattle feed. As analyzed by the University of Hawaii, it offers protein, high amounts of carbohydrate, as much vitamin B as whole wheat, and five times as much vitamin A as cereal.

Through use of ion exchange resins, sugars are extracted, purified, and concentrated from what was once pineapple waste – 4,000 tons of natural sugar a year from it! Citric acid, vinegar, and alcohol are among the end products.

Smiling Hawaiians welcome you to their plantations, proud of those expanses of thriving green. "Have a fresh drink," they urge you. The canneries lure you inside with the persuasive pineapple fragrance and the chance to see the speedy machines that convert a constant stream of whole pineapples into the various finished products. You may be invited into a plantation home. Hawaiians, like the people of Holland, cannot tolerate the least dirt. They scrub even their garbage pails to a silver brightness. And each home has its own garden. "Come see!"—a flowering hedge, palms, exotic flowers.

Only Cayenne pineapples and a variant Hilo type grow commercially in Hawaii, though cross-breeding has already produced some hybrids. Other varieties are

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seen elsewhere. Mexico offers white-fleshed Red Spanish and Monte Lirio, which has spineless leaves. Australia grows Queens, golden yellow and not so juicy as Cayenne but favored as fresh fruit. Florida grows mostly Red Spanish. Hawaii sells almost all its pineapples to the United States. The rest of what we eat comes to us from the Philippines, Puerto Rico, Cuba, and Mexico. Next to Hawaii, the Philippines furnish us most, but the U. S. Government is helping Puerto Rican production.

Though the Filipinos on their bright green islands eat bananas, coconuts, limes, and green custard apples, they grow pineapples largely for the leaf fiber, weaving it into pineapple cloth. The fiber is hand-woven by homemakers in suburbs or country towns, often within sight of high terraced rice fields or racks of hemp hanging to dry. It is an ancient art, mentioned by a missionary to the Philippines in 1591. The leaves must be just right. If too young, the fibers are soft and weak; too old, they are coarse and brittle. Leaves moderately mature, grown in partial shade, are best. The Philippine Republic takes great pride in its piña, and well it may. For it is exquisite material, famed in America and Europe for blouses, table scarves, luncheon sets.

James Dole, who did much for Hawaiian pineapples, has retired and lives in San Francisco but makes annual visits to Honolulu. A. E. Eames, Jr., took over his father's cannery at Wahiawa, Oahu, at a time when fresh pineapples had to be carried 22 miles on a narrow-gauge railroad and rarely could be canned within 24 hours of picking. Now, it's only four hours from picking to freezing. During the Second World War, he established the Nutrition Foundation, Inc., to build up our nation's health as part of the war program. The health values of pineapple entered into this.

From the sunlight and the soil, these luscious fruits manufacture vitamins, food energy, nutritive minerals. Pineapple is easy to digest and assimilate. A few chunks over cake or in a pie add values all their own. This, then, is the fruit that in the words of Oviedo "restores enjoyment"—larger and more delicious in this day of universal luxuries than it was when people thought of it as a treat for royalty.

Letters *continued from page 1*

Without the queen ant, the rest of the colony would pine away and die.

ARTHUR M. GREENHALL, *Curator*
Royal Victoria Institute Museum
Port of Spain, Trinidad, B. W. I.

Porridge Bowls?

SIRS:

Re "Mystery Mortars Under the Sea," in November issue of NATURAL HISTORY.

Why call them mortars? Why not call them porridge bowls?

So many (141) in a space 15 by 20 feet, makes it look like they were on the floor of a restaurant of a previous civilization. The floor is gone — naturally. They dropped to the cellar.

HUGH AUCHINCLOSS BROWN
Douglaston, New York

Eruption of Mt. Pelée

SIRS:

I enjoyed the October issue of NATURAL HISTORY Magazine very much. The article on Martinique was of particular interest to me as I visited it on my first ocean voyage in 1905. We visited many of the islands and finally arrived at Port au Prince. For some unknown reason our Captain did not want to use his ship for this side trip and hired a tug to take us there. All of the wharves having been destroyed, we landed in small boats, and went a short distance to where they had dug down about two feet to the cobblestones of a street. I bought a brick-shaped mass of nails fused together and had it put in a fireplace of our summer cottage.

I spoke (French) to the man who was saved. The other natives were very jealous of him as he could get money from visitors for taking off his shirt and showing his back.

The author has made a mistake in saying that Pompeii was covered with lava. I visited that city three times and have repeatedly been told that it was ashes that covered that city and lava the neighboring city of Herculanium.

As an old jeweler (85) I was also interested in the article on our early goldsmiths.

A. C. SKINNER
Sherbrooke, Quebec, Canada

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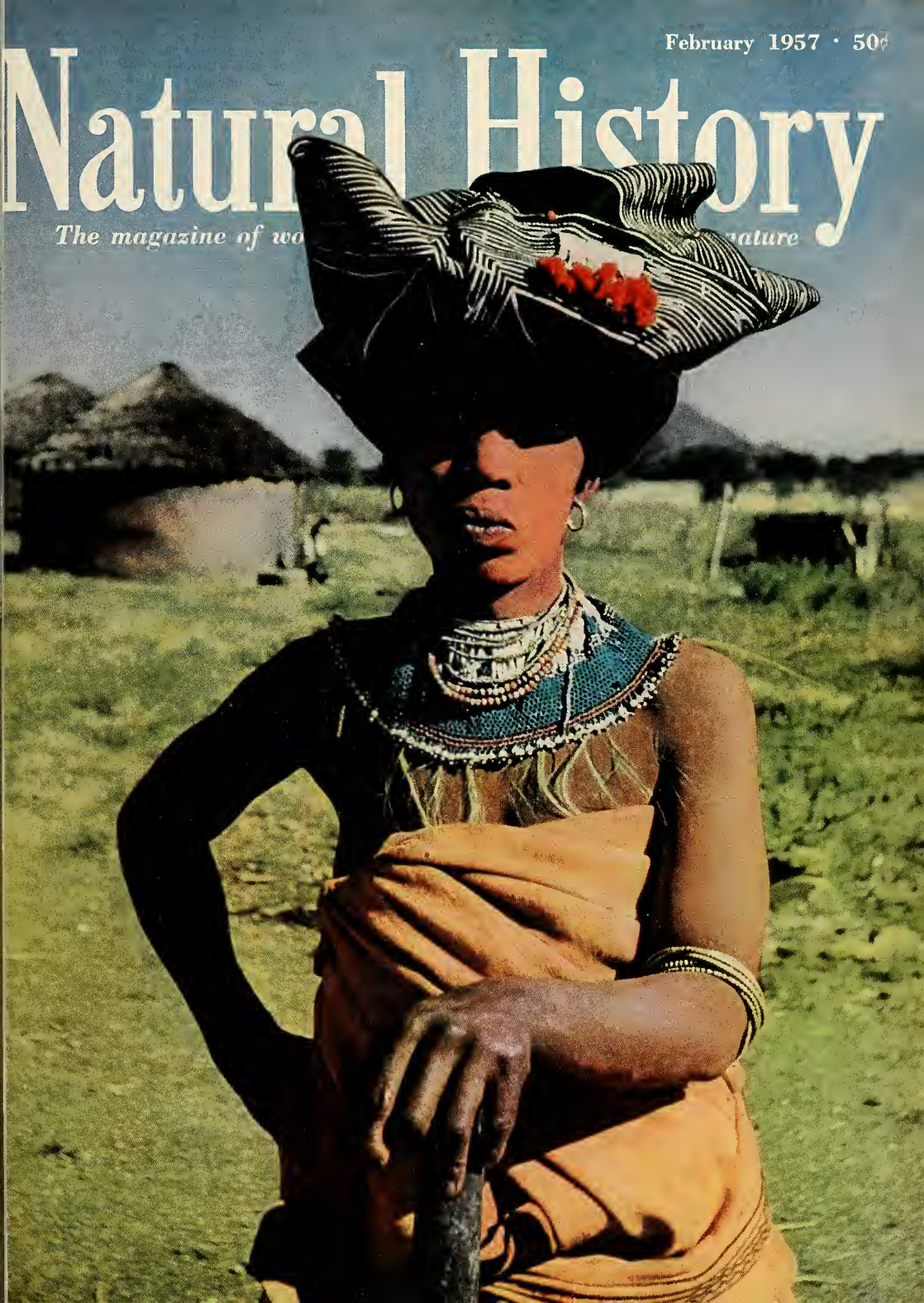

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Letters

Frog Choruses

Sirs:

I have never seen it explained why all the singers in a nocturnal chorus of frogs —sopranos, tenors, basses, and basso profundos—will suddenly fall silent. Then perhaps a timid soprano will venture a few notes and the other members will slowly join in to resume the full-scale concert. Is the orchestra under the control of the concertmaster?

L. L. Mills

La Mesa, Calif.

The following remarks are offered by the well-known specialist in amphibians and reptiles, Charles M. Bogert, of the American Museum's Scientific Staff:

One does indeed get the impression at times that a frog chorus is under the control of something comparable to a concertmaster. But the reasons for the starting and stopping of such choruses vary from the simple to the complex—and from one kind of frog to another.

Under ideal conditions, around the borders of Lake Okeechobee in Florida for instance, choruses may comprise thousands, possibly millions of green treefrogs spread over miles of territory. The din is continuous, for virtually nothing interferes with the chorus as a whole. Smaller groups of frogs, concentrated around a small pool or stream are more easily interrupted. Often they stop calling when approached.

Those of us who have utilized recorders to tape the sounds get the impression that frogs are warned of an approaching enemy by vibrations transmitted through the ground. For if you remain standing, an interrupted chorus will very often resume, despite movements of your hands or body that would disturb most animals. The abrupt stopping in unison of a moderate number of frogs can often be attributed to the approach of some animal that the frogs have detected even though we may not see it. At other times the number of frogs calling diminishes gradually and presumably spontaneously. As though to further complicate matters, the chorus may be started again by a noise such as the passing of an automobile, an airplane, or even the talking of a frog hunter.

When I was recording frogs in the Everglades I particularly wanted to record the so-called "rain song" of the green treefrog. This sound is uttered during the day, and it usually comes from frogs concealed in trees well above the ground. With many frogs, it sounds like a half-hearted rendition of the normal mating call. Often it accompanies a brief shower but the frogs may be stimulated to produce it merely by the sound of the raindrops on the leaves. At first I thought it was merely my bad luck that every time I heard rain songs an airplane interfered with my recording. Finally I realized that it was the noise of the airplane that stimulated the vocalizations of the frogs.

Perhaps it should be explained that although some frogs are voiceless, the males of many kinds can produce several different sounds. Near the Archbold Biological Station in Florida ten species were breeding simultaneously in and around a rather large pool. Such observations as we could make indicate that the few females present were, in every instance, attracted only to the males of their own species. Female oak toads were observed butting the male as though to attract his attention. However, the "attracting power" of the calls is still uncertain for many kinds of frogs, and what has been termed the "mating call" may actually function primarily to let the female know that her own species is present when she is about to deposit her eggs.

continued on page 111

NOTICE — Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $5.00 each, with full credit to the photographer. Return postage must be included.

Kurt Severin

A female Manatee and her baby basking in the sun while their tank is cleaned.

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February, 1957 Volume LXVI, No. 2

One of the Red People — Cover Design
From a color transparency by Marjorie Gowie

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The story of the Atka expedition, which defined U. S. participation in the largest exploratory venture in history — the international assault on the secrets of the antarctic continent

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A Progress Report on I. G. Y. in the Far South

A Plant that Captures Animals under Water — Eric V. Grave — 74
Its prey may be tiny, but the trap of the bladderwort is one of the most remarkable mechanisms of the plant world

Bushmaster! — William E. Lundy — 78
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You may easily find one of these geological prize packages, and it may contain the fossilized remains of a plant or animal that lived eons ago

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Exactly 100 years ago, this picturesque African tribe almost exterminated itself in pursuit of a vision

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Actual tests help to answer the age-old question of what would happen if insects should approach the size of man

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In this California suburb, peacocks have the run of the lawns and treat home owners to one of the most spectacular courtship dances in nature

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The animal puts it up like an umbrella, but not as protection against the rain

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When is a stalactite not a stalactite? When special conditions of growth produce these bizarre branched and twisted formations

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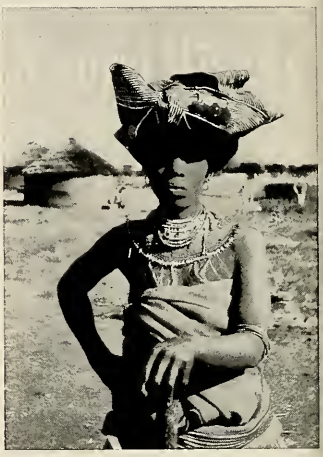

THE COVER THIS MONTH

This woman is one of the Xosas, or Red People, who live in the Eastern Province of the Union of South Africa. Some 25 years ago these women in their colorful costumes were a common sight in the towns as they rode in on the ox-wagons to the morning market or to visit the trader's store. Now they are seldom seen except in the native reserves or on the farms, for the traditional dress is rapidly giving place to the conventional styles of the white people.

Marjorie Gowie, who took this picture and those on page 84, is a South African of Scottish descent, her grandparents having emigrated to South Africa from Scotland in 1860. She was brought up in a district where many Xosas live and, since her student days, has painted, sculptured, and photographed these friendly, cheerful people in their brilliant costumes colored with the red clay of their land.

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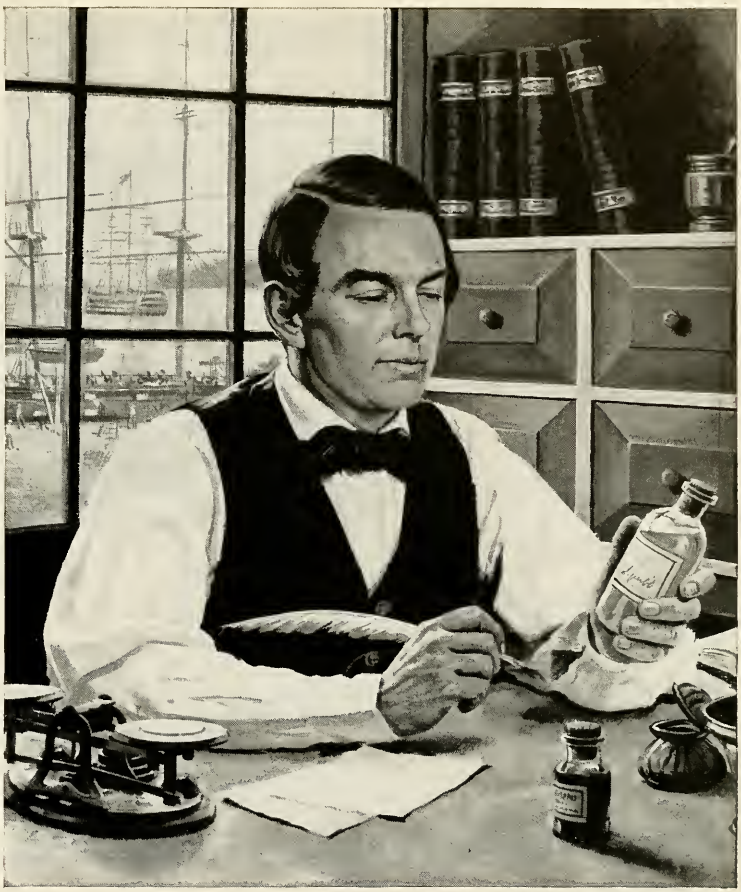

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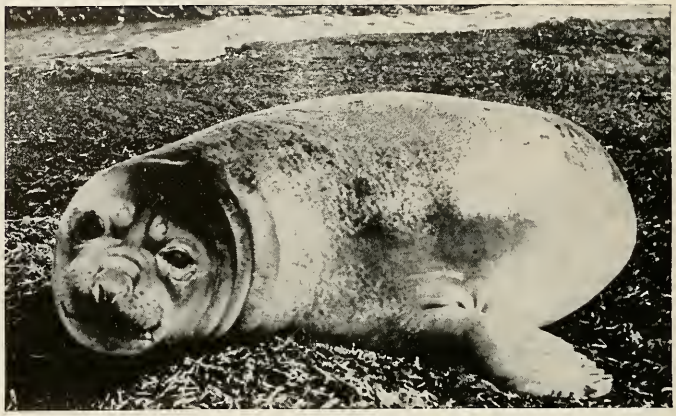

▲ A YOUNG SEA ELEPHANT of Kerguelen, from *Thin Edge of the World.*

THIN EDGE OF THE WORLD

- - - - - - - - - - by André Migot

Little, Brown, $4.50
242 pp., illus.

Reviewed by SIR HUBERT WILKINS

IN THIS interesting narrative, André Migot describes life on the Kerguelen Islands, which are found in the subantarctic zone of the Indian Ocean. He characterizes Kerguelen as bleak, barren, desolate, storm-swept, and forlorn. Yet, bleak as it is, Kerguelen is in many respects a hive of activity. In this wildlife sanctuary there are many species of gulls, terns, cormorants, stinking Nellie petrels, and magnificent giant albatrosses. There are penguins numbering in the hundreds of thousands. We read about the fantastic nuptial and extramarital dances of the albatross and the beaches teeming with huge bulbous-nosed sea elephants, each with his harem and multitudinous young.

Only the humans, apparently, exhibit deep dissent, as evidenced by Migot's frequent references to squabbles, petty grievances, and displays of bad temper at Port-aux-Francais. He tells of some amazing individuals too, such as his associate, the French choreographer-dog-driver-oceanographer with a strange passion for polar exploration. Though the author describes some parts of the islands as bleak, we read also of scenes which never look the same, where delicate pastels and unusual light effects always temper the view of land and sky. No words or pictures, according to Migot himself, are adequate to convey the incredible splendor of this polar landscape, where one seems always to be on the brink of a mysterious revelation.

There is a thrilling account of brave and hazardous attempts to force the ship through ice to the coast, and a hair-raising passage about the gallant effort of Captain Petersen to battle through sludgy seas bristling with icebergs. Finally, the return voyage in an empty ship with ice-cased decks, through 90-mile gales and iceberg-filled waters, is a fitting descriptive close to a remarkable story of adventure.

Eminent authority on both the arctic and antarctic, the reviewer has visited the latter continent eight times and has spent some time in the area covered by the book.

OTHER MEN'S SKIES

- - - - - - - - - by Robert Bunker

Drawings by Clif Ingram
Indiana University Press, $4.50, 256 pages

Reviewed by OLIVER LA FARGE

ROBERT BUNKER went to New Mexico for the Indian Service's inservice program—now, unfortunately defunct—in time to catch something of the strong, sometimes sentimental, liberalism of John Collier who, as Commissioner of Indian Affairs, was always strongly aware of human values. The war yanked him out, then he returned to serve among the Pueblos and New Mexico Navahos under a superintendent formed in the same tradition.

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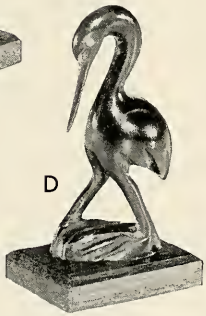

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It is apparent from his narrative of his years in active service with the Indians that he brought to his work a stress on human values, esthetic sensitivity, and enthusiasm. He brought also a philosophical tendency, a desire to develop and test a doctrine for those who intervene in the lives of others. It was apparent to those who knew him during his field period that his work was aimed at more than the achievement of the immediate result.

His account of those years is most easily classified as reflective autobiography, but this classification is inadequate. It is a highly subjective story, sometimes intensely so, filled with vivid descriptions of the Indians with whom he dealt, as well as of scenes and landscapes. At this level alone it is worth reading.

He was probably aware of the fact that he was engaged, not only in earning a living and rendering a government service, but in a self-appointed task of active research. How does one encourage a "depressed" or "backward" people to help themselves without creating a false initiative that will fade away when the helper stops pushing? When such a group does take the initiative, how does one advise and help without, again, distorting or undermining that initiative or pushing the line of action into a direction that the people will not follow? These were the questions he wrestled with, testing the answers in actual practice.

These are major questions. Even under Collier, our Indian Service never really answered them; under most other commissioners it has not even tried, which is one reason why we have failed so lamentably with our Indians. These questions go to the heart of what is needed if our plans for aiding peoples abroad—call the programs Point IV or what you will—are to succeed, or ever win us friends.

The administrator, advisor, technical expert, or whatever he may be called, must live with the people and their problems, which, for the time being, are his problems. He cannot operate in a vacuum; his personal life goes on and will be profoundly affected by his surroundings and the people with whom he deals. This in turn will affect his ability to retain serenity and perspective with which to carry out his task.

When this is recognized, the personal, autobiographical element in Bunker's book takes on new meaning. Because this is a highly subjective account, even if only of small operations among very small groups (but of vital import to those groups), it can be described as a needed supplement to Margaret Mead's large-scale, objective *Cultural Patterns and Technical Change*. Bunker anticipated some of the major principles laid down in that important work, and he has described fully and colorfully what happens when one applies them.

Other Men's Skies is well worth reading. If any fault is to be found with it, the absence of humor might be noted. The decorative drawings by Clif Ingram add to the appearance of the book.

One of the country's leading authorities on the American Indian, Oliver La Farge has written widely on the subject. Laughing Boy, the story of a Navaho child, was awarded a Pulitzer Prize in 1929.

FAMILIAR ANIMALS OF AMERICA

- - - - - - - - - - - By Will Barker

Drawings by Carl Burger

Harper, $4.95, 300 pp.

Reviewed by MARSTON BATES

WILL BARKER and Carl Burger have produced a handsome book on the more notable mammals of the United States and Canada. Carl Burger's drawings are particularly fine. They are like a series of portraits of individuals, caught in some action or mood that brings out the character of the subject: sly, inquisitive, playful, cruel, or stupidly busy. The text does not show the life and insight of the drawings, but it is a straightforward, informative account of the basic habits of the various species.

The mammals are covered under 46 headings, arranged in systematic order from "Opossum" to "Mountain Sheep." The book makes no pretense to being a manual for identification, though occasionally (as with bears and deer) there may be comment on how to distinguish similar species.

Mr. Barker's text is devoted mostly to summaries of the life histories of the different species or groups of species: food habits, mating habits, gestation period, size of litter, growth, abundance, range, natural enemies, and the like. The footprints of most species are illustrated and the track patterns described. There are occasional interesting asides on history, folklore, and the derivations of vernacular or technical names.

As a sort of afterthought, there is a short final section on "Amphibians and Reptiles" in which poisonous snakes, nonpoisonous snakes, turtles, lizards, toads and frogs, and newts and salamanders are discussed.

The book occupies a niche somewhere between the usual field guides for identification and the generalized introductions to natural history. Both the author and the illustrator have a deep feeling for their subjects. Their joint product, consequently, should have a particular appeal to the budding naturalist, whether young or old.

The reviewer is Professor of Zoology at the University of Michigan and has written widely on natural history and related subjects.

▲ DRAWING of an unidentified beast found in the cave at Lascaux, France from *Testimony of the Spade*

THE TESTIMONY OF THE SPADE

- - - - - - - - - by Geoffrey Bibby

Knopf, $6.75
414 pp., illus.

Reviewed by V. GORDON CHILDE

ARCHEOLOGISTS' spades and scientific induction have extended the range of history in northwest Europe half a million years back. To introduce this unrecorded era to American readers, Geoffrey Bibby has ingeniously adapted the method employed by Ceram in his popular *Gods, Graves and Scholars*. Like Ceram, Bibby uses brief witty biographies of outstanding prehistorians as pegs on which to hang his finished picture. He includes not only excavators but also armchair archeologists who provide the interpretation without which the excavators' finds would be just meaningless curios.

To be sure, the finds from north of the Alps are generally less glamorous than the treasures of Priam and the frescoed walls of Cretan palaces. Nevertheless, this story of how Europe's natural resources were opened up is fascinating, especially since these pioneers were the cultural ancestors of those who later opened North America to civilization.

In Bibby's skillful hands, even the arid but crucial topic of chronology is made readable. And he gives the reader some painless insight into prehistorians' methods, as for example his explanation in the first chapter of the Three Age system, a basic concept in prehistoric chronology.

Occasionally Bibby departs from the historical order. He discusses the Danish kitchen middens, for instance, before the Ukrainian mammoth hunters, because the former were discovered first, although the actual occurrence of the mammoth hunters' camps preceded the kitchen middens by 10,000 years. However, only the most casual readers will find these few inversions confusing.

Unfortunately, the interesting Maglemose culture, with its ingenious fishing and transport devices that are still used around the Baltic, was left out. Of course, there is not space for all the anonymous actors in this story, and the author's selection, on the whole, is good. To the discriminating reader, he gives a vivid and reliable picture of a great human enterprise, enlivened by sympathetic and amusing sketches of the personalities who have converted flint chips, broken crockery, and holes in the ground into a record of man's progress.

For 20 years, Dr. Childe was Professor of Prehistoric Archeology at Edinburgh University and is now Director of the

continued on page 105

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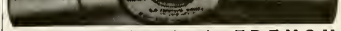

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Editorial Foreword:

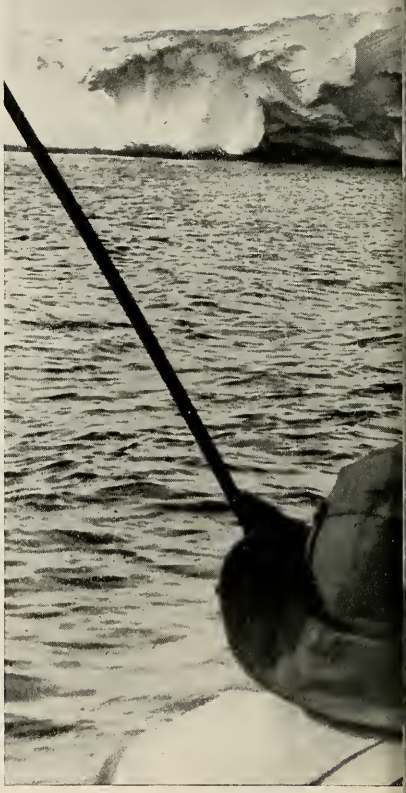
In advance of the program of antarctic exploration for the International Geophysical Year (1957-8), the U. S. Navy Icebreaker *Atka* was ordered south in 1955, under the command of Glen Jacobsen, on a solitary scouting mission. Its objective was to learn whether the installations at Little America and the nine aircraft left there could still be used. The expedition was also to look for other expedition sites along the coast.

As the vessel approached the edge of the antarctic icecap, her company was full of curiosity as to whether a large section of the Ross Ice Shelf might have broken off, permitting Little America to drift out to sea. No ship was known to have been there since the visit of the *Edisto* and *Burton Island* in 1948, though Soviet whalemen hinted they had visited the Bay of Whales a year later.

The present account is condensed from Walter Sullivan's book *Quest for a Continent*, to be published this month by McGraw-Hill. Mr. Sullivan had joined the *Atka* at Wellington, New Zealand, and was one of the 5 men on the 276-man expedition who had ever been in Antarctica before. Some had never even seen snow.—Ed.

New York Times

▲ The U. S. Navy Icebreaker *Atka* anchored at Kainan Bay, 35 miles east of the original site of Little America.



Littl

By
Walter Sullivan

About the Author:

Walter Sullivan began his newspaper career in 1939 as a copy boy for the *New York Times*. He is presently reporting from Antarctica for his newspaper. In addition to his present assignment and the trip described in *Quest for a Continent*, he was a member of the 1946-47 expedition to Antarctica, known as *Operation Highjump*. His interest in scientific projects dates back to a summer spent in central Alaska as a student helper on an American Museum of Natural History project.

New York Times

▲ In a small boat, crew members from the *Atka* investigate a new eight-mile fissure through huge masses of ice.

America Revisited

The story of the *Atka* expedition, which defined U. S. participation in the largest exploratory venture in history — the international assault on the secrets of the Antarctic Continent

HAD a section of shelf ice cracked off and gone to sea, carrying the Little America camps with it? Someone suggested, half seriously, that if the camps were found to be floating on a very large berg, it might be possible to fuel up the nine planes that had been left there and fly them to New Zealand. Better yet, perhaps the berg could be pushed or towed into port and its million-dollar cargo of aircraft and assorted vehicles unloaded—if the ice did not melt too fast en route!

While we were at dinner one evening, a radio-room messenger came in to show a dispatch to Lieutenant Commander Francis E. Law, the ship's executive officer. The point of origin was given as a Japanese whaler, and it was signed "Alex Borgenson, United Nations Whaling Observer." The message ended with the words:

> BAY OF WHALES CLEAR OF ICE TO SHORES OF ROOSEVELT ISLAND COMMA FORMER POSITION OF LITTLE AMERICA NOW OPEN WATER HOPE TO SEE YOU UPON ARRIVAL

There was a gasp from those who

New York Times

▲ "WHITE-OUT" is the greatest danger encountered by pilots in the antarctic. When there is no sun to bring the snow surface into focus, pieces of wood are dropped as markers. The helicopter in this picture, equipped with pontoons, is still on the ground although it looks as though it is hovering above.

had once lived at Little America. One said dejectedly, "Twenty-six years of work washed out to sea on an iceberg!"

I hurried below to the ship's office to type out a story on the disappearance of Little America. I was well into it when the door opened. It was Law. He scanned the office to make sure no one else was there, then said with a grin, "I wouldn't work too hard on that story."

Practical jokes, as I knew, were endemic in this part of the world.

At 2:30 A.M. on the morning of January 14, our ship was off the frontal cliffs of the Ross Ice Shelf. The navigator, Lieutenant Commander Frank A. Woodke, who had been on the *Burton Island* in 1947, felt that we should be close to Discovery Inlet about 100 miles west of Little America.

He looked at the ice cliffs through his binoculars, then scanned the radar screen, but no sign of the inlet entrance was to be seen. He was sure, however, that the ship was west of Little America, so the *Atka* sailed east along the 100-foot ice cliffs toward its destination. Woodke obtained a few fleeting glimpses of the sun, and when he had worked out his sights, he admitted rather abashedly that they placed the ship ten miles "inland."

At length, a huge shallow indentation appeared in the line of the cliffs. It was 38 miles wide and 14 miles deep. No feature of this nature was shown on the chart. The conviction grew as we skirted its edges that this must be what was left of the Bay of Whales. The jest of two days earlier had in effect become the fact of today.

Only Radio Masts Left

All hands were topside, except those standing watch below decks. Every binocular and long glass was in use. Suddenly, one man called down from aloft that he could see a pole about a mile inland on the shelf of the ice plateau. We caught a glimpse of it; then it vanished behind a jumble of ice mounds and pinnacles. As the ship slipped along, several poles came into view, and the man aloft shouted, "Hey, there's a propeller spinning on top of one!"

Amory Waite, who was standing at a lower level on the bridge, cried out, "That's my electric generator, still turning after 20 years!" He had helped install it in January, 1934, atop one of the three radio towers at Byrd's original camp.

A helicopter, with Jacobsen aboard, took off and located Little America III, the 1940 camp, which also appeared to be intact. But there was no sign of Little America IV, the 1947 tent city of *Operation Highjump*. Nor could we see anything of the nine planes left alongside that camp on the east side of the bay. As Paul Siple had predicted, the entire western side had broken off and floated out as one or more icebergs. Woodke's navigation had been right all along. The ship was, indeed, ten miles "inland," for that much had broken off. Discovery Inlet was gone. A section, at least as large as New York State's Long Island, had "calved" from the Ross Ice Shelf. The absence of the 1947 camp seemed to indicate that part of the eastern side of the bay was gone as well.

During the day I made a helicopter flight with Chief Aviation Pilot Albert P. Metrolis to establish whether or not the 1947 camp really was gone. I had brought a rough chart of the area as it was in 1947 and told Metrolis that if we went over the 1940 camp, which was visible, and flew due north we should pass directly over the location of the base camp of *Operation Highjump*.

This we did and skimmed along a hundred feet or so above the

New York Times

▲ Another means of locomotion is the Weasel snow tractor. At right: a scouting party sets out to find a safe route up over the 80-foot cliffs so the Weasel will not crash through a bridged-over crevasse.

U. S. Navy

▼ "How thick is the ice?" Commander Herbert Whitney (left) and Commander G. K. Ebbe, both of the U. S. Navy, seek the answer.

W. M. Cox, U. S. Navy

snow-clad surface while I peered ahead on both sides for some sign of our former home. We were fast approaching the brink of the ice cliffs which lay diagonally across our path, when we saw a pipe sticking 20 feet out of the snow—the flagpole of our old camp. Near by were two rows of tent poles protruding a few inches above the surface. One row was incomplete, breaking off abruptly at the brink of the cliff.

From out over the ocean we looked back and saw a dark object embedded in the face of the white precipice. Metrolis skillfully lowered the helicopter and hovered over the water abreast of the object. It was an oil drum, and beneath it was a dark line that ran for some distance parallel to the crest of the cliff, seven and a half feet below the brink. This line marked the snow level that had been on the surface eight years before. Soiled by our boots and vehicles, it now showed up in cross section on the face of the ice cliffs. Near by a tent hung clinging to the face of a cliff. It too had been buried until the great calving exposed it to view. Something that resembled a folded army cot hung free from one of the tent floor beams. A torn fragment of red cloth blew in the wind.

The camp had been cut in two as though by a gigantic meat cleaver. The other rows of tents, the operations hut, and the nine planes had vanished. Sooner or later erosion of the shelf was bound to spill the rest of the camp into the sea if a calving of icebergs did not do so beforehand.

Landing Difficulties

We radioed our news to the *Atka*, then looked for a safe place to land. With no sun to bring the snow surface into focus, we were acutely aware of the danger of white-out. Metrolis let the 'copter down with extreme care, but nevertheless we landed with a bump, both convinced that the surface was still some feet below us.

Later in the day another helicopter, with "Tim" McCaw at the controls and Chief Photographer Hassel White as passenger, had a more unsettling experience. They had brought two pieces of wood to drop when several hundred feet in the air, so that McCaw could use them as markers for his landing. When McCaw gave him a nod, White threw the boards out the door.

"The wood didn't drop at all," he said afterwood. "They just hung there in the air." Then they realized that the aircraft was only a few inches above the surface.

On the other hand the captain, on one of his flights, thought the machine had landed. He unbuckled his seat belt and prepared to get out. "Just a minute, Captain," said Tilghman, the pilot. "Let's make sure we're down." He found they were still 100 feet in the air.

After our landing, I walked about the remains of the camp. The snow

◄ THE AUTHOR, fitted out to travel on the antarctic ice.

▲ ALL THAT IS LEFT of Admiral Richard E. Byrd's original camp established in 1929 at Little America—the tops of the radio towers.

level was almost halfway up the flagpole that stood alongside the mess tent. No sign was visible of the tent itself, which with its field kitchens had daily fed hundreds of *Highjump* men, although it lay somewhere under the snow at my feet. Beyond, nothing was to be seen except the shelf—flat, glaring white, reaching endlessly toward the Pole. We headed back for the *Atka* along the line of cliffs at what seemed breakneck speed, since we were only 20 feet above the cornice, which zigzagged wildly close below us.

With no planes or other equipment left at the *Highjump* base, the carefully worked-out program of tests and trails had to be scrapped. Furthermore, without a harbor, the other installations at Little America were of little use, for they could only be reached by helicopter.

Hence Jacobsen had to revise his plans. The *Highjump* camp was too close to the brink for safety, so he ordered a party under Murray Wiener, a veteran of two former expeditions, ferried to Little America III by helicopter.

Not the slightest mound in the surface gave a clue to the location of the buildings, but Wiener had a map which placed his former home in relation to visible radio masts, and so, fortunately, he was able to tell the men where to dig.

Two feet down, they hit the crown of the Quonset hut built in 1947 on top of the 1940 camp. They located the escape hatch at one end of the roof and broke it open.

A Crystal Palace

The stagnant, frigid air of the blackness below was like that of a refrigerator that had been sealed seven years. Outside, the temperature was slightly above freezing, but in the hut it was 11 degrees.

One by one the men descended the vertical ladder, carrying lanterns. The scene that greeted them was breath-taking. Never had a Quonset hut — that drab structure born of World War II—been decked out in such glory. In the lantern light, its walls sparkled as though solidly encrusted with diamonds. The tunnel leading down to the older buildings had partially caved in, but where accessible it was a miniature crystal palace, completely covered with ice crystals in an infinite variety of proportions. Some were as large as the palm of a man's hand, others slender and eight inches long, a few thick and solid like quartz. Most were so delicate that they shattered with a puff of breath. Perhaps nowhere in the world could there be found so fragile a sound as the tinkling of these crystals when a man brushed past.

The crystals had been formed when the air, moisture-laden from warmth and human occupancy, cooled after the camp was sealed.

The floor of the hut was buckled upward as much as two feet in some places. Originally the heat of the sun on the metal roof melted the ice foundations under the sides of the building; then the accumulating weight of snow forced the sides down even farther, causing the floor to dome upward until now the tall radio transmitters were tilted crazily to both sides.

While the scientists were at work taking magnetic observations or digging pits to test the snow, Jacobsen decided to salvage as much as possible of the equipment in the Quonset. Thus Antarctica's first airlift was set in motion. The 'copters ferried out cameras, radios, surveying equipment, and — of particular interest to me — a generator which gave the ship enough power to transmit my stories directly to the offices of the *New York Times*. In two days, they flew 97 round trips without a mishap of any sort, and over a ton of equipment was lifted out.

A small party flown to Byrd's original camp found that after 26 years the 70-foot radio towers were

▼ BEAUTIFUL ICE CRYSTALS adorned the ceiling of a quonset hut of the 1947 camp (Little America IV). Built on top of the 1940 camp, it was buried deeply in snow by 1955.

New York Times

almost completely buried. One protruded only a couple of inches, and I asked Jacobsen to sit on it for a photograph. Here the fabulous tale of Baron von Munchausen, in which the snow was so deep that he hitched his horse to the tip of a church spire, had in effect come true.

Impressive as was the engulfing of the towers, this could not be taken as an accurate measure of snow accumulation during the previous quarter century. They had been tipped by wrinkling of the compressed ice sheet, and the uneven nature of the surface here made for drifting. The measurement of ice-sheet growth has long been a problem, since any vertical marker in itself causes drifting and hence gives a false picture.

While the *Atka* lay off Little America, Davies, the geologist, flew a circuit of the bay area. He found much pressure ice inland to the south and several places where the ice cliffs were low, but there was no suitable landing place for a ship. An eight-mile chasm that ran southward toward Roosevelt Island was lined with stretches of open water and was alive with Weddell seals, which had apparently survived the compression of the bay and the mammoth calving that followed. In 1947, Waite and I had found two seals in this area which had been branded by Alton Lindsey twelve years before. We could not help but wonder if members of this venerable and home-loving generation might still be living in the cleft.

Southernmost Point

While the *Atka* lay to, Charles M. Williams of the Navy Hydrographic Office was flown to the ice shelf plateau to take a series of sun-sights. These proved that the *Atka* had sailed farther south than any other American naval vessel and only eleven miles short of the record set by Amundsen's *Fram*.

The eight-mile cleft seemed to indicate that another large section of the shelf was ripe to break out. When it does, a ship should be able to penetrate as far as the *Fram*. This final calving may sweep away what remains of the Little America camps and destroy the last refuge of the Weddell seal colony, but at the same time the bay may again become useful as a harbor and remain free of major calving for another half century.

Using the "fix" established by Williams as a starting point, the *Atka* sailed back along the ice front to the westward and confirmed that a belt of shelf ice about 10 miles wide and at least 120 miles long had gone out, carrying with it such charted features as Discovery Inlet and Lindbergh Inlet — each about the size of New York Harbor.

By January 17, the survey of the ice front and the operations at Little America had been completed. A letter from Commander Jacobsen was posted inside the Quonset hut to welcome any future visitors. He noted that this might be the last visit of man to this historic spot, since it was gradually being destroyed by inexorable forces. Nevertheless, he wrote:

Little America will live in the annals of polar exploration. It was here that man first used modern methods to explore this trackless wilderness. The hard work and sacrifice of the men who preceded us here will never be forgotten by mankind.

Attached is a list of the personnel of this expedition which we leave for posterity.

Good exploring!

The escape hatch was closed, and all of those remaining prepared to be lifted out. I took a quick look around. Cloud shadows were moving across the shelf surface, and it occurred to me that perhaps the secret of its fascination lay, as with the sky, in its subtle changes of mood and overwhelming breadth. This sheet of floating ice, so thick that it seemed like solid land, girdled on three sides by mountains, was 550 miles wide and 480 miles long. Wispy streamers of drifting snow skimmed over the ice sheet, and as we left they had already begun to bury the camp entrance.

With the decision not to use the Bay of Whales as a base, its 44-year

continued on page 109

U. S. Navy

12 Nations Converge on the Antarctic

A Progress Report on I. G. Y. in the Far South

AP, photos by Don Guy

Wide World

United States

Top: A survey party leaving McMurdo by dog sled. The Globemaster (above left) has brought the smaller plane that is being unloaded. The bearded men are receiving their first mail in nine months, at the bleak McMurdo encampment seen at left.

AFTER the selection of Kainan Bay for the chief U. S. base in Antarctica, as told in the preceding article, the U. S. Navy Icebreaker *Atka*, under Commander Glen Jacobsen, sailed almost halfway around the antarctic continent to Cape Norvegia.

He then explored a large unnamed bay in the Weddell Sea about 150 miles to the west (72° 38′ S. — 17° 40′ W.) He also examined another indentation ("Atka Bay") about 110 miles on the other side of Cape Norvegia at 70° 33′ S. and 08° 04′ W. Some distance beyond this, an ideal bay (provisionally called "Admiral Byrd Bay") was found to afford plenty of room for an airfield. But this lay in territory regarded by the Norwegians as theirs, and it was also a bit far from the Pole to serve as an alternate base for the American explorers who would be wintering there. Therefore, the U. S. later decided to put its Atlantic base some distance to the west in the Weddell Sea. The Norwegians were disposed to use "Byrd Bay" for their I.G.Y. station.

The United States, in addition, has established another air base at McMurdo Sound, at the opposite end of the Ross Shelf Ice from Little America. It was from that base that Rear Admiral George J. Dufek, who is directing the U. S. programs in Antarctica, flew a distance of about 800 miles last October 31 to make the first landing at the South Pole. Other landings have now deposited personnel, construction materials, and instruments for the seventeen-man post that will conduct research at the Pole during the coming antarctic winter.*

Far around on the other side of the continent, at Vincennes Bay (longitude about 110 E.), it was decided to place another U. S. outpost.

The chief U. S. base, Little America V at Kainan Bay, is now well established. One of our most enterprising projects is the proposed research station deep in Marie Byrd Land, 600 miles from Little America V. In January of last year, after a tractor party traveled about 330 miles toward that objective, it was decided that further progress was not immediately practical.

Last November, renewed efforts to establish the Marie Byrd Station suffered set-backs in the heavily crevassed coastal area. The eleven-man team was directed to get as far as it could by Christmas and establish the station at that point.

*The experience of this group will be reported from time to time in coming issues of NATURAL HISTORY Magazine.

Great Britain

(Falkland Islands Dependencies Survey)

ABOVE: The Graham Land Base of the F. I. D. Survey, barely visible beneath Mt. Flora (right) and the Pyramid (left). The men at right are relaxing between jobs. BELOW: Some of the dogs bred at the base show eagerness at the prospect of a sled trip, while at right one of the meteorologists reads the weather recording instruments.

F. I. D. S. (Anderson, Lewis, and Gilpin) from Camera Press, London

U. S. S. R.

RIGHT: Expedition cameraman filming seals. BELOW: Members of the first Soviet Antarctic Expedition launching a radiosond to record the temperature, humidity, pressure, and wind velocity at high altitudes. FAR RIGHT: One of the dwellings at the Mirny Soviet Base.

Press Photo Agency, by Denison and Kochetkov

Operating out of McMurdo Sound between January 3 and 14, 1956, four large U. S. planes made a series of nine important flights totaling 23,000 miles, which criss-crossed Antarctica. One of these flights discovered four mountain ranges between the Weddell Sea and the Pole, which may hamper the British in their traverse of this region.

The 73 men who operated the base at Little America V in 1956 and the 93 at McMurdo Sound were the largest parties ever to winter in Antarctica.

The Soviet Union has placed its main base near Haswell Island on the Knox Coast, in the sector claimed by Australia. Their plans include the sending of tractor trains far inland to establish year-round observation stations at the Geomagnetic Pole and possibly at the Pole of Inaccessibility. Fourteen women have accompanied the expedition, which raises the question whether this can claim to be the first homesteading scheme in antarctic history. The settlement consists of 24 prefabricated houses arranged along a 200-yard street, all linked by an automatic telephone exchange.

The Soviet scientists received a visit from the head of the Australian Antarctic Expeditions, who described the Soviet equipment as up-to-date and their attitude as frank and friendly.

Early in 1956 the Russians set forth to establish a winter camp en route to the Geomagnetic Pole. This group established Pionerskaya Station 230 miles inland at 69° 44′ S. and 95° 30′ E. The six men who were left there are the first ever to try to winter on the inland plateau.

The British have for 13 years carried on extensive research in the antarctic through the Falkland Islands Dependencies Survey. The Falkland Dependencies embrace a number of islands ranging from South Shetland and the South Orkneys to Graham Land in the Palmer Peninsula and points on the continent of Antarctica. The Survey has been working from ten bases scattered over this region, at which 76 men spend one or two years in meteorology and other scientific work. The Governor of the Falklands has placed the experience and knowledge of the Survey at the disposal of Britain's Royal Society, the body responsible for British participation in the International Geophysical Year.

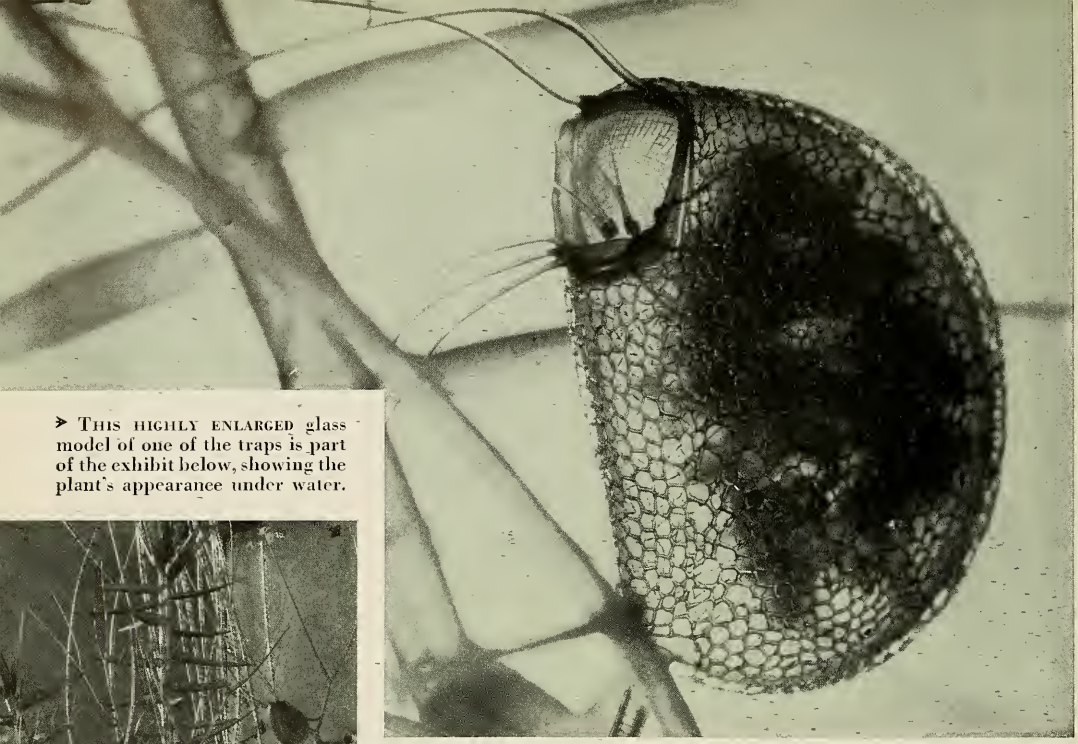
The two major British expeditions in Antarctica completed their reconnaissance in 1955 and are now operating near Vahsel Bay in the Weddell Sea. One, under Colonel Robin Smart, will carry on intensive scientific work in that neighborhood. The other, led by Vivian E. Fuchs, will attempt the first 2000-mile crossing of the antarctic continent. This will be coordinated with an advance from a New Zealand base on the opposite side by a team under Sir Edmund Hillary, the conqueror of Mount Everest.

The Australians have enlarged their station at Mawson to 20 men and are setting up another outpost on the "Australian Coast" of Antarctica in the Vestfold Hills.

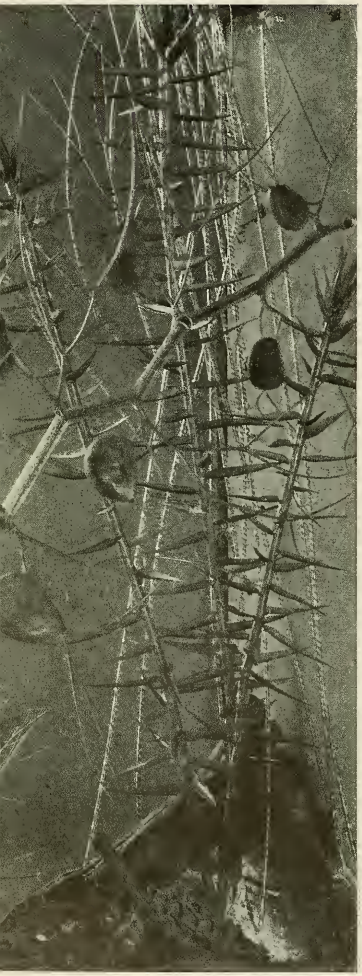
The French in 1955 enlarged their base at Geology Point on the Adélie Coast. From here they plan to haul fifteen tons of supplies (food for two years) to establish a station at the Magnetic Pole, about 300 miles inland. No air support was anticipated for this operation, owing to high winds.

The locations of the scientific headquarters of other nations in the antarctic are shown on the accompanying map, and first glimpses of the work and life of the men at these outposts on the "fringe of nowhere" are seen in the accompanying photographs.

THE EDITORS



➤ THIS HIGHLY ENLARGED glass model of one of the traps is part of the exhibit below, showing the plant's appearance under water.



A Plant that Captures animals under water

Its prey may be tiny, but the trap of the bladderwort is one of the most remarkable mechanisms of the plant world

By ERIC V. GRAVE

Many are surprised to learn that a plant as common as the bladderwort should possess such an astonishing set of mechanisms with which to capture tiny animals. We hear it said that plants are so simple they need only water, air, and sunshine to get along in the world. But *Utricularia*, as it is scientifically called, has evolved a trap that almost gives it status as a predatory creature.

You can find the bladderwort in swampy waters or in the shallow inlets of many of our lakes. It is easily overlooked, however, because it floats submerged near the surface. Its pretty yellow flowers, to be sure, about ½ inch in diameter, do stick out of the water on stiff

stems. But the countless traps with which the plant catches its prey are not connected with the flower. They are arranged neatly along delicate branches below the surface.

Pull the plant out of the water and you will see them. A magnifying glass is necessary to detect more than their general shape. They look like tiny sacs with openings in front. A number of conspicuous appendages are attached to the edge of the opening. These guide the prey toward the dangerous mouth. And woe to the animal that follows their invitation!

The mouth of the bladderlike sac is the most sensitive part of the whole mechanism. It has a door of fine tissue, which is only partly attached to the inner cell wall as though on a hinge. When closed, the free edge of the door rests against a thickened pad, which forms a threshold. With a fine bristle, you can push the door in. When you withdraw the bristle, the door snaps back into position.

It was originally supposed that the bladders were filled with air to keep the plant afloat. Then, when the German botanist Ferdinand Cohn first recognized them as animal-catching traps in 1875, he thought that the little animals on which the plant feeds unsuspectingly forced their way into the bladders by pushing in the door. Charles Darwin assumed the same thing when he independently tried to explain their function a year later. Today we know that the apparatus is a much more complicated affair.

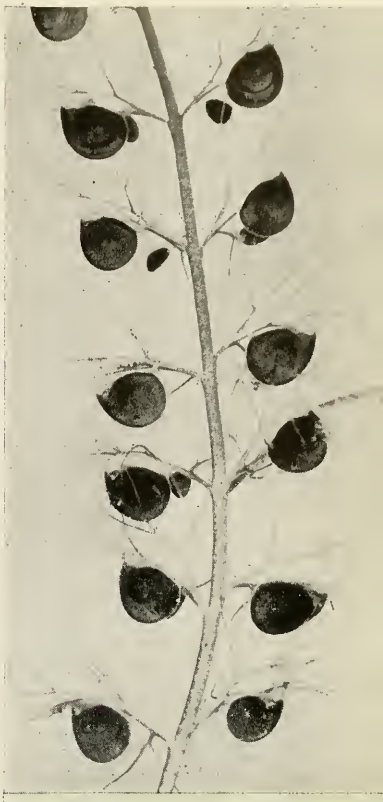
Two things had to be discovered before the working of the trap could be fully understood. First, from four to six stiff bristles were observed to be attached to the lower edge of the door. These are called trichomes. When they are touched, they set off the trap. Second, it was shown that when the door is closed, the sac is completely watertight. Not only does the door fit snugly, but a delicate membrane called the velum and a mucilage secreted by glandular hairs arranged around the mouth help to seal the door. It is this watertightness that is the most essential feature of the whole mechanism.

When first you pull the plant from the water, most of the bladders will appear rounded and bulging like well-filled purses. But if you put the plant into a jar of water and leave it undisturbed for half an hour, the side walls of the bladders will cave in like hollow cheeks. This is because the water inside has been absorbed by hundreds of microscopic hairlike structures, called quadrifids. The collapse of the walls of the bladder is possible only because no water can seep in while the process of absorption is going on.

In this condition, the sac is like a rubber syringe from which you have removed the air and closed the opening with a finger. The bulb of the syringe remains collapsed, and you can feel the suction at the tip. In the same way, the Utricularia trap is under tension until the water can be admitted. But the door remains firmly pressed against the opening and the bladder remains in a position of delicate balance — a state of "unstable equilibrium" — until some little animal approaches and touches it off.

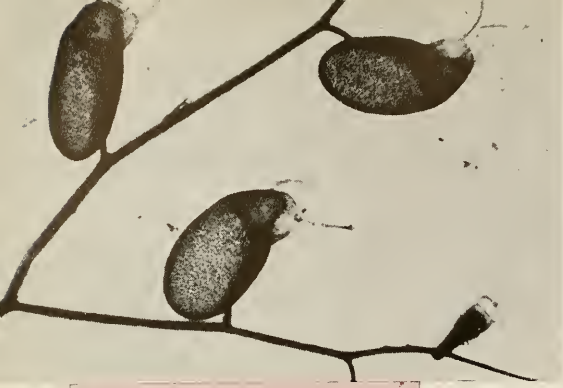
Perhaps it is a water flea *(Cyclops* or *Daphnia)* or one of the countless nematodes or insect larvae that swim and wiggle about in the water. Whatever the prey, contact with one of the trichomes in front of the door causes the edge of the door to be lifted a trifling amount. This is enough. The water pushes the door wide open and rushes into the sac as the walls spring back to their relaxed position. The unfortunate victim is sucked into the trap, and it closes immediately. There is no escape. The mechanism of an Utricularia trap is so sensitive that even an animal as small as a paramecium may touch it off.

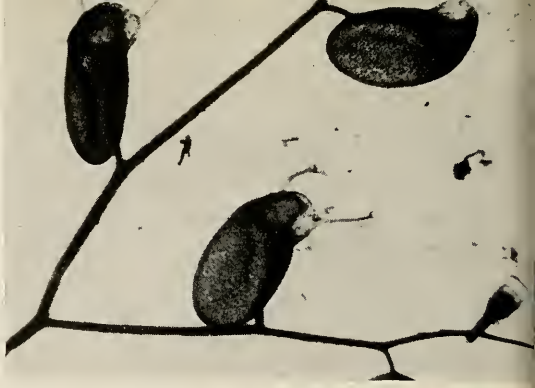
As soon as the trap is closed, the hairlike organs inside start to absorb the water. The side walls then fall in, and things are gradually made ready again for another capture. Though the sac is less than an eighth of an inch long, it is a big stomach with a good appetite for



▲ A GROUP OF TRAPS of *U. vulgaris*, magnified about five times. The main stem of a single plant may reach a length of several feet and support hundreds of traps.

The author holds the degree of Doctor of Social Sciences from the University of Freiburg and worked in Germany as an economist. As he was active in the fight against Hitler, he had to leave Germany before World War II and was granted an emergency visa. Here he has dedicated himself to the study of biology, which fascinated him from childhood. While in a swamp attempting to photograph the flower discussed in this article, he began to sink and had trouble getting back to safer ground. So he nearly got trapped by Utricularia himself.—ED.





▲ THE TRAPS in a "relaxed" condition (above). The sacs are filled with water and have a rounded appearance. They are not ready to capture anything in this condition. Half an hour later (above right) the fluid within has been absorbed and the side walls are sucked inward. The traps are now set and may go off whenever the trigger mechanism is touched.

➤ IF ANY SMALL ORGANISM now touches the six bristles, or trichomes (attached to the door inside the snout), the trap will spring open and the inrushing water will suck the organism in.

anything so small as a water flea. And it means slow death for those who are swept into it. If you put a trap under the microscope, you can watch the prey swimming around inside, as though puzzled about their strange imprisonment.

A cruel fate awaits animals too large to be swallowed. If you keep Utricularia in an aquarium and provide it with water fleas, some of them may get caught by their antennae. Unable to free themselves, they struggle desperately and finally die from exhaustion. Since the opening and closing of the trap takes only 1/35th of a second, there is no time for withdrawal, once the release mechanism has been touched. How much more merciful are the tentacles of the hydra, which paralyze the prey.

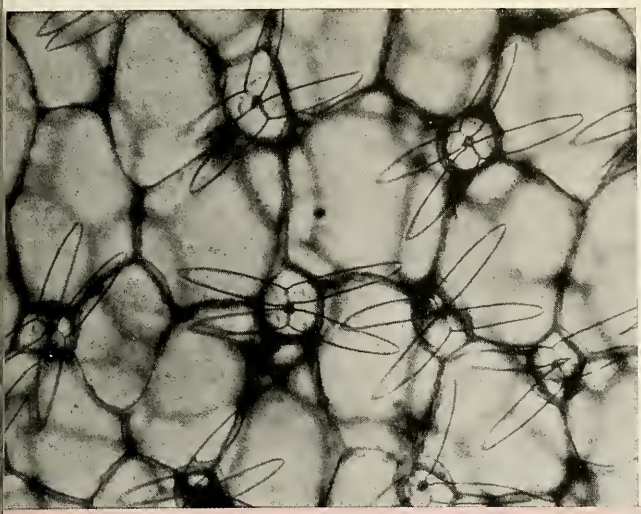
A single plant of the most common Utricularia in northern United States *(U. vulgaris)* can have hundreds of traps. One investigator counted the contents of 610 traps on a single plant of the species *U. neglecta* and found that 62 were empty, 44 contained unrecognizable debris, and the remaining 504 contained various organisms numbering 2084, or an average of about 4 to each bladder.

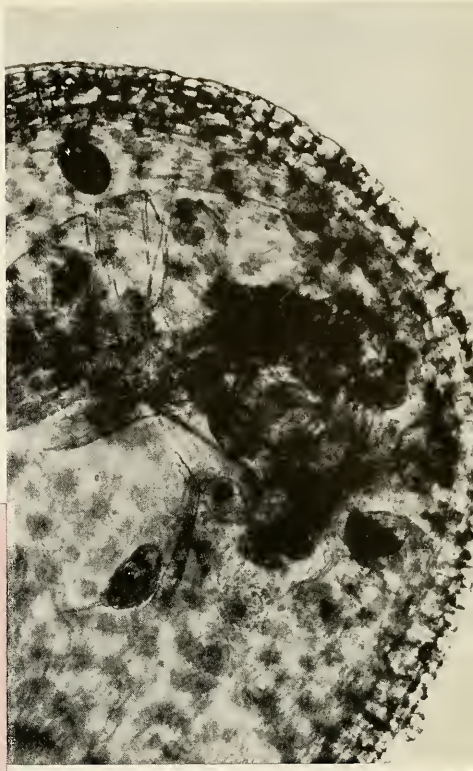
Contents Digested

Charles Darwin believed that the animals caught in the traps decomposed and that the decaying fluid was absorbed by the quadrifids. However, it is now known that no decay takes place inside the traps. Chemical analysis indicates on the contrary that the quadrifids secrete digestive juices and that a process occurs which is in some respects similar to the digestive process of animals. Benzoic acid, a compound that prevents decay, has been found in the bladders. It has also been shown that some of the bacterial flora existing in the bladders are types common to the digestive tracts of animals. Some of these bacteria belong to the coli-group; others are believed to take an active part in the digestive process by breaking down albumen.

The chitinous or horny parts of the prey cannot be digested, and they remain in the bladder, causing it ultimately to fall off the plant.

It is interesting to cut a trap in half and look inside with a microscope. Cut a wedge into a light splinter of wood, just large enough to hold one of the bladders. Put a bladder into this wedge, with the mouth of the bladder facing upward. Then make a cautious cut with a safety razor blade. Both halves of the bladder will stick to

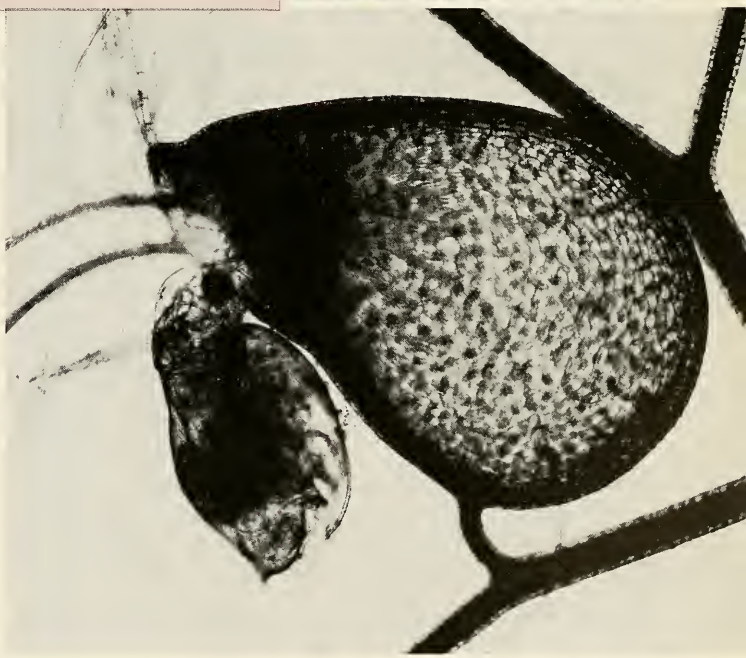




▲ THE CELLS on the inside of the sac are lined with hundreds of hair-like structures, the quadrifids. Their function is to absorb the water from the trap and thus reset it.

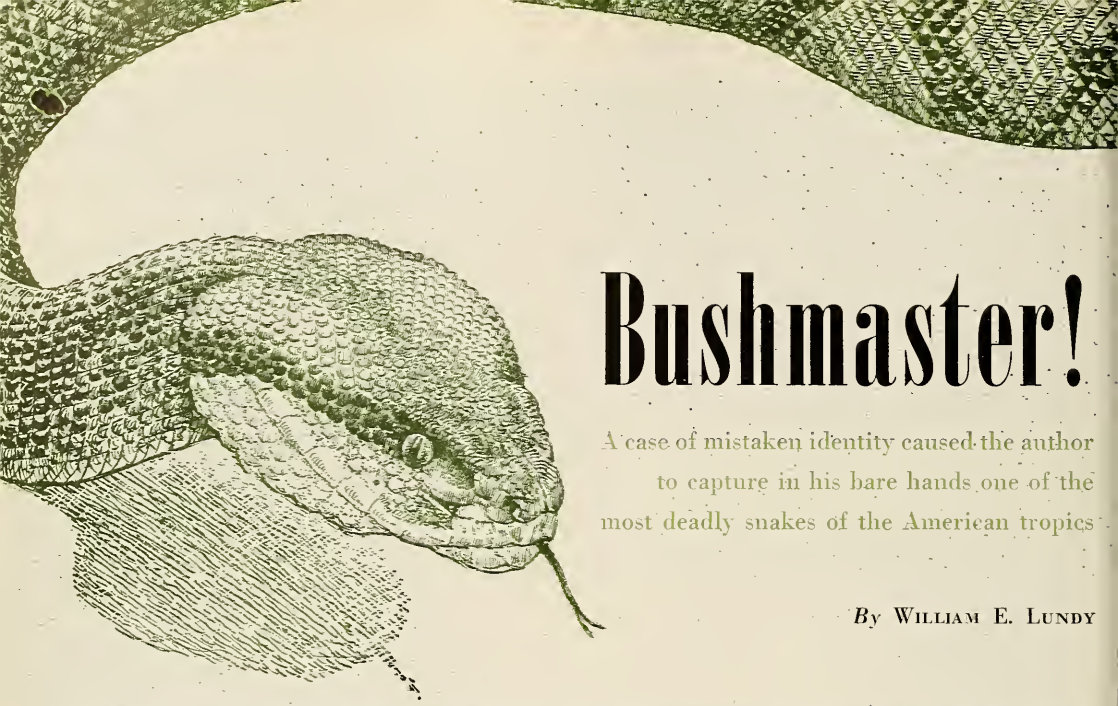
➤ A VIEW INSIDE A TRAP. It contains the partly-digested remains of a water flea. At lower left, a rotifer is still alive and swimming about.

▼ THIS WATER FLEA was caught by one of its antennae. After the photograph was taken, the author released the creature from the fatal embrace with a pair of tweezers.



the blade and can then be easily transferred to a drop of water on a microscope slide. This will enable you to see the hairlike quadrifids inside. You can also observe a host of microscopic organisms – protozoa, rotifers, diatoms, and desmids – some of them still alive. In fact, the naturalist can make the bladderwort provide him with abundant organisms for his microscope. The traps are at their best in spring and early summer.

The bladderwort has no roots. It bears yellow flowers; but it reproduces also by the formation of winter buds, which rest on the mud during the cold season. From these, new plants develop in spring. No fewer than 230 species are known. They show many variations in detail, but they all distinguish themselves from other plants by developing these remarkable traps.



Bushmaster!

A case of mistaken identity caused the author to capture in his bare hands one of the most deadly snakes of the American tropics

By William E. Lundy

MANY years ago while filling in a questionnaire for the Panama Canal Natural History Society, in answer to the question "Interested in?" I facetiously wrote "Anything that wiggles."

I have recently learned that that interest, unless diluted with a large amount of caution, can lead one to the brink of disaster.

The lure of the jungle had been unusually strong one Sunday, so in spite of occasional heavy showers my wife and I headed for the Madden Dam Forest Preserve. Near the crossing of the Madden Dam Highway and the historic Las Cruces Trail, we turned onto an abandoned road which during the last war led to some anti-aircraft outposts. Shifting into low gear, we climbed a steep hill. The road became little more than a shelf along the hillside, cut through virgin jungle. Then dropping into a valley, it grew increasingly narrower, for the jungle is rapidly reclaiming the space borrowed from it during the war. When brush began to scrape the car on both sides, reproving glances from my wife caused me to look for space in which to turn back.

At the turning point, we were serenaded by a pair of blackbilled wrens. From a dense thicket they repeated their fascinating song over and over, without once allowing themselves to be seen. A band of marmosets scampered through a small grove of balsa trees, stopping occasionally to feed from the vase-like, creamy-white blossoms, and making no attempt to hide themselves from us. When toucans began their froglike calling and the quavering notes of a tinamou came from the jungle depths, we knew that sunset was near and started homeward.

Turning a sharp curve, we saw a long, brown and black object stretched across the road ahead. "Boa!" I exclaimed, and sped forward. Stopping a few yards away I grabbed a four-foot butterfly net and ran to head the snake off, calling to my wife to bring her camera.

For some moments it remained quite still, as I have seen boas do in years past, but as my wife drew near, the front half of its heavy six-foot body drew back in a most peculiar combination of spirals and folds, "freezing" in a striking position, the head poised about eight inches above the ground. The assumption that the snake was a nonpoisonous boa was so set in my mind that I failed to heed that warning. *Why,* I will never know.

While my wife wound the camera, re-read the light meter, and fumbled for flash equipment which had been left at home, the snake slowly unfolded and headed for the

M. J. Fouquette, Jr.

➤ When meeting a Bushmaster, one yields it the right of way or takes the consequences. Its venom may cause death in 10 minutes!

➤ When the snake is alerted or excited, it may vibrate the spine at the tip of its tail. Among dry leaves, this resembles the sound of rattles.

Philip R. Houghton

bush. *Catching it by the tail,* as I have done with boas on Barro Colorado Island, I held on! This brought strenuous objections from the snake, but each time that it swung towards me, I caught the head in the butterfly net and pushed it away.

My wife could not be coaxed nearer for — so she said — all of the snake would then not show in the picture. Because the light was so dim, I wanted to take the snake home, where other pictures could be made. In spite of considerable protesting from the snake, and almost as much from my wife, the butterfly net was slipped over the snake's head. As it thrashed about, the net was maneuvered until over half of the body was inside. *Again catching the snake by the tail,* I lifted it into the trunk of the car.

As the tail was released, the tip vibrated so rapidly that it became only a blur, and brushing against an old newspaper, it gave off a sound quite similar to that of a rattlesnake. This, also, was most un-boa-like behavior, yet it *still* failed to put me on guard!

Reaching home, we used the same technique to transfer the snake from the car trunk into a large box. This was far more difficult, however, for the snake had become quite excited. Both ends would not stay put in the box at once, and the body was wound around the butterfly net. Once when it poked its head out, *I slapped it* to drive it back! Finally I grabbed it by the back of the neck! Untangling the long body from the net with the other hand, I pushed the snake deep inside the box, slid a heavy screen over the top, and jerked my hand away.

Soon the snake lay quietly coiled, but each time that the cage was touched, the tail vibrated angrily.

Lying awake that night I thought over the events of the afternoon. The strange striking position, the rapid vibrating of the snake's tail puzzled me, and the pattern on its back and sides seemed strangely unfamiliar. Doubt that the snake *was* a boa gradually grew in my mind! I did not sleep as well as usual.

The following day a neighbor told me that although he had never seen a snake just like this one, he knew definitely that it was *not* one of the boas. He pointed out the "pits" between the nostrils and the eyes — a characteristic of the pit vipers! While strange things turned handsprings in my stomach, my neighbor thumbed through a copy of Dr. N. W. Elton's *The Venomous Snakes of Panama.* Following a low whistle, he read out loud, "It is also known as *Cascabela Muda* (silent rattlesnake) because of the spine on the tip of its tail, which may vibrate among dry leaves so as to simulate the sound of rattles when it is alerted or nervous." This came under the heading — "Bushmaster"! Quickly I turned a flashlight on the snake's tail. There, indeed, was a short spine on the tip!

I leaned against a concrete wall, and the moisture on my brow was neither dew nor raindrops. Bushmaster! All of the horror stories that I had ever heard connected with that name raced through my mind. Particularly did I recall those of men who, having stepped on a bushmaster's tail, felt the impact of its deadly fangs as it struck back with the speed of a released rubber band!

In public life, the author is the Assistant Treasurer of the Panama Canal Company. But his favorite pastime is to study wildlife in the tropical rain forest of Barro Colorado Island, in a lake in the Canal system. He has been Secretary-Treasurer of the Panama Canal Natural History Society since 1937, and the present article is the seventh that he has written for Natural History Magazine.—Ed.

Running the light beam again along the snake's back, I saw the extremely rough scales that are said to be the reason why some bushmen dub it "*Verrugoso*" (the Warty One) or "Pineapple Hide"! Dr. Wm. Beebe wrote in *Jungle Peace,* "It was no easy matter to hold the snake, for the scales on its back were as rough and hard as a file, and a sudden twist fairly took the skin off one's hands." The last part of this statement may be somewhat exaggerated; however, the snake of which he wrote was somewhat larger than the one I caught.

News of the mistaken identity got around, and amateur photographers began to arrive, all anxious to get pictures of a *live* King of the Rain Forests! Each brought with him his favorite bushmaster story; sudden death being the main theme. One offered the dubious consolation that had I been struck, the suffering would not have been for long.

Many of the tales were no doubt exaggerated, but the late Dr. Ditmars wrote "on good authority" of a man who, having been bitten on the hip by a bushmaster, died "in less than ten minutes"! Dizzily I remembered that I had captured my snake a full 30 minutes drive from Gorgas Hospital.

Perhaps no name strikes such terror into the hearts of the native bushmen as "Bushmaster," or its local counterparts *Cascabella Muda, Verrugoso* or *Mapaná.* Dr. William

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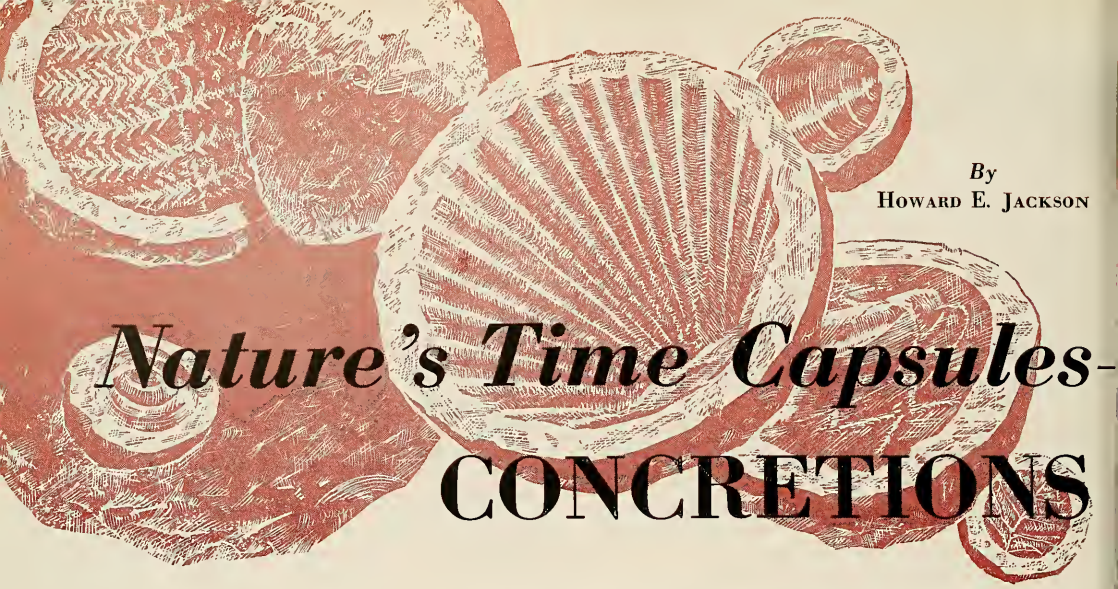

By
HOWARD E. JACKSON

Nature's Time Capsules— CONCRETIONS

You may easily find one of these geological prize packages, and it may contain the fossilized remains of a plant or animal that lived eons ago

Man has recently been making and burying time capsules, but nature has been producing them for over 100 million years. They look and feel like any roundish rock or aggregation of nodules. Some are so small you can hold a half dozen in your hand. Many are the size of cobblestones. Others are so big that six large men could hide behind one of them. These natural time capsules are called concretions.

While man places a number of objects within each of his air-sealed containers — currency, records of music, literature, and the like — nature often places but one object inside these natural time capsules — a fern frond, a tree leaf, a pine cone, a piece of wood, or any one of a number of aquatic things such as a clam, crab, or scallop. Each is fossilized during the 40, 50, 60, or 70 million years that it is inside its concretion. In other instances, one concretion may contain a number of fossils. And there are some concretions that contain no fossils.

The only way to tell what — if anything — is in the center is to break open the stonelike containers. You can chisel apart the smaller ones. A hydraulic jack or a sledge hammer must be used on the large specimens. Better take along a few sticks of dynamite if you are going to try to split the ten-foot variety, such as the "doughnut" concretions in Ohio or the equally large round ones found in central California, south of Bakersfield. The latter are so large that years ago, when they weathered out from the enclosing sediment and rolled out of the hillside, the Indians made murals where the concretions had been.

Concretions may occur wherever there are sedimentary rocks. Some rocks are full of them. Others have only a few samples or are completely devoid of them. There are millions scattered around the world. Germany, England, France, and the Isle of Timor are especially good places to hunt them. Kansas, Illinois, Washington, Oregon, South Dakota, and many of our other states are abundantly provided.

Concretions arouse curiosity wherever they are found. Imagine digging out a concretion in Alaska containing a 120-million-year-old ammonite fossil. Ammonites were the dominant type of marine animals when the dinosaurs roamed the land. They are a class of mollusks that had pearly, spiral shells. Or you may even find a chambered nautilus fossil more ancient than the ammonite, at the center of a concretion.

Concretions are interesting in themselves, whether or not fossils are inside them. The more common concretionary forms are called oölites. They are made in somewhat the same way that children make a snowball by rolling it, except that

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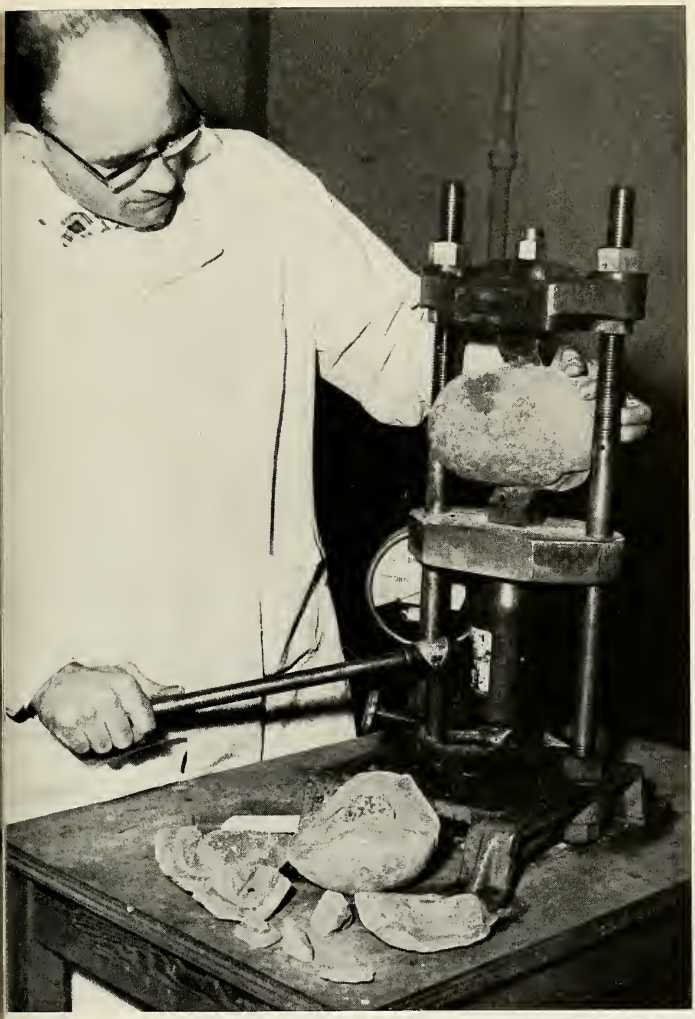
Well-trained in English through graduate study, Howard E. Jackson is a full-time writer. As evidence of his journalistic diligence, he attended The Seattle Times Ski School before writing on ski training and took up gem stone cutting and polishing in order to tell others how to do it. This article is based on interviews with experts at the Univ. of Washington, the Univ. of Oregon, and elsewhere.—ED.

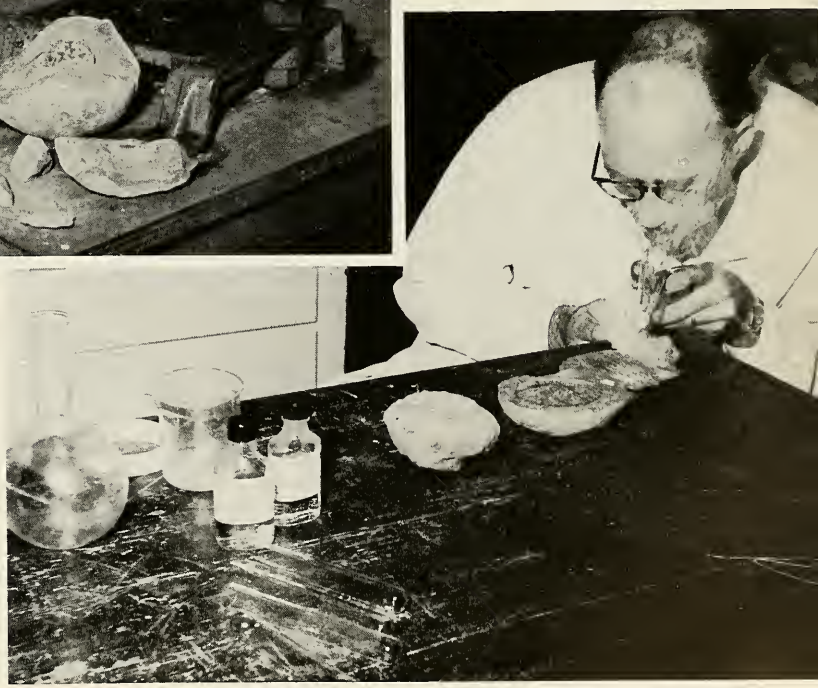
there may be a nucleus inside around which the concentric layers form.

Concretions are formed in saline waters under agitated conditions, along shores, limestone reefs, or in shallow places amid breaking waves. Calcareous oölites represent a somewhat even deposition of calcium carbonate around the nucleus. Great Salt Lake contains extensive deposits of oölites that are being precipitated there from the briny waters. However, the ordinary sort of oölites containing fossils are not formed while rolling around on the bottom of a body of water. They are formed in position in the sedimentary rocks, by deposition of mineral matter carried in water. Fossil-bearing concretions are always formed after deposition of the sediment. True, plants or shells in a hot spring may become encrusted with lime or silica and later be buried in sediments, but these are not concretions.

Some concretions formed in clay sediments take on weird shapes like human beings in miniature!



▲ Dr. Stan Mallory of the Geology Department of the University of Washington, cracking open a concretion with a hydraulic jack. The two "time capsules" shown here were found near Porter Bluff, Washington, and both contained fossilized crabs 40 million years old.



➤ Demonstrating how a mixture of two acids are blown onto a split-open concretion to "bring out" the fossil for photographing. The acid clouds the fossil white.

➤ Dr. Mallory points with his right hand to a concretion showing a fossil branch with shipworm borings in it. It is 40 million years old, whereas the two he holds in his other hand are only about 1,000 years old. The holes in them show where twigs or branches originally were, around which the concretions formed.

▲ Clams and snails from concretions. The snails held in the hand and the ones in the upper row are 40 million years old. The clams in the lower row are 30 million years old. All come from the Olympic Peninsula and Bainbridge Island, Washington.

▲ THE OPENED CONCRETION above contains a fossil scallop. The two fossil scallops in the foreground have been chipped out of their containers.

➤ HERE are two concretions containing fossilized crabs. The odd-shaped objects below are clay concretions containing no fossils. The latter type are being made today in lake beds and oceans. The upper type seem always to have been formed in position inside sedimentary rock. They result from mineral matter being laid down in layers from an aqueous solution.

Trampers prowling around the Lake Ozette region, on the Olympia Peninsula of Washington, often find these contorted shapes and think they are fossil reindeer horns or even dinosaur intestines.

Concretions are composed of different substances: calcite, silica, hematite, limonite, siderite (iron carbonate), and pyrite. Some of the more complex concretions show radial or concentric structure, but others appear structureless, such as the large "niggerheads" found in some shales in association with coal.

To put it simply, concretions are rounded or lumpy masses of mineral matter, usually different in composition from the surrounding rock. Many contain fossils, which originally formed the focal point for the chemical deposition. They are generally "discovered," or at least exposed, when the surrounding sediment weathers out, leaving the concretions sitting there.

Concretions are being formed today. Many are dredged up from the sea floor. The average person who stumbles onto one thinks he has found something rare. Actually, concretions—with or without fossils inside—are very common. They have no commercial value, but the fossils in them tell about the distribution of plants and animals that lived eons ago. They help geologists determine the age of a given formation.

About the only "honorarium" a collector gets for turning over concretions to a museum or university is a "thank you" and perhaps his name on the slip that is attached to the specimen. But at least he will have the satisfaction of making the acquaintance of something that puzzles a good many people.

◄ THE WATTLE AND DAUB HUTS of a Xosa village, shimmering on the sun-drenched veld, blend with the earth of which they are made.

The Red People

Exactly 100 years ago, this picturesque African tribe almost exterminated itself in pursuit of a vision

By MARJORIE GOWIE

▲ THE HEADDRESS is made from a square of heavy woolen material, decorated with white stitching done on a hand-cranked sewing machine. This woman is making a beautiful beaded band.

The Xosas are called the Red People because they color their clothing with red clay. No one knows just where they came from, but when the white settlers pushed northeast from the Cape of Good Hope in the middle of the last century, the two races clashed along the Great Fish River. Fighting continued for years.

The great crisis came in 1857 when a prophetess named Nongquase had a vision and told her people to destroy all their cattle, grain, and other possessions. This would bring an end to all their troubles. Their ancestors would return to earth bringing new herds and an abundance of food, and the hated white man would be driven into the sea.

The people slaughtered their cattle and burned and scattered all their grain. But the great day of plenty and triumph never came. The tribe starved by the thousands and their warlike strength was broken.

Today, the Xosas are again one of the largest of the South African tribes. But their beautiful dress and the old customs are fast dying out, for the young are drifting into the towns. And instead of seeking the white man's education to improve their cattle or their lands, they tend to make a fetish of book learning, as though it would somehow magically initiate them into a new life.

▲ Colored with rich red clay, the tribal dress of the Xosas stands out brilliantly against the tawny veld and hot blue sky. The traditional habit of carrying heavy loads on the head gives the Xosas the stately grace shown here.

↑MARRIED WOMEN smoke long handmade wooden pipes; the men use short ones. The babies pass their days tied firmly to their mother's back as she works in the fields or around the huts.

◄ Mealies (corn) and sour milk are staples. The kernels are ground between two stones as at left. The meal is made into porridge.

▼ The grain may be cracked with heavy wooden pestles in a hollowed-out section of tree trunk (background below). Enamelware has supplanted basketry in the ancient winnowing process.

▼ These young girls are dancing in short nd narrow skirts, which are often colored ellow instead of red.

► Original Xosa dress was of tanned skins. The young people who leave home to work in towns adopt strange new combinations. They learn to despise the ancestral traditions, yet tend to imagine that the road to civilization is simpler than it is.

▲ One "beetle-power." The Betsy-Bug, or Horned Passalus Beetle, provides a good subject for strength tests in the insect world. On top of its prothorax is a convenient "hitching post," and children in the South often attach small boxes to it. The beetle usually demonstrates obligingly.

How Stron

Actual tests help to answer the age-old question of what would happen if insects should approach the size of man

By Ross E. Hutchins

All photographs by the author

THE amazing feats of strength performed by insects have caused speculation since Biblical days. Early observers noted that ants could carry heavy loads out of all proportion to their size.

If insects were as large as men, would they be able to toss automobiles about? If a flea were enlarged to the size of a kangaroo, could it jump over the Empire State Building? Before we attempt to answer these questions, let us consider some of the things that insects actually can do.

The writer was once photographing a busy colony of Harvester Ants (*Pogonomyrmex*). One ant was

photographed as it lifted a stone up and out of the nest entrance. Both the ant and the stone were later weighed, and it was found that the ant weighed 0.0028 gram and the stone 0.1454 gram. Simple mathematics shows that the ant was thus lifting 52 times its own weight, which is equivalent to an average man lifting nearly 8000 pounds. It is interesting to note in passing that this is almost ten times as much as the 881½ pounds lifted by P. George, middleweight winner at the 1952 Olympics. And an Olympics winner is far stronger than an average man.

We think of a horse as a very strong animal, but proportionately its strength does not approach that of a bee. A horse can lift about one half its own weight. A drone bee has been found capable of lifting

About the author:

Reared on a cattle ranch in Montana near Yellowstone Park, Ross E. Hutchins early found an interest in nature. In due time, he graduated from Montana State College at Bozeman, with a major in zoology and entomology, and received his Ph.D. from Iowa State College.

In the South he says he has found "a biologist's Happy Hunting Ground." At present he serves as Entomologist and Executive Officer of the State Plant Board of Mississippi and as Head of the Department of Zoology and Entomology at Mississippi State College.

▲ Could a human wrestler compete with his insect counterpart if he had no advantage in size? Here you see two male stag beetles posed for photographic purposes in a posture said to be common when these insects engage in battles over females. From the human point of view, these insects appear to be strong out of all proportion to their size. But this does not mean that they could maintain their strength-weight ratio if greatly increased in size.

Are Insects?

▲ This Passalus Beetle easily pulled this loaded toy truck and trailer that weighed about 90 times its own weight. This is approximately equivalent to a man pulling a 14,000-pound trailer truck.

▲ A HARVESTER ANT actually lifting from the entrance of its nest a stone weighing 52 times as much as itself.

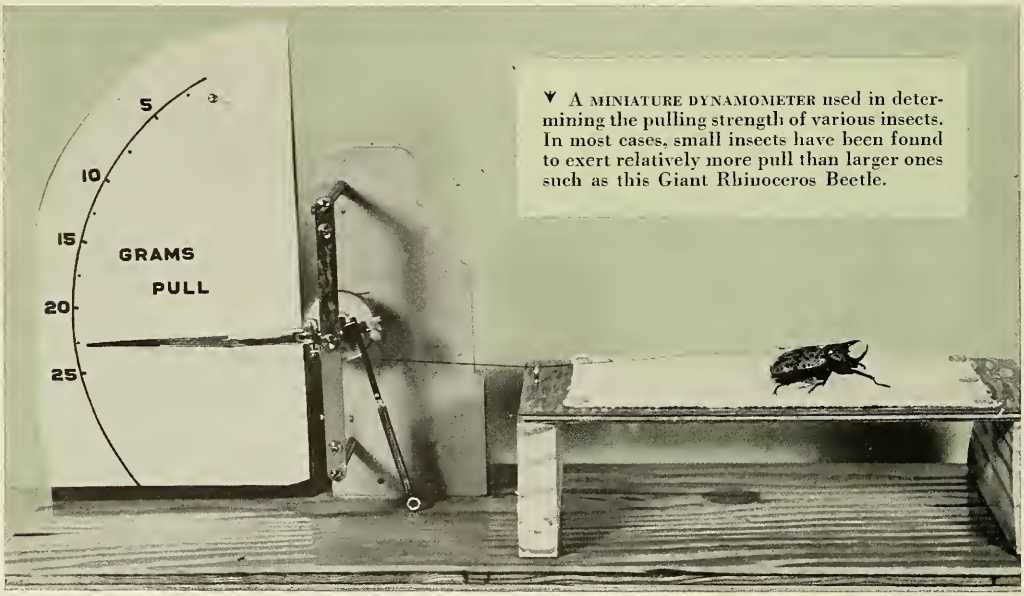
about 15 times its weight, a worker bee 24 times.

Tests on a miniature dynamometer at Mississippi State College showed that a Betsy-Bug *(Passalus)* weighing 1.88 grams could pull 14 grams, or about 7½ times its own weight. This is proportionately much better than a man could do.

When wheels are placed under weights, they are easier to pull, of course. When a loaded toy truck weighing 175 grams was hitched to the 1.88-gram Betsy-Bug, the insect pulled it with ease. By comparison a lone man should easily pull a 14,000-pound trailer truck! Under similar conditions a bee has pulled 300 times its own weight, the equivalent of a man hauling 3 trailer trucks hitched together.

An Insect Hercules

In research done a few years ago it was found that a large beetle could lift tremendous weights when they were placed on its back. It was found that this insect Hercules could thus lift about 850 times its own weight! At this rate an elephant could theoretically walk away with about 5,000,000 pounds on its back!



▼ A MINIATURE DYNAMOMETER used in determining the pulling strength of various insects. In most cases, small insects have been found to exert relatively more pull than larger ones such as this Giant Rhinoceros Beetle.

↑ At close range, the Giant Rhinoceros Beetle presents a formidable appearance. Considering its relatively small wing area, it is remarkable that the creature is able to fly at all.

In the jumping field, too, insects apparently excel man and other animals in proportion to size. Proportionately, a man could hop over a tall building if he had the capabilities of a grasshopper. His broad jump would exceed by far any human record, for he would be able to leap approximately 600 feet—the length of two football fields.

The leaping feats of fleas are well known. Mathematically-inclined entomologists have found that a flea with jumping legs one-twentieth inch long can broad jump about thirteen inches. It can high jump nearly eight inches. This is comparable to a man broad jumping 700 feet and high jumping about 450 feet! In the face of these facts, Olympic records seem almost trivial. In 1936, Jesse C. Owens broad jumped 26 feet 5 5/16 inches to establish a record; and Walter F. Davis, in 1952, high jumped a record 6 feet 8.32 inches.

High Jumpers

Man, of course, makes a poor showing as compared with some other animals of approximately his own size. Some records are as follows:

	Broad Jump (feet)	High Jump (feet)
White-tailed Deer	40	8
Puma	38	9
Kangaroo	32	9
Horse	27	8.5
Jack Rabbit	23.3	7

In the air, too, insects show some remarkable performance rates. Man cannot fly by himself, of course, but even the airplanes he has invented will have to hustle to keep up with the insects. For an airplane to carry a 100 per cent pay load is extreme aerodynamic efficiency, but many insects can equal this. For example, a mosquito that tipped the scales at five milligrams, took aboard a meal of five milligrams of human blood and flew off with it. And some bees can air-lift several times their own weight. Insects can fly great distances, too. Grasshoppers have been seen far at sea; so have butterflies. For example the Little Yellow Butterfly (*Terias lisa*) now and then appears in Bermuda in great fluttering clouds, and as nearly as can be determined, these swarms come from Cape Hatteras, more than 600 miles away!

Some interesting research has recently been done on the flight of the African Locust (*Schistocerca gregaria*). It was found that these locusts, which are serious pests and highly migratory, use 13.7 calories of energy per gram of body weight per hour of flight. One calorie of energy is equal to the work required to lift a 3-pound weight one foot. Thus in an hour of flying, a 2-gram locust expended enough energy to lift a 3-pound weight to a height of over 27 feet!

Considering size, insects fly at fairly rapid rates. A few examples are as follows:

Housefly	5 mph.
Wasp	12 mph.
Hornet	13.3 mph.
Grasshopper	15 mph.
Dragonfly	17.6 mph.
Honeybee	25 mph.
Horsefly	30 mph.
Bumblebee	35 mph.

Comparisons of strength based simply on the weight-ratios between man and the insects do not tell the whole story. There is no

arguing the fact that insects perform some remarkable feats of strength and speed, but many of these feats appear more remarkable than they actually are. The relatively small size of insects is what gives us the illusion of great strength. As an animal becomes larger, it does not become stronger in direct proportion. Actually, the muscles of humans are probably just as efficient as those of most insects. What most people do not realize is that muscle tissue of similar quality has the same power per unit area of cross section, regardless of length. In other words, a muscle one square centimeter in cross section and a centimeter in length would be just as strong as one having the same area of cross section but *two* centimeters long.

There is one difference between mammals and insects, though, that may give the insects some advantage. All insects have exoskeletons. That is, their skeletons are on the outside, with the muscles enclosed and attached to the inside walls. It is probable that some increase in strength is thus obtained by better leverage.

Also, there is yet another important factor that must be taken into consideration in comparing tiny creatures with large ones. As the size of a body—any body—increases, the volume increases much faster than the surface. In other words the weights of animals increase faster than their apparent sizes.

↑ THE LARGE, muscle-filled hind legs of grasshoppers enable them to jump relatively long distances. But recent research has indicated that if such an insect were enlarged to the size of a man, its feats would become less spectacular. This is partly because with increase of size, the weight of a body increases much faster than its length.

Basal Metabolism

Any discussion of insect strength soon becomes involved with the physiology of muscles, which is a complicated subject involving complex problems in chemistry. Perhaps it will suffice here to note a few surprising differences in the rate at which different creatures can expend energy.

The rate at which any animal utilizes energy when completely at rest is called the basal metabolic rate. This is the expenditure necessary simply to keep the animal's vital processes going. Muscular exertion increases the metabolism. The most that a trained athlete can increase his metabolism is about 20 times his basal rate, and he can only maintain this expenditure of energy for short periods. However, a locust's metabolism increases during flight to 50 times the resting rate, and a honeybee's to 52 times. They can maintain this pace for hours. No backboned animal can even approach this rate of fuel consumption. On the other hand, birds seem to operate more *efficiently* than insects. For equal amounts of muscle, they have shown a power output almost 2½ times that of insects.

If we consider the absolute power of muscles (that is, the maximum loads they can raise per square centimeter of cross section), then insects' muscles appear to be no more powerful than those of the higher animals. For example, the value for man is 6 to 10 kilograms per square centimeter. For a frog it is 3 kilograms. And for the hind leg of a grasshopper, 4.7 kilograms.

So it boils down, in general, to the strong probability that if insects were as large as humans they wouldn't be much, if any, stronger and could probably jump no farther. But don't forget that insects are still very remarkable creatures. Consider the fact that the wings of some flies and bees beat at the rate of hundreds of times per second, and that many insects can fly hundreds of miles without resting.

ARCADIA—*The* *Peacock Town*

In this California suburb, peacocks have the run of the lawns, and they treat homeowners to one of the most spectacular courtship dances in nature

By Maggie Butanier

DOMESTICATED peacocks on warm-climate poultry ranches are not uncommon, but in one suburban community of California, peacocks strut and roost as freely as their wild ancestors did near the sultry jungles of India. Here they are not the prey of tigers or the captured pets of maharajas. They are part of the bird life in a lush valley below the San Gabriel Mountains, 20 miles east of Los Angeles in the town of Arcadia.

A few regions of arid southern California, which act as basins for accumulated mountain rains, were startling in their pastoral beauty even when covered wagons first rumbled west. Arcadia, once a prolific ranch, is one of these regions. A decade or two ago it was the picturesque section where live oaks, interwoven with white-barked sycamores, dipped their branches to fallow earth, and mustard and wild oats, in season, provided natural pastureland for cattle and sheep. Squadrons of dainty quail patrolled the whole area, and thousands of elaborately plumed peacocks roosted undisturbed in the branches of the oaks.

Arcadia is entirely residential now, and still the peacocks remain. But they confine themselves mostly to one protected section, where they

↑ One of the male birds making a neighborly call. Tail feathers reach their full plumage during the mating and nesting season, from January to June.

The author became interested in writing while typing technical reports at Cal Tech and took home-study courses. She is now a full-time writer, lives in Arcadia, and specializes in subjects like this one.

adapt themselves to private lawns and gardens as readily as do robins.

It is the nature of the peacock even in savage regions to seek the protection of human beings, whenever men have proved their friendship by regarding these aristocrats of the pheasant family as too sacred or too beautiful to destroy. Yet in spite of the peafowl's keen discernment of friendship, it seldom loses its desire for freedom or its ability to sense danger. Although it does not take kindly to captivity, it enters voluntarily into a sort of semidomesticity, claiming crops and shelter from its hosts but reserving the rights of a wilderness bird.

It wasn't chance migration that brought peacocks to Arcadia. In the nineteenth century Rancho Santa Anita, which now includes Arcadia, covered a 21-square-mile section of the San Gabriel Valley. Its last owner, Elias J. Baldwin, lived in a sultan's luxury. He owned fruit groves in great variety, plains of twisting grapevines, and acres of amber wheat and deep green alfalfa. He considered only the best livestock and poultry suitable.

The First Birds

To complete his sultan's role, Lucky Baldwin, as he was best known, brought from India in the late 1870's three pairs of blue-breasted peafowl. These birds were never caged. The climate was ideal and enemies were nil, so they thrived and bred until they numbered over 2,000, as nearly as anyone could estimate.

Later, Mr. Baldwin imported a white domestic species from China, and his daughter Anita brought a few pairs of the green species from Java.

The township was established in 1903, when financial difficulties forced Lucky Baldwin to sell some of his property; but it wasn't until 1940 that people began to move in rapidly enough to alarm the peacocks. A few friendly human beings were fine, but when houses sprang up every hundred feet or less, and speeding automobiles blocked off the boulevards, the birds retreated to the site of the old Baldwin home and the quiet rambling streets around it. With a variety of imported trees already established, 127 acres of the Baldwin grounds were a natural site for a botanical garden and bird sanctuary. It be-

▼ THE CHILDREN of Arcadia get to know peacocks better than most kids living in their Asiatic homeland. The birds are all descended from a few pairs imported in the latter part of the nineteenth century.

came the Los Angeles State and County Arboretum. But the peacocks spend as much of their time on the lawns of residents as in the sanctuary.

A turn off busy Colorado Boulevard and a slow drive down Old Ranch Road, the street that once led to Baldwin's Queen Anne cottage, reveal a number of cocks congregating on lawns and fences around the cozy ranch-style homes. During mating and nesting seasons, from January to June, the cocks are most in evidence. This is the time when the cock's train has reached its full plumage, and he displays it frequently.

It is quite possible to get close enough to one of the cocks to see that his face is crisply black and

↑ THE PEAHEN (right) and year-old chicks. She is plumed in practical brown. The hen watches over her young for almost a year.

Courtesy Los Angeles Arboretum

← THE PEACOCKS still frequent the old home of Elias J. (Lucky) Baldwin, the original importer. At one time, the birds increased to over 2,000. Today the City Council holds them below 200 to keep their vocal concerts bearable.

white. His neck is a royal blue that blends to purple-blue at his breast, and then to sleek black. A close view also reveals that his thighs are white, his wings speckled black and white, and his back overlayed with bright silken green. On his head he wears a tufted crown of sapphire blue. The quills of his train are iridescent bronze fringed with the green of his back and studded with bells that in the sunlight glow like sapphires, emeralds, and topazes.

By contrast, the peahens, usually scattered around the cocks before nesting time, are plumed in practical brown, hardly more elaborate than a grouse.

While the cock, the artist and entertainer, glories in exquisite feathers, the hen, the sensible housewife, watches over her young for almost a year, until the next brood requires all her attention. She has no train; and except for her crest, which is like the cock's, one might think her a different species. Her only bright coloring is the mottled blue-green on her neck.

Peafowl love regularity, and as long as food is available they will return each day at the same time to feed on grain, bread, insects, or whatever their omnivorous appetites might desire — even snakes. Unless danger intrudes, they will choose identical spots each day for roosting, resting, and drinking. One cock plays the same game every day—teasing an Irish setter from the rooftop above the yard.

Dr. William Beebe, noted authority on pheasants, studied peafowl in their jungle habitats in Asia and found that where peafowl are hunted by men for feathers or food, they have the ability to hide or move so noiselessly that unless a man happens to come upon one fortuitously, he may cover leagues before detecting a single fowl.*

But along Old Ranch Road, the peafowl are so sure of their safety

*Beebe, William, *Pheasants, Their Lives and Homes*, Garden City, New York: Doubleday, Doran & Co., Inc., 1936.

that they reserve pedestrian rights to amble down the street. Like aristocracy who pay for their hospitality merely by accepting it, the peafowl share the gardens of Arcadians with their owners. They roost in the oaks, gobble up petunias and newly planted seeds, and leave debris on the rooftops. Few people object seriously, for in how many other communities can average Americans have peacocks to accent their gardens?

The bird has another vice. As one new resident explained it:

"We were thrilled that a peahen visited our property occasionally. Then one morning I heard a terrific scream, like a woman hysterically calling, 'Help.' Panic-stricken, I rushed out only to find the peahen perched in a tree calmly exercising her vocal chords. She was as proud as a would-be prima donna living in the delusion of operatic talent."

Oddly enough, the danger call, a rapidly repeated "wok-wok-wok," is not nearly so cacophonous.

But most people get used to the harsh choruses. As one lady expressed it:

"Every evening just before dark, a cock calls his harem to roost in my tree. In the morning at breakfast, I see him sitting on the limb with his train hanging down like a cascade of flowers. In the spring chicks play on the lawn. I tell you, it's a thrill I wouldn't trade."

Where foes are numerous, the peahen will build her nest in an isolated tree and never fly directly to it. But down near the Arboretum, she merely scratches a depression in someone's back yard and lays eight or more eggs. The incubation period is four weeks, and it is even possible to pull her from her nest. At first opportunity she will return or, if the eggs are destroyed and it is early in the season, lay another batch.

In June, when the cocks molt their trains feather by feather, the neighborhood gathers bouquets of quills. It is a period of disgrace for the cocks, and they seek seclusion—except when hungry—until the new quills appear.

There are only two true species of peafowl, the blue-breasted peafowl of India and Ceylon and the green peafowl of Java and Burma. Their trains are much the same in color and design. While the Indian cock has a breast of blue and his hen is dull, both male and female of the Far Eastern species are green, overcast with mottled bronze from crest to tail, with wings turquoise and black. They have a metallic appearance, as though they might have stepped out of a Chinese brocade, but their crests are tailored and less like a crown.

The white peafowl is an albino, a strain developed in captivity which is quickly lost through interbreeding with either of the true species. When the Indian and Javanese birds cross, the Indian strain predominates. Although all three species existed in Arcadia once, now only the Indian bird remains, with an occasional irregularity in coloring to indicate that their ancestors were not all Indian.

For all the peafowl's interesting characteristics, it is the traditional courtship dance of the cocks that has given the bird his prestige over all other feathered creatures.

During courtship time each cock chooses a stage for his dance, and usually other cocks respect his claim. One cock has selected a long residential driveway. Frequently he struts out and unfolds his tremendous train into a jeweled fan, held securely by stiff, brown tail feathers.

Two hens and a young cock gather on the lawn near him. The youngster, years too young for a fully developed train, will also spread his turkey-like tail feathers and look as comical as a small boy dressed in a tuxedo coat.

Hens Unresponsive

The dance of the full-plumed cock is not easy, for the feather fan tempts the wind, and the cock must exercise the utmost balance. Slowly he dances around and around, displaying first the front and then the rear. But the hens pay not the slightest attention. Quietly they peck away at this worm and that seed on the lawn. The cock continues to dance all the same.

Whether he is vain or merely generous with his talents is a matter of opinion. At any rate, he seems almost as eager to please his human spectators as his prospective family. When hens were nesting, I saw several cocks display when only people were passing.

From the front, the cock seems to have stepped out of a ballet, regal, formal, and colorful. To climax the

➤ If food is made available, peacocks readily form regular feeding habits. They will eat grain, bread, insects, even snakes.

dance every quill shimmers, vibrating audibly, a supreme effort to attract the hens' attention.

From the rear, the dance takes on an entirely different character. The train, a dull-brown half circle, is the background for a sort of rumba the cock is doing with his tail feathers —actually part of keeping his balance. But when he shuffles his stubby, brown rear feathers, all that seems lacking is an accompaniment of tamborines and castanets.

Still, nothing he does seems to impress the hens. Finally the owners of the house drive up the driveway, for dances occur far too often to interfere with putting away the car. The cock waits until the automobile is almost upon him, and then, with the lightness of a helium balloon, he lifts himself to a picket fence from which he ascends effortlessly to a limb, folding his train as though it were a fan made of the most delicate silk chiffon.

The dance has ended for the present, and although the feathered spectators give no applause, the hens will eventually accept the invitation to become part of the performer's family.

Fighting among the cocks is infrequent, even at mating time. Each has his own stage for the dance. An occasional intruder will be driven away by beak and spurred foot, but usually he will run, knowing he has violated the rules of peacock courtship.

But once a cock did get into a bloody battle. He was an amiable fellow usually, until he saw another cock approaching his stage. He ran at the other bird, and the trespasser ran toward him, matching step for step. He lunged. The intruder lunged, and both got a blunt bump on the beak. He couldn't quit because the other bird wouldn't. The more he fought, the worse his own wounds became, for his "foe" was his own image in a plate-glass window.

Out of consideration for the cock as well as for the window, several men cornered him. They locked him in a woodshed for several days, and he behaved peacefully. He was trustfully quiet, too, when they took him twelve miles by automobile to an estate where there were no plate-glass windows through which "rivals" could enter. But he didn't stay. He longed for all that was familiar to him. He disappeared but never succeeded in reaching the old neighborhood.

While most people try to allure peacocks to their premises, a few actually object. Some, unable to appreciate the generosity of vocal concerts, particularly in spring, even complained to the City Council. The Council saw their point, and as a result the number of peafowl is kept below 200, another reason for the birds to congregate in a smaller, protected area. Occasionally a cock, more venturesome although less able to fly than a hen, wanders across busy Colorado Boulevard and even up toward the mountains where a few years ago peacocks lived in uninterrupted freedom. But he never accepts an inducement to stay.

The Arboretum has a five-acre lagoon surrounded by man-made jungle, tropical vegetation where "African" movies are sometimes staged. If jungle were really the peafowls' preference, this could be their domain, but they choose instead the less dense sections. They might never leave the spacious Arboretum grounds except that food offerings on the other side of the fence are excellent. Perhaps, too, the cocks like the applause they get from people.

Although the Arboretum considers itself official custodian of the peafowl, the birds are still their own masters, and many prefer suburban life. Occasionally Arboretum visitors do not see peacocks at all and are disappointed. But there is never any doubt that peafowl are in the vicinity. Their cry of "Help" resounds across the lagoon through the eucalypti and palms like a savage cry from the jungles by the Bay of Bengal.

▲ TRUE to its reputation, this jaywalker is "proud as a peacock" despite the fact that his train has not grown back after the last molting.

The Lizard with the *Frightening Frill*

The animal puts it up like an umbrella, but not as protection against the rain

By C. M. Bogert
Chairman and Curator, Department of Amphibians and Reptiles, American Museum of Natural History

THOSE of us who date back to horse-and-buggy days will probably never forget runaways. These were the hot-rod hazards of the day—the frightened horses attached to wagons or buggies that tore headlong down the road at what we remember as breakneck speeds, often as not with a girl or a woman hanging on for dear life and screaming frantically for help.

What started runaways on their reckless dash? As often as not it was the sudden erection of an umbrella or parasol by some thoughtless woman unfamiliar with horses. Whether the flaring frill of Australia's most bizarre lizard produces the same reaction in horses I do not know. But the umbrella-like mechanism the lizard possesses has certainly produced "runaways" among other animals.

What is so frightening to animals about the sudden expansion of something that has been folded? It is difficult to say. But many birds and mammals find it disconcerting. In fact, it seems to scare the daylights out of some of them.

Reptiles employ innumerable ways of warning, frightening, intimidating, or discouraging attackers. Cobras rear the front end of the body and spread a hood. Iguanas and some of their relatives distend a conspicuous throat-fan or dewlap. And many other lizards have ways of giving an illusion of greater bulk from the viewpoint of the enemy. But only the frilled lizard of northern Australia and New Guinea possesses anything that remotely resembles an umbrella.

When this lizard forages for beetles and other insects that inhabit the bark on trees, folds of skin extend backward from the head over the neck. Closer inspection discloses the existence of four neat pleats in this loose skin. When disturbed on the ground, the lizard takes off on all fours. As it gains momentum, however, it raises the body to a semi-erect position and runs on its hind legs. It covers 40 or 50 feet at a stretch, coming to a stop sitting on its haunches. If threatened, the lizard suddenly

◄ Frilled lizard at rest, with its umbrella-like expansions of skin neatly pleated and folded.

Robert Smith from Black Star

◄ When confronted by a possible enemy, in this case, the photographer, the lizard erects its frill and simultaneously displays its gaping red mouth.

raises the pleated skin on the neck in much the same fashion, indeed on much the same principle, as an umbrella. The assailant suddenly finds himself confronted by a vast expanse of skin, in the center of which is a gaping red mouth that adds to the lizard's formidable appearance.

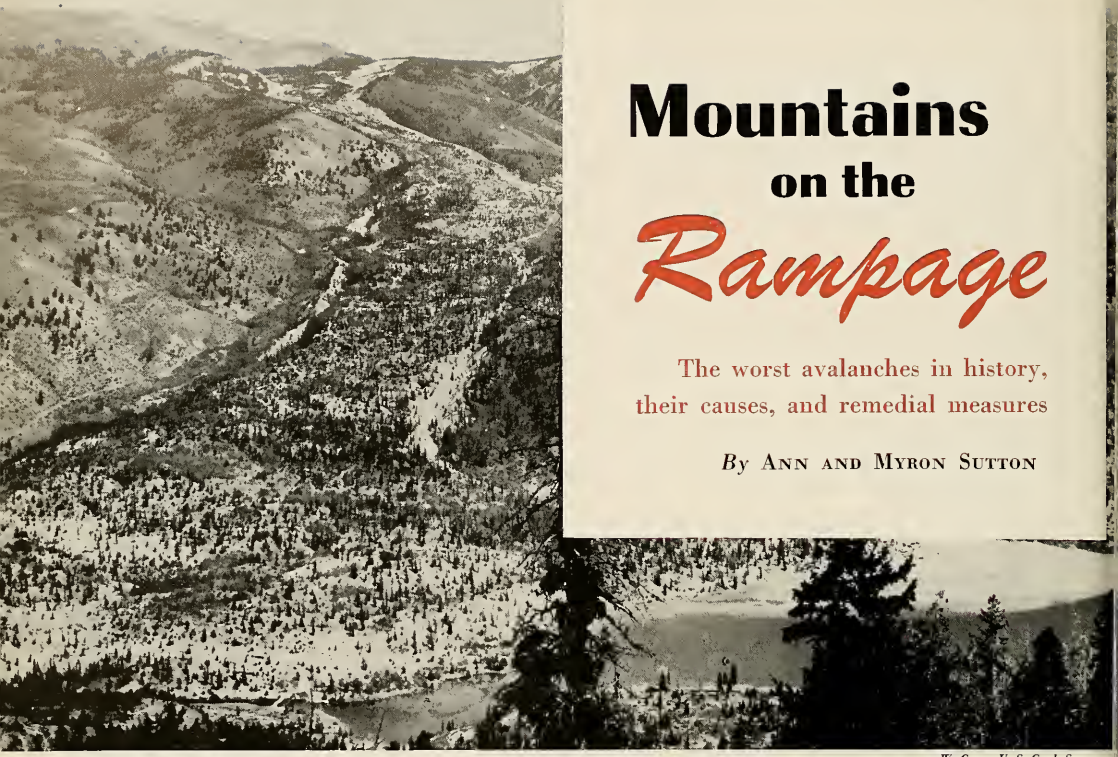
In Australia, dogs that have learned to pursue and kill larger and actually more ferocious lizards refuse to come to close quarters with a frilled lizard. A dog that chases one as it takes off on its bi-pedal dash for safety is in for more than the thrill of the chase. For the display of the frill is enough to bring the dog's chase to an abrupt end, as though the dog had been chasing a cat that suddenly stopped and simultaneously transformed itself into a lion. Doubtless the unexpected change in the lizard's appearance helps instill fear in native animals just as it does in the domestic dog.

The frill, a vast expansion of skin on each side of the neck, is intimately connected with extensions of bones in the throat. These are the same bones to which the tongue and the dewlap are attached in other lizards. In the frilled lizard, specially modified muscles attached to these bones serve to erect the frill simultaneously with the opening of the mouth. However, the mouth can, of course, be opened without distending the frill. The frill may be nearly ten inches across in a thirty-inch lizard.

Actually the frilled lizard is not a very bulky beast. One with a body scarcely ten inches long possesses a tail over twenty inches in length. The animal is not well equipped to inflict any serious harm on an attacker. The frill has been termed a "scare organ," a sort of specialized bluffing mechanism. It is not inaptly compared with the gaping mouth and flattened body displayed by American hognosed snakes, but it's still not quite the same sort of thing. Nor is the frill to be compared with the hood of the cobra, the gaping mouth of the moccasin, or the rattling of the rattlesnake. For these reptiles are prepared to back up their displays with far more formidable defensive measures. As such, their actions are to be construed as conveying a warning to the enemy.

With the frilled lizard, it's bluff, pure and simple, but seemingly very effective. Moreover, it comes close to being unique—unless you remember that innocent woman, the umbrella, and the horse.

Since 1927, Charles M. Bogert has contributed articles to 26 publications, including magazines, scientific journals, and books. He has done extensive field work, and his most recent publication in collaboration with a Mexican colleague, is a detailed study of the habits and behavior of the Gila monster and its allies.—Ed.



Mountains on the *Rampage*

The worst avalanches in history, their causes, and remedial measures

By Ann and Myron Sutton

W. Cross, U. S. Geol. Surv.

▲ Slumgullion mud flow, western Colorado: a four-mile slide that poured into the valley to a thickness of 300 feet. Melting snows caused it. It produced Lake San Cristobal, at bottom.

On the night of December 16, 1920, a cold and bitter wind swept across the bleak, treeless plains of China's remote Kansu province. Over an area of 30,000 square miles, night settled with icy suddenness into the valleys and along the cliffs. Peasants bundled together for warmth and sleep in mud huts and in hundreds of cave homes carved in the high bluffs.

Suddenly the ground cracked, and immense landslides of rock and sand gushed from yawning crevasses above the valleys. Mountains slid sickeningly into lowlands. Roadways dropped out of sight. Trees toppled. Gullies opened. City walls collapsed. Village after village lay buried or in ruins.

Seven slides crashed simultaneously into a three-mile gap in the hills, obliterating every living thing except three men and two dogs. These five living creatures, along with a house and orchard, were miraculously carried across the valley on the crest of one slide. The grotesque island was caught in the cross flow of two other slides, whirled in a giant vortex, and catapulted to the slope of a near-by hill.

After the movement subsided, 7,000 rescuers began releasing dammed rivers to forestall disastrous floods. The few surviving inhabitants remained so frightened by recurrent shocks that they dared not build substantial houses for the duration of the winter, and many froze to death under Kansu's bleak and icy winds. The final toll: 200,000 persons.

The Kansu earthquake, as such, might not have been so disastrous had it not triggered the chain reaction it did. For years the ground kept shifting, flowing, faulting, and traveling, inch by inch, until no road or path remained safe for passage. No camel driver crossed the fissured plains lest his beasts break through the uncertain crusts.

What actually had happened? Did a legendary dragon lash its tail beneath the earth? Nothing in Chinese vocabulary fitted this kind of catastrophe. They called it simply "a time when the mountains

About the Authors:

Myron Sutton, who is a museum planner for the National Park Service, and his wife Ann, who is a geologist with the U. S. Geological Survey, became interested in landslides during a trip along California's Route 1. Their avocations include bird-watching, skin-diving, hiking and camping, and writing.—Ed.

walked." Today mankind knows a little more about the sort of thing that happened to Kansu. We give the name "landslide" to all these deadly phenomena, be they flows, creeps, or sudden avalanches.

Alpine valleys in Europe have also been devastated. On September 4, 1618, a landslide in Italy's valley of Chiavenna buried two small towns, and out of the population of 2,430 only 3 escaped. Three villages in the Treviso area were buried in 1772 and their entire population wiped out.

On September 2, 1806, an eyewitness watched Switzerland's Rossberg peak crack and split, saw the forest on the mountainside wave to and fro, and then watched the whole gigantic rock mass move down the slope, gathering velocity and sweeping everything in its path. It was said that so much friction was generated that moisture turned to steam and flames shot out from the slide. But observations of this sort are usually based on misidentifying clouds of dust. The entire avalanche rammed into the Goldau Valley, burying four villages. Estimates of the lives lost range from 457 to 800.

What causes these catastrophic rock deluges? How do they get started?

Elm is the highest village in Switzerland's Sernf Valley, and for years its inhabitants had been digging slate from a quarry at the base of the Plattenbergkopf, a towering peak that rose directly above the town. From time to time, rock fell into the quarry and from the mountain. Even fatal accidents occurred. But no one seemed to sense what was happening.

The villagers continued, as the years went by, to work the quarry in spare time, removing the mountain's delicate underpinnings. Even after a great crack split the summit, blasting was continued in the quarry.

Finally, on September 11, 1881, after a month of rain, part of the mountain broke and splattered into the valley, its debris reaching to within 100 yards of the inn. The people ran for their lives. Seventeen minutes later another landfall crashed down upon the village, overwhelming the inn and several houses and killing a score of the villagers.

Four minutes after that there was a third fall, and it seemed as if the whole mountain had come loose. Witnesses said that as the great mass roared into the valley with terrific velocity, it pushed before it a tornado-like wind that overthrew houses like haystacks and blew down trees like so many matches. Within a few minutes, over 10 million cubic yards of rock had buried the village beneath 50 feet of twisted, jumbled earth. The landslide obliterated 115 townspeople.

In the Canadian Rockies, peaceful and sleeping Turtle Mountain rises 3100 feet above the village of Frank, Alberta. Frank is a mining town and always has been. Its coal seams lie squarely at the base of the mountain. Although coal mining was not the sole reason for what happened, geologists think it helped.

At dawn on April 29, 1903, after heavy rain had sopped the mountainside, a mass of rock nearly half a mile square and 500 feet thick broke loose from the east face of Turtle Mountain and plunged thousands of feet. It plowed through the village, blocked the mine entrance, destroyed 7,000 feet of track along the Crow's Nest Railway, and

S. R. Capps, U. S. Geol. Surv.

▲ A COLLAPSED FARM at Buhl, Idaho, which shows how large pieces of land can be lost through landslide. The lower flat areas were originally at the upper level.

G. K. Gilbert, U. S. Geol. Surv.

▲ LARGE BLOCKS of ground are breaking away from this cliff in California. Stabilization is often impossible when the situation has advanced so far.

rumbled on at express-train speed for 2½ miles to the far side of the valley. Between 60 and 70 persons were killed. The scene today is still marked by a wicked and naked scar that spans the valley, a shattering reminder that when old *terra firma* gets up and moves, nothing can stop her.

Thus man himself is occasionally the culprit. But even though coal mines and quarries sometimes encourage slides, nature's unaided forces often combine to make a cliff collapse. Streams undercut slopes. Weak rock strata crumble. Earthquakes generate subterranean forces that tear loose unstable mountainsides; and other deep-seated stresses and strains rattle precarious slopes beyond their equilibrium.

By far the greatest cause of landslides is saturation by water—part of the cause of the Swiss and Turtle Mountain slides. Every rock mass or jumble of boulders holds itself in place by friction—at a position known as the angle of repose. When heavy rains douse these slopes, each piece of rock is "lubricated" by ground water. The whole slope is slickened just as surely as if it had been greased. Then, if the bedrock on which it rests is nothing more than slippery clay—look out below!

In 1950, the Swedish town of Goteborg, built on a clay meadow and stream bank, rode along on a horizontal landslide that jumbled houses, swallowed up the railroad station, and pitched furniture, autos and inhabitants into the wavy, lurching streets.

Remedial Measures Successful

Just before the turn of the century, Portland, Oregon, learned about landslides the hard way. Two reservoirs were built on a clay slope and lined with concrete. The concrete began to crack, and it was discovered that the entire slope was sliding downhill. Since the reservoirs cost over a quarter of a million dollars, Portland engineers went to work to save them. The experts discovered that the more it rained each year the more slide movement occurred. Consequently, they drilled a network of tunnels and shafts and drained the ground beneath the reservoirs. It worked. The sliding stopped for good.

When landslides plunge into and block well-watered mountain valleys, they often create huge reservoirs. Probably the best-known one was formed in Wyoming's Gros Ventre Mountains, just south of Yellowstone National Park, on June 23, 1925. For days, the Gros Ventre valley lay under pelting rains combined with the downwash of melting snows. Suddenly an enormous rock mass, estimated at 50 million cubic yards (enough to cover Manhattan to a depth of two feet), pulled loose from the north spur of Sheep Mountain and slid across the valley, ramming against the opposite wall to a height of 350 feet.

This heap of rock, soil, forest, and debris jammed so tightly that it blocked the rampaging Gros Ventre River and formed a dam behind which a lake began ominously to rise.

For two years the dam held, discharging the lake's surplus waters by seepage. But on the morning of May 18, 1927, after heavy snows had begun melting in the mountains, the slide-blocked lake overtopped its dam and broke through. At that moment, four miles downstream the village of Kelly was anxiously eyeing the swollen river. Suddenly the appearance of ranch utensils warned Forest Ranger C. E. Dibble that something was wrong at the dam.

Jumping into his automobile, he rushed up the road leading to the dam. On a hill above Woodward's ranch, about a mile below the dam, he saw the flood crest. While he watched, it wiped out the remaining ranch buildings.

There was no time to lose.

Dibble turned around and sped back to the village, shouting the alarm. He dispatched messages down the Gros Ventre and Snake River valleys to warn the inhabitants of impending flood.

At 11:00 A. M. a giant wave fifteen feet high burst from the mouth of the gorge above Kelly and swept through the village, carrying away every building in sight except the

school, the church, and one high-level cottage. It continued on down the Snake River, to be felt as far away as Idaho Falls, Idaho.

Mudflows have wiped out forests on Lassen Peak in California and Mount Rainier in Washington. Even New England's Green and White Mountains have been scarred by avalanches in centuries past.

Canoemen in the upper Amazon's untamed jungle country live in dread of riverbank slides, which sometimes stir up violent waves that overwhelm good-sized boats.

The U.S.S.R. has had landslip catastrophes, especially in its Transcaucasus and Volga regions. In Scandinavia, slides are most common in clay banks along streams and fiords. An Allied bombing raid near Norway's Kjeller Aerodrome in April, 1944, started landslides that lasted all summer.

On a flight over Central and South America, scars, slides, and slump terraces give airline passengers the impression that the Andes are falling apart.

In truth, all mountains are. But they do not always collapse with violence and destruction. Some landslides move so slowly that their movement is perceptible only by measurement or by the visible displacement of trees and telephone lines.

Switzerland's creeping Monte Arbino remained harmless and virtually unmoving until the beginning of the twentieth century. Then its summit slowly began to move at a rate of about six inches a year. Nobody in the valleys below was alarmed. But Monte Arbino's annual rate of movement kept increasing until by 1928 the summit was "scooting" along at six inches an hour.

Cracks appeared in the mountain, and boulders started sliding downhill. At length, the menace became so great that government authorities ordered the valley evacuated. And just in time. On October 2, 1928, over 30 million cubic feet of rock rumbled into the valley, burying forests, fields, houses, and roads.

Panama Canal Problem

Whether they move fast or slow, landslides are costly wreckers. Slides closed the Panama Canal seven times after it was opened in 1914 and caused the loss of millions of dollars in tolls. Before that, slides had disrupted excavation of the canal for weeks at a time, destroying steam shovels, locomotives, and other equipment, as well as miles of track. Said Lieutenant Colonel D. D. Gaillard, who had charge of the Central Division where most slides occurred: "So far as my own experience . . . is concerned . . . I know of no single thing which has done so much to complicate the engineering problems of our work, or to hinder and lessen the yardage output, as the slides. . . . I do not think it any exaggeration to say that nearly 200 miles of track work . . . has been necessitated since the commencement of the work, solely on account of slides."

Landslides, big and small, cause far more damage to roads than is generally realized. In the Appalachian Mountains, where rock strata are upended anyway, slide damage runs into millions of dollars annually. West Virginia alone has suffered more than 1,000 slides, which have pulled out large sections of primary and secondary roads.

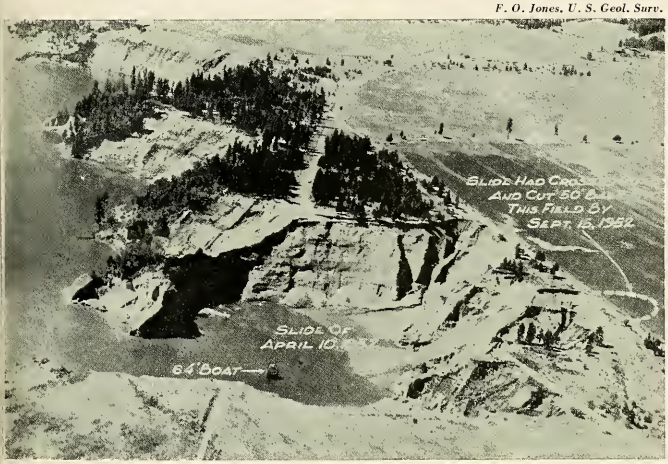
How can this wholesale damage be prevented? What can be done about it? Though slides have always plagued mankind, only within the last century, and particularly in the last 40 years, have engineers and geologists made much headway.

The Highway Research Board of the National Research Council is grappling with the problem. Landscape experts and general engineers have devised mathematical methods and formulae for determining how stable a slope is and what the chances are of its giving way. Probably the most fundamental step in stabilizing a slide is to provide proper drainage. Plantings or stairstep embankments are important safeguards. Buttresses, cribbing, walls, and pilings also help. But when these are not enough, the slope has to be removed entirely or the road relocated, whichever is less expensive.

Highway engineers are a long way from knowing fully about slides and how to control them. So far, corrective and preventive techniques are inadequate, and geologists are constantly searching for new remedial measures. When more is learned about these catastrophes, it may be possible to stop landslides before they start, thus avoiding the kind of doom that befell Kansu, Frank, Goldau, Elm and other valleys where the mountains walked.

▼ Near Kettle Falls (Wash.), slides have eaten into fields and forests. Erosion controls, if prompt, sometimes prevents wholesale damage.

F. O. Jones, U. S. Geol. Surv.



▲ THE ORIGINAL DRAWING, evidently done with a sharp knife, at right. The mirror image at left was evidently produced because the cambium or growth layer was injured by the knife and did not lay down new wood for a time.

A Tree with a Boy Inside

A picture carved in a tree turns up some 60 years later inside the trunk

By JACK MCCORMICK

EARLY last November I received a letter from Miss Mary A. Meyer of Liberty, New York, in which she told an almost incredible story about a section of a tree trunk that fell apart and revealed a drawing of a boy near its center. The chunk of wood had been displayed in a store window, where it caused a great deal of amazement. A tree surgeon from Rochester told Miss Meyer that he had never seen anything like it.

At first I frankly doubted that this could be anything but a "freak of nature," a chance resemblance. The most likely explanation seemed to be that some normal pattern in or on the wood had been interpreted by an overimaginative person as a human face. It might be merely an unusual configuration in the wood, or it could be the product of a peculiar series of cracks that had developed in the felled trunk. Or, the portrait of the boy could be an intricate design etched by the mycelia of a wood-rotting fungus.

My other thought was that it might be the work of a prankster who had found the chunk of wood after it had been cut, carved a picture on its inner surface, and then

◄ IT WAS in this section of the log that the picture came to light when the wood split along one of the growth rings.

placed the artificial curio where it would be certain to be found.

Then came a second letter from Miss Meyer, together with the photographs accompanying this article. Imagine my surprise to learn that the picture inside the tree had actually been drawn by someone.

The explanation must therefore be as follows. Employing a sharp knife, the artist apparently carved an outline of his subject on the tree trunk, penetrating the bark. In the process, the thin cambium tissue, the growth layer of the tree just beneath its bark, was wounded by the artist's lines. For the next few years, the cambium layer produced new wood everywhere except along those wounds. But each year, the new growth closed in slightly upon the lines. Finally, the wounds were overgrown and remained hidden until the tree was felled. According to Miss Meyer's estimate, approximately 60 years of growth rings grew around the trunk after the picture was drawn.

The wounds must have created a weak zone in the wood of the trunk, for after the tree was cut down, a fracture developed in this weak zone. This split resulted in the unveiling of the original carved wood surface on the convex (inner) section and of a mirror image of the caricature on the concave (outer) surface. This mirror image was produced by the growth of new wood everywhere but along the wounds caused by the artist's knife.

The appearance of the caricature in the photograph suggests that it has been emphasized slightly by tracing its lines with ink or paint. Perhaps this was done to make certain it would show in the photograph. Or it may have been done to help people see the picture while it was on display in the store window.

Be that as it may, this is the only curiosity of its kind I have ever seen among the many strange phenomena of plant growth that have been brought to my attention.

JACK McCORMICK is Staff Ecologist of the American Museum of Natural History. He holds degrees in Botany from Butler University and Rutgers University.

YOUR NEW BOOKS *continued from page 63*

Institute of Archaeology in London. His many writings include The Dawn of European Civilization.

THE GREAT CHAIN OF LIFE

- - - - - - by Joseph Wood Krutch

Houghton Mifflin, $3.75
227 pp., illus.

Reviewed by N. J. BERRILL

DR. KRUTCH'S newest book, like its predecessor, *The Voice of the Desert,* finds much of its inspiration in the dry wilderness near his Arizona home. This time, however, his theme is broader: the nature of life and the emergence of its manifold forms, starting with growth, sex, and death in the Volvox, that colonial enigma at the junction of the plant and animal kingdoms.

Throughout the first part of the book, Dr. Krutch is concerned mainly with phenomena and problems of instinctive behavior, which he strongly feels are not fully accounted for by the theory of mutation and natural selection. No doubt many biologists share his belief, for even if current genetic theory can be stretched to embrace all instinctive behavior, it may yet be far from the whole truth. There are good reasons, I think, to suspect that something vital to our understanding is still missing. In any case, the alternative to neo-Darwinism is not necessarily some form of neo-Lamarckism, as Dr. Krutch seems to suggest, any more than the alternative to fascism must be communism. Later on he turns his attention to the phenomena of emergent consciousness and intelligence among salamanders, birds, and mammals and again is not satisfied with orthodox evolutionary theory.

In one fascinating chapter, Dr. Krutch describes and discusses the dependence of life upon life, the robin and the worm, and the agricultural ant and his fungus gardens, for example. In another chapter, he describes superbly the transformations of the Monarch Butterfly from egg to flying insect. At all times, he is interesting, and most of the time persuasive.

When Krutch goes on to condemn the callous attitude of most allegedly civilized humans toward the rest of creation, most biologists will agree with him; it is our common concern that much is being destroyed, perhaps forever. His plea that man should both respect his fellow creatures and, at the same time, cultivate his own distinctively human qualities is one that should be heeded. And this is poignantly emphasized by his point that many birds manifest a joy in living at least as clearly as we ourselves, even though, by our standards, they are not particularly intelligent. *The Great Chain of Life* is extremely good reading, and the pleasure is enhanced by Paul Landacre's beautiful drawings.

British born and educated, N. J. Berrill is Professor of Zoology at McGill University. He has written on a number of subjects for Natural History.

CHIPPEWA INDIANS

- - - - By Sister M. Carolissa Levi

Pageant Press, $5.00, 385 pages

Reviewed by SOL TAX

THIS is a lively account of a very alive people—the Chippewa Indians of Wisconsin. The author, a teaching member of the Franciscan Sisters of Perpetual Adoration, once taught in the Bad River Reservation School. Her admiration for the Indians grew with acquaintance; and she undertook to know them better. Guided by solid sense and scholarly care, she has produced a book that is both sound and original.

Sister Carolissa doesn't take account of the theoretical literature in anthropology, or on the Chippewa. (It happens that the Chippewa have figured very importantly in studies of changes in culture as they affect individuals.) But this isn't a book about social theory. It is a book about the Chippewa, and on that subject she has used the best descriptive and historical sources. Better than that, she has read newspapers and dug out documents. More important, she has talked to people and breathes life into the story she tells.

The Chippewa story after white contact is not unlike that of other woodland groups who have remained in their ancestral environments. Explorers were followed by missionaries, then fur traders, then settlers and government agents. The French were first, and their influence continued.

The 80-odd pages devoted to the present-day Indians on their six Wisconsin reservations against their historical background constitute one of the fairest short accounts available on problems besetting Indians.

Sister Carolissa analyzes problems of Indian livelihood, education, health, and law enforcement. She offers no solutions, and not too much hope. Perhaps she senses that "solutions" couched in terms of progress simply demand that Indians become like whites, which is what Indians have never particularly wanted to do.

Most of the book is devoted to brief descriptions of Indian customs — social, ceremonial, and economic — as recalled by

older persons, recorded, or seen today. Chippewa ways are interestingly illustrated in dozens of drawings by Peter Whitebird, a Chippewa Indian, and in numerous anecdotes. It may come as a surprise to some that the Chippewa (like many other North American Indians) still live pretty largely in terms of Indian—not white—values and ways. External trappings have changed, but Sister Carolissa did not have to engage in archeology to learn about Chippewa customs; she could see or hear about most of them firsthand. This account of the Chippewa Indian makes fascinating reading.

The reviewer, Professor of Anthropology at the University of Chicago, is a leading authority on the American Indian.

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BUTTERFLIES AND MOTHS

- - Introduction by Alfred Werner

Random House, $10
176 pp., 34 color plates

Reviewed by ALEXANDER B. KLOTS

THIS book, which has a minimum of text, is noteworthy chiefly for the beauty and fidelity of its color reproductions. However, although the individual composition of the plates is attractive, there is no continuity to be found in the selection and arrangement of the various specimens illustrated. North American varieties are almost entirely ignored. The text consists of a hodgepodge of miscellaneous facts and includes a number of elementary errors as well as several unjustified statements. As a source of information the book is feeble and unreliable. Americans will be annoyed or amused to see William Beebe constantly identified as Lucius Beebe, the distinguished writer.

The reviewer, an authority on butterflies, is Associate Professor of Biology at City College (New York) and Research Associate at the American Museum of Natural History.

THE BOOK OF THE SKY

- - - - - edited by A. C. Spectorsky

Appleton-Century-Crofts, $10.00
490 pp., illus.

Reviewed by
JOSEPH M. CHAMBERLAIN

AIRPLANES, rockets, bombs, birds, angels, butterflies, grasshoppers, and aurorae are among the 91 subjects that A. C. Spectorsky includes in his *Book of the Sky*. The list of authors is like a roll call of great literary names from the past, interspersed with contemporaries from the fields of radio, humor, and even science fiction.

The editor's aim has been to capture within one volume some of the most fascinating aspects of man's relation to the sky. Indeed, this is the one tenuous thread that connects most of the selections. The unrelated exceptions are excerpts from astronomical literature, which represent another field altogether.

Diversity is an important factor in the success of this book. The authors provide a variety of literary styles, ranging from the pedantic authoritarianism of Cotton Mather to the wittiness of Robert Benchley and the realism of Rose Wilder Lane. Spectorsky sets the stage for each with a brief preface.

The book contains one of the nicest collections of historical and modern pictures ever assembled in support of one subject. It might be added that it is not always easy for the reader to determine into which century he is transplanted as he progresses from one selection to the next. Nor is it always clear what is fact and what fancy. But the sheer delight derived from each page more than makes up for any lack of chronological or scientific precision.

The reviewer, Chairman of the American Museum—Hayden Planetarium, has written many popular articles on astronomy and related subjects.

THE GREAT MIGRATIONS

- - - - - - - - - by Georges Blond

Translated from the French
by Frances Frenaye

Macmillan, $4.00, 192 pp.

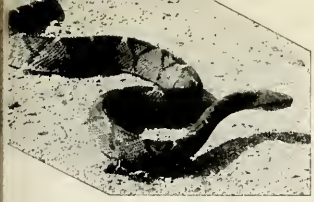
Reviewed by ROBERT P. ALLEN

THIS is a well-written, dramatic, and sometimes imaginative re-creation of the migrations, journeys, plagues, and dispersals of gray lag geese, herring, salmon, eels, American bison, locusts, and lemmings, in that order. The author, who has obviously spent many rewarding hours going through the pertinent literature, excuses any deviation from known fact by stating in advance that he has treated his subject "not as a scientist but as a writer." This gives him a latitude which is artistically convenient and often pleasant in its results.

The anthropomorphic approach to natural history seems to me unwarranted, however, if not downright silly, in a book for adults. The story of devotion between a pair of gray lag geese is especially at fault in this respect. M. Blond rejects the orderly and fascinating mechanics of animal behavior, failing to see that no amount of humanizing can possibly present a picture of animal life that is nearly as exciting as the real thing. Mature readers can appreciate the astonishing perfection and beauty of innate behavior patterns, social releases, and other established evidence of the lesser animals' ability to get along in the world without thinking and communicating in the same manner as you and I.

Nevertheless, this is an entertaining book and good reading.

Robert Allen is a naturalist and ornithologist with the National Audubon Society. He is an authority on rare North American birds. His latest book, On the Trail of Vanishing Birds, *will be published in April.*



Bushmaster! *continued from page 79*

Beebe once wrote: "An Indian will milingly undergo any physical hardship, and he will face any creature in the jungle except a Bushmaster." This awe is due in part to the fact that the average length of those seen is about eight feet, while possibly one of twelve feet may be encountered. Rarely is a Bushmaster of less than five feet seen. Of all the venomous snakes of the world, it is second in size to only the King Cobra. The natives are well aware that these large, heavy-bodied reptiles pack a lethal dose of venom! Furthermore, unlike other snakes, they hold the right of way, letting man yield ground or suffer the consequences.

The reason no small snakes of this species are seen, scientists believe, is because the young of the Bushmaster *(Lachesis muta)* live in burrows of rodents and armadillos, feeding on the young of those animals and spending little time above ground until they are mature snakes.

In 1937 Dr. C. H. Curran wrote, "The Bushmaster, although famous, is not well known. It is not a common snake, and there are few accounts of its actual capture." One years of areas where the bushmaster is plentiful, but Dr. Ditmars spent weeks looking in vain for a specimen in an area reported to be infested with them. During 30 years in the tropics, I have come upon only this one, and none has been taken on the six square miles of Barro Colorado Island. Unlike the Fer-de-Lance, which gives birth to from 30 to 60 or more living young, the bushmaster lays eggs in groups of 7 to 14. Although it is reported that the bushmaster guards its eggs until hatched, coatis, peccaries, and rodents undoubtedly take their toll, holding the bushmaster population to a minimum.

In spite of its robust appearance, the bushmaster has a comparatively weak backbone. At capture or when being forcibly fed, it must be handled carefully, lest a valuable specimen be lost through this weakness.

Although this snake may be transported safely by automobile or boat, according to Dr. Elton it will not, for some unexplained reason, survive a long ride on horseback.

From egg to maturity, the bushmaster is practically unknown. Little more is known of the mature snake except that it is sullen, fearless, deadly. Refusing to take food voluntarily and sometimes succumbing to internal parasites, it seldom lives more than a few months in captivity. To study it in its natural habitat is practically impossible.

One little incident stands out sharply in my mind as I recount this snake story. An engineer who has worked in the Panamanian jungles for many years and knows bushmasters from personal contacts with them, refused to believe that any six-foot snake, captured with a four-foot butterfly net and bare hands, *could* be a bushmaster. He came to see for himself. Making no comment about the snake as he turned from the cage, he looked me over for several moments before drawling, "Mister, I reckon from now on you're living on borrowed time!"

"But we're over 200 miles away from snake country, Fenwick."

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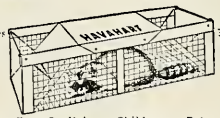

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▲ THE AUTHOR in a room of Timpanogos Cave where the ceiling is a mass of coiled and intertwined helictites

The Helictites of Timpanogos Cave

When is a stalactite not a stalactite? When special conditions of growth produce these bizarre branched and twisted formations

By WILLIAM B. SANBORN

Photographs by the outho

▲ OUTSTANDING CLUSTERS of helictites such as these abound in the chamber known as the Coral Gardens.

HIGH in the south wall o American Fork Canyon ar the chambers of Timpanogos Cav National Monument, the "gem" o Utah's Wasatch Mountains. A tra winds a mile and a half upwar from the headquarters of the Monu ment to the cave entrance, som 1,000 feet above the canyon floo Regular guided trips are conducte through the well-illuminated pa sageways deep inside Mount Tim panogos.

A small cave, Timpanogos is ac tually a series of three interco nected caves: Hanson Cave, whic is the entrance; Middle Cave; an Timpanogos Cave proper. Lik other caverns, these chambers ar decorated with numerous stala tites, stalagmites, columns, dra eries, and similar formations. A though some claim that all cav look a good bit alike, the "Tim Cave" has one feature that sets apart from the others. It reall

parkles when it comes to *helictites.*

Helictites may be described as an unusual twisted or branchlike form of stalactite. Whereas stalagmites rise from a cavern floor, and stalactites hang down from the ceiling, helictites seemingly defy gravity and protrude from the walls of caves or encrust the sides of stalactites. Helictites are not rare; they occur in many limestone caverns. However, the helictites in Timpanogos are unsurpassed in profusion, size, and beauty.

Many chambers in Timpanogos are resplendent with spectacular displays of helictites. Some areas look like underwater gardens, brilliant with fantastic coral-like forms. Other walls are festooned with amazing intergrowths of twisting, curling, and wreathlike helictites. Some resemble a woman's feathered headpiece from the '20's; others end in a glistening burst of needle-sharp aragonite crystals. Although the predominant color of the formations is pure white, these calcite and aragonite formations frequently contain mineral impurities that impart pastel shades of red, green, blue, brown, and even lavender. The delicate coloring and brilliance of the formations is best viewed in the Coral Gardens, Father Time's Jewel Box, and the Chimes Chamber.

What causes helictites? Basically, like other cavern formations, they are formed by the evaporation of mineral-laden waters. However, there is no precise explanation for the weird, intertwined growths. It is believed that the combination of various factors, such as changes in cavern temperature as well as the volume, direction, and humidity of air currents, are causes.

If you are in the Salt Lake area you will find the Timpanogos Cave well worth a visit. It is accessible by good highway, and fine picnic facilities are available at the headquarters area. Oh, yes; don't worry too much about that mile and a half climb to the entrance. The trail is excellent, and hundreds of school children make it every year.

Little America Revisited *continued from page 69*

history as one of the chief centers for antarctic exploration was at an end — or at least suspended. The *Atka* therefore headed east to look for a substitute site, and her first destination was Sulzberger Bay, some 200 miles from Little America. This was far closer to the projected site of Byrd Station, deep in the heart of Marie Byrd Land, and would therefore reduce the number of miles to be covered by tractor trains setting up that outpost. Byrd Station was to become one of the three main U. S. posts in the I.G.Y. plan, the other two being this coastal base we were looking for, and the station at the Pole itself.

The chief drawback of Sulzberger Bay was its inaccessibility. It had never been entered by a ship, although the *Discovery, Kainan Maru,* and *Bear* had come near its entrance. It was a flight from the *Bear* in 1940 that revealed the great dimensions of the bay, about 100 miles wide and 70 miles deep. Its eastern portion lay in unclaimed territory.

Blocked by Ice

Around Cape Colbeck, almost within sight of Sulzberger Bay, the *Atka* encountered pack extending up to the coast—the same situation that had turned back the *Edisto* seven years earlier. Ice-floe pressure may not be fatal to a ship far offshore, but where the pack is blown against immovable ice cliffs it might crush even the stoutest icebreaker. Jacobsen turned seaward in an attempt to make an "end run" around the area.

The way at first was made easy by "Iceberg Alley," so named by the crew because the bergs were lined up in a double row, holding back the pack on either side and allowing the ship free passage between. These were flat-topped tabular bergs, apparently aground. Several as measured by radar had a surface as large as New York's Central Park. Once we came to the end of this avenue the pack became extremely heavy.

The ship was equipped with special pumps capable of moving 104 tons of water from one side to the other in 90 seconds through a series of huge two-foot mains. The system was capable of making the ship roll about ten degrees to either side, but its effect was disappointing. It helped to keep the icebreaker from freezing in but did little to crack ice in front—where it counted.

Damage to a Screw

Jacobsen felt the ship was in serious danger of being beset. The ice floes in this area were reinforced by pressure ridges that made them 22 feet thick in places, although the thickness of the over-all floe was only 8 feet. It was old blue-green ice — in Jacobsen's words, "hard as armor." The heavy layer of snow on top made it even more difficult to break, because it cushioned the blows of the *Atka.* Despite constant backing and charging, it took the ship three hours to gain two-and-a-half ship lengths. Open water was reached at last but at the cost of a casualty that was to endanger the ship for the rest of the operation. At one point, as she backed away for a charge, there was a sharp jolt, which could only mean that one of the twin screws had struck a submerged extension of floe. We later discovered that one entire three-ton propeller blade had been lopped off.

The situation was serious enough to make Captain Jacobsen decide to go back and make a careful examination of Kainan Bay, 35 miles east of the original Little America. Here the *Atka* made fast to the bay ice, and a six-man scouting party under Major Wiener, including Waite and me, set off on skis. Our purpose was to find a route up over the 80-foot cliffs of the shelf ice which might be used by the tractors. We wore sledging harness, consisting of a loose canvas belt held up by shoulder straps, similar to that used in Scott's day. Each man's towing line was in turn fastened to a long alpine rope, at the end of which trailed a boat sled, in which we

carried a small load of food, extra clothing, cameras, etc.

Wiener went first to select the trail. Waite brought up the rear, a quiver of trail flags over his shoulder. Every few hundred yards he would plunge one of them into the snow to mark our return route.

As we proceeded, a polar fog known as "sea smoke" moved in, first obscuring the icebreaker and finally our nearest trail flag. For a half hour we waited, until at length we could see the hazy outline of the sun, and with that as a clue to direction, we continued toward a "ramp" we had seen from the ship.

When the fog lifted, we seemed to see at least two crevasses cutting across the ramp. Wiener decided to go up alone, since this would enable the rest of us to tend the line and keep it taut in case he fell through. He had brought a long slender pipe with which he probed as he ascended. He reached the top without difficulty, and we soon followed; but beyond, the surface looked uncertain.

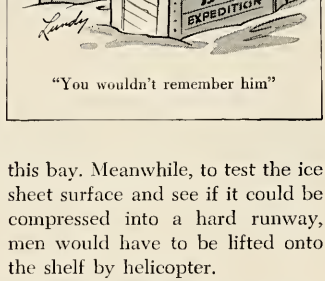
Dangerous Crevasses

Unfortunately, the ramp had not brought us to the smooth shelf ice plateau but rather to an area of pressure ridges at the head of the bay. There were great canyonlike crevasses on either side of the ramp, and it was possible that they looped around in front of us, bridged with snow. Wiener rammed his pipe into their area as deeply as he could without putting his weight on it and reported that it became softer, instead of denser, indicating possible hollowness underneath.

On our way back, we found that several of our trail flags were lying on the snow or missing. We were later told by men on the ship that skua gulls — the "vultures" of the antarctic — had swooped on the flags, thinking them edible, and plucked them out.

Later in the day, after the sun had come out, we revisited the ramp and Wiener's suspicions were confirmed. There was indeed an immense crevasse at the top, 20 to 40 feet wide and probably 50 feet deep—enough to swallow all six of us at once, had it caved in.

Although our scouting trip could report no safe surface route to the top of the ice shelf, the engineers who were along as observers felt that one of the existing ramps could be made passable by bulldozers if the big expedition decided to use



"You wouldn't remember him"

this bay. Meanwhile, to test the ice sheet surface and see if it could be compressed into a hard runway, men would have to be lifted onto the shelf by helicopter.

The next morning I was below in the observers' living compartment when Tilghman, a helicopter flier, suddenly rushed in and seized his flight clothes.

"There's been a crash," he said.

I ran up on deck and learned it was John Moore who had crashed. Within a few minutes we heard the pulsing beat of a helicopter in flight. It was Metrolis coming in with Moore.

"Tell him to land on the ice!" someone shouted. That would make it easier to get an injured man to sick bay without too many twists and turns. As the helicopter lowered onto the ice, I realized that we were immersed in a typical antarctic white-out. Nothing could be seen beyond the vicinity of the ship except out to sea. A group of men hurried to the 'copter, including the Chief Pharmacist's Mate. Moore had been lashed inside a boat sled which in turn was tied to one of the landing pontoons. They quickly untied the cords and carried him across the snow and up the gangway. The men on the quarterdeck and upperworks looked silently and anxiously at the bundled-up figure of their shipmate. We could not see his face, but his hand moved gently, so we knew he was alive.

"White-out" Crash

From those who saw the crash, the story was gradually pieced together, though Johnny Moore never lived to give his version of it. He had just brought the Reverend Daniel Linehan, S.J., director of the Boston College observatory at Weston, Massachusetts, to set off some explosives to determine the thickness of the ice sheet and find out whether it was aground at this point. Lieutenant Robert H. Loreaux, Jr., was there already. Moore dropped the scientist-priest and then lifted his machine into the air to return to the ship. But imperceptibly a white-out situation had developed and there was no horizon. He tilted his machine forward for horizontal flight, but instead of flying parallel to the earth, he flew in a 30-degree descent. The machine crashed into the ice sheet at full power and tumbled through the air for about 75 yards before coming to a stop, its pontoons in the air and the rest of the machine a tangled mass.

Meanwhile, Metrolis was flying in with Joseph L. Tavares, Gunner's Mate 2d Class, who was to help Father Linehan set off his explosives. Northwest of Father Linehan's equipment on the shelf, Metrolis saw the wreckage and radioed the ship, "I think the other plane has crashed."

Cautiously bringing his machine down, he ran to the wrecked helicopter. At first the pilot could not be seen. Then he was spotted entmeshed in the wreckage, his face in the snow. He was carefully pulled out and laid flat on the snow. Metrolis explained to the injured man that he was going to cover his face so that he would not freeze during the flight. The boat sled on which he was put was lashed to the

wind-swept pontoon. The pilot lifted into the air, keeping his eye on the wreck, then looked for the sharp horizon formed by the ice cliffs against the charcoal "water" sky over the sea. He spotted the top of the ship's mast three miles away and had begun horizontal flight at 55 knots when he felt a jolt.

To his horror, he realized that he himself had hit the ice sheet. He was luckier than Moore; his pontoons had hit flat and did not trip but bounced him back into the air.

The crash took place at 10:20 A.M., and fifteen minutes later Moore was aboard ship—a quicker rescue could hardly be imagined. The ship's doctor, Murray Kahn, found Moore in deep shock due to multiple internal and head injuries.

Moore's death threw a blanket of gloom over the ship. Johnny Moore had had many friends on the *Atka*. He was constantly cheerful, dashing, yet gentle—in fact, that most attractive of human beings, a Southern gentleman.

For Commander Jacobsen it was a particularly severe blow. Over and over he had emphasized the principle that safety had priority above all other objectives of the expedition. The captain is father to his crew; the leader of the expedition is responsible for all his men; and when one of them is lost the heaviest burden falls on him, regardless of the circumstances.

Kainan Bay the Choice

At a meeting of the observers, it was agreed that Kainan Bay could serve as a harbor for a major base. An examination of aerial photos taken on *Operation Highjump* showed no substantial change in the structure of the bay during the past eight years, indicating that it was more stable than the Bay of Whales.

In six weeks the *Atka* had girdled half of Antarctica, sailing 7,500 miles. Its scientists had brought home new knowledge of the air, water, snow, ice, and ocean floor at the bottom of the world, and of the regions of outer space that circle the earth.

Letters

continued from page 57

The calls are produced with the mouth and nostrils closed, by shunting air back and forth between the lungs and the vocal pouch, passing over vocal cords en route. When seized, virtually all toads and many treefrogs also produce a warning chirp. Under natural conditions, this enables the male to ascertain whether he has clasped a female or one of his own sex. He will promptly release a male but will ordinarily remain with a female to fertilize her eggs when they are extruded. Toads commonly produce a warning vibration along with the chirp.

The true frogs *(Rana)* in particular may give vent to "screams of fright," with the mouth widely opened at the time. One night in Florida we had just finished recording an enormous chorus of barking treefrogs whose loud voices could be heard above several other species. I was gathering up the wire for the microphone when behind me I heard the most spine-chilling scream I've ever

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heard. I whirled around with my headlight to see a raccoon scarcely twenty feet away that had just seized a leopard frog and was carrying it in his mouth.

What interested me was that I was the only other creature there who seemed to be disturbed. Leopard frogs as well as treefrogs and toads went on calling as though nothing had happened, even those within a few feet of the wading raccoon! It seems, therefore, that when a chorus is at its peak following heavy rains, nothing short of his being seized will inhibit a vocalizing frog.

There, at least, was one noise that might have been expected to put a momentary stop to the frog chorus but didn't. We have not yet found all the answers to these questions, but with portable tape recorders the research is going forward apace and we are learning new things about animal communication all the time.

▲ Comrades from different continents, by William Vaughan.

The Tree That Isn't a Tree

Sirs:

I was particularly interested to read the article on the Welwitschia tree in Natural History some time ago. I am afraid, however, that the author is wrong as to where the tree is to be found. The Welwitschia is found not only in Angola, but in many parts of South-West Africa.

The Welwitschia tree can also be grown from seeds. This has been done successfully by the Chief Inspector of the Botanical Gardens at Kiel, Germany. The seeds were obtained from Mr. W. Triebner, our chief botanist here. I am sure he would be glad to send seeds and instructions to anyone in the United States interested in growing a Welwitschia.

D. M. L. Fock

Windhoek,
South-West Africa

The Welwitschia was discovered in 1860, almost simultaneously by two explorers operating separately and independently: Welwitsch in Angola between Mossamedes and Cabo Nagro, and Baines in the Walfish Bay area, in South-West Africa, more than 400 miles south of the Angola border. As Mrs. Fock indicates, it has since been found to exist in many places in between, in some spots in great numbers.—Ed.

Greetings from Peru

Sirs:

I am a Peruvian teacher. Allow me to express my gratitude to you for your excellent, valuable publication. Please accept my gratitude and best wishes, and to you and to the ladies and gentlemen who collaborate with you in the preparation of this scientific material, a very happy 1957!

Ricardo Tello DeVotto

Huancavo, Peru

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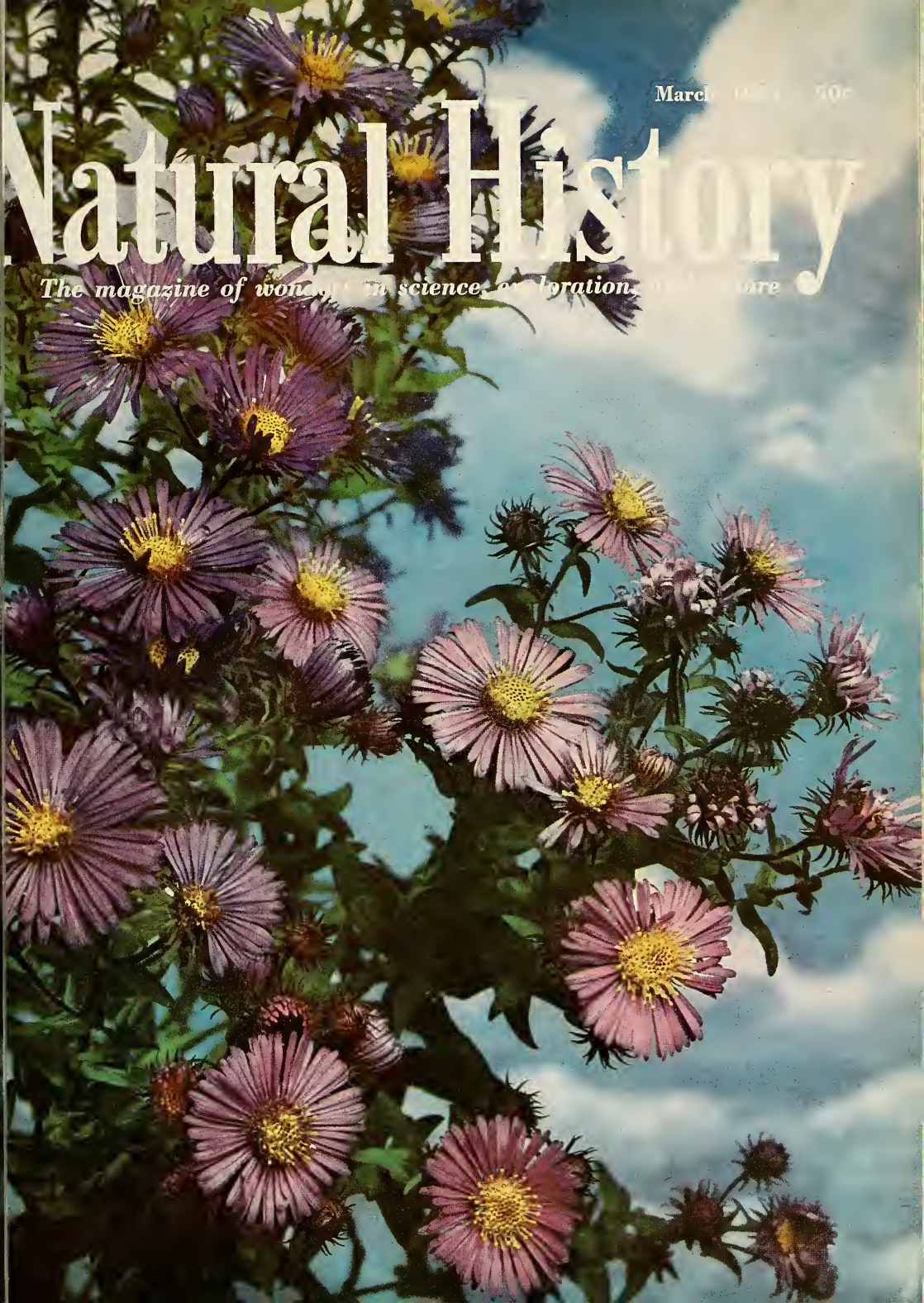

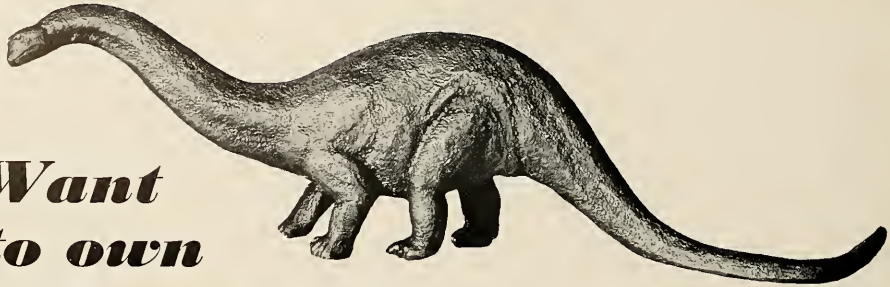

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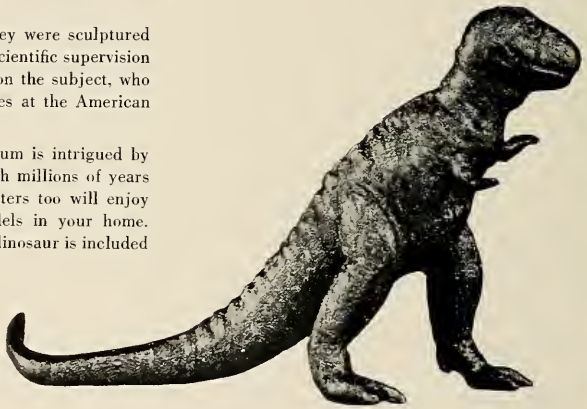

TYRANNOSAURUS

This huge reptile was the largest of all land-living carnivorous animals. Its skeleton stands 18½ feet high and 47 feet long. It probably weighed about 10 tons and undoubtedly preyed upon other large dinosaurs. This model is 3½ inches long.

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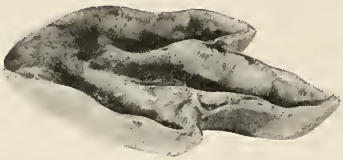
Dinosaur Footprint Ashtray



It's an accurate replica of a track made by one of the small, early dinosaurs that lived during the Triassic period of earth history, about 175 million years ago. This ceramic tray is attractively finished in a green glaze and is about 6½" long and 4" wide.

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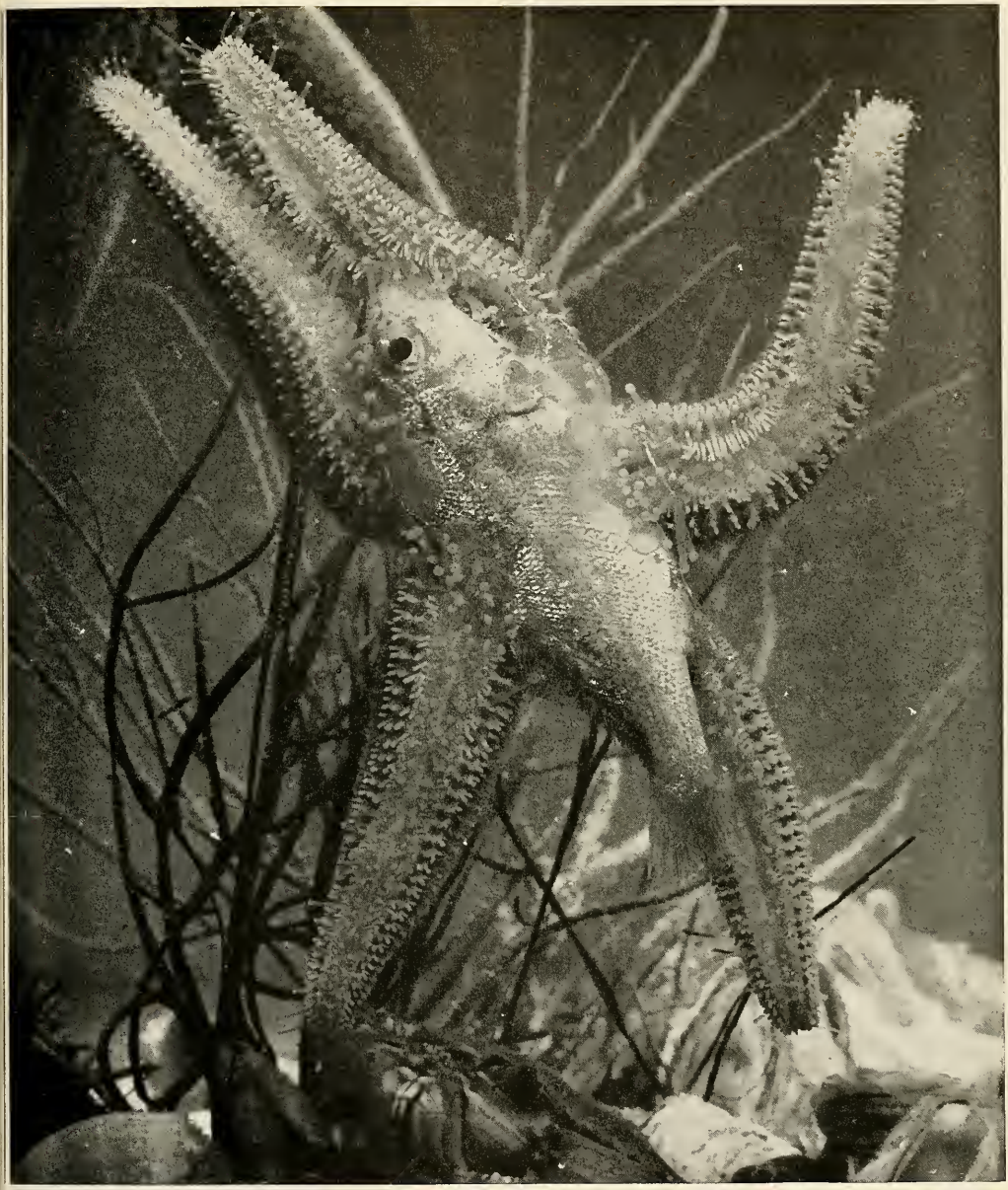

▲ Part of the everted stomach of the starfish can be seen, enveloping and digesting the fish.

Letters

A Fish Eaten by A Star

Sirs:

Recently visitors to the Virginia Fisheries Laboratory in Gloucester Point were given the rare treat of seeing a sea star eating a fish, as shown in the accompanying photograph. The fish, a small spot, had been injured in the collecting seine and was numbed by the chill waters entering the display tanks. Thus it fell prey to the slow snail-like advances of the sea star. The starfish extended its arms over the fish's body and fastened its suction cup feet to the wall of the aquarium. Then it everted its stomach through the small mouth opening and placidly digested the fish.

Sea stars are also able to open and consume oysters. Fortunately, however, their depredations are not serious in Chesapeake Bay.

Robert S. Bailey,
Assistant Biologist

Virginia Fisheries Laboratory
Gloucester Point, Virginia

continued on page 168

NATURAL HISTORY

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March, 1957 Volume LXVI, No. 3

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From a color transparency by W. H. Hodge

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Few ever see it, though its importance to the life and history of the world is mentioned in every textbook

The Screen 165
Authoritative comments on films in the field of nature, geography and exploration

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THE COVER THIS MONTH

The New England Aster *(Aster novae-angliae)* is one of America's most familiar and best-loved wild flowers. Its name belies its range, for it grows throughout much of the United States east of the Rockies. This colorful species delights in sunny sites in fields or moist meadowlands, where in good soil its harshly hairy and very leafy stems rise to a height of over six feet. The showy violet-purple or rose-colored flowers contrast wonderfully with companion goldenrods.

Asters, or Starworts (so-called because of the starlike floral heads), comprise one of the largest and most widespread genera of the giant daisy family *(Compositae)*. Some 200 species of asters occur, chiefly in North America, where they are well-known wild flowers. Unfortunately, they are good examples of the old adage, "Familiarity breeds contempt." For in their native America they are practically unknown as cultivated garden flowers. European horticulture, on the other hand, has welcomed them with open arms and with another name, Michaelmas Daisies.

W. H. HODGE

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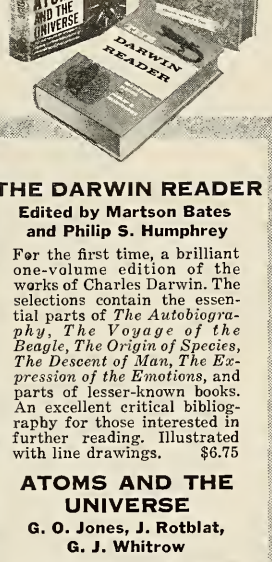

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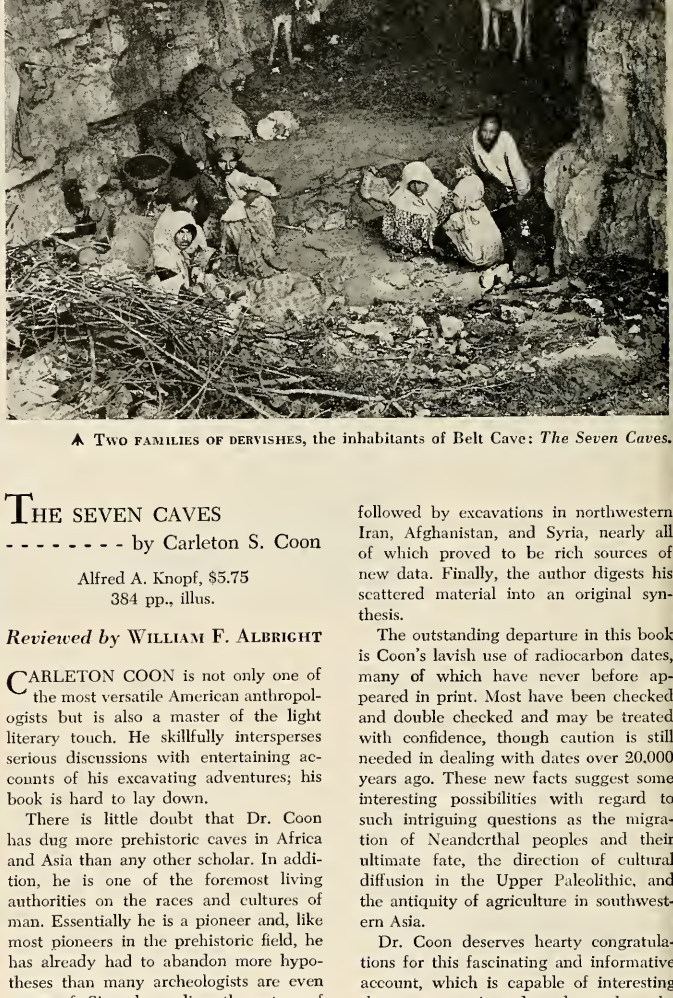


▲ Two families of dervishes, the inhabitants of Belt Cave: *The Seven Caves.*

The Seven Caves
- - - - - - - - by Carleton S. Coon

Alfred A. Knopf, $5.75
384 pp., illus.

Reviewed by William F. Albright

Carleton Coon is not only one of the most versatile American anthropologists but is also a master of the light literary touch. He skillfully intersperses serious discussions with entertaining accounts of his excavating adventures; his book is hard to lay down.

There is little doubt that Dr. Coon has dug more prehistoric caves in Africa and Asia than any other scholar. In addition, he is one of the foremost living authorities on the races and cultures of man. Essentially he is a pioneer and, like most pioneers in the prehistoric field, he has already had to abandon more hypotheses than many archeologists are even aware of. Since he realizes the nature of scientific exploration, Dr. Coon is always ready to recognize past errors and use them as steps to further achievement.

After a lucid introductory chapter on "Why Some People Dig Caves" and how, the author goes on to describe his adventures. First comes High Cave near Tangier in Morocco, where he began his digging eighteen years ago. This was followed by excavations in northwestern Iran, Afghanistan, and Syria, nearly all of which proved to be rich sources of new data. Finally, the author digests his scattered material into an original synthesis.

The outstanding departure in this book is Coon's lavish use of radiocarbon dates, many of which have never before appeared in print. Most have been checked and double checked and may be treated with confidence, though caution is still needed in dealing with dates over 20,000 years ago. These new facts suggest some interesting possibilities with regard to such intriguing questions as the migration of Neanderthal peoples and their ultimate fate, the direction of cultural diffusion in the Upper Paleolithic, and the antiquity of agriculture in southwestern Asia.

Dr. Coon deserves hearty congratulations for this fascinating and informative account, which is capable of interesting the most experienced reader and at the same time of giving the intelligent novice his first glimpse of the charm of archeology.

Dr. Albright, an eminent orientalist and archeologist, has spent many years in the Middle East. He is Chairman of the Oriental Seminary at Johns Hopkins University.

Meeting Prehistoric Man

- - - by C. H. R. von Koenigswald

Translated from the German
by Michael Bullock

Harper, $3.50, 216 pp., illus.

Reviewed by
Roy Chapman Andrews

Dr. von Koenigswald gives the keynote of this book in his foreword remark that it should really be entitled *Diary of a Paleontologist*. For instead of a critical analysis of human fossil remains, it is actually the account of a dedicated man's visits to the shrines of his scientific religion. I doubt that any other student of human evolution has personally examined so many sites of important discoveries as has this author. "I have roamed Java;" he writes, "entered the caves of Peking Man; hunted through Chinese apothecaries' shops; visited the sites of prehistoric finds in South Africa; and gathered material in Oldoway Gorge [Tanganyika]. These are the experiences I wish to record in this book."

The narrative of his pilgrimages is interesting and informative reading for both laymen and scientists. At times his story changes from one place to another in a somewhat confusing manner, but such lapses are not particularly important.

In 1931, von Koenigswald received an appointment from Holland as paleontologist for the Geological Survey of Java, the country of the Ape Man, the famous *Pithecanthropus erectus* about which a storm of scientific discussions had raged for decades. Nothing could have been more welcome to the author. For years he worked in Java, where he not only solved the question of the age and relationship of *Pithecanthropus* but also made some important discoveries of his own.

A very productive source of fossils, he relates, proved to be Chinese apothecary shops all over the world. The Chinese believe fossils are remains of dragons and possess medicinal qualities. Consequently, every drugstore carries an assortment as ordinary stock. With the aid of a "prescription" for dragons' teeth, von Koenigswald found several enormous teeth from a creature he named *Gigantopithecus blacki*. Some authorities consider it to be definitely human, but as the author cautiously states, "The riddle . . . remains to be solved."

In 1941, a collector in Java sent him the fragment of a gigantic jaw containing three teeth. This was undoubtedly human, and von Koenigswald designated it *Meganthropus palaeo javanicus*, Giant Man of Ancient Java. "How big he was," says the author, "is difficult to estimate; some credit him with the height of 8 feet, 3 inches."

When the Japanese occupied Java, von Koenigswald became a prisoner of war, but he had already arranged for the safety of his fossils. All of them survived the war, even the one Solo skull which was carried to Japan as a birthday present for the emperor and was recovered after the war.

Dr. von Koenigswald has led an exciting, satisfying life as a fossil hunter. This he successfully transmits to his readers in *Meeting Prehistoric Man*.

The reviewer, Roy Chapman Andrews, is the world famous explorer and is Honorary Director of the American Museum of Natural History.

Affable Savages

- - - - - - - - - by Francis Huxley

Viking, $4.75, 287 pp., illus.

Reviewed by **Charles Wagley**

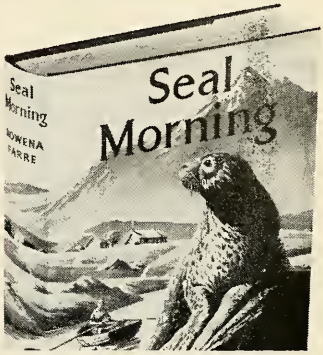
In 1941, when I was on a prolonged expedition to northeastern Brazil, several parties of Urubu Indians came to visit the post on the Pindaré River that was our base. They were naked and largely untouched by civilization. Only a few years before, they had made war on Brazilian frontiersmen and the Tenetehara tribe. In view of this, we all looked upon them with awe and considerable respect.

▲ Author Francis Huxley with Urubu friend Tero: *Affable Savages*.

But they were gay, friendly people, who even invited us to visit them in their villages.

I decided then either to go soon myself and study this unknown Tupí tribe, or to urge another anthropologist to do it. Ultimately I did neither, but since then two young anthropological experts have visited

Her friends were otters and squirrels and birds— and especially Lora, the seal



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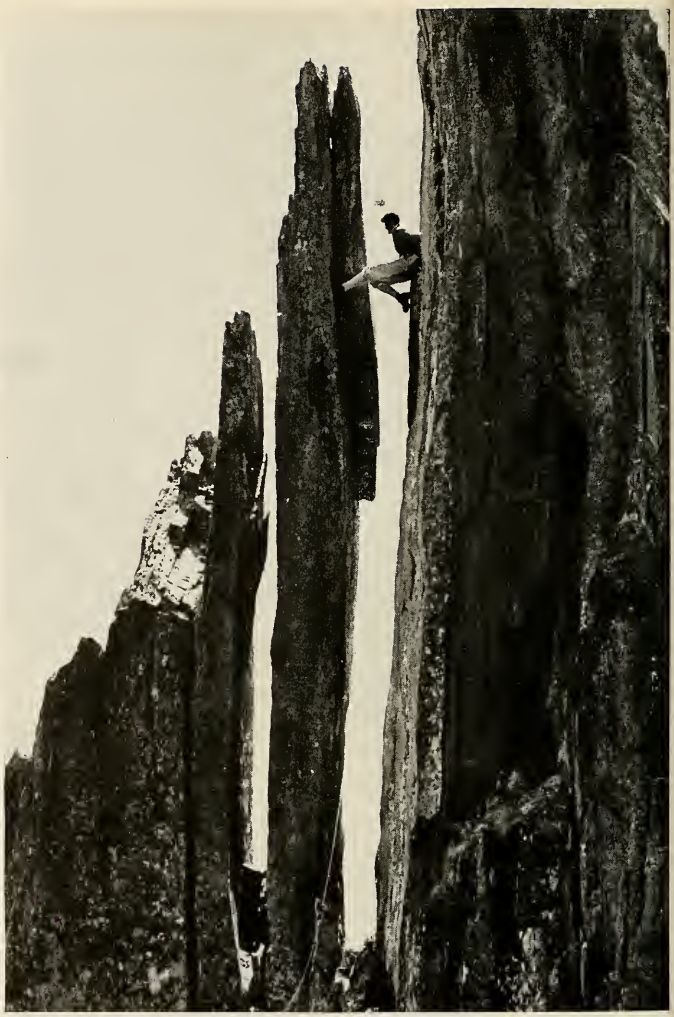

▲ OPPOSITION TECHNIQUE for climbing a broad chimney: *Starlight and Storm.*

and studied these Indians. One is Darcy Ribeiro, whose writings are now being published in Portuguese. The other is Francis Huxley, who has just written this unusual book based on his two trips to Urubu villages.

Like his great-grandfather Thomas and his father Julian, Francis Huxley has the ability to set down scientific concepts in a most readable form. His presentation of scientific information is both sensitive and personal. His book is at once a useful scientific document and a highly interesting account of his own experience. He gives a rather complete picture of Urubu tribal life and culture; but he is at his best when describing individuals and the details of his personal relations with them.

In my opinion, emphasis on the Urubus as former cannibals is quite tenuous. Huxley's basis for such an interpretation is one story from the past and a comparison with the extinct Tupinamba Indians. He makes a point of describing clearly his background facts, however, so the reader can judge its validity for himself.

Reading this book was to me like revisiting and learning more about an old acquaintance. I believe that others, who have never been there, will find equal enjoyment in sharing Huxley's experiences.

Professor of Anthropology at Columbia University, Dr. Wagley is a leading authority on the ethnology and sociology of Brazil.

Starlight and Storm

- - - - - - - by Gaston Rébuffat

Translated from the French by
Wilfred Noyce and Sir John Hunt

Dutton, $5.50, 189 pp., illus.

Reviewed by
J. Monroe Thorington

THIS book, which is the English edition of *Etoiles et Tempêtes*, transmits faithfully the spirit of the original; it will fascinate all readers who enjoy the thrills of climbing.

Part One contains four sections dealing with the techniques of mountaineering. Part Two is the story of Rébuffat's ascents of six classic Alpine peaks: Grandes Jorasses, Piz Badile, the Drus, Matterhorn, Cima Grande di Lavaredo, and Eiger. These climbs were made, in each case, on the great north faces of the mountains along perilous routes.

Rébuffat is a guide by profession. He was born in Marseilles, learned to love the hills of his native Provence, and subsequently became one of the greatest mountain climbers of all time. In 1950 he participated in the French expedition to Annapurna and later acted as supply agent for the British Everest expedition. Sir John Hunt describes him as "an intensely human person, who has discovered through the medium of mountains the true perspective of living."

Fortunately, guides are more articulate now than they were in the Victorian era. Rébuffat expresses his own contentment in saying, "the vocation of guide is one of the best in the world."

Dr. Thorington is an American Alpinist and an authority on the history of Alpine climbing. His books on the subject include Mont Blanc Sideshow *(1934).*

Quest for a Continent

- - - - - - - - by Walter Sullivan

McGraw-Hill, $4.50
375 pp., illus.

Reviewed by Henry M. Dater

EVER since Admiral Byrd's first antarctic expedition in 1928-30, Americans have been increasingly interested in this remote part of the world. This interest will reach a peak during the International Geophysical Year (1957-58), when 12 nations will support more than 50 scientific stations in the antarctic.

Walter Sullivan has put together from research and experience a timely book on the background of this international effort. *Quest for a Continent* is basically the work of a good reporter setting down the material he has found useful in interpreting the events that daily take place before his eyes. This information will be equally useful to the general reader who is on the receiving end of current dispatches from the antarctic.

Mr. Sullivan's opening chapter summarizes existing geographic and scientific knowledge of the South Pole. But from here on, his approach is primarily historical. From the mass of available material, his selections emphasize United States accomplishments and the more recent explorations, with especially full accounts of the expeditions in which he himself participated. Mr. Sullivan has a good journalistic eye for lively episodes that capture reader interest.

At times, Sullivan's treatment does less than justice to the earlier explorers and occasionally he overlooks the accomplishments and significance of others. Still, these faults are minor and will perhaps offend the specialist but not seriously mislead the general reader. The book's extended coverage of Byrd's U. S. Antarctic Service Expedition of 1939-41 should bring that extensive effort the public recognition it deserves. Its significance at the time was quite overshadowed by the outbreak of World War II.

In brief, nowhere else can one find so much useful up-to-date information so attractively presented. To the American reader who has time for only one volume, *Quest for a Continent* is fully recommended.

Dr. Dater is the official Historian of the Office of United States Antarctic Programs in Washington, D. C.

On Climbing

- - - - - - - - - by Charles Evans

Countryman Press, $5.00
191 pp., illus.

Reviewed by William O. Douglas

THIS is a book that will be cherished by all who turn to the mountains for recreation. It is written by one of the world's greatest authorities, a member of the victorious Everest team and leader of the expedition that conquered Kanchenjunga. Some chapters tell of per-

continued on page 166

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▼ Not outdoor swimming pools, but the oceanarium, Marineland of the Pacific, in California. At left is the largest salt water tank in the world. It is four stories deep and 80 feet in diameter.

Collecting for the World's Largest Fish Bowl

It is a real challenge to go fishing when your goal is to bring your fish back alive and unharmed

By Kenneth S. Norris
Marineland of the Pacific photos

BEFORE dawn, the smell of coffee and bacon induced me to wriggle my way out of my warm sleeping bag into the chilly morning darkness. Breakfast over, I helped carry our pile of gear down to the water's edge. With the first gray streaks of light stretching across the glassy Gulf of Lower California, we launched our skiff, climbed aboard, and started for the fishing grounds.

This morning, as on many others, we were going fishing, but not in the ordinary way. Our purpose was different from that of the party already aboard the chartered Mexican shrimp trawler in San Felipe Bay. My companions and I were after fish too, but we were out to bring 'em back alive for our oceanarium (Marineland of the Pacific) in California.

We had one fish in particular on our minds this morning. For six months, the Totoaba (pronounced "to-twa-va") had been vainly sought by our staff. These magnificent bronze fish undergo a yearly migration up the Gulf of California. The migration starts during the early months of spring, passing the fabled fishing port of Guaymas and gradually reaching the shallow muddy delta waters of the Colorado River at the head of the Gulf of California. In this brackish water the Totoaba spawns and disappears again into the depths of the Gulf. In the latter part of April, great schools arrive at the little Mexican fishing village of San Felipe, enroute to the delta. Here individuals weighing as much as 225 pounds are caught.

Totoabas are the giants of the croaker family. The weakfish of the Atlantic and the white sea bass of the Pacific are close relatives. The nearest relative to the Totoaba is a very similar though smaller fish found only along the shores of China.

The Chinese prize this fish for a white taffy-like sac that runs along under its backbone. This sac, called the gas bladder, is used by the Chinese for a special soup stock considered a great delicacy. The Totoaba has a similar gas bladder, and for years Mexicans fished this giant animal solely for this bladder, which they dried and exported to China.

Now once again we were back at San Felipe for another try at locating the Totoaba. For four days we had fished without success, and this was our last day. Even if we were lucky enough to find one, we must haul it quickly from the water. A badly fatigued specimen would stand little chance of surviving the rough trip across the 350 miles of desert and mountain that lie between San Felipe and our oceanarium.

Our plan was to catch the Totoaba on heavy hand lines and large hooks, using live two- to three-pound channel croakers for bait.

▲ LUNCHTIME in the huge fish tank at Marineland of the Pacific.

We would bring the big fish quickly to the surface and slide it into a partly sunken portable fish tank, or "live car." The live car would then be towed back to port, beached on the sand in front of our camp, and the fish carried to the tank truck. From there it would go non-stop to its new home in Marineland's great oval fish tank, where over 100 species of fishes already shared the half-million gallons of sea water.

Far out on San Felipe Bay we boarded our chartered Mexican shrimp trawler. Obeying the seemingly inviolable custom of the land, the boat arrived four hours late—and with another charter party already aboard. Our momentary anger subsided when we found them to be good sports who took an interest in our quest.

The live car and skiff were tied astern, and we chugged off toward the fishing grounds a few miles offshore. Before we had gone far, the boat stopped. It is a constant source of wonder how these trawlers manage to hold together, not to say run, so we were not surprised. Their ancient decks are cracked, scarred, and mostly paintless. Their engines are of many extinct species for which replacement parts have long since ceased to exist.

However, parts or no parts, the Mexicans are equal to the antics of their engines. The engineer, Gregorio, plunged into the smoke-filled engine room with a piece of wire in one hand and an oily rag in the other. When he emerged empty-handed a few minutes later the engine was thumping evenly.

There were four of us from the oceanarium. The two collectors were equal to the task. The Chief Collector of Marineland of the

---

Formerly a Research Assistant at Scripps Institution of Oceanography, author Kenneth Norris is now Curator at Marineland of the Pacific. His special interests and projects include the evolution of desert lizards, the zoogeography of Baja California and Mexico, and the thermal behavior of intertidal fishes.—ED.

▲ When a fish such as this 200-pound black sea bass is hauled rapidly from deep water, its gas bladder swells until the fish's internal organs are compressed. The fish will die unless the bladder is immediately deflated with a hypodermic needle.

▲ The Chief Collector of Marineland of the Pacific, Frank Brocato, with his assistant, "Boots" Calandrino. A fisherman in Pacific waters for 30 years, Brocato is a master at designing new nets when needed.

➤ New specimens arrive at Marineland's pier on the collecting boat, *Geronimo*.

Pacific, Frank Brocato, is a stocky powerful man of Sicilian descent. His father fished the waters of the Mediterranean before coming to the United States at the turn of the century. He brought with him designs for boats and nets unknown in this country. The virgin waters yielded huge catches, and the foundation of a new industry was laid.

A Superb Collector

For 30 years Frank fished the Pacific, using every sort of commercial gear. Then he was offered the position of Chief Collector for the new oceanarium being built at nearby Portuguese Bend. The challenge of keeping alive the fish he had so often caught intrigued him. All the old enemies who had ripped and tangled his nets in the past would be fair game. Basking sharks, dolphins, and giant black sea bass would have to be caught. Fishes he had never seen would be met and conquered in the tropics and the arctic. Being inventive and curious by nature, Frank couldn't resist, and Marineland acquired one of those rare beings—a superb collector. He uses all his seemingly limitless knowledge of marine life to search out and capture fishes never sought or encountered by commercial fishermen. New and strange nets are created from balls of twine. Traps and fish stretchers, porpoise catchers, and fish tanks are built as needed.

The other collector was "Boots" Calandrino. He had been apprenticed to Frank at thirteen and has worked with him for nearly 20 years. He is called "Boots" because he is so thin that about all you see of him are his big rubber sea boots. Frank is Boot's *gumbah,* or the rough equivalent of godfather. To the Italians, family bonds are very strong, and a *gumbah* has a very real authority over his godson. Frank's teaching, well leavened with his volatile Sicilian tempera-

ment, has given Boots marvelous skill with nets, lines, blocks, and all the variety of gear found on fishing boats.

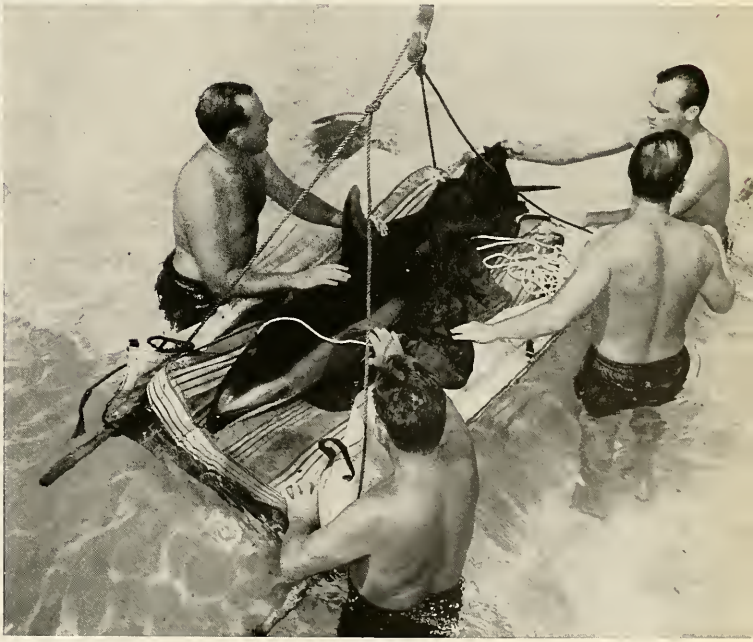
Generally it is utterly useless for the uninitiated to help these two men. All one succeeds in doing is slowing things down and disrupting a smoothly running team. The third member of the group was Jim Long, a Marineland announcer along for the ride. My job as Curator at the Oceanarium had brought me along.

Out on the fishing grounds, bait was quickly caught and placed in wash tubs set on the after hatch. The big Totoaba hooks were baited and dropped to the bottom. We sat quietly on the heaving deck for a long, long time. Suddenly my line gave a mighty yank. I yelled in surprise and dropped it. At the same moment, Frank set his hook in another unseen fish. Luis, the Mexican skipper, snatched up my line, which was rapidly snaking its way off the deck. Frank and Luis worked the fish around astern while Boots opened the ports on the live car, and let it sink almost level with the surface of the sea. The strength of the big fish dug the heavy lines deep into the men's hands. In a few moments we could see the flash of the fish, 20 or 30 feet down. Then the fighting stopped and both fish were easily pulled to the surface. Each weighed close to 100 pounds and was between 5 and 6 feet long.

Critical Moment

Once at the surface, both Totoabas turned over, belly-up, and feebly sculled in circles. When a fish such as the Totoaba is hauled rapidly from deep water, its gas bladder swells until all the fish's internal organs are crowded and compressed. If it is left long in this condition, death is certain. Accordingly, I took off most of my clothes and jumped into the live car in water up to my shoulders, waiting for the two fish to be ushered in. Acrobatics were required to get them into the car as the sea had become quite rough, but in they came. I wrapped my arm around each fish in turn and inserted a long hypodermic needle into it's swollen body just behind its pectoral fin. As the waves dashed over me, I held them under water and

↑ A COMMON DOLPHIN rates a foam rubber mattress on her journey from the sea to a waiting truck.



➤ A STRIPED DOLPHIN being lowered into the quarantine tank at Marineland. It will stay there for a while before being introduced into the porpoise pool.

massaged their bodies to let the gas from their bladders escape through the needle in a hissing stream of bubbles. Once the needle was removed, the fish righted themselves and sank to the bottom. When I felt them brush against my legs as they circled around the car, I knew they stood an excellent chance of surviving.

A Long Vigil

Afternoon was upon us and the wind was rising, so we brought in our lines and headed for home with the live car bucking along behind.

As we slipped along the coast in front of our camp, we dropped the anchor of the live car overboard and left the fish and the car bobbing in the rough sea. After landing, we saw that the surf was far too rough to beach the live car, so we cooked dinner and waited for the wind to drop.

We were worried about our Totoabas for two reasons. First, we knew it was possible that they might become seasick from the unusual motion of the live car. Strangely enough, many fish are subject to motion sickness when carried on vehicles of one type or another. Second, we were afraid that, as darkness came, the isopods might rise from the bottom of the bay and chew our Totoabas to death. These are little white crustaceans that swarm in uncountable numbers in the waters of the Gulf at certain times. A trapped fish has no protection against them and is soon reduced to a pile of clean bones. These little demons nip at anything alive that comes their way. They are a plague to swimmers in the Gulf, but the worst they can do is to drive bathers ashore.

Morning came with the wind still blowing a gale into my sleeping bag. It came, unchecked, directly across the Gulf from the east, stirring up waves that now crashed on the beach as four impenetrable lines of breakers. Frank, Jim, and Boots were already out on the beach, peering anxiously at the sea. It was useless to think of bringing the fish ashore. San Felipe has no piers, but the breakers piling on the beach would dash our live car to splinters in a few moments.

Most of the morning we waited, pacing the beach in hopeless frustration, knowing that every delay gave us less chance of bringing the Totoabas back to Marineland alive. It was maddening to think that our long-awaited and coveted Totoabas were swimming in the bobbing live car within a few hundred yards of us and that we could do nothing but futilely curse at the elements that kept us from them. Time was everything. Every lost hour weakened the fish more in the bucking swash of the live car. The Mexicans stood with us, their sad faces turned to the foaming surf. All the American fishermen and their wives came down on the beach to watch and commiserate with us.

Finally, the wind began to shift slowly toward the north, and before long it was blocked from the bay by the cone-shaped peak of Punta San Felipe. Almost immediately, the sea began to calm. Out through the surf went Frank and Boots in the skiff. Soon the cumbersome live car was wallowing in the still-formidable surf. Jim and I tied the tow line to our big truck and slowly drove up the beach, inching the live car onto the sand. We moved slowly because if the live car were hauled out too far at once, the weight of water inside would split it open like a watermelon. Sea water gushed from its open ports. Frank and I jumped inside the car as waves crashed over its open hatch. We could see our precious fish still vigorously alive, sculling around the tank in two feet of water. We eased each one into a big canvas stretcher and handed it out to Jim and Boots, who then ran it across the beach and slid it into the salt water tank on the waiting truck.

Once the Totoaba were all loaded into the truck, we hauled the live car out onto the dry beach. Its keel had been cracked by the pounding surf, but it had done its job well. Then we stopped for a moment to savor the realization that our prizes had actually survived their ordeal and that with good luck on the trip home they would soon be swimming in the big oval tank for all to see.

As there was no chance to refresh the salt water in our truck tank on the trip home, we pushed along the highway without stops, except for an occasional sandwich and to check our pumps, aerators, and temperature control apparatus. At every gasoline station where we stopped, we hopped on top of the tank, lifted the slatted cover, and peered down into the murky water at our, by now, priceless cargo. Since large Totoabas had never before been transported alive, we didn't know what to expect. So every time we saw our specimens moving slowly but strongly in their little private 10,000-pound sea, we looked at each other and breathed simultaneous sighs of relief.

Early in the dark morning, Jim hopped down from the truck and opened the gate at Marineland of the Pacific. We brought the big truck under the boom and quickly hoisted the Totoabas into the quarantine tank on the top deck, where they were checked by Dave Brown, the Aquarist. He decided that they were in good enough shape to be put directly into the display tank, so the gates were opened and the fish swam into their new quarters. The four of us watched through the glass ports from below, as the big fellows cruised strongly around the tank, scattering the smaller fish in front of them.

White Sea Bass Problem

The other fishes at Marineland have been captured in numerous ways. The white sea bass of California waters is a lordly silver-colored fish, which we dearly wanted to capture and add to our display. We caught many, but each one went into deep shock when it was lifted into the holding tank on board the collecting boat, *Geronimo*. Invariably each one died be-

▲ BERTHA, the 400-pound black sea bass, gives spectators a fishy glance through her viewing port.

fore reaching the comparative freedom of Marineland's huge fish tank. Experiments were carried out on this species for a year before the first fish reached the tank and lived.

Some were blindfolded. Others were injected with curare, a potent muscle-relaxing drug used by Amazonian natives to tip their blow gun darts. Pure oxygen was bubbled into the mouths of still others, and some were attached to floats immediately after capture in an attempt to tire them slowly. Nothing worked, or even gave promise of working. Finally an entirely new boat tank was built that allowed the captives to swim in a wide circle in partial darkness, into a strong current of water. Success was then immediate, and this species is no longer a problem.

Mounted on the prow of the *Geronimo* is a harpooner's pulpit. When a school of dolphins is sighted, Frank turns the helm over to Boots and climbs into this little steel basket, with the white bow wave curling away just beneath his feet. He grasps a strange-looking apparatus called a "porpoise snare," which he developed as a result of many discouraging weeks of trial and error. Just ahead, a large school of striped dolphins mill lazily at the surface of the calm sea. A cloud of gulls circles over the school. Grotesque, archaic-looking pelicans flap laboriously into the air, glide along with their long bills pointed downward, then suddenly tip over and plunge with wings half open into the sea. Glittering scales shining in the water reveal that all these creatures are harrying a school of anchovies.

As the *Geronimo* cuts through the school, the dolphins are galvanized into leaping pursuit of the boat. By two's and three's they veer toward the bow, where Frank waits, tensely clutching his snare. Ten feet down, the dolphins streak into view, rolling over as they swim and peering up at the onrushing *Geronimo* above them. Almost without increase in the speed of their powerful flukes, the beautiful black and white mammals streak ahead of the boat and surface for an almost instantaneous breath of air, many yards from the bow. Others swim up from under the vessel and nearly rub their backs against the prow as it shears through the water.

Finally one big dolphin starts to surface just ahead of the pulpit. Frank lunges. We turn to see the

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Operatio

Science Service

A VOLUNTEER OBSERVER demonstrating the Moonwatch Telescope near one of the T-shaped poles.

MOONWATCH

America's amateur astronomers are building "optical fences" for charting the behavior of the first space satellites

By John T. Kane

"SATELLITE spotting" by amateur star gazers is expected to make an important scientific contribution to one phase of the International Geophysical Year. Under the supervision of astronomers at the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, the amateurs are being organized into volunteer satellite observation teams.

The prototype of the spotting stations that will be set up throughout the country has already been developed in an apple orchard in Silver Spring, Maryland, a suburb of Washington, D.C. There, a group of amateur astronomers have worked out the instruments, system, and techniques to be used for spotting the tiny, elusive space voyagers as they flash overhead at a speed of some 17,000 miles an hour — a velocity that will take them around the earth in about 100 minutes.

Just how do you go about finding a 20-inch metal sphere traveling at that speed, several hundred miles from the surface of the earth?

That's the question the scientists are up against in visually tracking the space satellites of Project Vanguard. There are no precedents to go by. The whole idea of an artificial moon is so unique that no one really knows whether or not the satellites will ever be seen by human eyes.

It is also planned to have them tracked in their orbits by an elaborate radio combination known as Minitrack. A minute transmitter in the satellites, operating on a frequency of 108 megacycles, will transmit continuously at a power of between 10 and 50 milliwatts. But several things are worrying the scientists responsible for the tracking. One is that the satellite transmitters may not function after being blasted up to an orbit by three-stage rockets. The chances of such malfunction may be slight, but with each satellite representing an investment of millions of dollars and many thousands of engineering man-hours, the tracking people cannot afford to put all their eggs in one electronic basket.

Another problem is the fact that the small battery-powered transmitter in each satellite can last only a short time. A satellite may have a "life" of several months before it spirals into the dense lower atmosphere and comes to a fiery end. As it begins to be slowed by atmospheric friction, it will spiral into an unpredictable orbit. Observations of this final orbiting are much needed to determine atmospheric density at heights about which little is now known.

Thus, if the radio transmitters are inoperative, it will be up to the visual observers to find the satellites and make enough accurate observations to establish their orbits. And in any case, when the battery in a satellite transmitter goes dead, visual observation will supplant radio tracking. In the last stages before it spirals to a flaming death, visual observers will be needed to keep track of the satellite's erratic orbital wanderings.

The Smithsonian Astrophysical Observatory, designated as responsible for the optical tracking program by the National Academy of Sciences, is installing 12 powerful telescope-cameras in strategic areas. These are maneuverable, but not nearly maneuverable enough to find a satellite when it is first placed in its orbit. The operators have to know where to point the instruments. The same thing will apply when a satellite is in its final stage.

Here is where the teams of amateur astronomers come into the picture. The Smithsonian Observatory scientists are supplementing the telescope-cameras with "optical fences." These will be located throughout the country at favorable points and manned by the skilled "eye power" of volunteer teams organized by local astronomy groups. In this way the scientists hope to cover the skies along specific meridians where the satellites can be reasonably expected to pass in the United States and in participating foreign countries.

When a committee of amateur astronomers was appointed early in 1956 to develop the volunteer visual observing program of Operation Moonwatch, its members were faced with something that has been all but overlooked in the blizzard of publicity concerning the satellites. The moons are, of course, visible by reflected sunlight. A 20-inch sphere, even though polished to

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John Kane is Assistant Director of Public Relations for the National Society of Professional Engineers but in his free time writes articles on astronomy, a subject that has fascinated him since high school days. For some time he has pursued his astronomical interest with his own four-inch reflector telescope.

mirror-brightness, will, at its closest distance of about 200 miles, appear only as a point of light of the sixth visual magnitude. Experienced star gazers know that this represents the faintest star one can see with the naked eye on a very clear night. As the satellite swings out to the apogee of its orbit, which may be as far as 1500 miles from the earth, it will fade to an object of perhaps the ninth or tenth magnitude. Such a faint object can only be seen with a telescope.

Other Hindrances

Amateur astronomers know that very few nights in a given area offer really good "seeing." Even on cloudless nights, atmospheric haze may be present. This will further dim the appearance of the satellite. Cloud cover can be expected over many places, even in dry summer weather, so this also will limit the opportunities for visual spotting and tracking.

When the space satellite program was announced, many newspapers were headlining stories about how the satellites would be visible at dawn and dusk over their cities. The satellites will be visible, but only to those who are making a definite and well-equipped sky search. The chances of casually looking up and seeing one are about as poor as seeing a man with green hair at 2 P.M. on Tuesday.

The amateur astronomers began their attack on this visual problem by finding a suitable optical instrument. G. R. Wright, chairman of the National Advisory Committee, and his group tested a variety of binoculars, monoculars, army surplus optical systems, and other odd devices, before they decided to design and construct an instrument themselves. Hoy Walls and Robert Dellar, both government engineers, figured the optics for the "satellite spotter" that became the recommended instrument for Moonwatch. It is simply an 8½-inch aluminum pipe with a series of lenses giving a wide-angle view (12½ degrees) at a magnification of 5½ times. To enable the observer to have an overhead view while looking straight ahead, the telescope has a front-surfaced mirror mounted at a 45-degree angle in front of the objective. Any amateur who has ever made a telescope should be able to assemble this device.

Here is the system that has been worked out to date for the observing teams of Moonwatch:

A number of observers, possibly 15 to 20, will be seated along a north-south line, in the center of which is a 25-foot pole with a 10-foot crossbar at the top. Each observer will mount his telescope on the meridian and align it by means of two small lights on the pole. Each observer's view will take in a different, although overlapping, section of the sky.

The exact latitude of the observing station is known, as are the fixed angles of the instruments above the horizon.

For timing the observations, one recommended procedure will employ a tape recorder to pick up short-wave time signals from WWV, the National Bureau of Standards station at Beltsville, Maryland. The recording machine will operate continuously during the entire observing session. Then, when an observer spots the telltale point of light speeding across the sky, he will watch it closely until the instant it passes behind the pole or the crossbar. At the precise moment the satellite crosses the line, the observer will call out a prearranged word signal. This is recorded on the tape along with the WWV time signal. Other timing methods are also being considered.

The leader of the observing team will then send the exact time at which the satellite was seen to cross his station and the angle above the horizon at which it appeared. This information will go to the operators of an electronic computer at the Smithsonian Observatory in Cambridge. The memory system of the computer already "knows" the latitude and longitude of each observing station. It takes in the new data and calculates an orbit for the satellite. Once the orbit is known, the telescope-cameras can be pointed at the proper section of the sky.

As the satellite spirals into its

Science Service

A TABLE-TOP MODEL of the Moonwatch set-up, with astronomers receiving instruction in the background: a scene at the home of G. R. Wright, Chairman of the National Advisory Committee.

final stage, the same visual observations will be used to calculate its ever-changing path. It is from these orbital changes that scientists will get the data concerning atmospheric density.

From this description of Operation Moonwatch, it can be seen that lone-wolf observers can make no contribution to visual satellite tracking. A network of functioning observation stations will be needed. Sighting reports will be accepted only from team leaders who have been carefully screened and selected.

The visual dimness and great speed of the satellite (it will cross the entire United States in about ten minutes) are not the only complicating factors. The satellite's orbital plane, even if unaffected by air resistance, will actually undergo certain changes because of the influence which our planet's equatorial bulge will have on the satellite's path. It will cause the orbital plane to keep swinging around in the direction opposite to that in which the satellite moves, with a period of about 70 days.

This motion of the orbital plane, along with the rotation of the earth and the motion of the earth around the sun, presents a complex geometrical situation. The problem is further complicated by the fact that the satellite can be seen only at dawn or dusk, when it is illuminated by the sun and when the observers are looking up from the darkened earth. The variations in the satellite's orbit and other things having to do with its schedule may prevent a given observing station from seeing it under favorable conditions oftener than two weeks apart.

When a definite orbit has been determined, the observing stations will be kept informed as to when they can expect the satellite to pass overhead.

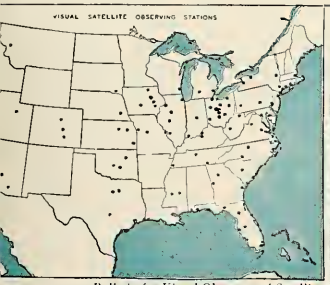
Many Volunteers

G. R. Wright, at whose apple orchard the prototype observing station has been constructed, has received a steady stream of applications from amateur astronomy groups volunteering to join the Moonwatch program. Future applicants are requested to write to: Coordinator of Visual Satellite Observations, 60 Garden St., Cambridge 38, Mass.

"Practice" observing sessions with aircraft will be held, but there won't be any satellites to practice on until the first one is sent up some time in 1957 or 1958. By then, the observing teams will be expected to make "real McCoy" sightings.

Dr. J. A. Hynek, associate director of the Smithsonian's satellite-tracking program, is depending on his "optical fences" to make the first and last visual observations of the satellites. "The amateur astronomer teams of Operation Moonwatch may well be the backbone of the visual tracking assignment," he points out.

The whole satellite project is full of uncertainties. But one of the certainties is that a lot of skilled observers from the ranks of the country's amateur astronomers will be giving nearby outer space a concentrated scrutiny during 1957. They feel it's worth many hours of sky watching to help spot and track the first man-made moons in this planet's several-billion-year history.



Bulletin for Visual Observers of Satellites

▲ THE DOTS show the locations of almost 100 stations that are expected to take part in the first Moonwatch alert.

▼ MISS MARTHA L. HOLT of the Smithsonian Astrophysical Observatory staff shows how the observer will look down to see up. A mirror does it.

American Export Lines

▲ REMNANTS of the once plentiful tree are preserved in a national park near the village of Becharre, 84 miles north of Beirut, in the Lebanon Mountains. Note the size of the trees as compared with the horse in the distance.

Where are the Cedars of Lebanon?

History's celebrated tree is being protected and cultivated in various parts of the world

By PHILIP FERRY

LEBANON is a nation with a background of history that spans all the classical epochs of recorded time. It has known conquerors and invaders from the Phoenicians to Napoleon's legions and from the armies of Europe during the two world wars to the present Arab-Israeli crisis.

The Cedars of Lebanon (*Cedrus libani*), the country's national tree, reflects this continued process of invasion and destruction. Cedars of Lebanon National Park is an easy three-hour drive from Beirut, the capital of Lebanon. The route follows the shore of the Mediterranean, or the Phoenician coast as the Lebanese call it, for most of the way until the road begins its climb to the uplands of the park. The country is rocky and bare; in places the landscape for miles around is so covered with rocks that the ground is hardly visible.

The route climbs steadily upward until it reaches an altitude of about 6500 feet at Les Cedres (the park site is still called by its French name). The Cedars hotel is set in a high semi-circular ridge. Refreshments are provided for visitors. The setting together with the altitude makes the Cedars a favorite summer resort area, while in winter it is equally popular with skiers.

Here at Les Cedres is the protected remnant of the historic Cedars of Lebanon, possibly the most celebrated trees of all time—a single grove totaling only a few hundred trees. There are several smaller groups in Lebanon, and—as is not generally known — a much larger one exists in Turkey some 370 miles northwest of Beirut. It is in the Taurus Mountains at Katran dagi, south of Elmali. Unfortunately, this

stand is being gradually destroyed by lumbering, as all the more southerly ones have been through the ages.

The ancients called the Cedar of Lebanon the "Tree of God," because the wood went into the roof beams of all the celebrated temples of Egypt, Sidon, Tyre, and Baalbeek. Solomon's Temple, begun in the tenth century before Christ, was roofed with cedar from Lebanon. When this edifice was destroyed by Nebuchadnezzar some five centuries later, another temple was built on the spot and likewise roofed with cedar. The Ark of the Covenant, most sacred of Hebrew reliquaries, is thought to have been constructed of cedar from Lebanon. The ancient Egyptian solar boats recently unearthed near the great pyramid of Giza, which were supposedly constructed about 2800 B.C., are of Lebanon cedar. One can still see in the Dome of the Rock in Jerusalem grille work of Lebanon cedar overlaid with gold leaf. Jordan today, as in Solomon's time, is practically treeless and must import its wood. Most of it now comes from Europe and none from Lebanon. The few surviving trees at Les Cedres are a rigidly protected national treasure.

It is sad to see the pitifully small stand of cedars remaining in their native habitat. The grove contains between 350 and 450 trees. There is a myth current that some of them are 6000 years old, but tree experts will be greatly surprised if anything like this age is ever proved. The tree is so revered by the Lebanese that it is the official symbol of the nation and appears on everything from the flag and military uniforms to postage stamps.

The Phoenicians are blamed for decimating the cedar forests, which once covered much of Lebanon. Although the Arabs and Turks, who ruled the country for 350 years, contributed to the destruction, the enterprising Phoenicians floated cedar logs down the Litani (or Leontes of the ancients), which empties into the sea between Sidon and Tyre. Here the logs were loaded on vessels and shipped to Jaffa, then transported to Jerusalem, where they went into the great temples.

Today, centuries too late, this traffic in Lebanon's most celebrated natural resource is prohibited by national law, and efforts are being made to propagate the trees from seed. The tree is already growing in cultivation in quite a few places in Europe and North America. I was encouraged to see in the Jardin des Plantes, the botanical garden in Paris, a 220-year-old Lebanon cedar with a diameter of eight feet and a height greater than any I saw in Lebanon. England has specimens in various old parks and botanical gardens. Here in America we have one in Kissena Park, Flushing, Long Island. And there is a plan to plant the cedar of Lebanon in the Beth Israel Memorial Park in Woodbridge, N. J., in the section devoted to Bible Gardens of Israel.

Actually, growers are said to have developed three horticultural varieties of the tree, differing in form and leaf. The Cedar of Lebanon is closely related to the Atlas Cedar (*C. atlantica*) from northern Africa, which is far more common in cultivation, as well as to the Deodar Cedar (*C. deodara*) of the Himalaya and the Cyprus Cedar (*C. brevifolia*) from Cyprus. All three, in fact, are sometimes regarded as varieties of it.

The Cedar of Lebanon is said to be hardy as far north as the zone where average annual minimum temperature ranges from minus 5° to minus 10° F. This zone extends in an irregular belt from Massachusetts and Connecticut through parts of Pennsylvania and Ohio, southern Indiana, Illinois and Missouri, eastern Kansas, northern Oklahoma and New Mexico, parts of Utah and Nevada, western Oregon and Washington, and even into British Columbia and coastal Alaska.

Arab Information Center

▲ THE CEDAR OF LEBANON thrives where the winters are cold, and near the Cedars of Lebanon National Park are the best ski slopes in Lebanon. Other attractions in the vicinity are the beautiful grotto of Kadisha and the museum of the renowned Lebanese author, Jebran Khalil Jebran.

A helping ha

THE current outburst of national concern over the plight of the whooping crane represents something new in the field of conservation in this country. Never before has such widespread anxiety been displayed as a species makes its final struggle against extinction. Never have so many Americans devoted so much effort, time, and money toward saving a wild creature from oblivion.

At each migration time an astonishing amount of attention is focused on this little band of big birds. Persons who would have a hard time distinguishing a whooping crane from a pelican demand to know the latest developments. Pelicans, snow geese, American egrets—almost any largish, white birds—have been reported as whoopers by eager amateurs. This brings headaches to the authorities checking migration reports, but it is also a healthy indication of the deep feelings aroused over America's tallest bird.

Everybody wants to know the score. Each fall they ask, "How many whoopers came back?" At last reports, the population was twenty-three wild whooping cranes and three crippled captives. Partly as a

the Whooping Crane

Unprecedented public and scientific interest rallies to preserve North America's tallest, rarest, and most imposing bird

By John O'Reilly
Drawings by Matthew Kalmenoff

result of popular concern, the governments of both the United States and Canada are making special efforts to preserve the cranes; organizations ranging from the National Audubon Society to gun clubs are taking part; industrial companies have helped; and individuals have worked harder than could be expected.

Why should the whooping crane, a bird comparatively few Americans have even seen, elicit such deep emotion? No such general solicitude has been associated with any other struggling species. When the last passenger pigeon died in the Cincinnati Zoo in 1914, its passing was not marked by any great public outcry. Before the last heath hen disappeared on Martha's Vineyard in 1933, there had been no national effort to save the race. Even the campaign to save the buffalo met with general apathy, particularly in some of the western states whose history was closely linked with this mighty mammal. Leaders in the drive were hard put to raise $10,000 to save this emblem of the West.

Yet public sentiment over *Grus americana*, the whooping crane, is now so strong that individuals, corporations and branches of the government exercise extreme caution lest any of their activities affect the well-being of this handful of birds.

This is not something that sprang up overnight; yet its growth has been comparatively rapid. During the last ten years, more and more individuals have learned about the whooper and its struggle and have come to take a personal interest in the outcome. An examination of the recent history of the whooping cranes and the efforts to perpetuate the species throws light on this phenomenon.

In the first place there is the distinctiveness of the bird itself. The whooping crane is a creature of natural dignity, a bird that commands respect more than affection. Standing more than five feet tall, it looks upon its world with a yellow eye that is cold and aloof. Its dignity is heightened by it formal plumage, pure white except for the black wing-tips.

The whooping crane demands plenty of living space. Originally it was a bird of the great plains, although fragmentary records indicate that it sometimes wandered to the eastern seaboard. Even on its present wintering grounds in the coastal marshes of Texas, each family maintains a territory of 400 acres or more. It is among the wariest of birds, and lucky is the observer who gets within half a mile of one of them. On the ground it walks with great strides, and in the air it has the characteristic flight of the crane family: a slow downbeat of the great wings and a quick upbeat.

The dignified reserve of the bird, its wariness, and its wide migration range have impressed all naturalists and writers who have seen it. Through them, the whooping crane has become identified with the great open spaces of America, a bird that typifies the wide sweep of the prairies before they became wheat fields. And, as such, it has become the symbol of wildlife conservation in America.

In the present upsurge of interest, an impression has spread that whooping cranes were once so numerous that they darkened the skies. This is not true. According to Robert P. Allen, research ornithologist of the National Audubon Society, who has studied the whooping crane more intensively than any other man, their total population was probably not more than 1,500 before their decline started around 1870. The species apparently reached its

John O'Reilly is nationally known as a nature writer and takes an active interest in exploratory research and museum science.

Allan D. Cruickshank, National Audubon Society

◄ So close to extinction is the whooping crane that special watchtowers were built on the Aransas Refuge in Texas, where the cranes are protected, counted, and observed during the winter.

► THE BIRD that arouses so much concern stands nearly 5 feet tall and has a wingspread of 7½ feet. It has a fierce, untamed nature. The female is similar in appearance to the male but is slightly smaller and more gentle.

peak during the glacial epoch known as the Pleistocene. But as far as recent times are concerned, this country, even before the white man, could not have supported myriads. There just wasn't enough land for birds demanding so much territory.

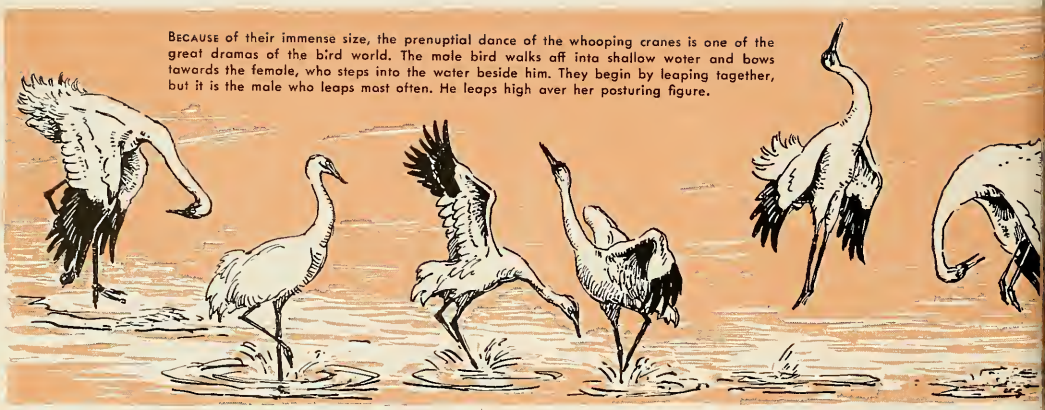
With the coming of the white man, the whooping cranes retreated before the plough and the gun. As in the case of other threatened species, there were premature announcements of its demise. The whoopers were declared extinct as early as 1923, and there were frequent pronouncements that *Grus americana* was on the point of going under. As far as the general public was concerned, these declarations were of little moment, for even 15 or 20 years ago most Americans had never heard of the whooping crane.

The first step in bringing this impressive creature to national attention was the creation of the Aransas National Wildlife Refuge down on the Texas coast in 1937. People often ask the question, "How do those whooping cranes know enough to go straight to that 47,000-acre refuge to spend the winter?" The fact, of course, is that a small, wintering group of whooping cranes had been using that tract for many generations. That was one of the reasons why it was selected as a refuge by the United States Fish and Wildlife Service, then known as the Biological Survey and headed by Dr. Ira N. Gabrielson.

In the 16 years during which the whooping cranes have been carefully counted, the migrating flock has fluctuated between an alarming low of 15 individuals and a high of 34. But during that time a great many things have happened. Here are some of the highlights.

At the time the refuge was established, little was known about the few remaining migrants except that they passed their winters on the bleak marshes and went north each spring. No exhaustive study of their life history had been made. The next important step came in 1945 with the setting up of the Whooping Crane Project. This was a joint effort on the part of the United States Fish and Wildlife Service, the Canadian Wildlife Service, and the National Audubon Society. Beginning as a research project to establish the status and life history of the whoopers, it has since been broadened into an international campaign to perpetuate the species.

An important decision early in



BECAUSE of their immense size, the prenuptial dance of the whooping cranes is one of the great dramas of the bird world. The male bird walks off into shallow water and bows towards the female, who steps into the water beside him. They begin by leaping together, but it is the male who leaps most often. He leaps high over her posturing figure.

Allen D. Cruickshank, National Audubon Society

the project was the selection of Bob Allen to do the basic research, to solve the mysteries of their habits and their migration. Allen is not only a tireless and dedicated worker when a bird species is threatened, but he creates interest and goodwill wherever he goes. His cause becomes the cause of the local people. He hadn't been working very long on the Aransas Refuge before the whole community was crane conscious. Even the boys who hung out at the local beer parlor in the village of Austwell, Texas, formed the Austwell Science Club and sat around each night discussing whooping crane problems. Later, when I joined Allen at Fort Smith, in Canada's Northwest Territories, I found the local citizenry there had also been infected with Allen's enthusiasm for the whoopers.

After Robert Porter Allen, National Audubon Society

Charles A. Keefer, U.S. Fish and Wildlife Service

↑ THE BIRTH of young whoopers is of great moment. The downy chick is cinnamon and russet-brown on the back and grayish buff beneath, but in adulthood both sexes are predominantly white.

Allen studied the cranes intensively for three years, and his work on the species has been carried on intermittently for ten years. On the windswept marshes of the Aransas Refuge he led a lonely and uncomfortable existence as he studied the winter habits of the wary birds. It was a life of camping out in raw weather, tramping the open marshes, and sitting in a blind for weeks on end. Weeks turned into months before even one crane family would come close enough to the blind for good observation.

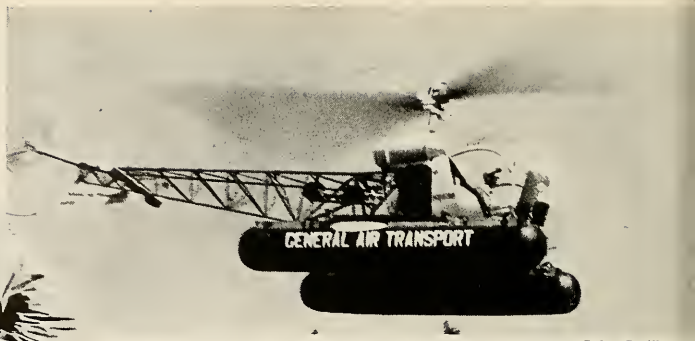
Among the many hindrances to his prying into the home life of the cranes were the raccoons that roamed the wide marshes. While sitting silent and still in his blind, he would see a small pair of hands reach in and part the curtain. A black-masked face with bright eyes would appear in the opening and stare at him. Any movement might disturb the cranes so all Allen could do was say in a gritty whisper, "Get outa' here, you bum."

Having shared the winter life of the cranes, Allen planned to migrate north with them in the spring. Elaborate arrangements were made in advance. There had been numerous reports in previous years of whoopers near North Platte, Nebraska. Radio stations and newspapers had been asked to co-operate and did so willingly by broadcasting and publishing descriptions of the cranes and requests that they be reported when seen.

Allen saw the cranes off in Texas.

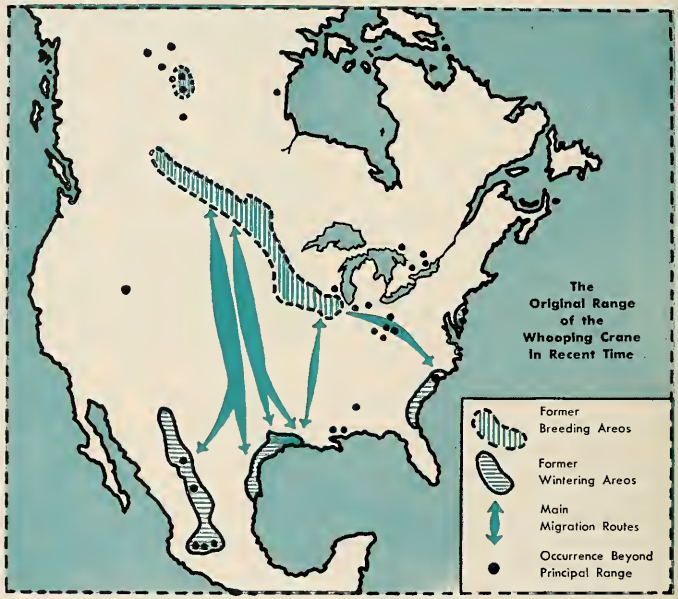
Robert E. Stewart

↑ IF THE WHOOPING CRANE survives, thanks will be due Robert P. Allen, Ornithologist of the National Audubon Society, shown above at right with colleague Ray Stewart.



Robert P. Allen

↑ ALL MEANS are used to locate the few remaining wild whoopers. Helicopters are employed to seek them out and count them during their summer nesting season in the Canadian wilderness.



After Robert Porter Allen, National Audubon Society

Then he traveled 800 miles north by plane to await their arrival on the Platte River, which has since been established as one of their favorite stopping places on the way north. He arrived to find that the whole community had joined the Whooping Crane Project.

"ALLEN ARRIVES; CRANES STILL IN TEXAS," announced the local newspaper in big headlines. That was ten years ago and marked the beginning of the big wave of public interest. Everybody was on the alert. It was a farmer who reported the first cranes, and Allen hurried out in a small plane to see five whoopers. There was no doubt that this was part of his migrating flock, for he was able to recognize one young bird he had seen in Texas only a few weeks before.

But there he lost track of them. The great birds, as usual, disappeared into the north, heading for their nesting grounds which, up to that time, had not been found. But by that time many Americans, not just a small group of ornithologists, were keen to know where they went.

Another milestone for the Whooping Crane Project and for the public was the arrival of Rusty, the first whooping crane ever hatched in captivity. The Gothenberg Gun Club, of Gothenberg, Nebraska, had a male whooping crane which had been found wounded by gunshot in 1936 and which they had kept in a pen. The club members voted to turn their rare bird, which they called Old Devil, over to the project for a breeding experiment. Old Devil, already a captive for twelve years, proved too old to breed and died the next year. Another cripple, a large male, which also had been shot in the wing and could not migrate from the Aransas Refuge, was captured and placed in the pen. He had been named Crip, and the female was called Josephine.

This mating was more successful. The cranes built a nest, a single egg was laid, and on May 24, 1950, Rusty entered the world amid more fanfare than had ever been attached to the hatching of a single bird. Julian Howard, the refuge manager at that time, established a round-the-clock guard. Allen and other ornithologists were on constant watch from a tower 1,200 feet from the

nest. But on the fourth day Rusty, already spry and wandering some distance from the nest, disappeared in the reeds. A search failed to disclose any trace, and the chick was believed to have been taken by some predator, possibly a raccoon.

Meanwhile each passage of the migrating cranes brought greater public interest, not only along their flyway but over the entire country. More appeals for their protection were broadcast; state conservation magazines published drawings of the bird and warnings not to shoot it. Thousands of persons mailed descriptive postcards to friends living in the states through which the birds would pass. Concern for the survival of the cranes spread in Canada as it had south of the border.

Canadian interest was great because the migrants were known to penetrate the northern wilderness each spring, returning each fall with their young. Allen and Bob Smith, flyway biologist of the U. S. Fish and Wildlife Service, combed the north country by plane, flying a total of 14,272 miles—without sighting the cranes. But, as usual, the flock returned to Texas with their offspring. Other experts joined the aerial search, but the results were the same.

Then, in 1954, G. M. Wilson, a Canadian forestry superintendent, and Don Landells, helicopter pilot, sighted a young whooper with its parents while the men were flying in their helicopter over Wood Buffalo Park, a vast wilderness south of Great Slave Lake. The sighting of a fledgling whooper in the north in summer led the partners in the Whooping Crane Project to set up an intensive search for the nesting grounds in 1955.

William A. Fuller, biologist of the Canadian Wildlife Service, and Edward Wellien and Wesley Newcomb, of the U. S. Fish and Wildlife Service, spotted three whooping crane nests from a plane on May 18, 1955. An expedition to reach the area on the ground and study the nesting habitat of the cranes was already on the point of starting north. It included Allen, Raymond Stewart of the Canadian service, and Robert E. Stewart of the U. S. service.

These three fought millions of mosquitoes and assorted biting flies, log jams on the rivers, and other obstacles for a month, without reaching the nesting grounds. Bob Stewart then went back to Washington. A helicopter dropped Allen and Ray Stewart into the vast swamps again, and this time the search proved successful. Although by this time the young had left the nests, the men collected specimens of the snails, frogs, and other animal life composing the bird's summer diet and made notes on all things related to the life of the whoopers in the north.

I met them when they emerged from the wildnerness onto the Slave River. They were bearded, tired, and mosquito-bitten, but happy. The nesting ground of the last remaining whooping cranes was no longer a mystery. I got a better idea of what they had been through when, a few days later, we flew out over that formidable country in a small plane.

Below us was an endless tangle of small ponds, twisting sloughs, and reedy marshes. As we flew over the ponds, too small for landing even a light plane, we came upon a circular one with an island in the center. On the island was a whooping crane family, the white parents and a pair of rusty young. In the next pond a moose plodded through the shallow water, and on the other side was the bed of a dry pond across which scampered a black bear and her two cubs.

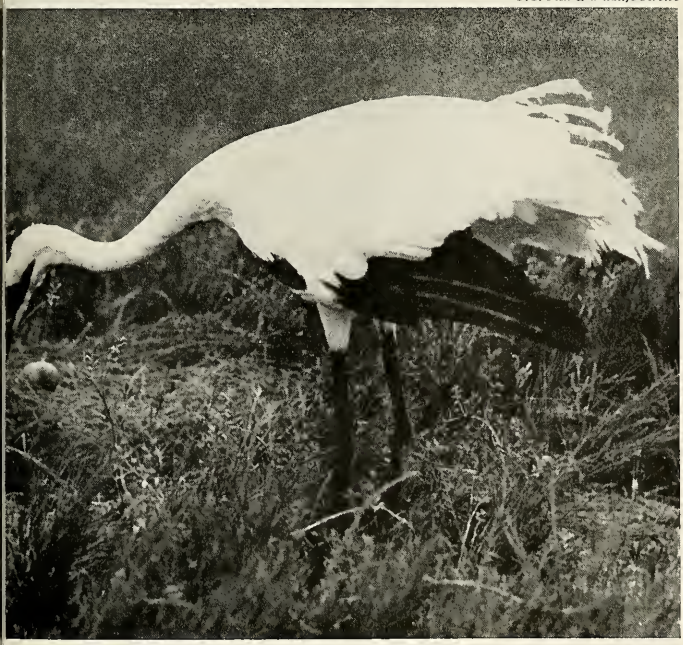
The picture of the crane family in that rugged wildnerness with the bears and the moose so close to them was an exciting one, but it became more so when Allen and I realized that these two adult cranes were the same birds we had seen on the Texas marshes 2,400 miles away.

The discovery of the nesting grounds was another milestone in the growth of international interest

continued on page 163

Josephine, mother of the first whooping crane born in captivity. The event ok place at the Aransas Refuge on May 25, 1950, but "Rusty" only survived ree days. It was thought that raccoons made away with him during the night.

U. S. Fish & Wildlife Service



↑ One of the whales emerges for air, while others churn the water in the background.

Pat-the-Whale Club

A strange qualification is necessary for membership in Antarctica's most exclusive fraternity

MEMBERS of a British research party based on Graham Land in the antarctic have formed an association whose membership is not likely to increase much beyond its present figure. Known as the "Pat-the-Whale Club," it has only eight members, each of which has touched the snout of a rorqual whale coming up for air. All members have qualified in a small pool in the center of the frozen Crown Prince Gustav Channel between James Ross Island and the Graham Land Peninsula.

Never before had whales been known to appear in such small pools cut off from the open sea. It is believed that they stayed too long in the channel and became trapped when the winter reached its peak. The continued threshing about of the whales kept the water from freezing over and allowed the whales to emerge for the needed air.

The men who discovered the whales were on their way back from setting up weather stations on the east coast of Graham Land.

British Information Services photos Cameras Press, London

↑ Meteorologist A. F. Lewis, about to gain admission to the club.

↑ No casualties have yet been suffered.

↓ Several whales appear at once to make possible the oddest initiation ceremony in the world.

▲ In the Pennsylvania woods near her home, Christine enjoys the leaves of black walnut, dogwood, sassafras, oak, maple, and hickory, – in that order.

She not only climbs trees but swings from one to another with ease.

A *Chimp* IN THE WOODS

Christine behaves like any well-trained chimpanzee at home, but in the woods the burden of civilization falls away from her

By Lilo Hess

MANY stories and pictures of the activities of chimpanzees have been published. There are well-trained chimps that play tennis and ride motor bikes. There are also chimps like my pet, Christine, who do not know any stunts or tricks but are used to living like a child, eating with spoons, playing with dolls and balls, and handling certain tools quite well.

"But how does a chimp occupy its time in nature?" I have often been asked.

Well, Christine at five years is still 100 per cent chimpanzee, with no trace of the burden of civilization on her.

Her favorite sports are climbing and jumping. She can climb any tree that she can span with her arms. Bracing her feet firmly against the trunk, she "runs" up it very fast. She usually swings from the branches by one hand, but she is also capable of swinging vigorously suspended by just one finger or one foot. Either her judgment of branches is very poor or she does it on purpose, but she often swings from dead ones and consequently comes crashing down with a thud. She hardly ever hurts herself.

She is extremely destructive in the woods, and I can well imagine that a large group of chimps romping in the jungle could destroy a number of trees in a short time. It is not so much the eating of leaves or the breaking of branches that does the damage; it is her habit of stripping the bark from the smaller trees. She will eat quite a bit of the bark, but mostly she throws it away. It seems to amuse her to get long strips, and she sometimes drapes them around herself like a shawl.

Here in the Pennsylvania woods, she prefers to eat the leaves of black walnut, dogwood, sassafras, oak, maple, and hickory in that order. She also likes ferns and some flowering grasses and eats almost

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Lilo Hess specializes in animal photography. Her work has appeared in *Life* and many other national magazines.

Miss Hess often makes pets of her subjects. Her 10-acre Pennsylvania farm has been the home of an anteater, an armadillo, a chimpanzee, a coati, a kangaroo, and a tame bat named Oscar, who slept on the curtains and came flying down to rest on her finger when called.

▲ Tent caterpillars fascinate the chimp and she never tires of watching them or poking at their nest. But she is always very careful not to get her fingers too deeply into the web.

▼ When she is sure it is safe, she puts her hand inside hollow logs and pulls out the soil and leaves, examining and smelling everything carefully. Hollow logs and holes in the ground have always intrigued her.

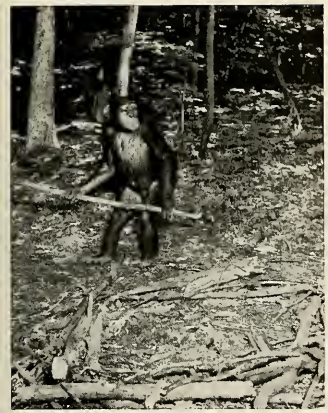
➤ If nothing else is at hand, Christine amuses herself by arranging sticks in the ground. She prefers a patch of moss, as at right, but soft earth will do.

all the young shoots, even pine and spruce. The flowers of dogwood are a favorite, and no garden flowers are safe. Christine will eat all the berries and fruits regardless of whether they are ripe. To my dismay she also eats all mushrooms. The brighter red or yellow they are, the better she likes them. I don't know whether she is exercising some discrimination or whether chance has spared her any adverse effects. I suppose it is barely conceivable that she can eat things we can't.

When she was three years old she seemed to be mildly interested in insects and would occasionally eat a grasshopper or butterfly, but in the last two years she has shown no interest in them. This might be because she eats a certain amount of meat at home.

Jumping is Christine's main pastime in the woods. There are days when this kind of activity seems to be a necessity with her. She can leap about fifteen feet across from one tree to another and will jump sideways, backward, straight down, across, and sometimes upward. She pushes herself off with her feet and spreads out her arms. Falls don't seem to discourage her. She will run up a tree, jump down, and repeat it over and over again on the same tree until she is exhausted.

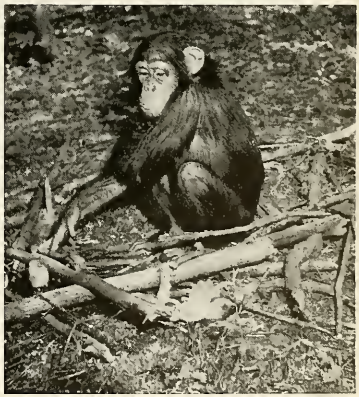
She is an inquisitive animal and has sharp eyes. She can spot small objects or animals and insects quickly. This year tent caterpillars were abundant, and Christine never tired of watching them or



ANOTHER "GAME" may be a kind of nest building. To make her "nest" she sits on the ground and arranges the sticks all around her. When finished, she sits in it for a time but soon moves on to something else. Only the actual building seems to interest her.

poking at their nest. But she was always very careful not to get her finger too deeply into the web. She has shown caution with all things unfamiliar to her since she was a tiny baby. Hollow logs and holes in the ground have always fascinated her, but she would never put her hand into one before she had tested it with a stick. When she is sure that it is safe, she puts her hand inside and pulls out the soil and leaves, examining and smelling everything carefully. Unfortunately, there is no way of knowing to what conclusions she comes, if any.

When there is nothing new to investigate in a certain area, she



▼ CHRISTINE will test a stream or pond with one foot, and if it is not too cold, she will soak her feet in it.

(*Above and right*) SHE POUNCES on a turtle with a cry of joy. She always "kisses" it, smells it, and puts it to her ear, for sometimes they make a hissing sound. Often she carries a turtle around with her for a while before letting it go.

starts to play with objects at hand. There are two pastimes that have preference. One is putting sticks into the ground, and for this she needs soft earth or if she can find it, a patch of moss. First she gathers a handful of small twigs and lays them down. Then, sitting down, she starts to stick them into the ground. There seems to be no definite pattern, but usually they are arranged in a sort of semicircle. She can amuse herself a long while with it, pulling the sticks out and rearranging them again.

The other "game" is a sort of nest building, though I hesitate to use the term, because she has never once tried to build a nest in a tree out of branches, as is supposed to be the habit of chimpanzees. She will gather fallen sticks and arrange them in a rough circle. She does not take every stick she finds, but is very selective, though what makes a "good stick" I cannot see. She carries them, walking upright, often from a distance of fifteen feet or more, even when others are closer. To make her "nest" she sits on the ground arranging the sticks all around her, often using her feet as well as her hands. When the "nest" is finished, she does not seem to enjoy it much. She sits in it for a time, chewing on some of the wood, but soon moves on to something else. (She also makes similar nests out of her toys and blankets in the house.) She might return the following day to her nest to sit in it or add a few more sticks, but it seems clear that only the act of building is of interest to her.

Whenever Christine finds a little stream or pond on our walks through the woods, she has to stop to play there. She pokes the bottom with a stick and is interested if any frogs or fish are stirred up. She will also test the water cautiously with one foot, and if it is not too cold, she will soak her feet in it. She may even wade if the temperature is right.

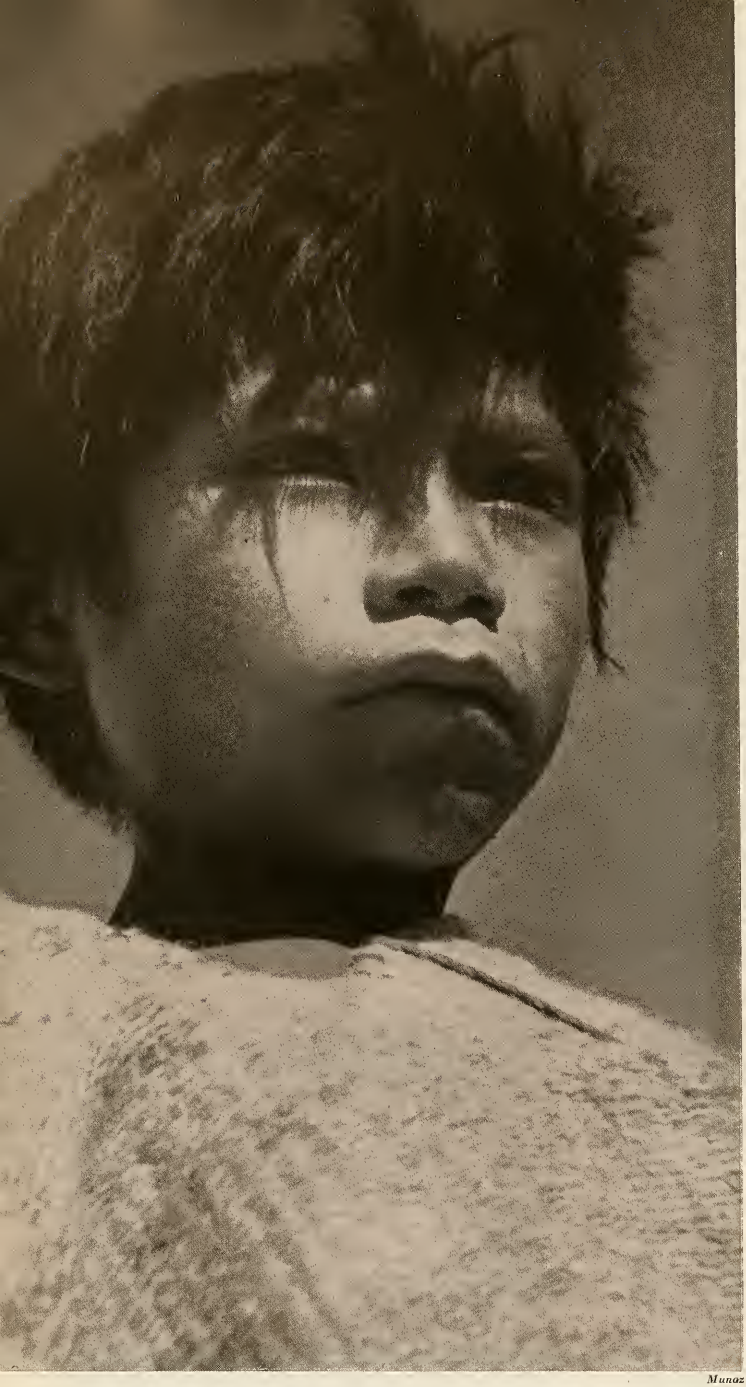
Sometimes Christine is lucky enough to find a turtle. She can spot one right away and pounces on it with a cry of joy. She always "kisses" the turtle, smells it, and puts it to her ear, because they sometimes make a hissing sound. Often she carries a turtle around with her for a while before letting it go.

Usually Christine gallops through the woods on all fours, but she sometimes stands erect and shuffles forward like a tired old man. As a matter of fact, she tires very quickly, for at the beginning her play is wild and active, and in an hour-and-a-half she is worn out. Then she will begin sitting quietly, twiddling a couple of stones in her hands, just watching me. Soon she may pick up an armful of dry grass or pine needles and rock back and forth. If I make no motion to go, she starts examining herself for insect bites or bruises, crying softly. If that does not bring results, she makes somersaults to attract my attention. If all this is ignored she sits down and screams loudly *hoo-hoo-hoo,* until I take her back to civilization.

Readers will find earlier views of Christine in NATURAL HISTORY for September-1953, October-1953, and December-1955.

↑ When Christine wants to go home, she may pick up an armful of dry grass or pine needles and rock back and forth.

↑ As a final indication that she wants to go home, Christine turns somersaults. If all else fails, she sits down and screams.



Munoz

↑ As an Otomi, this lad belongs to one of the oldest ethnic groups in Mexico. Yet these people have the simplest culture, the most meager history, and are virtually untouched by civilization. Most children die before the age of twelve, with pneumonia and intestinal diseases the leading causes.

Peopl

By
W. J. Granberg
with
Maurilio Munoz,
Anthropologist,
Patrimonio Indigena del Valle del Mezquital

DRIVING southward toward Mexico City along the Pan-American Highway, the tourist at one point will pass through country where the oldest ethnic group of Mexico lives at the same submarginal level of existence as did their forebears 600 years ago. Historically a nomadic people, the "archers of the birds," as these Otomies were called, have made only sporadic moves to congregate in villages. In the mountains and deserts of the Mezquital Valley, their hovels are hidden in the midst of cactus and scrubby trees, their thatched roofs blending with the landscape and making them as difficult to find as water.

The people themselves are more conspicuous and easily identified. If while driving through the Mezquital you should see a man, woman, or child trudging along the highway with a mass of whitish fiber over the shoulder, that will be an Otomi. He will be twirling a *malacate*, a long, slim wooden spindle, on which he is spinning *ixtle*, which looks like the hair of a blonde woman. He may be wearing a serape, which, if he is from the mountain region, will have been woven for him by his wife. The woman beside him will have a sling of cloth over her shoulder, an *ayate*, in which she may be carrying firewood, charcoal, or even a baby. If the Otomi is thirsty, and he often is, he will probably be thinking of pulque, not water, for this beverage, made from the juice of the maguey,

f the Maguey

Throngs of motorists drive through their territory en route to Mexico City, yet 20,000 of the Otomies know no language except their own, and almost nothing has been written about them in English

or century plant, is the only drink available over large parts of his territory.

The whitish fiber he is spinning and the thatched roof of his hut also come from the maguey, which provides him with food, clothing, and shelter and therefore represents life itself to him.

The hub of his world is Ixmiquilpan, 100 miles north of Mexico City. There are a few stragglers in the states of San Luis Potosí, Querétaro, Tlaxcala, Puebla, and Mexico, but most Otomies live in the state of Hidalgo. They number about 65,000, and virtually all of them live in hovels of sticks, stones, and cactus. Within hailing distance of the Pan-American Highway, you will see their huts at various points, thatched with dried maguey leaves and having walls of sticks, stones, or organ cactus. Oddly enough, the interiors of the huts and the yards are usually neat, swept clean with brushes of twigs. The scarcity of possessions prevents litter from becoming a problem.

When an Otomi greets you, his handshake is as light as the flutter of a bird's wing. His courtesy is deep and genuine for those he

Granberg

↑ Desperate scarcity of water makes the aguamiel, or honey water, of the maguey vital to survival. A collection basin is hollowed out of the base of the plant, and the fluid is sucked up from it. The gourd, when full, is emptied into the jug at right.

W. J. Granberg and his wife directed a work camp in the Otomi country sponsored by the American Friends Service Committee (Quakers). It was six months before he was able to get one photograph of the people and eight months before he could enter one of their homes. Maurilio Munoz is an Otomi himself and a graduate anthropologist.

Granberg

▲ So that his parents will have *ixtle* for the day's weaving, this boy is flaying a maguey leaf to separate the fiber from the pulp. Boys in the Mezquital know all the chores of manhood before they are ten.

Granberg

▲ The whole family spins *ixtle*. It is used for weaving cloths in which to carry everything from a baby to a pigskin of pulque. The boy is feeding the spindle in his right hand from the wad of fiber on his shoulder.

knows, but the Otomi is not at all hospitable to strangers, even today. As recently as 1952, strangers entering the village of Mejay were unceremoniously fired upon and killed by the villagers. By the same token, they are reluctant to change their ancient ways. In the winter of 1956, when a mother was urged by an American to have her baby treated by a government doctor rather than by the medicine man, she grew irate and threw stones at the visitor.

An old myth among the Otomies relates how they came from southern waters and landed near what is now Tampico on the Gulf of Mexico. However that may be, authorities believe they reached the Valley of Mexico from the Gulf region. Some credence is given the theory that the Otomies moved into Mexico from South America, but their distant ancestors presumably reached America from Asia via the Bering Sea.

Until about 1350, before the Spanish Conquest, the Otomies lived on the east shore and islands of Lake Xaltocan, near the present site of Mexico City. With waterfowl on the lake and deer in the mountains, they had a good life there until the Tepanecs on one side and the Texcocans on the other began to fight. It was plain that the Otomies were going to get squeezed no matter who won. They chose flight to the Mezquital Valley, a forlorn land. Many of them perished before they could adapt themselves to its limited resources.

The Aztecs had called them "stupid" and enslaved as many as they could as bearers of arms and food in war. The historian William Pres-

cott called them an "untamed race," a "rude nation of warriors." For lack of a more definite classification, early writers bracketed the Otomies with six other ethnic groups as comprising the Chichimec culture, a designation meaning literally "sons of dogs" and bespeaking the unkind opinion that the Aztecs had of them.

Even to nomads, the parched Valley of the Mezquital must have seemed miserly, and the newcomers took to caves at first. One known cavern is a succession of subterranean chambers large enough to hold about all the Otomies in the Mezquital today. It is called Las Grutas and would excite any speliological enthusiast. It is located 3½ miles from the Pan-American Highway, east of the village of Lagunilla. Otomi children living near by know these caverns as the storied home of their forefathers.

The Spanish Conquest

In the early days, the Otomies made sporadic efforts to form villages, such as Chalma, Xillotepec, and Ocuilan, but these were short-lived. At the present site of Querétaro, however, the Otomies did establish a settlement that prospered until the Spaniards conquered it in 1531. This calamity caused the Otomies to take to the desert and mountains, never again to form a real village. Eleven years earlier, the few Otomies still left in the Valley of Mexico at Teocalhueyacan had given food and shelter to Cortes. Now they were committed to a life of isolation in the desert. Thanks to the maguey, they have survived in a region where human existence often approaches the animal level.

That some of their communities are able to survive with no water at all makes them one of the most extreme examples in human survival. *No water.* Say it slowly; say it 1,000 times 1,000, and you yet cannot come to know what the lack of water means. No water to drink, none for coffee, for soup, for shaving, washing—no water for anything at all. This is the unhappy fate of many of the Otomies most of the year, if not all of the time. Fortunately, the Otomi needs but little water for cooking, just enough for soaking a few handfuls of corn now and then. No water is expended on washing either the person or clothing, save by those who live near a river or spring.

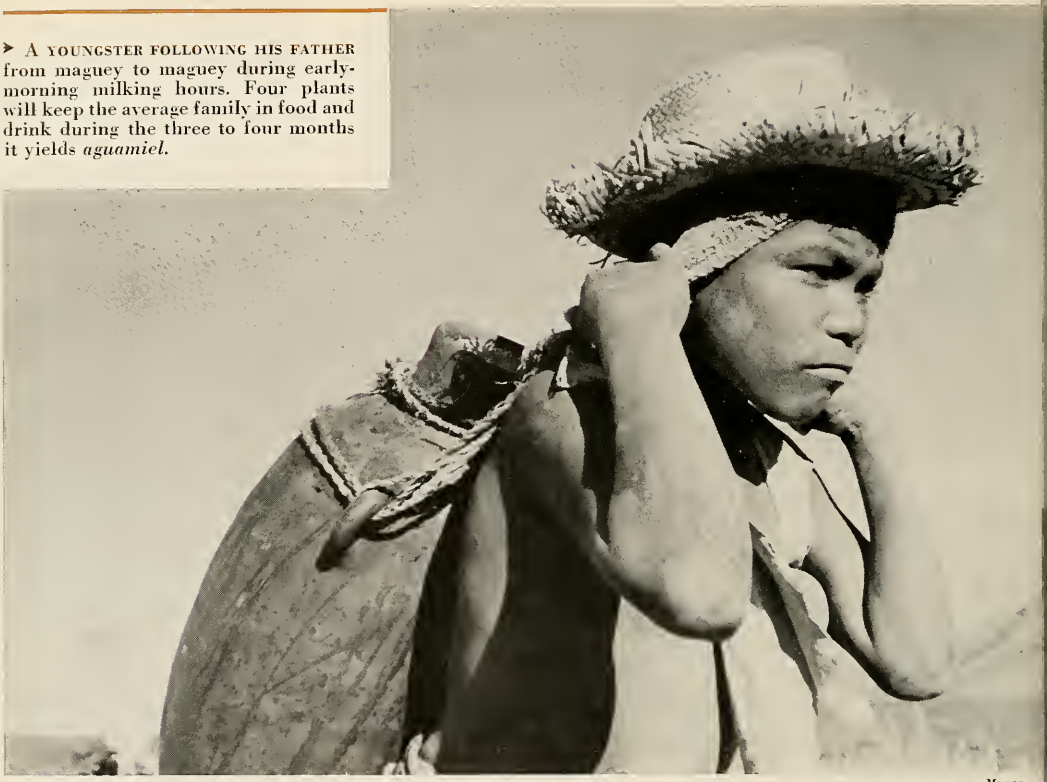
Instead of water, there is *aguamiel,* the clear, tasty liquid yielded by the maguey. It sours within a day or two, but before this calamity can occur, the "honey water" is converted into pulque. This beverage is "water" as well as food for everyone from babies, who know no milk from cows or goats, to the aged.

When a maguey is first tapped for its life-supporting fluid, a hole is punched in the base of the trunk, deep within the cluster of huge pointed leaves that grow as long as six feet. A steel bar is used, and the wound causes the liquid to flow. An iron spoon is used to hollow out a cavity in the plant in which the fluid collects. At intervals, the juice is collected in a gourd, then transferred to a pottery jug carried on the "milker's" back. The mature plant is tapped twice daily, and its yield continues for three months if it is tapped in winter or four months during spring and summer. About two quarts are gathered from each plant a day. One family (5.5 persons on the average) can survive, eating and drinking adequately, on four magueys during the months in which it is yielding.

Aguamiel or pulque supplies all the proteins, vitamins, and minerals

Granberg

◄ MATERIAL FOR A SLEEVELESS JACKET called a *coatarina* is being woven by this Otomi girl of Mejay, several miles from Ixmiquilpan. She is one of the few who are being taught a handicraft by government-trained instructors. She earns the equivalent of about $1.40 a week in part-time weaving.



➤ A YOUNGSTER FOLLOWING HIS FATHER from maguey to maguey during early-morning milking hours. Four plants will keep the average family in food and drink during the three to four months it yields *aguamiel.*

Munoz

necessary for survival. And just as important, it quenches thirst. Given enough pulque, maguey, and cactus by-products, the diet of these people is balanced enough. Lamentably, however, undernourishment is common and starvation is far from unknown in the Mezquital. In at least three villages in the Mezquital there is never any water, which means that the few animals there must join the people in drinking pulque.

Aguamiel is converted to pulque much as an Alaskan sourdough makes his bread. A bit of "starter," which is nothing more than very strong pulque, is added to the "honey water," and fermentation begins immediately. The "starter," or yeast, is called "mother of pulque," or often simply *pie,* for "foot." An Otomi is as careful as a sourdough about replenishing his jar of "starter." The alcoholic content approaches that of beer, and fermentation is said to continue in the stomach. Thus germs gathered from the mugs – which are rarely, if ever, washed—have free scope to multiply. Disorders of the stomach and intestinal tract are among the chief causes of death in the Mezquital, with pneumonia the leading killer.

Babies, lacking water, suck the fingers of their mothers dipped in pulque, and from then on they go through life in varying degrees of intoxication. Occasionally children will arrive at school in no condition to study, or even to stay awake.

Subsistance Acreage

To depend entirely upon maguey, a family must have at least 100 plants in production, occupying about 1½ acres. Since six or seven years are required for a plant to reach maturity for milking, this means that 100 plants must be set out every year to assure a continuing crop. Plantations of this size are rare, and no more than four villages depend upon maguey solely for a livelihood. Most Otomi families must be content with small plantings, with the men seeking occasional and temporary work outside the village at a few pesos a day in order to eke out a precarious existence.

Most villages have a pond, or *jaguey,* which holds water from a few to eight months of the year. These stagnant, contaminated pools, utilized by animals and humans, are a prime source of parasites. Most children die before they are twelve; thereafter, life expectancy is fifty-five.

Within the last four years, the government agency charged with seeing to the welfare of the Otomies, the Patrimonio Indigena del Valle del Mezquital, has built concrete water tanks *(pilas)* in a few dozen villages. These are filled by

Munoz

Granberg

↑ One of the 150 government schoolhouses built since 1952. This community, Cuesta Colorado, is high in the mountains, but maguey grows here too.

← Washing clothes in waste water from a tank filled by a government truck. The tank is usually empty from one to three days a week, and clothes are rarely washed.

tank trucks twice a week, theoretically, but breakdowns of equipment and other reasons interfere with regular service.

The maguey supplies more bulky foods than pulque, too. Scrapings from the bowl in which the *aguamiel* collects, called *corozon* ("heart") or *ximphi,* are taken home to be eaten either raw or roasted. In the large, thick, sharp-pointed leaves are worms, which are roasted and counted a delicacy, as they are indeed even in Mexico City. The skin of the leaves serves as a dressing for wounds, and the sharp thorn at the tip, threaded by nature with a strong fiber, serves as a stout needle. The blossoms of the maguey are eaten roasted and have a honeylike flavor. The tender parts of the 20- to 40-foot stalk are also eaten, while the tough sections are fed to pigs.

Other foods of the desert utilized by the Otomi include the fruit of the prickly pear and its leaves,

which are peeled and diced. In earlier days, the flower of the mesquite was dried, pounded, and mixed with water for making bread.

Milk is unknown, and meat is such a rarity that it might better be considered nonexistent. Even beans are a rarity, and aside from pulque there will be only tortillas, pounded out from corn soaked in limewater and then ground. Occasionally, chili peppers appear on the menu to enhance the tortillas.

Some Otomies own scrawny sheep or goats, but only rarely does a man kill an animal for meat. Livestock is looked upon as a prestige item. The animals are virtually useless; one may be killed for making a fiesta in the event of a funeral or a wedding.

Rainfall is so scant that the people cannot count on a corn crop oftener than once every eight or ten years. They never take a chance at losing a crop once it begins to ear up, and in ancient days neighboring tribes called the Otomies "the people who cut their corn when it is green."

In mountain areas where rainfall is plentiful, two crops of corn a year are possible, while in lush tropical valleys coffee and fruits are grown. But distances and lack of roads preclude extensive marketing. In general, the Mezquital is cursed on one hand by drought and on the other by a surplus of water, which erodes and leeches the land.

There was a day when maguey yielded material for the shirt, skirt, and trousers. Today, it is utilized for making the carrying cloths *(ayates)*, which will accommodate anything from a baby to a pigskin of pulque. This loosely woven material, which resembles burlap, is still used by many of the people for rude *rebozos* (scarves) and serapes.

It is in the making of *ayates* more than in the sale of pulque that the maguey supplies a cash crop. The family maguey patch may yield only enough *aguamiel* for home use, but there will be fiber in the leaves for marketable *ayates*. After a plant has yielded its capacity, the leaves are chopped off, beaten with a wooden club or mallet, and then flayed clean with a stick having rounded edges to avoid breaking the fiber.

Cranberg

↑ An Otomi kitchen. In most homes the fire is simply built on the earthen floor. But this woman has a stone stove, in addition to the flat grinding stone.

Washed and dried, a huge skein of this material is thrown over one's shoulder, and the work of spinning on the *malacate* begins. The spindle is spun by the right hand, and the fiber is fed to it by the left as it is torn away from the mass with the teeth. Outsiders are surprised to find that the spinning of *ixtle* is not too undignified a task even for the *juez*, the judge or headman of the village. Children just old enough to be in school are also able to spin.

Weaving

Daughter knows the art of weaving *ayates* before she is twelve. The weaving is done on the crudest of looms, just as it was centuries ago. *Ayates* sell for around 3 pesos (25¢ U. S.), and as many as six may easily be made in a day if the family has the necessary fiber. Beyond his own tasks, a man may expect to earn about 4 pesos a day or 20 pesos a week. One family, if able, will spend around 10 pesos a week for 11 quarts of corn. Simple arithmetic reveals that there isn't much left for cooking grease, beans, medicines, and fiestas.

Diseases, as any Otomi can tell you, are caused by mountains, which are deified, by angry saints, by the "evil eye," by simple sorcery, and by "bad airs." During the summer of 1955, the mountain community of Defay was struck by measles, and the people were certain that this was brought on by their having enclosed a little figure of a saint in a small box. The remedy was not the government doctor. Flowers and candles were carried to the mountaintop to appease the god,

and since only ten persons in the village died, the remedy was considered effective.

A red string around a child's neck will ward off measles. A bit of metal held against the stomach of a pregnant woman will save a child from having physical defects. Deadly coughs can be cured by dried deer dung mixed with water and rubbed on one's shoulder, for has anyone ever heard of a deer coughing itself to death? If everything else fails, the wily village witch doctor, the *curandero,* is called in. "See, he sucks scorpions and snakes from the invalid; surely now the illness will be cured."

Among the ruins of the great pyramids, temples, and tombs in Mexico, only one structure is linked to the Otomies. This is the relatively small pyramid at Cuicuilco, believed to be the oldest on the continent and thought to have been built by the Otomies. Its age, judging from the lava flow from Mt. Xiple that covered it, has been estimated as at least 8,500 years.

Language

About 20,000 of the Otomies are one-language people, and to them Spanish is as foreign as English. Prescott said that the monosyllabic composition of Otomi, and its vocabulary, "show a very singular affinity to the Chinese," but this opinion should not be taken too seriously. Otomi has no grammar and seems to the uninitiated to be more dependent upon sound effects than actual whole letters or even words. Many words sound like a catch in the throat, a light grunt, or a nasal-twanged effort at speaking. The alphabet has 34 letters and includes such extras as KK, KH, KJ, PH, PJ, and PT. The vowels have two sounds, clear and nasal. Learning Otomi much beyond the point of being able to say "*Ah-sha-wah,*" the equivalent of "Good day," is apt to appear hopelessly difficult. Try, for example, *ngu,* house; *hme,* tortilla; *t'afi,* honey water; *uxutsi,* girl; *Ma ha aro sei,* "Let us drink some pulque." The Otomies are making progress in learning Spanish, although teaching in the desert and mountain schools is largely in Otomi.

These are the people you may meet informally on Mondays at the market in Ixmiquilpan.

But most of the wares are offered by the Otomies from the more fertile mountain areas. When you see how little those from the desert bring to sell, remember that their homeland is desperately poor. The marvel is that they have survived at all.

▼ MARKET DAY at Ixmiquilpan, heart of the valley of the Mezquital. The natives have carried the produce many miles, mostly from the mountains rather than the desert.

Granberg

▲ SMALLER THAN A SCREECH OWL, the saw-whet measures between 7 and 8½ inches.

The Saw-Whet Owl

Through his hobby of bird banding, the author learned a lot about this tiny owl

By G. RONALD AUSTING

Photographs by the author and Donald Koehler

MANY amateur bird enthusiasts have found pleasure in banding birds and thus participate in the worldwide effort to probe the mysteries of migration and to gain information on the longevity of birds. But it is with the absurdly tame little saw-whet that I have become particularly fascinated. Many devious traps and techniques have been developed for capturing and banding other birds. But with the saw-whet, the skilled bird-bander can rely solely upon his own hands. Thus the task is both a sport and a scientific pursuit.

It was during the winter of 1945 that, quite by accident, I came upon a saw-whet owl roosting in a dense honeysuckle tangle. Drawing closer, I actually touched the little owl with my fingertips before it took flight. Its remarkable tameness was without precedent in my experience, and this incident led to a rather intensive study.

Worth Randle and I spent the winter of 1949-50 observing the roosting and feeding habits of these birds, and when I secured my banding permit in 1950, I was anxious to band every bird we found.

Banding can become quite a time-consuming occupation. The bander, after having secured the necessary Federal Permit (and an additional State one is required in some parts of the country), must keep accurate records of his operations and submit seasonal and annual reports to the Banding Office. The actual banding may take but a few seconds, but accurate information must be filed on each individual as to species, age, sex, location, date, type of trap, and bait.

▲ THE AUTHOR approaches a saw-whet in order to band it, while his dog distracts the bird's attention.

Most saw-whets will flush at the last moment if the would-be captor is alone, so a second person is desirable in order to distract the bird while the other creeps up from behind. With an especially wary bird or when I am alone, I have good success with a dog. The birds tend to freeze even more at sight of a dog than a man.

On my first few tries, I missed more birds than I caught, but I eventually learned the knack of doing it. It is simple to approach within five feet of a saw-whet, but closing the gap requires a bit of care and steadiness. Before attempting a capture, I like to study the situation for a few minutes to select the clearest approach, as free as possible from obstacles. If the bird is too high, it may be necessary to flush him several times until he selects a lower perch. Saw-whets seldom travel more than 100 feet when first disturbed, but they travel swiftly, flitting through the pines with an agility that gives proof of their keen vision in daylight.

After the approach route has been selected, I station myself about five feet from the bird with my arm half extended and hand open. I must now remain as motionless as possible, for the owl is gazing at me intently. My companion now walks slowly to the opposite side, making as much noise as possible—shouting, waving hands, or shuffling the leaves. Finally, the bird begins to take an interest in the commotion and turns its head to watch. Now I begin cautiously to inch forward, until my hand is about three feet away. Be-

coming aware of my actions, the bird snaps its head around, wide awake and alert. It is now necessary to remain perfectly still, not even to bat an eyelash. My companion must do his part with even more enthusiasm. If I see the bird cock its head back and forth several times, I know I'll have to make one desperate lunge for it. Moments later, the tiny predator will have flown, a bit wiser to the ways of men.

However, if my companion has put on a convincing act, the owl will again be distracted and turn its head. Very slowly, I now try to gain another foot, and then, just as the bird again becomes conscious of my presence, I quickly lunge forward and pluck the surprised little creature from its perch.

The bewildered owl usually fights blindly for a few moments, snapping its bill and striking out

THE BANDING OPERATION is, in itself, quite simple. Upper left: the author holds the sixteenth bird he has banded. Above, he bands a saw-whet while his friends look on.

▲ THE ADULT SAW-WHET (above) is streaked brown. The young birds are chocolate-brown with a blackish face and conspicuous white patches, or "eyebrows," forming a broad V between the eyes.

with needle-sharp talons. It then resigns itself.

On occasion, I have employed other techniques. One especially, I think, is unique. In 1953, Worth Randle, Ed Johnstone, and I located a bird in a white pine, just beyond arm's reach. In order to gain the necessary height, I climbed on top of Worth's shoulders. Staggering beneath his load, he inched his way forward, while Ed shuffled around on the ground, barking like a dog. Carefully parting the branches, I was able to

▼ THE OPERATION OVER, the owl is returned to its perch, none the worse for the experience.

A PAIR OF SAW-WHETS, the female perched, the male in flight.

A SAW-WHET OWL makes off with a mouse.

snatch the little fellow from his perch.

After banding this bird, I replaced him on the same branch. Much to our astonishment, he remained there without taking flight. When we returned several hours later, the owl was still at the same spot, apparently having forgotten what had happened.

After an exciting jaunt to band saw-whets, I often wonder what enjoyment the man can find who does his birding with a shotgun. The days I have spent at this work are filled with a certain mystery and enchantment, and my memories are not spoiled by the thought of having reduced the life of our countryside. Rather, there is the hope of some day recapturing one of the saw-whets banded years before. A young black-crowned night heron that I banded as a nestling at Cincinnati in the spring of 1952 was found in Cuba, and a female Cooper's hawk that I banded in 1953 turned up six months later only about a mile away. But I have yet to hear from any of my saw-whets.

◄ Beginning low in the valley between these two hills, the petroglyphs are found in a concentrated band 15 or 20 feet wide, up the escarpment and along the ridge in the distance. A few, formed by rubbing instead of pecking, exist on the escarpment of the nearer hill.

▼ The first group of petroglyphs found by the writer. He happened to see them when he was climbing the hill for a photograph of the plain. The prominent design at the top was of fairly frequent occurrence, and reasonably close duplicates of the two designs at bottom were also found elsewhere.

Rock Pictures IN MEXICO

Petroglyphs have been found in many parts of the world, but it is rare for an inquisitive traveler to find a thousand of them in one place

By William J. Cox

While on a vacation expedition that took me as far into Central America as Guatemala, I found these petroglyphs just off the road between Saltillo and Torreon in the Mexican state of Coahuila. Thousands of persons must have passed them without realizing that this astonishing aggregation of rock pictures lay within short walking distance. My guess is that I saw about one thousand of them.

The petroglyphs started in the low area between the two hills seen in the photograph at left above and continued in thick profusion for perhaps 200 yards along the crest of the farther outcrop. This was as far as I went, but at this point, they were decreasing in number, possibly because the rock was somewhat inferior in quality.

Nearly all the pictures I saw had

The author is an engineer who has taught at Yale University and was for nine years the State Highway Commissioner of Connecticut.

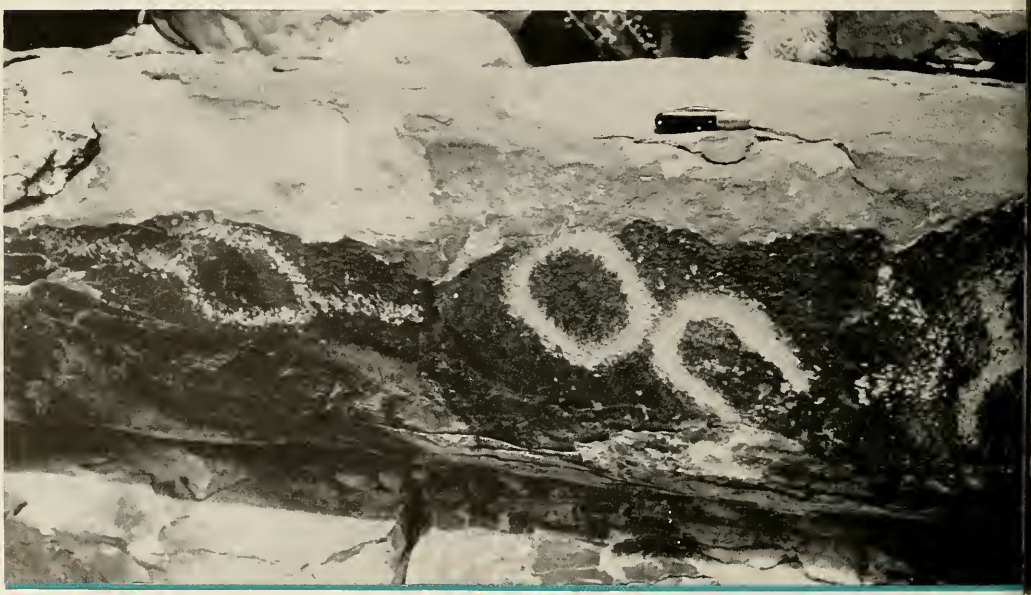
▲ THE MIDDLE DESIGN, which may represent a serpent, occurred often. The other two were not seen elsewhere.

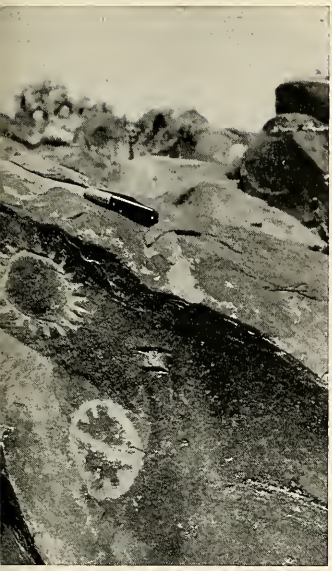
been cut into the rock by percussion or pecking. However, there were several examples, found on the nearer hill, where the picture had been made primarily by rubbing, probably because the rock was of a different type—sandstone, I believe. Rock of this sort underlay the hard traprock on the farther hill. Most of the designs were on inclined surfaces, which were often more nearly horizontal than vertical.

I understand that anthropologists have recorded rock pictures of this general sort from widely separated localities in North America and elsewhere. Though it is difficult to assign a specific meaning to most of the symbols, it seems likely that they had religious significance. In line with accounts from modern tribes in northwestern United States, the pictures may have been made by young men on lonely vigils seeking to attain spiritual power through fasting and contemplation. Any spot as crowded with symbols as this may well have been a sacred place to the people who drew them.

I could not judge the age of these pictures beyond observing that weathering had not reduced the pecked surfaces to the same patina as the surrounding rock. This was not the case, however, with the "rubbed" rocks.

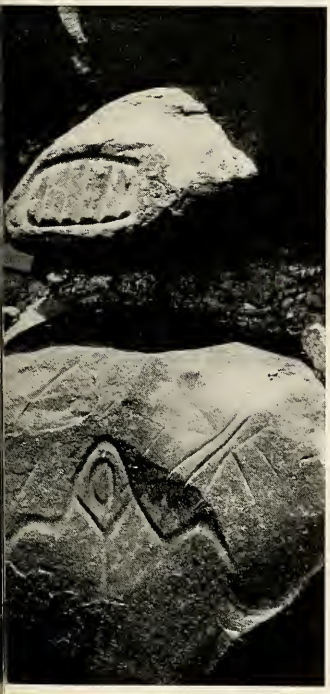
▼ SIMPLE GEOMETRICAL SHAPES of this sort were about as frequent as the more elaborate figures.





Could these be symbols of the sun d the moon?

Designs like these, which were bbed into the rock, were comparaely few, because the outcrops of this ter rock were limited in extent.



Collecting for the World's Largest Fish Bowl

continued from page 125

manilla line spiralling from its coil into the *Geronimo's* wake. Boots brings us around in a broad arc toward the dolphin; it is leaping little short restrained leaps at the end of the taut line. The big net skiff is brought around alongside, and the two collectors leap aboard. They move down the line that restrains the struggling dolphin. Another dozen or so dolphins from its school can be seen pressing against its flanks and criss-crossing and thumping against the thin line. They refuse to leave even when the captive is brought alongside but continue to circle in the clear blue water beneath it. Boots, with his knees braced against the rail of the broad skiff, leans over the side and wraps a strong arm around the tail stock of the 250-pound animal. Both men lean over the water, bringing the gunwale nearly down to the water. A quick motion and the big mammal is rolled into the bottom, onto a waiting air mattress. The timing has to be perfect, for the sea is sometimes far from calm.

Strangely enough, once the dolphin is rolled out of the sea and placed on its mattress, it seldom batters the bottom with its flukes or thrashes about. Most lie perfectly still, only giving evidence of life by their irregular explosive breathing. Some give apprehensive whistles but most do not utter a sound.

We cover the docile dolphins with heavy blankets and spray them constantly with salt water during their trip to the unloading pier at Marineland. They sunburn easily, but the main concern is to keep them cool. The sea is a world of cool temperatures compared to the internal warmth of a dolphin's muscle and blood. These "little whales" are covered with a layer of blubber and skin, devoid of sweat glands. The blubber allows them to roam the seas but does not prepare them for life out of water where the sun can quickly heat and kill them.

Newly-captured striped dolphins must be taught to eat. In the sea they feed exclusively upon various silvery schooling fishes, such as anchovies and sardines. The cuisine at Marineland consists of a daily ration of about 350 pounds of mackerel, silver smelt, shrimp, sardines, and squid, but all these delicacies are brought from freeze lockers before being prepared, whereas dolphins normally feed on live food. However, after a day or two, the new arrival is generally tame enough to swim to the edge of the tank and take food from the feeder's hand. Once the new dolphin is eating 10 to 20 pounds of fish each day, it is lifted onto a stretcher and hoisted into the circular tank. There it rockets off followed by a pack of curious inmates. The occupant dolphins established in the tank immediately begin a spirited dolphin conversation, consisting of a series of whistles, clicking sounds, and loud snaps of their jaws. These sounds are clearly audible through the double layer of glass of the hundreds of ports that circle the tank walls. After a short time the novelty of the newcomer is gone, the conversation quiets, and attention is once again turned to throwing pebbles at spectators lining the rail, or pulling tail feathers from the pelicans that share the tank with them. The new dolphin has been accepted. Before many weeks have elapsed he will be joining the others in their numerous antics.

The sea is full of wonderful animals like the Totoaba and the striped dolphin which have seldom been viewed by the public. It is our continuous quest to bring these creatures to Marineland of the Pacific in good condition, there to treat them to the best of food and care, so that we may all see them and learn a little more about their interesting lives and habits.

▲ The edge of the Gulf Stream: a remarkable photograph taken off Cape Hatteras from the Danish freighter *Olav*, by Hawthorne Daniel. The demarcation is due not to a difference in the color of the water but to a thin layer of vapor over the Gulf Stream.

Look, The Gulf Stream!

Few ever see it, though its importance to the life and history of the world is mentioned in every textbook

By Robert Cushman Murphy
Lamont Curator Emeritus of Birds, American Museum of Natural History

HERE is a photograph of the mighty current of the Atlantic that gives northern Europe its mild climate. It vitally influences the oceanic creatures of the latitudes it traverses; it has shaped the paths of exploration and the course of empire. And it inspired one of the most eloquent passages in scientific literature—Matthew Maury's description, published in 1855:

"There is a river in the ocean. In the severest droughts it never fails, and in the mightiest floods it never overflows. Its banks and its bottom are of cold water, while its current is of warm. The Gulf of Mexico is its fountain, and its mouth is in the Arctic seas. Its current is more rapid than the Mississippi, and its volume more than 1000 times greater."

When a vessel enters the Gulf Stream, one is more apt to feel it than to see it. Under extreme conditions, the effect may be very sharp, as when a United States Ice Patrol craft once lay with her bow in the frigid waters of the Labrador Cur-

Robert Cushman Murphy

▲ The current boundary off Ecuador, where the pale coastal water is seen to be overflowing the saltier and heavier blue offshore water.

rent and her stern in a tepid offshoot of the Gulf Stream Drift.

Attempts to photograph the boundary between two different masses of water are usually disappointing, but the pictures reproduced here represent two efforts that were quite successful. The one above, taken a dozen miles or so off Cape Hatteras, shows the line of demarcation between the Gulf Stream and the colder water of the Atlantic slope beyond. It was taken in 1916 by Hawthorne Daniel, who was the Editor of NATURAL HISTORY Magazine from 1928 to 1935. As Mr. Daniel explains, the demarcation was caused not by an actual difference in the color but by a thin layer of vapor, which can be seen if the picture is examined closely. A cold wind was blowing from the northwest, and when it reached the warm waters of the Gulf Stream, it apparently chilled the moisture-laden air immediately above the sea, causing this vapor to form. Mr. Daniel writes:

"The captain, at my request, sent a man to the bow and another to the stern, each with a bucket on a rope. As we passed the edge of the Stream and had the plainly marked line about amidships, he blew the whistle. Thereupon each man dropped his bucket over and brought up some water. The two buckets were brought to the bridge, and we took their temperature. My recollection is that the water from the stern (the Gulf Stream end) was 82 or 83 degrees, while that from the bow was 62 or 63 degrees. The largest school of porpoises I have ever seen had followed us that day, but when we left the Gulf Stream at this point, they let us go on and stayed in the warmer water."

Mr. Daniel mentions that the water of the Atlantic slope appeared green, and this is the color it generally shows when viewed by transmitted light. Sky reflections, of course, may lend it blueness.

Even bluer than the water of the Gulf Stream is the ultramarine surface water of the North Atlantic Sargasso Sea. This water has been shown to be more transparent than the purest spring water on earth. This is because it lies beyond reach of river silt and is extraordinarily deficient in plankton except for the creatures inhabiting the floating Gulf weed.

The second photograph shows how two masses of water may look different because of differences in saltiness and in the amount of material in suspension, including living organisms and the "dust" of the land. This photograph shows the current boundary off Ecuador and was taken by the writer in 1941 during the "Askoy" Expedition of the American Museum of Natural History.

When we approached this area on April 14, the pale coastal water of low salinity (at right) was moving northward and overflowing the blue, saline, and heavier offshore water (left). We first encountered it about six miles from the coast and followed the turbulent border for some time, taking pictures of it. It is the most conspicuous example of this sort that I have seen in a good many years of observation.

A Helping Hand for the Whooping Crane

continued from page 137

in the cranes struggle to survive. The Canadian government restricted all airplanes from flying low over the area during the nesting season. Meanwhile another incident occurred which demonstrated how strong the feeling of responsibility for the welfare of the cranes had become.

The United States Air Force announced plans for establishing a photoflash bombing range adjacent to the Aransas Refuge. The site was only a mile from part of the wintering grounds of the cranes. This announcement brought forth a wave of protests. They came from the National Audubon Society, local Audubon Societies, the U. S. Fish and Wildlife Service, the National Wildlife Federation, the American Nature Association, the Canadian government, and a host of other organizations and individuals. At the height of these protests, the Air Force announced that its proposal to establish the bombing range had been withdrawn.

The next milestone was provided last spring by that determined pair, Crip and Josephine. George Douglass, the director of the New Orleans Zoo, had insisted, after the loss of Rusty at Aransas, that his bird, Josephine, be returned. As it was pointless to separate the pair, both Crip and Josephine were turned over to him, and they took up residence in the zoo. Gradually they became accustomed to the unusual surroundings and proceeded to nest.

I hurried to New Orleans and joined the group of observers who perched on a slate roof for a week looking down at the entire hatching process. Two chicks were hatched, but once more the efforts of the crippled birds to rear young ended in tragedy. Again some predator, possibly a cat or rat, made off with one of the chicks during the night. The other, after attaining the astonishing height of 33½ inches in 6 weeks, died of aspergillosis, sometimes called brooder pneumonia, a lung infection common in chickens and turkeys.

Although Crip and Josephine had been thwarted in their efforts to raise a family, the deaths of the two chicks resulted in an increased desire on the part of wildlife experts to do even more toward saving the species.

This culminated in an unusual meeting last October 29 in the conference room of the Secretary of the Interior in Washington. At the invitation of John L. Farley, director of the U. S. Fish and Wildlife Service, leaders in the movement to save the whoopers came from many parts of this country and Canada. There were more than 40 of them, including wildlife officials, ornithologists, heads of conservation organizations,

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and directors of zoos. Among them were W. Winston Mair, chief of the Canadian Wildlife Service, Bob Allen, John Baker, president of the National Audubon Society, George Douglass, John J. Lynch, biologist of the U. S. Fish and Wildlife Service, and Fred Stark, director of the San Antonio Zoo, who has the third crippled whooper.

Various ideas for perpetuating the whoopers were presented during the all-day meeting. Some wanted to capture wild birds and breed them in captivity. Others opposed this strongly, on the ground that, as there are so few breeding pairs, any tampering with the migrating flock would only further endanger the continuance of the cranes as a wild species. It was pointed out that somebody has yet to prove that whoopers can be raised in captivity.

These differences of opinion as to survival usually come up whenever a species gets down to a few individuals. In the case of the heath hen, the dissension was so great that some groups withdrew their support of the effort. This meeting, however, was rather an opportunity for the Fish and Wildlife Service to get expert testimony on which it could base its future action on behalf of the cranes.

It was suggested that (a) further steps be taken to protect the birds on the Texas refuge and along their flyway; (b) efforts to breed cranes in captivity be confined to the crippled captives now on hand; and (c) public education should continue on an increased scale. The group proposed that an international advisory committee be formed, and an eleven-man committee has been appointed.

Public interest, a powerful factor in any such project, has now reached the point where the steps taken toward saving the cranes will be watched by a multitude of critical eyes. It seems that a large segment of the public has come to the realization of what the extinction of a species means, a concept that was perhaps best expressed by Henry Beetle Hough, in the *Vineyard Gazette* in 1933.

When the last heath hen disappeared from Martha's Vinyard. Mr. Hough wrote, "Now we know there are degrees even in death. All around us nature is full of casualties, but even they do not interrupt the stream of life. When most living things die, they seem only to revert to the central theme of existence from which they were temporarily detached. There is a spirit of vitality everywhere which enfolds the dead with a countenance of consolation, and bestows upon the living races more than has been taken away. But to the heath hen something more than death has happened, or, rather, a different kind of death. There is no survivor, there is no future, there is no life to be recreated in this form again. We are looking upon the uttermost finality which can be written, glimpsing the darkness which will not know another ray of light. We are in touch with the reality of extinction."

It is important that the American people can become disturbed as a precarious handful of whooping cranes, representing the entire species, teeters on the brink. It is important that fewer and fewer persons shrug and say, "What good are they, anyway?" If this outburst of feeling can take place among Americans now, the day is not far off when the public will become aroused before a species reaches the brink—in time to ward off the grim finality of extinction.

★ ★ ★

As this story goes to press, another whooper has been discovered on the King Ranch in Texas, making the total number of the wild flock 24 instead of 23.

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▲ ANIMALS, released by a dismissed employee, stampede across the Kenya animal farm.

The Screen

Authoritative comments on films
in the field of nature, geography and exploration

"Odongo"

Reviewed by T. DONALD CARTER
Assistant Curator, Department of Mammals, American Museum

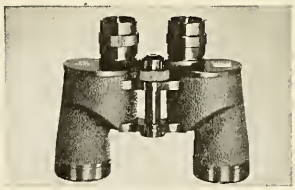
THIS picture is laid on an animal farm in Kenya, East Africa. It contains many interesting shots of African animal life, including those which display the speed and grace of the cheetah, fastest of all four-footed mammals. Scenes shot on the farm show a number of well cared for animals awaiting shipment to foreign zoos. Most notable of these was a pair of white rhinoceroses. There was a fine shot of a swarm of locusts, as well as some interesting pictures of the African plains.

A number of captive okapi shown on a safari are, unhappily, referred to as a species of deer. Actually the okapi is closely related to the giraffe and lives in the Belgian Congo. Many of the elephant shots were also undoubtedly taken in the Congo, although the picture does not clarify this fact. The herds of zebras, white-bearded gnus, ostriches, giraffes, and antelopes were doubtless taken in East Africa.

A few other errors were allowed to creep in. A klipspringer was photographed near a thornbush on the plains, when its natural environment is a steep, rocky hillside. Also, an Asiatic macaque monkey was shown as a baboon. This monkey must be a very skillful actor for he has appeared in at least one other film going through the same act of entering an automobile and frightening its occupants.

Odongo is a good picture and gives a far more accurate account of Africa than the usual Hollywood production. It was particularly appealing to me because of the absence of the usual fake dangers and horrors common to most commercial films of this type.

▲ ODONGO playfully wrestles with his favorite friend, the chimpanzee.



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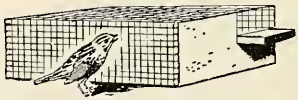

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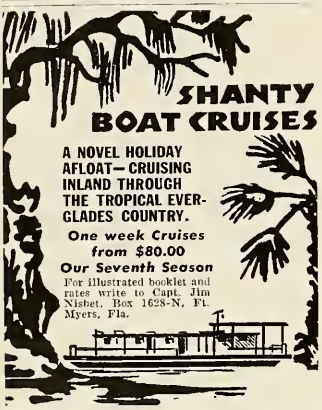

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FLYING "U" CARAVAN CAMP

Harold N. Cohn, Dept. of Biology

University of Colorado, Boulder, Colo.

YOUR NEW BOOKS *continued from page 119*

sonal climbing experiences in England and Wales, the Alps, and the Himalaya—fascinating accounts of alpine adventures in which the author transfers his enthusiasm for the heights and his adoration of the wilderness to his audience.

But the meat of the book is its advice to climbers. Written especially for the uninitiated, this material will interest experts as well. One part covers the use of rope on cliffs, glaciers, and snow fields. Some of this, though technical, can save the lives of those who take it to heart. Such mundane matters as suitable shoes, clothes, and packs are also included.

One of the most interesting chapters is on rock climbing. Drawn largely from Dr. Evans' experience in England and Wales, it gives the fundamentals for coping with cliffs the world around. There is a vast amount of useful information on crampons, the design and use of axes, the cutting of steps, how to avoid avalanches, and the management of dangerous cornices. The chapter on glaciers is as good for our Cascades as for the Alps. Tents and mountain camps are described, with many helpful suggestions. And the chapter on mountain rescue is a unique contribution to literature on mountaineering.

Pen and ink sketches of such things as the right and wrong way to climb rocks, arranging a pack, and tying butterfly knots bring the technical parts to life. And 27 pages of black-and-white photographs—some of them startingly beautiful—add greatly to the charm of the book.

I do not think there is any other book on mountaineering published in America that is so useful to the beginner. There are few which succeed, as this one does, in portraying the spirit of those who, having once reached the heights, must go back over and over again for spiritual fulfillment.

Known chiefly as a Justice of the United States Supreme Court, William O. Douglas is also a keen mountaineer and explorer.

THE UNDERWATER GUIDE TO MARINE LIFE

by Carleton Ray and Elgin Ciampi

A. S. Barnes, $8.75
338 pp., illus.

Reviewed by EUGENIE CLARK

HERE is a text for skin divers, written by a pair of marine biologists who have acquired firsthand knowledge of marine life through their own diving experience. Their well-organized book is an especially good guide to Californian and Bahaman waters but is also applicable to diving anywhere.

The book is divided into three sections. The introduction touches lightly but deftly on such topics as important physical features of the sea, its zonal divisions, communities of marine life, and the relationship between sea and diver. The second section briefly reviews marine plants, from microscopic algae to 100-foot kelps, and then presents a more detailed survey of representative marine invertebrates of all the major phyla and classes. Section three covers marine vertebrates, a fine review of more than 100 fishes. An interesting final chapter on "re-entrants" discusses the turtles, snakes, birds, and mammals that have gone back to living much of their life in the sea.

The authors not only describe the basic identifying features of these animals but also tell, wherever possible, how they would look, feel, and react to a diver encountering them alive in their natural surroundings. Many readers will be grateful to learn about the feeding habits of sharks and the danger they present to divers. Sharks can sense low-frequency vibrations at great distances, though they hunt at close range mainly by smell.

For a book with so much technical information on so many species, there are few errors—only an occasional oversimplification or unproven statement of fact. In general, the presentation is accurate, comprehensive, and readable.

The material is greatly enhanced by 16 pages of color pictures, including handsome illustrations by the Japanese artist, Teiji Takai, and underwater photographs by the authors.

Dr. Eugenie Clark, Director of the Cape Haze Marine Laboratory, specializes in the reproductive behavior of fishes, among other subjects. Some of her own adventures collecting fishes are found in Lady with a Spear *(1953).*

NATURAL HISTORY OF BIRDS

- - - - - - - - by Leonard W. Wing

Ronald Press, $6.75
939 pp., illus.

Reviewed by AUSTIN L. RAND

THIS volume is arranged as a text. The table of contents would indicate a comprehensive treatment of the whole subject of birds, from classification, anatomy, and physiology through the various aspects of behavior, to the economic relations and suggestions for field study and photography. Actually, Wing gives scant consideration to any but the land birds

of North America. He remarks, for example, at the end of one chapter, "Although the bird music considered here is of North American origin, other writers have described as musical the bird songs of other countries." This hardly does justice to the 8000 or so species of birds not resident in North America.

Wing does take up numerous different aspects of bird life and comes to some shrewd conclusions. He points out, for instance, that the waterfowl "flyways," a widely accepted concept, are in reality more an administrative than a biological phenomenon. He also refuses to accept daylight as the over-all controlling factor in breeding seasons.

At times Wing seems more preoccupied with statistics than with biology. His treatment of many subjects is remarkably incomplete. He often seems unsure of his data and there is much needless repetition. The errors are too numerous to excuse.

The 230 illustrations include photographs, line drawings, charts, maps, and diagrams. A selected list of references closes each of the 24 chapters. The appendices include lists of bird families and of official state birds.

Dr. Rand is Curator of Zoology at the Chicago Natural History Museum. His specialty is ornithology, and he has done extensive field work in New Guinea, Madagascar, the Philippines, and elsewhere.

A SPACE TRAVELER'S GUIDE TO MARS

- - - - - - - - - by I. M. Levitt

Henry Holt, $3.50, 175 pp., illus.

Reviewed by ARTHUR C. CLARKE

SO MANY books have been written about Mars that one wonders if there is room for more. The answer depends on the book, and in this case it is "yes." Dr. Levitt is a professional astronomer (Director of the Fels Planetarium in Philadelphia) who knows what he is talking about, can put it across clearly, and doesn't lead his readers astray in the uncertain realm between fact and speculation.

A Space Traveler's Guide to Mars—though the title may be slightly premature—contains all the information an interested layman could need about our tantalizing neighbor in space. The movements of the planet, the history of Martian observation, and the attempts to unravel the secrets of its markings are all fully described. The problem of reaching Mars is discussed briefly, with particular reference to Dr. Wernher von Braun's colossal *Mars Project*.

Like most astronomers who have studied the subject, Dr. Levitt is cautiously optimistic about the possibility of life on Mars, though he points out that the absence of oxygen in that planet's atmosphere rules out most types of organisms known on earth.

One of the book's most interesting features is an appendix showing in detail how life may arise from inorganic materials under suitable conditions. Another appendix discusses the Martian calendar. The Martian year contains 668 days, a pleasant thought for parents recovering from Christmas shopping.

Arthur C. Clarke, who during the war was in command of the RAF blind-landing apparatus, now devotes all his time to writing and lecturing on scientific subjects. Space travel is his specialty, and he has twice been Chairman of the British Interplanetary Society. Among his published works are Exploration of Space *and* Sands of Mars.

SOUTH AFRICAN ANIMAL LIFE, Vols. 1-3

- - - edited by Bertril Hanström, Per Brinck, and Gustaf Rudebeck

Almqvist & Wiksell, Stockholm
1586 pp., illus.

Reviewed by JOHN C. PALLISTER

THE Lund University Expedition in 1950-51 was conducted chiefly to gain more information on the "distribution of the fauna of the different regions and biotopes" so as to "permit a closer analysis of the history of the South African animal world." Members of the expedition were Dr. and Mrs. Per Brinck (entomology) and Dr. and Mrs. Gustaf Rudebeck (ornithology). The collected material was assigned to specialists for study and is presented as separate papers, usually in the form of catalogs with descriptions of new species. Some of the authors have compiled extensive ecological and distributional maps and some have included species recorded by other sources. No attempt has been made to keep them in phylogenetic order. A few papers are in German or French, but most are English. Three volumes have been published so far, and five more are planned. When completed, the series will provide a fairly comprehensive survey of the species in this region.

John Pallister is Research Associate of the Department of Insects and Spiders at the American Museum of Natural History. Among his published works is a contribution to the section on invertebrates in the popular reference work, The Animal Kingdom.

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Letters *continued from page 113*

How Do Flamingos Bend Their Knees?

SIRS:

After seeing several flamingos recently, I became interested in their leg structure. They appear to have no space for muscle attachment in or around their knees (patella surface); yet I know they do bend their knees.

Can you answer this question for me?

BERTA L. OWEN

Evansville, Ind.

Dr. Charles Vaurie, Assistant Curator of our Department of Birds, offers the following explanation:

The proportions of the different bones are not the same in the leg of a bird as in the legs of human beings and most other mammals. A bird's thigh is largely hidden by a fold of feathered skin, and the first joint that appears below the plumage is actually the heel or ankle joint. It seems to me that what you call the "knee" is in fact the ankle. The section below this joint is the foot, which on flamingos is very long and hence liable to be confused with the tibia.

There are no muscles in or around this joint but only ligaments and tendons. The tendons spring from muscles connected to the tibia at a point high above the flamingo's visible leg. These long tendons are what bend the "knee" (that is, the ankle) of the flamingo.

Solar Still

SIRS:

The article entitled "Thirst" in your December issue greatly interested me since I am attached to the Marine Department of the Gulf Oil Corp. Before that I put in 16 years at sea. Could you supply me with the name and address of a manufacturer who makes the solar still?

E. MARCUS

Philadelphia, Penna.

The manufacturer of solar stills for the U. S. Navy is the U. S. Fiber and Plastic Corp., Union Street, Stirling, New Jersey. The solar stills are manufactured under contract, in quantity lots.

The desalting kits are sold by the Aero Engineering Company, 220 Old Country Road, Mineola, Long Island, New York. Their cost is under $20.00.—ED.

U. S. Navy ▲ SOLAR STILL.

★ ★ ★

SIRS:

Far too often, in my opinion, when we see a job well done, we are too busy to acknowledge it. This time, I am not committing the oversight.

The last several issues of NATURAL HISTORY are good, getting better . . . I really enjoyed reading the January issue . . . keep it up. You are on the right track, so far as my reading likes and dislikes are concerned.

ROY BROCKMAN

Wentzville, Missouri

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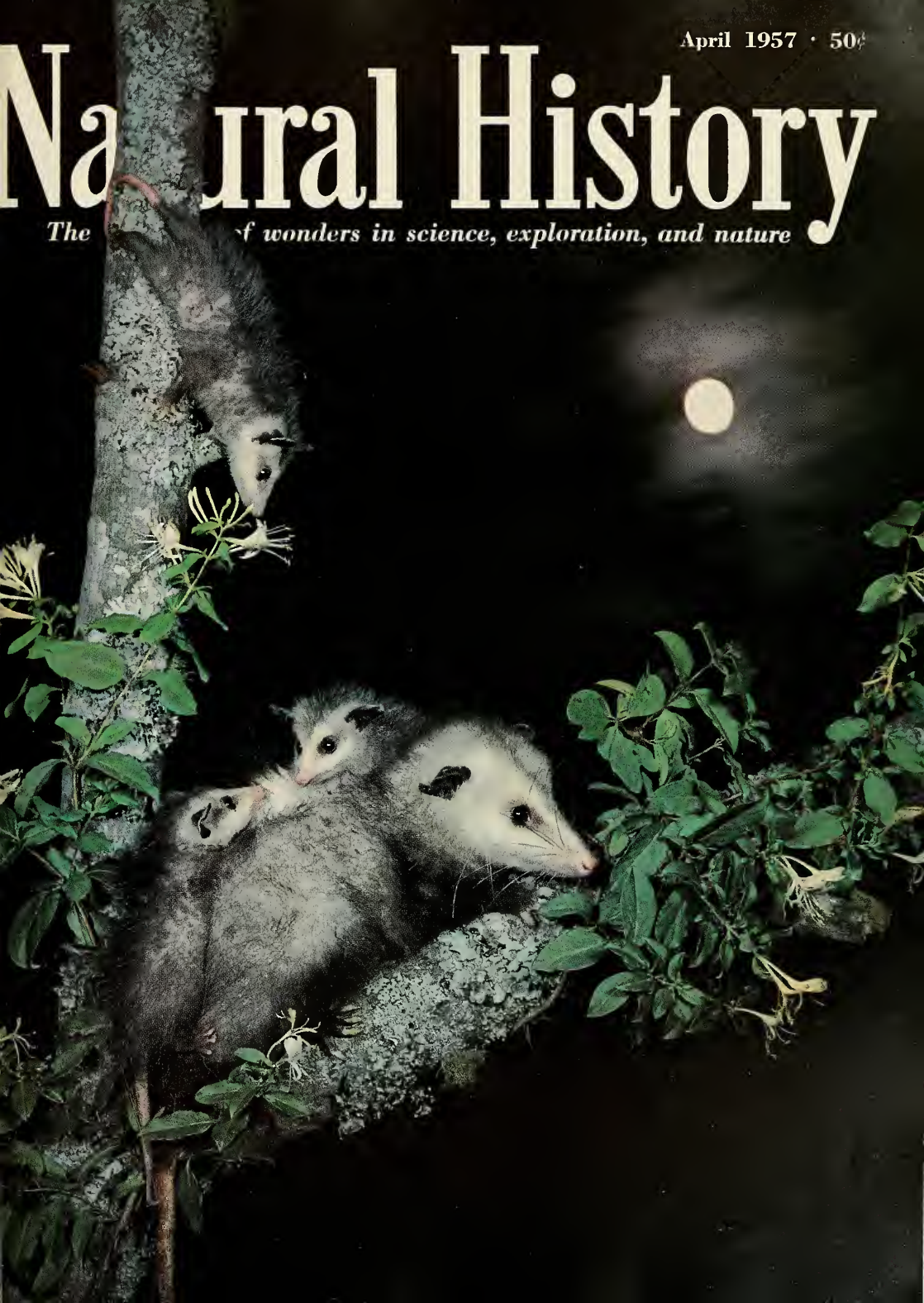

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Letters

"Shelter Belt" a Success

SIRS:

I am seeking some information on the so-called "Shelter Belt" of trees planted in a north-south line across the Dakotas and Nebraska over twenty years ago. Did these trees thrive? Or did Nature insist on keeping the plains treeless? If the trees thrived, how much shelter did they give?

Your magazine continues to get better and better. I appreciate the addition of cartoons, and I liked the photographs that looked so astonishing it was hard to guess just what they were. I hope you can give us another set of such pictures soon.

(MISS) HELEN T. FARRELL
Westport, Conn.

Dr. Jack McCormick, in charge of Vegatation Studies at the American Museum of Natural History, supplies the following answer:

The Shelter Belt Program, established in 1934, called for parallel strips of trees 7 rods wide and one mile apart across a 100-mile-wide area. The objectives of the program were conservation of moisture, reduction of soil erosion, cutting off of hot dry winds, and providing wildlife refuges.

In 1944, a survey revealed that at least 90 per cent of the plantings were in satisfactory condition. Another survey in 1953 showed continued success. On the whole, the coniferous trees proved to be hardier in the long run than the hardwood types, since the latter are subject to killing-back of terminal growth which means that they have not gained too much height after their first ten years.

Nature has not actually "insisted on keeping the plains treeless," but without special protection from natural hazards, such as fire and grazing herds, these trees would probably not have been successfully established. Even now, without further interference from man, the trees could be obliterated.

As windbreaks, the shelter belts have been found effective for a distance to leeward about 20 times the height of the trees. As a result of the wind reduction, there is also a reduction in evaporation and hence moisture is conserved. Also, there is less snow drifting and soil blowing.

Oddly enough, perhaps the most direct immediate benefit to the inhabitants of the area was the employment afforded by the project. In many ways, then, this project may be considered an achievement.

Insect Strength and Speed

SIRS:

In the article "How Strong Are Insects?" Mr. Hutchins credits a middleweight weight lifter with lifting 881½ pounds. The implication that any human lifted such a weight is most misleading. Actually, Pete George's 1952 Olympic record was the total of *three* lifts, which is the way the competition is scored.

ARTHUR J. MORGAN
New Rochelle, N. Y.

Our author, Ross E. Hutchins, makes the following statement.

You are correct that the total weight Pete George lifted in 1952 was actually the total of three lifts: the Press, the Snatch, and the Clean and Jerk. In these lifting feats, of course, the weight is lifted above the head. As you probably know, the 1956 record was established by Tommy Kono, a total of 986¼ pounds.

Actually, this type of weight lifting is not at all comparable to the sort that insects can do. Paul Anderson, who has been on several television shows, does a kind of weight lifting which is much more suitable for comparison with insects. He has lifted, by a Back and Harness lift, over 5000 pounds, which makes the insect record even poorer by comparison.

SIRS:

Dr. Hutchins lists the speed of the dragonfly at 17.6 mph. This is much slower than my readings have led me to believe.

Rutherford Platt, in *River of Life*, states that a dragonfly has been clocked at 60 mph. *The Animal Kingdom* states that dragonflies can travel at 55 mph.

Your comments will be appreciated.

E. R. LYON
Laurinburg, N. C.

Dr. Hutchins again provides the comments.

Since writing the story for NATURAL HISTORY, I have run across additional records which indicate that these insects actually do travel faster than the figure quoted, and you are right. Dr. R. J. Till-

continued on page 223

John H. Gerard

▲ WHO'S talking about Capital Gains.

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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April, 1957 Volume LXVI, No. 4

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THE COVER THIS MONTH

The opossum was originally found throughout the southeastern United States and as far west as Texas. In recent years it has gradually extended its range to the north and is now established in New England and Ontario. It has been introduced into California, Oregon, and Washington and is increasing in numbers there.

The opossum has the distinction of being the only marsupial mammal found within our borders. The young remain in the pouch for over two months, and for an additional month they are dependent on their mother, who carries them about on her back, clinging to her fur.

Br'er 'possum is as truly a part of the Old South as is the magnolia and the alligator. He is featured in much of the folklore and in many of the plantation songs, so characteristic of that part of the country.

The full moon and the bough draped with honeysuckle make a pleasing and authentic setting for this arboreal and nocturnal animal.

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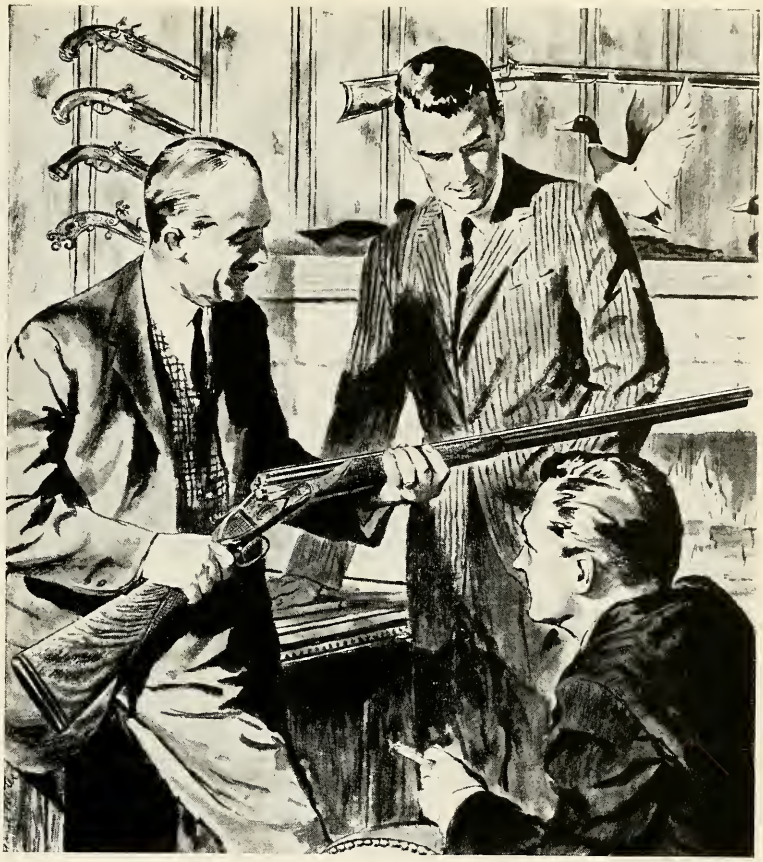

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YOUR NEW BOOKS

S. F. Briggs, National Audubon Society

Roseate spoonbills from *On the Trail of Vanishing Birds*

ON THE TRAIL OF VANISHING BIRDS

- - - - - - - - by Robert P. Allen

McGraw-Hill, $3.95
264 pp., illus.

Reviewed by ROGER TORY PETERSON

BOB ALLEN is surely the world's first authority on the long-legged "glamour" birds. In addition to his pioneer behavior study of the black-crowned night heron, he has lavished years on three exhaustive monographs: *The Roseate Spoonbill, The Whooping Crane,* and *The Flamingo.* These are absorbing documents but, by their very nature and purpose, do not give Bob Allen the full play of his excellent prose.

This new book, which makes the best kind of bedside reading, tells all the things that could not be developed in the more technical publications. Here we are given glimpses of the author at the age of ten, a Seton Indian whose world did not extend beyond Bald Eagle Mountain near his home in Pennsylvania; his seafaring days (before the age of 21, he had sailed twice around the world and been shipwrecked in the Sulu Sea); his contacts with various great ornithologists of the last generation; and his life-long dedication to those birds that are treading close to the threshold of survival.

The book describes such entertaining episodes as his construction of an artificial red bull inside which he could watch his cranes unsuspected and how he captured the last Louisiana whooper by helicopter, so he could take it to the Texas flock. He tells of camping with all kinds of people, from Aklavik Eskimos to Yucatan Indians. During his flamingo studies he was caught in the middle of an abortive Cuban revolution, and on another occasion he nearly lost his life in a West Indian hurricane.

I am sure no other field naturalist of our time has seen so much of wild America, from the Arctic Sea to the Caribbean, and none has such tales to tell. The spoonbill seems quite safe today, and so do most of the herons; but if the whooping crane and flamingo survive, we will have Bob Allen to thank for his inspired effort.

The most recent work of Roger Tory Peterson, the well-known naturalist, is Wild America *(1956).*

ANIMAL NAVIGATION

- - - - - - - - - - - by J. D. Carthy

Scribner, $3.95, 151 pp., illus.

Reviewed by LESTER R. ARONSON

MOST of us have occasionally wondered at the comings and goings of a flock of migrating birds, a trail of foraging ants, or even a lone dog running along the road. Most of all, we have questioned how they find their way. This question has been "answered" at times by attributing to these animals a mysterious directional sense or a nebulous homing instinct. But this is not really an explanation at all; it merely gives a name to the problem without offering a solution.

Biologists have been attacking this riddle, and we now know quite a bit about orientation and navigation in animals. This knowledge is presented by Dr. Carthy in an orderly manner. He sets down the facts in clear, simplified form, yet without sacrificing scientific accuracy. Ultimately, he believes, all animal navigation will be explained in terms of the senses already known to man. But certain of these senses may be far superior in many animals. Some fish, for example, can detect extremely dilute concentrations of chemical substances; to the ant, taste has shape; and insect eyes can distinguish patterns of polarized light in the sky.

For those who are interested in the current scientific theories concerning the methods by which animals find their way about the world, this small book is highly recommended reading.

Dr. Aronson is Chairman and Curator of the Department of Animal Behavior at the American Museum of Natural History.

THE OPEN SEA

- - - - - - - - by Alister C. Hardy

Houghton Mifflin, $6.50
335 pp., illus.

Reviewed by LIBBIE H. HYMAN

THIS authoritative and thoroughly scientific volume is a notable addition to books about the sea. From diatoms to squids, it covers the floating and swimming plant and animal life of open waters, except for most of the vertebrates. It is sumptuously illustrated with line drawings and delicate water-color plates by the author, and with photographs by Douglas Wilson of Plymouth Laboratory, famed photographer of marine life.

There are chapters on the microscopic plants and animals of the plankton (the author has specialized in this subject), on medusae, siphonophores and ctenophores, on floating mollusks and tunicates, on crustaceans from tiny copepods to shrimps, on squids and cuttlefish, and on larval life. A chapter on life in the depths is followed by a discussion of phosphorescence.

The text, giving anatomical, ecological, and behavorial information, is readable and interesting, as well as rigidly accurate.

Dr. Hyman is Research Associate in Invertebrates, Department of Fishes and Aquatic Biology, at the American Museum of Natural History.

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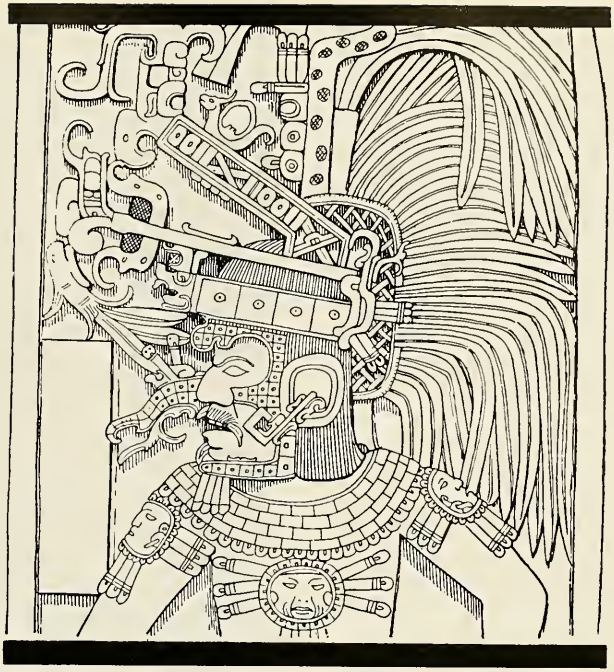

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Lion cub from *No Room for Wild Animals*

NO ROOM FOR WILD ANIMALS

- - - - - - - by Bernhard Grzimek

Translated from the German by R. H. Stevens Norton, $3.95
271 pp., illus.

Reviewed by LEE S. CRANDALL

THIS appealing book is an account of what should have been a prosaic trip to the Congo for the purpose of bringing back an okapi for the Frankfort Zoological Gardens, of which Dr. Grzimek (pronounced Jimek) is the Director. The author is not only an experienced veterinarian-zoologist but a keen conservationist as well. It is not surprising then, that the rapidly changing conditions in Africa, as they affect both the human and animal population, are treated in some detail before the final chapter sees Germany's first okapi safely landed at Frankfurt.

Dr. Grzimek takes a grim view of the future of the larger mammals of Africa—his first chapter is headed "Africa's Wild Animals are Doomed"—and he goes to some pains to support his point which, unfortunately, seems more or less well taken. Wild animals do still survive in Africa, but it is true that development of the land (sometimes ill-advised) for agricultural purposes and the encroachments of cattle grazing, are rapidly restricting them to the confines of the great reservations which, fortunately, have been established under the control of various governments.

This gloomy outlook might have meant heavy going for the reader but for a light and amusing thread of continuity provided by the constantly recurring vagaries of the motor truck in which Dr. Grzimek and his son Michael made the journey from

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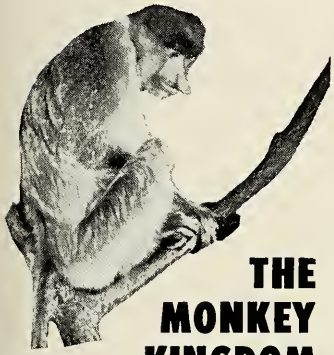

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Stanleyville deep into the interior. Encounters with various animals along the way lead to engaging accounts of their lives and histories, the discovery of the Okapi, for example, and the Congo Peacock, Dr. James P. Chapin's well-known find.

As in most translations, there is a gain and loss. English colloquialisms, sometimes British and sometimes American (strangely enough), which no German, particularly the scholarly Dr. Grzimek, would ever use, make for charm and easy reading. Unfortunately one or two errors have crept in. The European Bison is not extinct, as implied on page five, although the surviving remnant is held in reservations and zoological gardens. (Two pairs of young animals are now living in American Zoos.) But these small slips do not mar the interest and pleasure to be found in this absorbing account of animals and men in the Congo.

The reviewer is General Curator Emeritus of the New York Zoological Society's Zoological Park.

ARCHAEOLOGY AND ITS PROBLEMS

- - - - - - - by Sigfried J. De Laet

Translated from the French
by Ruth Daniel

Macmillan, $4.50, 136 pp., illus.

Reviewed by LOUIS DUPREE

SINCE 1950 the public has been deluged by popular books on archeology. These best sellers generally discuss important finds and the romance of exploring with a spade, but rarely show the mechanics of excavation. This thin volume by Professor De Laet (Ghent University), as the title indicates, goes into the *problems* of archeology and offers answers to the familiar questions: how does one know where to dig and how can one tell the age of a find?

The author includes in his discussion the academic qualifications and research necessary for undertaking field work; expenses and raising money; reconnaissance (including the latest aspects of underwater archeology); excavation techniques; preservation of specimens; dating of specimens; and, finally, both the limitations and the possibilities of archeological interpretation. He illustrates with recent discoveries the role of other sciences (geology, botany, nuclear physics) in dating and interpreting prehistoric finds. For example, in 1930 the stomach contents of a 2000-year-old corpse found in Tollund Bog near Jutland yielded new information on the diet of Iron Age man in Denmark. This man's last meal had been a porridge of cultivated and wild plants — indicating

continued on page 221

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ALFRED A. KNOPF
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Family Life of the ANTS

Marvels unimagined may be watched through a hand lens at your back door

By Neal A. Weber
Swarthmore College, Swarthmore, Pa.

Copyrighted photos by Lennart Nilsson
from BLACK STAR

PEOPLE throughout much of the world have been impressed by the activities of ants. The admonition of Solomon, "Go to the ant thou sluggard; consider her ways and be wise," referred to *Messor,* the conspicuous harvesting ants of Biblical lands, and alluded to their habit of gathering and storing seeds, as contrasted with the improvident locusts. In Aesop's fables is a similar story. The spectacular raids of the American army ants and the African driver ants, and the economically important activities of the leaf-cutting *Atta* have become well known.

Other domestic activities inside the nest are not so conspicuous. These remarkable photographs from the Swedish photographer, Lennart Nilsson, well illustrate details that are seldom seen and still less frequently photographed. Popular writers and the public may form new analogies with human societies, and the comparisons are indeed tempting. Here are shown obstetrical activities and co-operation among the workers of wood ants, *Camponotus herculeanus* or *ligniperda,* which result in successful egg-laying and emergence of the new worker from its cocoon. Here also you see *Formica* ants tending aphids, capturing insects for food, and attacking one another.

These things can be observed by anyone, and closely related ants are found in North America. *Camponotus herculeanus* and its relatives are the common wood ants, often found nesting in cabins in forested areas or in rotted wood that has been untouched for some time. Recently, when fire wood was being split in below-freezing weather, some of these big, black ants were exposed in a rotted knot. They were placed in a shallow glass container with damp sand, given a frosted cookie for food and then left alone. A few weeks later the workers were found to have laid many eggs and some of these had already hatched into small larvae. Had the queen been present the colony could have been continued indefinitely. The genus *Formica* is even more widespread, and common species of it nest in the soil, such as in one's own backyard.

To observe the ant world as Lennart Nilsson did requires patience. His skillful photography cannot be copied by everyone, but a good hand lens or magnifying glass will enable one to see for himself the organization and behavior of an ant society.

Egg-laying among ants is a social affair, and one or two worker ants may be useful obstetricians. The queen stands in the midst of her colony and may rest on a pile of older brood. Workers frequently come up to her, determining her condition by applying the tips of the antennae to her. It is the antennal tips that appear to be the primary sense receptors in some ants. In this case they are used to determine whether the skin is clean, whether foreign objects need to be removed, and whether movements of her abdomen indicate an egg is ready to emerge. After inspection with the antennae, the area may be

Since 1947 the author has been Associate Professor of Anatomy at Swarthmore. In 1950-52 he helped to organize a Department of Zoology in the College of Arts and Sciences at Baghdad, Iraq. In 1948, he accompanied the Central African Expedition of the American Museum of Natural History as its biologist.

He has studied the biology and habits of ants on four continents and has collected them in every state of the U.S., and from Alaska to Newfoundland.

▲ THE MOMENT OF "BIRTH" has arrived, and it is just as dramatic in the world of ants as it is in ours. Workers gather around the queen, and while others keep guard, they palpate the rear part of her body with their antennae. Every five minutes, a new egg emerges. Special nurses take care of the eggs as soon as they arrive.

well licked. When the egg emerges, or even before, a worker ant may be ready with antennal tips touching the orifice. As the egg slowly emerges a worker is ready to seize it. A *Cephalotes atratus* female observed on the island of Trinidad laid nine eggs in less than two hours. In the Swedish ant observed by Nilsson, workers gently pulled on the eggs as they emerged. Egg-laying may proceed much more rapidly in such ants as *Eciton* that have the abdomen (or technically the gaster) distended with eggs.

Recent work in Brazil and France with the *Atta* females show that two kinds of eggs may be produced. One type is larger and is used as food; the other is smaller and capable of hatching and growing into a new ant. In any event, it is common practice for ants to eat the eggs at the beginning of colony formation or at other times when food supplies are inadequate.

The eggs are handled gently. The powerful mandibular muscles that are capable of cutting wood are controlled so that the egg is hardly "dented" as it is held by the mandibular teeth. The eggs are thoroughly licked and may then be deposited in a pile. The fungus-growing ants may plant tufts of fungus mycelium on them and the eggs are soon encased in a veil of thread-like hyphae.

Eggs hatch into grubs or larvae which at first are the size of the eggs. The workers then bring food to them as they lie helplessly on their sides or back. Larvae are also licked and, again, in the fungus-growers they have a habit of "pouting" by partially extruding their mouthparts, which indicates to the workers that they are ready to accept food. The larvae are "felt" continually by the antennal tips, and their condition is thus indicated to the workers in the dark cells of the nest where eyes would be of no use.

A Silklike Cocoon

After a transitional pre-pupal interval, the next stage of development is the pupa. In *Formica* and *Camponotus* the pupa is encased in a cocoon of silklike fibers which the larva spins. Pupae of the largest group or sub-family of ants (the myrmicines) often lack a cocoon.

The new *Camponotus* pupa is white; as it matures it becomes dark in color. A pile of brood consisting solely of cocoons, as shown here, indicates that a number of eggs have been laid at approximately the same time and reached this stage together. The workers handle the cocoons at intervals and "feel" them with their antennae so that they would be aware of slight movements indicating maturity. Two workers stationed at opposite sides, pinch and feel a mature pupa, then tear open the head end. The head and underside of the thorax is first exposed by the growing tear.

▲ THE SMALLEST OF THE ANTS take on what is perhaps the most important job in the community. They are not big enough to fight or to build, but they have charge of the newly laid eggs.

▶ AS SOON AS AN EGG IS LAID, it is fetched by a nurse and taken away to the nursery. The jaws, which are otherwise used as a defense weapon, are surprisingly gentle when carrying the eggs. The eggs hatch into grubs, or larvae, which grow and encase themselves in cocoons of silklike fibers, such as are seen in the background here. This is the pupal stage. A *Camponotus* pupa is at first white. Later it darkens as the ant inside acquires pigment.

▲ WEEKS LATER THE COCOON is opened by the workers. They look as if they are gasping for air as they saw at the cocoon with their jaws, but this is not the case. First the head appears.

▼ IF THE WORKERS DO NOT HELP, the ant cannot emerge from its cocoon. It is now called a callow. It is being "felt" by all the relatives. Slowly it gathers strength to stand erect.

An antenna, then a leg may protrude as the new ant feebly struggles. With the workers tearing open the cocoon and the ant struggling inside, it finally emerges. Strands from the inside of the cocoon may adhere to the new-born, and these are pulled away by the attending ants. The ants "feel" it all over with their antennae and lick it while it is slowly gathering strength to stand up. It will be fed by a mature ant. In this process, the two ants put their mouthparts together below their mandibles and one forces liquid food out, presumably through contraction of muscles.

Change of Color

Ants emerging from the pupal stage are called callows and are markedly paler than mature individuals. In the mature ants of this *Camponotus*, the head and abdomen (gaster) are dark brown, the thorax reddish. Ants under unusual stimuli may open an immature cocoon, in which case an abnormally pale ant will emerge, and it will probably not survive.

In those ants with naked pupae, it is striking to see pigmentation gradually appear in what starts out as a snow-white individual. The eyes first become pigmented and may be quite black while the rest of the body is white. After this the body becomes a dirty white, then pale brown if the mature ant is dark.

The whole developmental period

from egg to adult takes about two months in the fungus-growers, and this is true of New Jersey, Panamanian, and Brazilian species. In northern countries, the female starts laying eggs early in the spring and by August or September only pupae may be found. It is unlikely that this brood is carried over the winter in most species, if indeed in any.

Valuable to Man

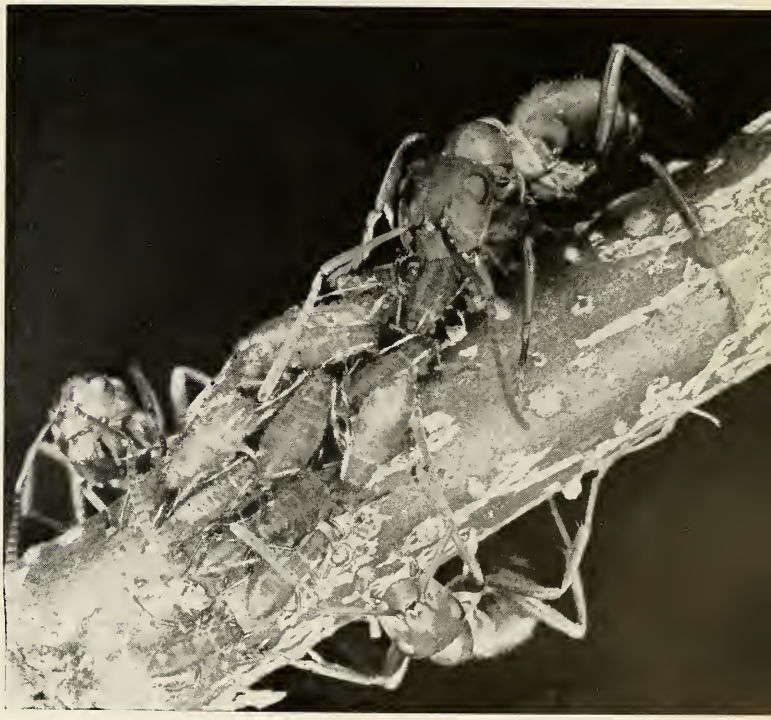
Ants are important insect eating animals. It is this habit that led Germany and Austria to pass laws protecting the large thatch nests of the forest ant *(Formica rufa)*. These ants are believed to be significant agents in keeping down the populations of insects harmful to the coniferous forests. A closely related ant, *Formica obscuripes*, was shown to bring to its nest large numbers of dead insects, including grasshoppers, in our own Middle West. The tropical army and driver ants feed primarily on insects and any other animals they can overcome.

Ants are shown here attacking a common adult chrysomelid beetle, whose larvae are found in the ant nest and are considered to feed on the ant brood. The ants swarm over the beetle, tugging at each leg and antenna, often pulling in opposite directions on opposite sides of the insect. The final effect is to dismember the beetle and tear it apart. Contrary to a common belief, the attackers do not act in what we would consider an "intelligent" and concerted effort. Because of their numbers and persistence, however, they can overcome a much larger animal.

Another widespread food of ants is the secretion of aphids or plant lice and their relatives, like the young of leaf-hoppers and coccids. These so-called "ant cows," feeding on the sap of plants, give off a sugary secretion, or honey-dew, that is gathered by the ants. The ants do indeed treat these insects like domestic animals and carry them from one place to another on the same plant. They may erect shelters of carton over them and take them into the nest over unfavorable periods.

One group of tiny, blind, and yellow ants found in the tropics is dependent on coccid excretions for food. They live underground, forming tenuous tunnels from root to root. When a female flies off on her marriage flight, she carries a plump coccid in her jaws. The coccids are often kept in the nest with the brood. The ant strokes the rear part of the coccid with its antenna, and the coccid may respond to the stimulus by omitting a clear droplet of the honey-dew, which the ant then imbibes. A remarkable photograph here shows one ant with the entire rear end of the aphid in its mouth. Some ants may feed so extensively on honey-dew that the abdomen becomes markedly distended. Extreme conditions are reached by these "honey-pots" of our South-

➤ THIS CHRYSOMELID BEETLE is the ant's biggest parasite. It forces its way into the anthill and lays its eggs there. Here the ants are swarming over the beetle, tugging at each leg and antenna in an assault that will ultimately tear it apart.



▼ SOME ANTS KEEP "COWS"—aphids, plant lice, leaf-hoppers, or coccids. The "cows" excrete a fluid that the ants use as nourishment. This remarkable photograph shows one ant with the entire rear end of the aphid in its mouth.

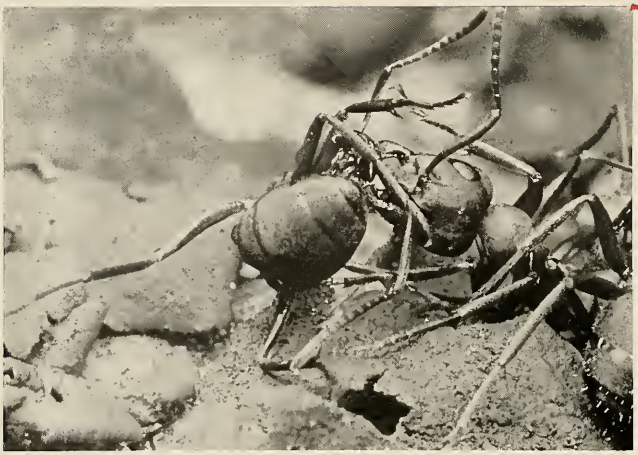
west and Australia. Such individuals may be a general source of food for the colony, regurgitating to any ant that applies.

Among the widespread afflictions of ants are mites. These minute arthropods take advantage of the concentrated number of individuals in an ant colony and feed either on the adults or the brood, or on food brought into the nest. They commonly ride on an ant, holding tightly by their legs, and transfer quickly from one ant to another as the two touch antennae or brush by. An ant may carry half a dozen at once. While the mites may feed on ant excretions, they have also been seen frequently to eat the food the ant may be eating, taking a position on the underside of the mouth where they can reach the food without leaving the ant.

Ant versus Ant

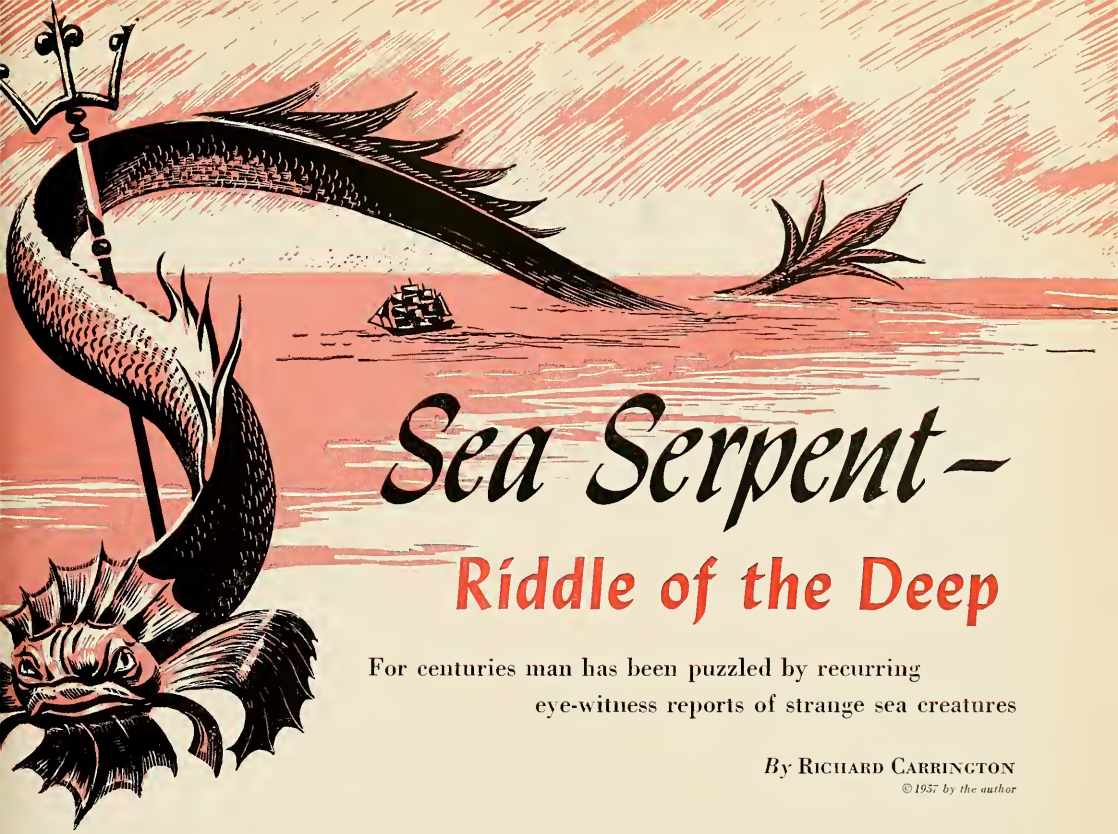
The greatest enemy of man is said to be man, and it is also true that ants fall prey to other ants. In Sweden as in northern countries generally, the reddish and brown *Formica sanguinea* preys commonly on *Formica fusca* and its allies. Both ants have a weapon in the form of formic acid, which they spray from poison glands at the posterior end of the ant. In combat, each of the two species may attempt to disable each other by a combination of biting and spraying. Spraying into the mouth has a paralyzing effect and may cause the recipient to fall over with its legs in the air and be at least temporarily out of action. When one ant pulls off an antenna, cuts off a leg, or in one case shown, cuts off the head, victory is clear.

Civilized man has always taken pleasure from watching ants at work. The temptation has been to infer that their societies are similar to ours. But they are in no sense similar in organization, and it is more fruitful to consider the ants as highly successful co-dwellers on this earth, rather than to worry about their supposed intelligence or lack of it.



◄ In mortal combat. The weapons of the ants are their mandibles, or jaws, in front and their spraying apparatus behind. Primitively, the ants had a sting with poison glands for spraying the wound, but in these examples the sting is absent. When one ant sprays into the mouth-parts of another, it has a paralyzing effect and the stricken ant falls over. The jaws are most effective when they can snip off an antenna or a leg, or damage one.

▼ An ant may keep on fighting with its abdomen cut off, but when its head has been severed as in this round, it is definitely *hors de combat.*



Sea Serpent—

Riddle of the Deep

For centuries man has been puzzled by recurring eye-witness reports of strange sea creatures

By Richard Carrington

© 1957 by the author

THE earliest historical mention of the sea serpent is in Aristotle's great *Historia Animalium,* written in the fourth century B.C. The hair-raising tales of classical authorities (probably based on travelers' tales of pythons and fishermen's reports of conger eels, or genuine water snakes) were borrowed and embellished by natural historians until well into the Middle Ages, when the sea serpents' main habitat seems to have been the coasts of northern Europe.

In the 1730's a new element began to creep into the sea serpent story. Instead of highly colored variations on a traditional theme, for the first time there were eyewitness reports by responsible persons. One such witness was a Norwegian missionary, Hans Egede, who reported in 1734 the following extraordinary incident which took place near the Danish colony of Godthaab on the Davis Straits, Greenland:

"On the 6th appeared a very terrible sea-animal, which raised itself so high above the water, that its head reached above our maintop. It had a long, sharp snout and blew like a whale. With broad, large flappers, the body was covered with a hard, wrinkled, uneven skin. On the lower part it was formed like a snake, and when it went under water again, it cast itself backwards, and in doing so raised its tail above the water, a whole ship-length from its body."

Born in England and educated in that country and France, Richard Carrington spent six-and-a-half years with the RAF during the war. He now is a free-lance writer specializing in natural history, with geology his main interest. *The Story of Our Earth* appeared in 1956, and his latest book, *Mermaids and Mastodons,* to be published this month, will contain the chapter on the sea serpent that is condensed and presented here.

This account, with the ring of a genuine observation, was followed 12 years later by another appearance of a monster in northern waters, this time between Trondheim and Molde on the Norwegian coast. This monster was different from that seen by Egede. As described by the ship's captain, Lorenz von Ferry, "The head of the sea-serpent, which it held more than two feet above the surface of the water, resembled that of a horse. It was grayish, and the mouth was quite black and very large. It had large black eyes and a long white mane, which hung down to the surface of the water. Besides the head and neck, we saw seven or eight folds, or coils of this snake, which were very thick, and as far as we could guess there was a fathom's distance between each fold."

Later descriptions of sea serpents often bear a family likeness to one or the other of these animals seen by Egede and von Ferry.

It has been suggested that what the Rev. Egede saw was a giant squid. The "head" would actually have been the tail part of the cuttle, as above. Below is a surface view.

▲ In 1734 the Norwegian missionary Hans Egede saw this "frightful sea monster" in the Davis Straits, Greenland.

With the dawn of the nineteenth century, sea serpent reports began to occur in better documented form, such as the episode of "the animal of Stronsa." The carcass of this famous monster was found in 1808 on sunken rocks off the island of Stronsa in the Orkneys. It was at once heralded as that of a genuine sea serpent. Excitement ran high, and a sworn deposition with measurements, a drawing, and several fragments of the corpse was sent to the Royal Museum of Edinburgh University. The Scottish naturalists rose nobly to the occasion. A paper was read to that distinguished body confirming that the animal of Stronsa was a creature previously unknown to science. All the writer's colleagues seem to have agreed with him, for no record can be found of a single dissenting voice. A few months later Sir Everard Home, the celebrated surgeon and anatomist of the Royal College of Surgeons in London, declared that, far from being an unknown monster, the animal of Stronsa was simply a large specimen of *Squalus maximus,* the basking shark!

The next sea serpent could not be so easily explained. It appeared in August 1817 in the waters of Gloucester Harbor, Massachusetts, and was the subject of a comprehensive report published by the Linnean Society of New England. The tale told by witnesses was as follows:

About midday on August 10, 1817, Amos Story was sitting on the shore of Gloucester Harbor when he saw about 150 yards away a strange animal with a turtle-like head projecting ten to twelve inches above the water. It was in view for an hour and a half, and at times exposed up to twelve feet of its total length. Story estimated that the animal was about as thick as a man and could move at the surprisingly fast speed of 30 miles an hour. It remained in Gloucester Harbor until August 23rd, before finally disappearing, and in the meantime other witnesses added many details to the somewhat flimsy sketch provided by Amos Story. Solomon Allen estimated the creature's length as between 80 and 90 feet, confirmed the reptilian appearance of the head, and added that the body appeared to be jointed from head to tail so that a series of humps or bunches rose 8 or 10 inches above the water. Epes Ellery and Matthew Gaffney observed that the serpent, if such it was, took no notice of boats or men, but seemed often to be indulging in play by making slow sinuous turns in the water. Even when Gaffney took a pot shot at it with his gun, its only reaction was to submerge for a short period. It reappeared 100 yards away and continued playing as before. Opinions differed as to whether its skin was smooth or scaly, but there was general agreement that the body was limbless and snake-like and exhibited the vertical sinuosities or humps first described by Allen.

A month or so afterward, a small black snake was found on the beach, and the suggestion was made that the sea serpent had laid eggs on the shore and that this one was one of its offspring. It was forthwith called *Scoliophis atlanticus,* or "the flexible snake of the Atlantic." The following year, the great French zoologist Henri Ducrotay de Blainville pointed out that the baby sea serpent was, in fact, a somewhat diseased specimen of *Coluber constrictor,* the common black snake. Rightly or wrongly, the Gloucester sea serpent was thenceforward consigned by most people to the limbo of classic fishing stories.

1848 Appearance

Now comes the most famous of all sea serpent yarns, the dramatic episode of August 6, 1848, witnessed by the captain and six members of the crew of H.M.S. *Daedalus.* According to the captain, "On our at-

tention being called to the object, it was discovered to be an enormous serpent, with head and shoulders kept about four feet constantly above the surface of the sea. And as nearly as we could approximate, there was at the very least 60 feet of the animal level with the water, no portion of which was, to our perception, used in propelling it through the water, either by vertical or horizontal undulation. It passed rapidly, but so close under our lee quarter, that had it been a man of my acquaintance I should easily have recognized his features with the naked eye. It did not deviate in the slightest degree from its course to the S.W., which it held on at the pace of from 12 to 15 miles per hour, apparently on some determined purpose.

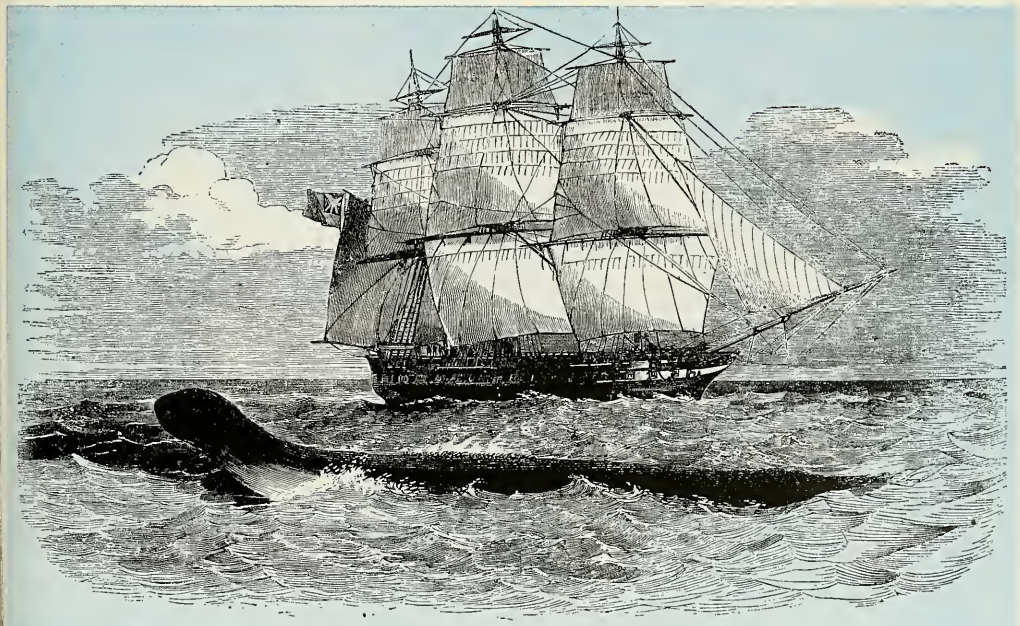
"Its diameter was about 15 or 16 inches behind the head, which was, without any doubt, that of a snake. It was never, during the 20 minutes that it continued in sight of our glasses, once below the surface of the water; its color a dark brown, with yellowish white about the throat. It had no fins, but something like a mane of a horse, or rather a bunch of seaweed, washed about its back."

Several Possibilities

A set of pictures of the serpent appeared in the *Illustrated London News* on October 28, 1848. These had been supervised by the captain himself, so their authenticity is beyond question. The report and pictures strongly suggested an unknown creature, and naturalists of the time proposed that this must have been a mammal, such as Anson's sea lion, or a sea elephant. Still, since sea elephants are less than 25 feet long, this explanation is not satisfactory, though it is doubtless true that many sea serpent reports are accounted for by seals, squids, whales, and porpoises.

The next instance of a sea serpent being noted from a shipboard occurred in 1893 in the Atlantic off the coast of French West Africa. In December, a large creature with a serpentine head and neck arose from the sea 400 to 500 yards away from the Natal Line steamer *Umfuli*. It was seen not only by the captain but by several passengers and members of the crew. The mate in the ship's log described the creature as a "Monster Fish of the Serpent shape, about 80 feet long with slimy skin and short fins at about 20 feet apart on the back, and in circumference about the dimensions of a full-sized whale. I distinctly saw the fish's mouth open and shut with my glasses. The jaws appeared to me about 7 feet long with large teeth. In shape it was just like a Conger Eel."

The next important appearance of a sea serpent was in view of two expert naturalists who were actually taking part in a scientific expedition. The episode took place in the winter of 1905 off the northeast coast of Brazil and was witnessed from the Earl of Crawford's yacht *Valhalla* by E. G. B. Meade-Waldo and Michael J. Nicoll, both of the Zoological Society of London. Here is the story in Meade-Waldo's own words: "I saw a large fin or frill sticking out of the water, dark sea-



▲ THE CAPTAIN and six members of the crew of H. M. S. *Daedalus* saw the above creature in 1848.

weed-brown in color, somewhat crinkled at the edge. It was apparently about 6 feet in length and projected from 18 inches to 2 feet from the water. I could see, under the water to the rear of the frill, the shape of a considerable body. I got my field-glasses on to it and almost as soon as I had them on the frill, a great head and neck rose out of the water in front of the frill; the neck did not touch the frill in the water, but came out of the water in *front* of it, at a distance of certainly not less than 18 inches, probably more. The neck appeared about the thickness of a slight man's body, and from 7 to 8 feet was out of the water; head and neck were all about the same thickness. The head had a very turtle-like appearance, as had also the eye. I could see the line of the mouth, but we were sailing pretty fast, and quickly drew away from the object, which was going very slowly. It moved its neck from side to side in a peculiar manner: the color of the head and neck was dark brown above, and whitish below—almost white, I think. . . . Since I saw this creature I consider on reflection that it was probably considerably larger than it appeared at first, as I proved that objects, the size with which I was well acquainted, appear very much smaller than they really are when seen on the ocean at a similar distance with nothing to compare them with."

Michael Nicoll's report added that the head and neck, which he estimated as being about 6 feet long, lashed up the water with a curious wriggling movement. He also compared the fin to a gigantic piece of ribbon seaweed, and added that every now and then it disappeared entirely below the surface. In his book, *Three Voyages of a Naturalist* (1908), Nicoll observed, "I feel sure that it was not a reptile that we saw, but a mammal. It is, of course, impossible to be certain of this, but the general appearance of the creature, especially the soft, almost rubber-like fin, gave one this impression."

Loch Ness Episode

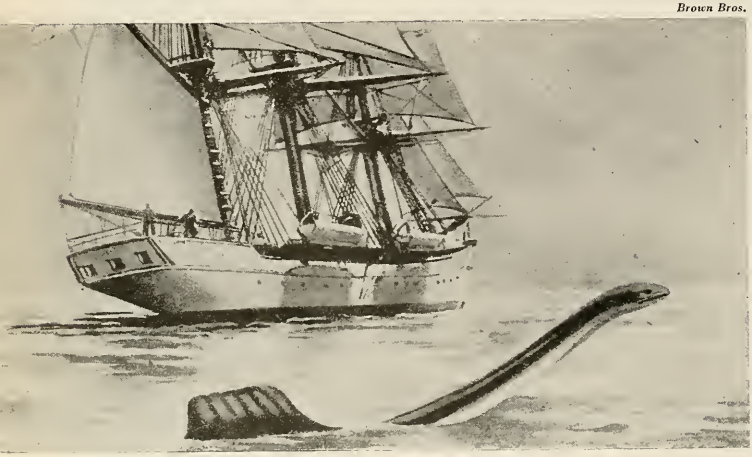
We come now to one of the most famous and, I regret to say, one of the most suspect, of the creature's many visitations — the Loch Ness monster. Reported during the summer months of 1933, it had become by October a major international sensation. There were articles, lectures, and broadcast talks, and the hotels of Inverness were crammed with representatives not only of the British press but of such unlikely journals as the *Osaka Moinichi* and the *Tokyo Nichinchi*. One enthusiast even offered, in the columns of the *Glasgow News*, to swim across the loch, "as a challenge to the Monster." Finally, in June 1934, the creature reached the pinnacle of its fame with the publication of a 228-page book by Commander Gould

entirely devoted to its doings. No sea serpent had received such an honor before.

Although the evidence in Gould's book is most painstakingly compiled, it is also extremely unconvincing. The only fact to emerge from the numerous reports is that a number of black humps were seen floating or moving at various speeds along the surface of the loch. Their number ranged from one to eight, and the witnesses agreed that they must belong to some large animal moving just out of sight below the water. Some people also claimed to have seen a long serpentine neck and small head emerge from the loch, which turned slowly from side to side, as if spying out the land, before sinking once more beneath the surface. This was sometimes seen alone and sometimes in association with the mysterious humps described above.

The really classic description, however, is probably that provided by Mr. and Mrs. G. Spicer who claimed to have seen the monster on dry land. On July 22, 1933, they were motoring round the loch in broad daylight when a most extraordinary animal crossed the road in front of their car. It had a thick body without any sign of legs and a long neck which undulated up and down "in the manner of a scenic railway." It was gray and it moved in a series of jerks. On the forepart of its back it appeared to be carry-

Brown Bros.



◄ TWO SCIENTISTS witnessed the 1905 appearance of the "sea serpent" from the yacht *Valhalla*.

AMNH

THE 30-FOOT OARFISH (left), sometimes called the Sea Serpent Fish, probably accounted for many of the tales of sea serpents. Compare below, a "Sea Serpent" found in Hungary Bay, Bermuda in 1860.

Culver Service

ing a small lamb, young deer, or other animal. The head was not observed, but Mr. Spicer likened the general effect of this astonishing apparition to a huge snail with a long neck.

Sea Serpent on Land?

Mr. Spicer's story, at first regarded as a hoax, was confirmed in startling fashion by Arthur Grant of Edinburgh, who some six months later claimed that an animal closely resembling Spicer's had loped across the road in front of his motor bicycle. This occurred at night, but in the moonlight he was able to make out the details of the head. This was like that of an eel, with large eyes set high up toward the crown. He also observed that the animal had strong front flippers and a rounded tail. It was black, about 18 feet in length and moved by arching its back on front and hind flippers alternately.

This description, combined with that of Spicer and those of witnesses who had seen the animal in the water, gives us such a clear and unmistakable picture of one of the Phocidae, or true seals, that it seems almost impossible that the Loch Ness monster could have deceived the public for so long. This seal, probably a large specimen of the common seal, *Phoca vitulina,* must have entered the loch by way of the river Ness sometime in the spring of 1933. After nearly a year it probably returned to the Firth of Beauly and thence to the open sea by the same route. Admittedly some observers of the monster report it to have been much larger than the usual run of seals, and there are several slightly different versions of its color and shape. In my opinion, however, there is not one of these that cannot be accounted for by tricks of light or faulty estimation of measurements. It is also most probable that some of the reports refer not to the seal at all, but to other mammals such as otters, or even to water birds or floating tree trunks, which untrained and expectant witnesses might easily transform into mysterious and sinister forms. I feel then we must discredit the Loch Ness monster as a genuine sea serpent.

Although, as was suggested earlier, squids and other known but unrecognized animals can account for many alleged appearances of the sea serpent, they cannot account for all. What explanation are we to give, for instance, of the New England serpent or the creatures seen from the *Daedalus,* the *Umfuli,* and the *Valhalla?*

A popular explanation of the sea serpent is that it may be a survival of one of the great sea reptiles of the Mesozoic Age. The nineteenth-century naturalist Philip Gosse was a great supporter of this theory, and in *The Romance of Natural History* he examines the evidence and comes to the conclusion that there is no *a priori* reason why a descendant of the Mesozoic reptiles should not have survived and attained the

continued on page 222

24,600 YEARS AGO the glacier overrode the location of Cleveland, as indicated by driftwood doted by the Carbon 14 method.

18,000 YEARS AGO it must have reached southwestern Ohio, because the trees it snapped off date that period.

ABOUT 13,000 YEARS AGO the ice la north of Detroit, judging from peat an driftwood it left in its woke.

Moving Picture of the Last Ice Age

Dating by Carbon 14 makes it possible to fill in some of the details in the last invasion of the United States by glacier ice

By Richard Foster Flint
Professor of Geology, Yale University

EVERYONE knows that the Ice Age was a period measured in hundreds of thousands of years, during which continents and seas were cold and glaciers covered a third of the world's land. Hairy elephants and woolly rhinos roamed the northern tundra, and in the latter part of the Ice Age, primitive people of Asiatic extraction hunted elephants and bison with quartz-tipped javelins over much of North America. Today, the gently rolling country from Ohio to Montana is largely covered with earth and stones left by the ice, a deposit whose rich soils yield a big piece of America's agricultural wealth.

But not so many realize how close the Ice Age is to our time—at least the most recent part of it. It is so close, in fact, that Lake Michigan and Lake Huron were half filled with glacier ice barely 10,000 years ago, only about half again as long ago as the beginning of the civilization in ancient Egypt.

The startling recency of this huge change in the map of North America has been fixed by Carbon 14 dating, a method of time calculation that was unknown ten years ago. By measuring the amount of radioactive carbon in a sample of wood, peat, shell, or other organic substance, we can determine the amount of time that has elapsed since the death of the plant or animal of which the sample was a part.*

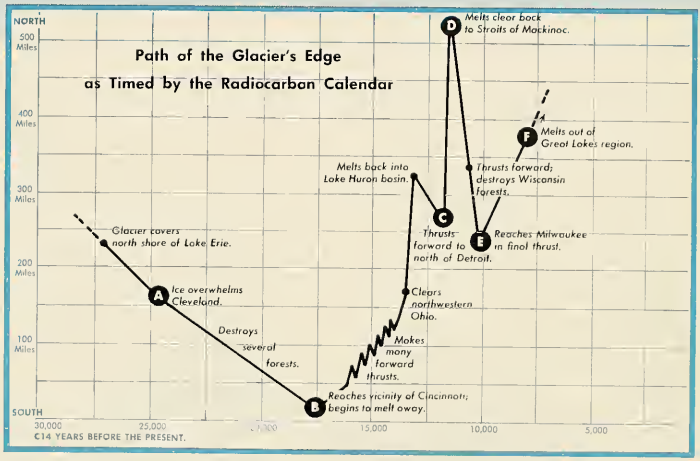
The original purpose of Carbon 14 study was quite other than dating. But soon after this special form of carbon was discovered, scien-

*See: "The Radiocarbon Clock," Natural History Magazine, vol. 60, 1951, p. 200.

12,000 YEARS AGO it melted out Strait of Mackinac, according to reasoning.

ABOUT 10,700 YEARS AGO a final forward push carried it to Milwaukee. Destroyed forests again are the evidence.

BY 8,000-8,500 YEARS AGO the ice was nearly out of the Great Lakes. It never went far south again.



tists realized the magnificent possibilities of using it as a clock, or rather a calendar. Since 1950, thousands of samples have been dated by this method. These dates make possible a "moving picture" of the latest invasion of the United States by glacier ice. The picture is a bit jerky and contains holes and gaps here and there, but it is basically reliable. To put the moving picture together, we must know more than merely the dates of many samples. We must also know the exact relation of each sample to the invading glacier, whether it comes from the glacial deposits themselves, from a lake dammed by the glacier, or from a bog formed in a basin left when the glacier melted. Most samples are logs or bits of wood, the wreckage of spruce forests bulldozed by the advancing wall of ice as it plowed relentlessly across the Great Lakes region. Other samples are bits of driftwood washed up on the beaches of glacier-dammed lakes and covered with sand. Still others are peat that began to accumulate in damp meadows as the melting glacier uncovered the country.

Putting together the results, we get the maps shown here and the time chart adjacent. They show the sheet of glacier ice invaded Ohio, Indiana, and Illinois around 25,000 years ago, snapping off the trees of spruce forests like matchsticks and smearing the wreckage with earth that formed the foundation of today's soil.

Around or shortly after 18,000 years ago, a warmer climate gained the upper hand. The glacier, having reached the Mississippi River and southward almost to the Ohio, then began to melt. During melting, the climate turned colder twice, giving the glacial sheet two more chances to gain ground. The result was that forests that had grown up in areas abandoned by the melting ice were once again destroyed. In its last thrust, the ice came down as far as Milwaukee, Wisconsin, and Saginaw, Michigan. Thereafter it shrank away from the United States and most of Canada. Today it remains in strength only in Greenland and parts of Ellesmere and Baffin Islands.

So, by scientific methods undreamed of ten years ago, scientists are piecing together the latest of a series of events that have worked great changes in the surface of North America. If human beings witnessed these changes (and those primitive mammoth-hunters certainly saw conditions very different from those of today), they undoubtedly thought that it was a permanent state of affairs. Indeed, educated people have only in recent decades gained precise knowledge of how extensive the changes have been. Today, there is no longer any doubt that climates do change and that this bulldozing of the Great Lakes region by a vast ice sheet is only the latest of several such invasions. Some day we may know enough to tell whether or not still another cold era is in store for the world.

Richard Foster Flint is Professor of Geology at Yale and has been active in furthering the application of radiocarbon dating to Pleistocene geology.

FAR ahead, hazy in the heat waves and elongated out of all proportion, lay a gray smudge that Sam announced was Cotton Cay. "When we get there," said he, pointing with his pole, "we maybe hear the fillymingos." "And see them, too?" I asked. Sam scratched his head beneath the band of his well-ventilated Bahamian straw, as if invoking deep thought. "Maybe yes, maybe no," he said doubtfully. But it was fairly clear from the beginning of my survey of the flamingo population for the Audubon Society that the largest surviving group of these birds would probably be found here in the isolated backwaters of Lake Rosa in the West Indies.

Not long after this we sighted a few small and far-off files of flamingos, outriders of the colony, flying one behind another in an easterly direction. As the numbers of these increased Sam could scarcely contain himself. "Them is sure 'nuff goin' straight into the nestes!" he exclaimed, nearly dancing with excitement. "We find 'em sure, we find 'em sure!" The lake had narrowed, and as we approached Cotton Cay, the outline of the horizon to the east was broken by the tops of black mangroves and tropical buttonwoods on Long Cay and the unnamed spits and shorelines of the Upper Lakes region beyond. Then, about eight

Few have seen this confused fandango of tightly-packed birds, surging and swaying like one great, red, many-legged creature

Flaming

Copyright 1957 by the author

o'clock, as we were wading laboriously, pushing and shoving our way through jagged coral rocks close to Cotton Cay, Sam heard a new sound and raised his arm for silence. We stood as we were, poised like a pair of sun-blasted statues. In a moment I, too, could hear it, a rumble of distant sound, low and high at once – pulsating – rising until it was clearly audible, then falling until the ear almost lost its vibrations in the murmur of the wind. His broad face turned toward me, radiant with pleasure, Sam anticipated my own words. "That's 'em!" he cried. "The Lord be praised! That's th' fillymingos!" Hauling the now useless skiff up on a dry rock, hastily securing its painter and grabbing the water jug, he started walking rapidly toward the east, his muscular legs swishing and splashing through the warm, salty water. Equally excited, I scrambled along in his wake.

Now and again we stopped to listen. The sound soon became a distant uproar—a din, a clamor, a constant and prolonged uproar. Now it seemed high-pitched and toneless, the sort of sound that can only be made by the dissonant unison of thousands of voices. Still, we could see nothing, except the now more frequent and more lengthy strings of flying birds, their long slender necks stretching out in front and their equally long and slender legs out behind, so that each bird seemed like an animated spear hurtling through the air. When they passed close to us these swiftly-moving lines honked much like flocks of geese, but we scarcely heard them against the growing volume of sound in the background.

Soon Long Cay lay behind us, and the sound of the flamingo multitudes on ahead was suddenly louder. We hastened on, greatly encouraged and in a rage of excitement, until at length we came close up against another barrier of low trees. As we drew near to them, Sam all at once grabbed me by the arm with one hand and with the other pointed off toward a break in the vegetation about a half mile farther on. Openmouthed, we stood and stared in silence. Through the thin screen of brush we could see a solid band of red. It shimmered and undulated in the heat exactly as if it were a long sheet of flame. I thought at once of Frank Chapman's classic account of a similar view of these birds, a half century before on Andros Island. "It was an appalling sight," he wrote. "One of the boatmen said it looked 'like hell,' and the description is apt enough to be set down without impropriety."

ove Dance

By ROBERT PORTER ALLEN

Drawings by Matthew Kalmenoff

SINCE 1930 Robert Allen has held various positions with the National Audubon Society and is now research associate with that organization. He is an outstanding authority on rare North American birds and on the behavior and distribution of wading birds. He has written widely on these specialities, and the present article is a condensation from a chapter in his latest book, *On the Trail of Vanishing Birds* (McGraw-Hill) which will appear this month.—ED.

S. F. Briggs photo from National Audubon Society

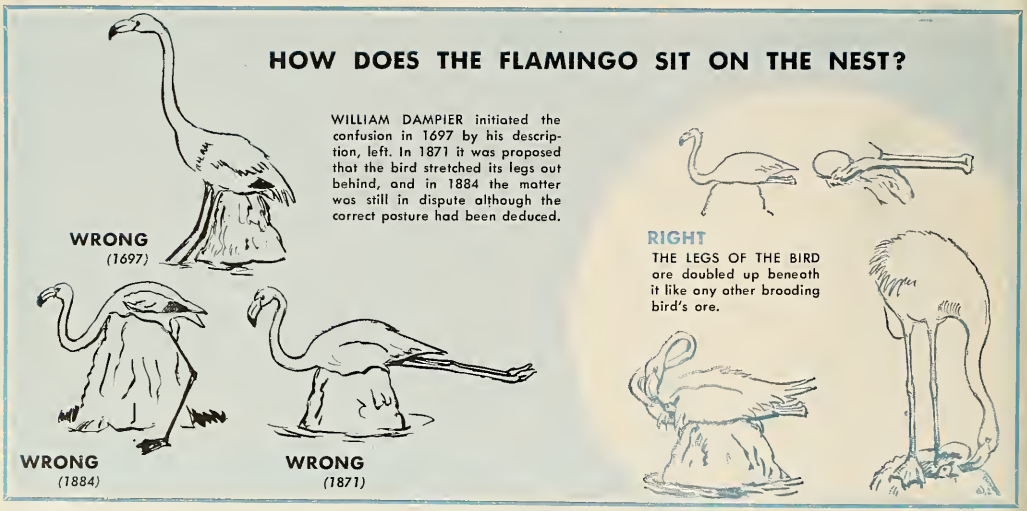
↑ THE AUTHOR and colleagues set out for the nesting grounds.

Knowing only that this moving mass of red must be a great assemblage of flamingos, we walked rapidly ahead until we had reached the shelter of a narrow growth of low trees. There we flopped on our bellies and stared out across the large pond wherein the flock was congregated. I guessed that there were well over 1,000 flamingos in the group, but they were packed so closely together—literally shoulder to shoulder—that it was difficult to judge. There might easily have been more than twice that number. They moved this way and that, without obvious purpose, like a hysterical and leaderless mob. Tightly packed as they were, and with every individual jostling his neighbor and all of them jumping about like madmen, the outlines of the flock ebbed and flowed, as if it were molten, red-hot lava. Here and there we could see taller, redder heads and necks of the older male birds, riding high above the crowd and bickering with other birds close to them in what appeared to be a frenzy of emotion. These outbreaks rose to a fever pitch and then abruptly subsided. It seemed to be these larger flamingos that set up pressure, first to one side then to the other, so as to keep the entire flock churning about so furiously.

From so close at hand the din was frightful, every kind of flamingo sound—honks, cackles, groans, high froglike notes—issuing forth in one grand, overwhelming chorus from more than a thousand throats at once and without end. I was not only stirred to my depths by the spectacle itself, but I felt at almost a complete loss. Eyes and ears were not enough to take it in. Now the whole body of birds churned still closer to our hiding place, bearing down on us as if the entire flock were a huge, many-legged creature, a thing of cohesive living tissue, fluid and unpredictable. Then it moved off, nearly across the pond from us, swelling and receding, sinuous necks waving and thrusting along its rim and black wingtips flashing as if to remind us that, after all, this was only a flock of birds.

Long Vigil

We watched until the sun was high in the heavens, until, at length, the birds appeared to have exhausted themselves or had gradually lost interest and scattered to other parts of the lakes. Only then did we realize how hot it had grown and feel with real discomfort the



bites of the maddening little mosquitoes that lay in wait in every shady spot. Aware from what I had seen and from what Sammy told me that nest building had not yet started, I agreed that we should retrace our steps and return to the settlement for the time being.

The Upper Lakes, probably because of their greater isolation, have long been an important nesting area for the flamingos. They are quite distinct from Lake Windsor but, like that larger body, are supplied with fresh sea water by the movement of tides through breaks in the bottom, or floor, of each of them. With no other inlet or outlet, plus the rapid evaporation of that hot, windswept climate, the salinity will average about twice that of normal sea water. As in the big lake, this salinity factor may limit the number of species that can exist in such an environment, but it does not necessarily limit them numerically. Certain microscopic organisms – diatoms, dinoflagellates, rhizopods, bacteria of several kinds, nematode worms, immature mollusks, and other forms—may be astonishingly abundant.

These conditions result in a specialized group of birds that can exist within such a restricted habitat. Again, these are limited as to species but not as to quantity. There are stilts, egrets, herons, and others that feed on killifishes and aquatic insects, but the prime example is the flamingo. It may crowd into the Upper Lakes at the

S. F. Briggs photos from National Audubon Society

▲ Robert P. Allen goes native on the trail of the elusive flamingo in Yucatan.

▲ The flamingo is a salty creature if ever there were one. Its food consists of mollusks (which it swallows whole), insects, fish and algae. It also eats mud for its high organic content.

▼ When an egg begins to hatch, one or both parents stand by, ready to administer the first feeding, which consists of regurgitated liquid food.

start of the breeding season in vast multitudes that, even in recent years, have approached 10,000 individuals, the largest assemblage of this species that now survives anywhere. These great flocks quit the nesting lakes when the young are able to fend for themselves, leaving the remaining food supply to their growing offspring. Nor do they generally occupy the same breeding site two years in a row. There are too many of them, and their demands as to daily supplies of food are too great. The whole pattern seems to be beautifully worked out.

Brown from National Audubon Society

↑ THE AUTHOR with his friends at a campsite near Upper Lakes, Inagua.

Through the winter months the Inagua flamingo flocks have been content to feed and rest in leisurely fashion in the coastal ponds and lagoons away from the big lake. They are more vulnerable near the shore, for it is easy to reach most of these places by boat from the sea, but the flocks are scattered and wary, and little harm can come to them. They are not tied down to any one spot, as is the case at nesting time. Then March arrives, pregnant with change, bursting with the promise and the challenge of the vernal equinox. Within the birds themselves progressive changes also have been taking place. Restlessly they begin to move about more and to show signs of involuntary reaction to an inward pressure. What has been called "the hereditary clockwork of the population" is now rhythmically ticking off the minutes of a new phase in the cycle. To the histologist each stage in the physiology of this cycle is measurable—the changes can be interpreted by weights, graphs, metric scales, and photomicrographs. To the ethologist, who studies the psychological aspects, each stage is a series of related behavior patterns and innate releaser mechanisms. To the poet and the unabashed lover of nature, each shifting scene is one of increasing beauty and wonder. All of these together are like mirrors reflecting some small part of the normal development of a reasonably complex organism. This organism—the flamingo—is reacting quite naturally to the well-ordered machinery of its own specific identity, within the particular environment that it has won for itself by its long struggle for existence. Perhaps the most remarkable thing about all this is its perfection. Hundreds of infinitely small parts—physiological, psychological, environmental—must fit together smoothly, consecutively, purposefully. And more often than not they do, with survival the aim and the net result.

Pre-nuptial Dance

On the first morning of my first visit to Inagua, we had happened to stumble on the performance that is perhaps the most intriguing in the flamingo's entire repertoire. It was March, the season when these birds usually begin the involved quadrilles and cotillions that lead to courtship, and eventually, to what W. S. Gilbert, in the guise of "Bab," once referred to as "connubial fondlings and affectionate reciprocities." The wonderful confusion I saw that first morning became even more wondrous when, on another trip, I observed it with less fluster and more understanding.

As we came to the last fringe of trees between us and the gathering flocks, we could see that many new arrivals were funneling into the very core of the great red mass of birds already on the pond. From the high-pitched "*eep-eep, eep-eep*" of their voices, from their smaller proportions and slightly paler plumage, I assumed that most of these milling birds were females. To one side, in several closely ordered companies, stood the undoubted males. They strutted even when standing still, long, deeply red necks held straight and tall, heads raised so that the mandibles were thrust upward, arrogantly. Now and then they would turn their heads halfway around, stiffly, almost mechanically, always to the left. First one male would turn his head quickly to the left—pause—then back to the front again. Another male immediately followed suit, then yet another, until all of them were engaged in this behavior. These head-turnings were never in unison, but jerky, nervous, fitful. I felt a desire to shout, "All right now, boys, when I say the word let's all turn our heads together!"

The head-turning was often followed by another and more complicated male display in which the wings, with primaries held close together, were flicked upward to their full extent, held there momentarily, and then smartly lowered. As the wings came down, the bird rapidly twisted his long neck downward, so that his head, thrust backward, brushed sidewise across his back feathers. The entire performance seemed to say, as effectively as if spoken in so many words, "Behold! I am a male!"

Throughout all this, the females alternately milled about in massed formation and, after reaching a violent and deafening peak of both

sound and movement, gradually broke off and reverted to a seemingly unconcerned and probably simulated feeding activity. Then, perhaps in response to a renewed stimulus from within and the visual promptings of the performing males, the milling began again, in another sector of the pond, and again the scene was one of sound and flurry.

Flocks of both males and females were still coming in, the males forming remote little troops of alert, stiff-necked observers on the fringes of the pond, the females either joining the hard mass of dancing birds directly or dropping into the shallows some distance off and then walking slowly, in single file, toward the demonstrators. Suddenly, just as one of the female performances had broken up, several males rose and flew in wide circles over the now scattered flock. As they made several turns the circles grew progressively tighter and tighter. Beneath them the hubbub was resumed, with the low, gutteral voices of the males joining in, "*cak-cak! cak-cak! cak-cak!,*" until the whole volume of sound reached distressing proportions. As the males settled into the pond, the excited females now moved toward them, as if pulled inward by a powerful magnet (as indeed, in one sense, they were), until the males, their heads thrust high above the entire assemblage, were in the center of a closely packed, weaving mass of birds. When this demonstration reached its peak and broke off, another company of males arose, circled the flock, and came down to set up a second center. This was repeated until the massed flock, in a final moment of hysteria, had become a creature with several nuclei, of wheels within wheels, each an island of upthrust male heads in a moving sea of paler backs and lesser necks, necks that were lowered in modest, almost demure recognition of the momentary importance of the male of the species.

Gorgeous Plumage

At no other season is the tall male so wonderfully feathered, or so deeply and brilliantly colored. The graceful plumes that extend beyond his tail, curving elegantly, are never so long or so scarlet as now. The yellow and orange of the bill is never so bright as at this time. Even the black at the tip of the mandibles is more glossy than it will be later on. And his bearing is something you will see only during this period. He is like a very dignified gentleman who is all dressed up for an exceedingly festive occasion, but has had one glass of punch too many and so is striding about with exaggerated care, as if walking on eggs. Nor can the more modest female be overlooked. She, too, is more beautiful than at other seasons, but she is a trifle smaller and a trifle less brilliant than the male, while her behavior, except for the excusable frenzy of the dance, is quite unassuming, and never ostentatious, or vain, or overbearing.

Once the birds are gathered and the quadrille gets under way, it is apparent that the males act in their own masculine way, and the females after their fashion. They are now readily distinguishable as to sex, whereas at other times, without the emphasis of certain adornments and of specific and unusual behavior, the sex of an individual might not be evident and, for that matter, at such a time, would be of no particular consequence. In addition, pairing off can now follow quite naturally and relevantly. All this leaping and milling about stirs responses that serve to push each individual over the line into an ecstatic state of things that will carry them through courtship and connubial bliss. Then, as the peak of this phase is passed, other objects and other patterns take over—the egg-bearing female, the nest mound, the newly hatched chick—and these release still other manifestations, so that, unless broken off by outside disturbance, the cycle gradually unfolds and step by step is ultimately completed.

S. F. Briggs from National Audubon Society

▲ FLAMINGO CHICKS look remarkably like young geese. These are from 25 to 30 days old. Such a milling swarm have lost all individual identity and are fed and cared for as a unit; adults feed the nearest or most insistent chick.

A YOUNG BRIDE in all her finery. Before a Newari girl marries, she participates in a form of wedding with the fruit of the wood-apple. This marriage is considered divine and is permanent and indissoluble. Earthly marriage is a subsidiary and voidable contract.

the Valley of Nepal shows

The N

THE casual visitor to the Himalayan kingdom of Nepal is usually under the impression that the country is inhabited solely by Gurkhas and Sherpas. Yet when his twin-engined Dakota airplane touches the small airport near the capital city of Kathmandu, after an exhilarating flight between the peaks that line a pass leading into the central Valley of Nepal, the first Nepalese he meets are neither Gurkha nor Sherpa.

The Aerodrome Officer who stamps his passport, the little boy

◄ THE MAIN SQUARE of Patan. The high copper-gilt statue is of a former Malla king. The Mallas divided the Valley of Nepal into three unfriendly principalities. In 1769, these were conquered by an ancestor of King Mahendra, who was crowned last year on May 2.

▼ THE ANCIENT COSTUME of the Newari men is today limited to certain orders of priests, as seen here. The man with the censer who is leading them is a layman.

nown, the oldest and most numerous ethnic group of cultural ties with the Mongoloid peoples to the east

ars of Nepal

By FERDINAND E. OKADA

who is struggling to carry his suitcase, and the taxi-driver urging him towards an ancient touring car, dating from the late 'twenties, are all Newars. They belong to an ethnic group of which many people have never heard.

The Newars are but one of ten or twelve former tribal groups that today comprise the Nepalese population. Their origin is obscure, but a Mongoloid affiliation is indicated. Their distinctive language, the only indigenous language of Nepal that has a literature of its own, is of Tibeto-Burman stock. Though intermarriage with Indo-Aryans has tended to blur physical characteristics, many Newari babies are born with the so-called Mongoloid spot, a blue patch on the skin at the base of the spine, which disappears within a few months after birth.

Two customs reminiscent of the Orient may be mentioned in passing: Newar women carry their babies on the back rather than on the hip as in India. And the Newars are the only people in Nepal who carry loads in a *karpan,* that is, in two baskets slung on ropes at either end of a pole over the shoulder. Because of this, other Nepalese refer

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Dr. Okada is now an instructor in the American Museum's Department of Public Instruction.

▲ MORNING in the Newari town of Patan, one of the three largest communities in Nepal.

▲ NEWARI PEASANTS turn the soil with a heavy short-handled hoe. The clods are later pulverized by women using wooden mallets.

to them by the rather derisive nickname of *karpane*.

The Newars, on the other hand, call the non-Newars *parbate*, "hillmen," and the term reflects the long association of the Newars with the Valley of Nepal, dating back probably 1,500 years according to documentary evidence. Archeology may push this date back at least another 1,000 years.

Art and Architecture

The Valley is, indeed, a monument to Newari culture. Its soil was, and still is, laboriously turned by Newari cultivators using short-handled hoes. The Newars built the more than 2,700 temples and shrines that dot the Valley, and it is claimed that they developed the pagoda style of architecture usually associated exclusively with eastern Asia. It is to the labor, skill, and aesthetic sense of the Newars that we owe the embossed plaques, statuettes, and effigies of burnished brass and copper-gilt, the stone sculptures that embellish the temples, and the riot of intricately carved window decorations, door posts, lintels, eave supports, and bridge struts. These are the things that give the Valley its distinctive appearance and medieval atmosphere.

The Newars, therefore, are to be considered the aboriginal inhabitants of the Valley. In historical times at least, they have been ruled by a succession of Indo-Aryans, some of whom, such as the Mallas, became so assimilated that they are considered high-caste Newars today. The Mallas divided the 300 square miles of the Valley into three mutually hostile principalities. This disunity resulted in their being conquered in 1769 by Mongoloid hillmen from the district of Gurkha (hence the popular and generic name of Gurkha for the Nepalese). The leader in this conquest was Prithvi Narayan Shah, the Indo-Aryan ancestor of the present king. He unified the Valley and adjacent areas, thus laying the foundations of the modern state of Nepal.

Perhaps two-thirds of the Newars are Buddhists, either Mahayana or

A NEWARI YOUTH wearing the rice paste marks that indicate he has been to worship at a temple.

THE PAGODA STYLE of architecture, generally associated with the Far East, is claimed as a Newari development. This temple, dedicated to the Hindu deity Ganesh (the Elephant God), is typical of the many that dot the Valley. Its topmost roof is of copper-gilt.

SPINNING in the streets of Patan. The hair-do at left is a Newari style that is giving way to braids and pigtails.

Hinayana. The remainder are Hindu. The majority of the people, however, do not really distinguish between the two religions. A number of the temples, for instance, are sacred to both groups, since the same deities are called by one name by the Buddhists and another by the Hindus. A special form of this synthesis of religions is called Vajrayana, combining elements of Tantric Hinduism with those of Mahayana, or Lamaist, Buddhism. But whether a Newar considers himself a follower of Tantrism, a Hindu, or a Buddhist of either Mahayana or Hinayana leanings, he is first of all a Newar. Ethnic solidarity overrides all considerations of religion or caste.

The caste system was brought in by the Indo-Aryans, and the Newars are now considered as one of the castes of Nepal. They are, however, further subdivided into some 70 groups, mainly on the basis of reli-

gion and occupation. In contrast with India, there is a certain amount of intermarriage between subcastes (in which case the child belongs to the mother's group) and even between castes. A new major division, Khatri, has in fact arisen as a result of marriage between Newars on the one hand and non-Newar Brahmins or Chettris on the other.

Still Predominant

The Newars are today still numerically preponderant in the Valley. The biggest towns in Nepal next to Kathmandu — Patan and Bhatgaon — are centers of Newari culture. As traders and merchants, the Newars are to be found living all over the country in every community of any size. A newspaper in the Newari language is now published in Kathmandu, and of the seven cabinet ministers appointed in 1956, four were Newars. Because the Valley was, and is, the center of Nepalese culture and government, the history of the Newars is essentially the history of Nepal.

▲ A COPPERSMITH displaying a type of helmet that is worn by the highest order of Newari Vajrayana priests.

▲ IN NEPAL, only the Newars carry loads by this method, reminiscent of the Orient.

▼ A NEWAR of the *Jyapu*, or peasant subcaste.

A Moth THAT LIKES COMPANY

By Ralph J. *and* Mildred L. Donahue

▲ Three groups of larvae on a dew-covered leaf, showing the circular formation in which they fan out as they feed.

The larvae of the American Procris moth show devastating patterns of behavior when they strip a grapevine of its leaves, but they meet their match in the soldier bug, who has a built-in soda straw

OTHER insects feed on wild and cultivated grape leaves, but the one known as the American Procris moth *(Harrisina americana)* is perhaps the most interesting in behavior and development. These moths are with us every summer, but they are not well known to the casual observer because their wingspread is less than an inch and they are seldom attracted to lights. They are seen on Virginia creepers as well as on grape leaves.

After overwintering in hidden cocoons, they begin to emerge and fly about toward the latter part of June. They seek mates and suitable leaves on which to lay their eggs. If the emerging young did not have food to their liking, they would die. The eggs are somewhat rectangular and translucent green.

Within a few days, these "square" eggs begin to hatch, releasing tiny

pale green larvae, which are about twice as long as the shell-prisons they have left. Without delay, they begin to feed on the leaves. They range themselves side by side as they dine and fan out slightly as they advance.

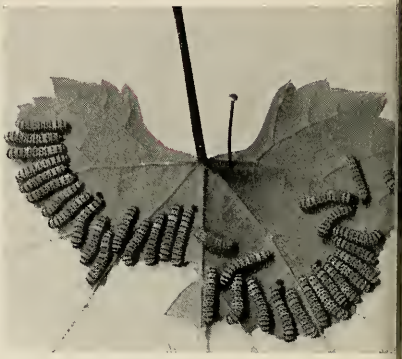
Each of these creatures seems to prefer the company of its own group. When two groups approach each other head-on, they turn aside and do not mingle. You will know when you have found a group of these larvae, because they are the only gregarious ones that feed on grape foliage in the region between the Great Plains and the Atlantic Ocean.

At first, they forage in a circle around the spot where the eggs hatched, moving forward as they feed. Finally, they abandon the denuded leaf by way of the stem. This forces the formation to be broken up, and after the general mix-up that follows, they never reform in the same pattern. From that point on, the plan of feeding is again side by side but in reverse. The larvae go to the outer edges of the new leaf before starting to eat, and then, facing outward, they retreat back toward the stem as the leaf disappears.

At first, they consume only the most tender portions of the leaf, leaving the network of veins and ribs untouched. The leaves of the grapevine thus take on something of a crowfoot design. Later, as the larvae grow larger, they seem willing to eat anything they find, and when they depart, they leave only fragments of greenery adhering to the stem.

However, the life of the larval Procris is not all grape leaves and community dining. As they grow, the caterpillars, as with other insects, must change their skins. This requires time-out from eating, and for a short period the creatures are more or less helpless.

▲ Two patches of Procris moth larvae that have recently hatched. They will fan out and then reverse their tactics.



▼ The larvae have now grown much larger and are systematically retreating from the edge of a new leaf, devouring it as they go.

It is at such times that an enemy may chance upon the scene. This is the soldier bug, *Stiretrus anchorago fimbriatus* (Say), a black and orange creature with a built-in soda-straw beak. It can and often does wipe out whole platoons of Procris larvae. The soldier bug works with gusto and dispatch and does not seem to find the sameness of diet at all tiresome. Grape growers are happy to have the soldier bug help maintain the balance of nature in this way.

With the coming of July, surviving Procris larvae usually have attained their growth. They are then a little over half an inch in length and taper somewhat toward either end. The body color has now turned to sulphur yellow, with a row of black spots on each of the main segments. The head is small, brown, and usually slightly drawn under.

By mid-July, these larvae begin to lose their "sociability" and scatter, ranging farther and farther from their feeding grounds. Some even leave the vines entirely.

Soon most of this first brood have spun a silken blanket over themselves in cupped areas formed by the grape leaves, in bark crevices, or elsewhere. Three days after the silk covering is in place, the larvae have transformed into tiny brown pupae.

Ten days to two weeks later, the blanketed Procris pupae emerge as the adults of the season's first brood. They lose no time in getting a second generation under way. However, summer has by now begun to show her age. There has been an abundance of new foliage on the vines, but many of the leaves have been disfigured by the galls of the grape aphid *(Phylloxera)*. This disfigurement seems to make poor eating for Procris larvae, and the moths and their offspring seem to stay clear of such leaves. But the eggs are laid nevertheless, and the second brood gets busy as did the first one. Thus the cycle of Procris life rolls on.

Ralph Donahue is a naturalist of long standing, a traveler, and a writer. He has collected specimens in various parts of the world, many for the Smithsonian. He now writes for the Kansas City *Star* and "plays at farming" in Bates County, Mo. His wife Mildred has been a student of botany from early childhood through college. The Donahues started watching and photographing Procris moths on a wild grapevine that grew by their front door in suburban Kansas City.—Ed.

↑ Here the main body has converged to the stem of the leaf and moved to other feeding grounds. The larvae left behind are finishing up the remains.

↑ From time to time, Procris larvae change their skins by hooking their toes into the leaf and literally backing out of their old garments. At the right is a bright orange and black soldier bug, enemy of the Procris equipped with a soda-straw beak.

↑ After eating their fill, the Procris larvae scattered to fashion over-spun cocoons like this one.

→ Only about a month after their parents have mated and laid their eggs, these adult Procris moths emerge from their cocoons. They are entirely black except for an orange-colored collar. They will do their best to raise a second brood before summer is over.

The *Opossum*– our only pouched mammal

It weighs only 1/2800th of a pound at birth and is not abundantly endowed with gray matter, but it has managed to survive in competition with other animals and is extending its range

By T. Donald Carter

Photos by Charles Philip Fox, *except as otherwise credited*

▲ One entire litter. At 16 weeks, they showed no fear of the photographer's son. Young opossums at this age have become independent of their mother.

THE baying of a foxhound came to us from across Walden's Creek. The sound soon changed to a series of excited barks and yelps. "They've treed him," drawled Oscar Ogle, Jr., and his comment sent us splashing through the creek with flashlights bobbing.

After a short run, unmindful of blackberry briars and dog hobble, we came to a small tree, about the base of which two dogs were jumping and wildly barking. "He's somewhere in that tree," announced Oscar. Flashlights searched through the branches.

Finally two eyes returned their glow, and a gray form was spotted far out on one of the upper limbs. To perfect the picture, the small rounded fruit growing on the outer branches proved that the tree was a persimmon.

One more exhibit had been need-

T. Donald Carter's interest in field work began while he was employed at the New York Zoological Park and made trips to Central and South America to collect live animals and birds. He has been a member of the scientific staff of the American Museum since 1928 and has made over 20 expeditions, embracing Africa, Asia, and South America.

He wrote the text for *The Hoofed Mammals of the World* and is co-author of *Mammals of the Pacific World*. His hobby is raising wild ducks and observing the wild animals on the 130 acres of his woodland home in northern New Jersey.

↑ More teeth than any other land mammal of North America — 50 to be exact. The long pointed jaws can snap open and shut with amazing speed.

↑ Peculiar feet. The opossum's rear paws are not unlike the human hand. The inner toe, however, lacks a claw. Opossum prints in snow or mud are unmistakable.

▲ This little fellow with large black ears cupped forward has an inquisitive look. Only at this age is the opossum really attractive.

ed to complete the Hall of North American Mammals in the American Museum of Natural History—an opossum and gray fox group. But gray foxes and opossums would rarely be attracted to the same spot except to share persimmons — the opossum finding them in the tree and the fox eating the ones that had fallen. So here was our perfect setting, with the brilliant fall coloring of the Great Smoky Mountains to provide the background.

An Unusual Expedition

It was early October, and James Perry Wilson, the Museum's artist, had accompanied Freidoun Jalayer, a talented accessory man, and the writer on the journey to collect this material. The *New York Herald-Tribune* had considered the expedition interesting enough to send along one of its popular reporters, John O'Reilly. Work progressed rapidly. The background sketches had been completed and the accessories gathered. There remained only the procuring of the opossum.

Three boys and two dogs from Gatlinburg, Tenn., were helping us. True to the Museum's ideal of accuracy, the very branch of the persimmon tree upon which the animal had taken refuge was also brought back to the Museum and installed in the habitat group. There hundreds

▼ When first discovered, the young were estimated to be about a week old, possibly a little less. Comparison with the thumb nail shows how tiny these creatures are. The well-formed front legs were apparent.

▲ At approximately three weeks, the hind legs were getting longer, and dark spots were forming where the eyes would be.

▼ The ears were distinguishal when the opossums were ab seven weeks old. They still hu on to the teats constantly.

▲ When nearing twelve weeks of age, on June 5, they were still dependent on their mother. She carried them about on her back, but they were beginning to show their independence by taking short exploring trips.

of thousands who have never seen an opossum in the wild are able to view the animal in a setting as natural and realistic as the original scene.

Oscar was hardly a bloodthirsty hunter. He said that sometimes his dogs treed as many as fourteen opossums in an evening. But since none of his folk relished possum meat and as the hides were not worth much, he let them all go free after bagging them. He was therefore sure of good hunting for many nights to come. Not all opossums in the South are so fortunate. By many they are considered fine food and are hunted for that purpose.

At nine weeks, the young had wn silky coats. Two out of eleven e white like the mother; the other e were gray like most opossums.

A Pouched Mammal

The opossum (genus *Didelphus*) is one of the most interesting but perhaps one of the most lonely mammals found in the United States, for he has no near relatives north of Mexico. He is a marsupial, or pouched mammal, a member of the order to which the kangaroo, wombat, and koala belong. Marsupials are principally restricted to Australia, Tasmania, New Guinea, and the near-by islands. The exceptions are the opossums and the caenolestes, small terrestrial shrew-like creatures found in the Andean region of western South America.

South and Central America can boast of eleven genera of opossums, but only one of these has had the hardihood to travel and establish itself in the United States. The opossum is still extending its range and has recently been reported even in Ontario, Canada. He was introduced into California and has apparently become well established there. He has also been recorded from Oregon and Washington.

As with all marsupials, the birth of an opossum differs from the normal procedure among mammals. Only thirteen days after mating, the young are born. They are considerably less developed than the young of most mammals. In fact, they are only about as large as the end of one's little finger. They weigh about 1/2800 of a pound.

The forelegs have developed out of proportion to the rest of the body, and the toes are armed with sharp claws. There is good reason for this. As soon as the baby opossum is born, it must find its own way into its mother's pouch, which will be its home for the next two months. The forelimbs with their grasping fingers and sharp claws are the only means of transportation for making this journey of three inches over the mother's furry coat.

Once safely within the pouch, the young opossum searches for a life-giving nipple. It attaches itself to this by pressing the nipple against the roof of the mouth with its powerful tongue. The pouched youngster becomes so firmly attached that it takes considerable force to separate it from the nipple.

The average North American

A TREE FULL OF OPOSSUMS. They were well able to climb at 12 weeks. Although the tail is relatively short, it was already used for grasping.

BY THE TIME the young opossum was about 15 weeks old, its tail had grown and strengthened so that the animal could hang by it without difficulty. A full-grown opossum would be unable to do this except for a very brief period.

opossum mother has thirteen teats in her pouch, and since the brood may be more numerous than that, it is a case of first-come, first-served. Those that cannot find a place to feed, cannot survive. In fact, various hazards usually reduce the litter to seven or eight by the time they are weaned.

After spending 60 to 65 days in the pouch, the young move out into the open and travel about with their mother, clinging to her fur. For another month, they associate with her, gradually becoming more self-reliant until finally they move on to seek their own fortunes.

The young opossum does not have to travel far to find food, for he is an omnivorous feeder. Fruits, grain, vegetables, and all manner of flesh, including carrion, are acceptable. During the warm months, insects form a high percentage of his food. But in winter, other kinds of nourishment must be substituted. In and near towns, garbage pails and dumps are regularly visited. And it may surprise many to learn that the slow-moving opossum includes both rats and mice on his bill of fare.

In autumn, the opossum may visit old apple orchards, and I have personally seen opossums with the fur about their face and chest stained with the juice of the pokeberry. Though the opossum is not a persistent killer like the mink, weasel, or raccoon, he has won disfavor for his occasional visit to the poultry house. If the opportunity presents itself, he will kill birds and feed on their eggs or nestlings. However, on the whole, it has been pretty well proved that the opossum's account with man is on the credit side.

Enemies

Chief among the opossum's enemies is man and his dog, and a very close second is man and his automobile. The carcass of a rabbit or a squirrel that has been hit by a passing car will attract an opossum to the same fate.

Many animals appear to treat the flesh of the opossum with disfavor. I have never seen a dog voluntarily eat one. Dogs like to hunt the opossum, but they will content themselves with giving the animal a few shakes and leaving it, believing that the creature is dead and of no further interest. A few moments later,

the opossum will continue on his journey, none the worse for his encounter. Had it been a woodchuck, the dog would probably have carried it home, perhaps eaten a little, and then buried it for a later day, when it would be more tasty.

The only time I ever found evidence of a wild predator capturing an opossum was when I came upon the half-eaten body of one under a hemlock tree. I feel fairly sure that this was the work of a great horned owl, the bird that undoubtedly is one of the opossum's chief enemies. A fox may take an opossum, especially if it is young, but this is evidently not common. I have examined a number of fox dens and carefully studied the remains of Reynard's larder without ever finding the remains of an opossum.

The fairly dense under fur is light in color, and although the long guard hairs may be tipped or ringed with black, many are white, and the animal has the over-all appearance of having a gray coat. White opossums are not uncommon, and true albinos are occasionally seen. A black phase also occurs, in which the black color on the guard hair is predominant, and on some specimens the under fur may be black-tipped. Though rare in the North, blacks are more common than grays in some sections of the South. A third and much rarer phase is the cinnamon, in which the hairs are brown. It is possible for a litter to contain some of each color.

Small Brain

Even the opossum's staunchest friends will have to admit that he is lacking in intelligence. A glance at his skull will show the reason, for the capacity of its brain case is ⅙ that of a raccoon's. Surprisingly, the opossum survives in competition with animals of much higher intelligence. Nor has he any apparent means of defense as have the porcupine and the skunk. He is endowed with a number of lesser attributes, however, many of which help in his preservation. He lives by night and is secretive. Much of the time he remains hidden in a hole in the ground or in a tree cavity. He is a good climber and can seek the protection of a tree when necessary.

The one section of the opossum's brain that in development equals that of the raccoon is the center for the sense of smell. The opossum needs a keen sense of smell, for he relies on his nose in the search for food.

Fifty sharp teeth (the greatest number possessed by any land mammal of North America) give him a very effective bite. Another asset is his disagreeable odor, which is undoubtedly repellent to some animals. He is also a great believer in large families, and this is an important factor in perpetuating the species.

One of his greatest assets is his habit of feigning death, and he does it so perfectly that many are fooled. Some ascribe this behavior to fright, others to shock. But whatever the cause, he is able to regain his composure quickly after the danger has passed. Not all opossums will react in this way. On many occasions, I have tried to make one of the animals play possum for friends but without success. They simply refuse to let me exploit the habit that has made the opossum famous.

A hole in the ground, a fissure among the rocks, a hollow in a tree, or a bird's or squirrel's nest will provide a home for the opossum, and there he will spend most of his daylight hours. Sometimes he uses his

continued on page 224

▼ A DOG WILL READILY CHASE AN OPOSSUM, but after shaking it a few times is apt to leave it for dead. A few moments later, the opossum will go its way, none the worse.

Hugo Schroder

↑ JOAN SANBORN standing under the best preserved corner of the building.

WUKOKI

An empty citadel tells a story of ancient prosperity and defeat in the desert of Arizona

By WILLIAM B. SANBORN

Photos by the author

THE last rumbling of the sudden afternoon thunderstorm faded as the towering white thunderheads scudded eastward toward the Hopi Mesas, rain still pouring from their black interiors. Now the sun was shining bright and hot, and as if on a sponge the moisture was rapidly disappearing from the desert floor. We parked the truck on a knoll, climbed out, and gazed at our goal, about half a mile away.

Like a ghostly medieval castle, the ancient ruins of Wukoki rose from the gentle desert slopes west of the Little Colorado River. Wukoki is one of the more remote and interesting ruins within the Wupatki National Monument in northern Arizona. Over 200 archeological sites are enclosed within this monument, ranging from one-room houses to pueblos of considerable size.

Wukoki was part of the ancient land rush that brought Indians from many directions to farm a fertile soil created when Sunset Crater erupted around A.D. 1066. Either

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disaffection among villages in this area or harassment by outside invaders drew the ancient people's attention to defensive sites like this one.

Like many other villages in this area, Wukoki was a fortified apartment house built of native rock, mud mortar, and timbers. It stood atop a massive block of red sandstone — approximately 90 feet long and from 15 to 30 feet wide — protruding from the desert flats. The village was built to the very edge of the miniature mesa on which it stands, thus making its outer wall virtually impregnable. Only a few fragmental walls remain in the western end of Wukoki, but the eastern portion is well-preserved, with rock walls reaching to a height of three stories.

Wukoki contained about 20 rooms. On the surrounding flats within a quarter of a mile of Wukoki, a number of small one-room or two-room dwellings once stood. It is probable that these were associated with the village and were located in, or adjacent to, the former farmlands, perhaps serving as field houses or storage facilities. Their ruins are now barely discernible. Access to this village was blocked on all sides, with the exception of entrance-exit gaps in its protective outer wall.

Inspection revealed practically no debris remaining within the ruined compound, probably because unwanted rubbish was simply thrown over the edge. A few petroglyphs adorn the sandstone base. Potsherds are abundant in the area, and occasionally a chipped piece of chalcedony or petrified wood is found among the stone fragments.

During its occupancy in the eleventh and twelfth centuries, Wukoki must have been an impressive building. It was the center of an active farming community, compact and defensible, well-constructed, and dramatically located on its rocky perch above the then fertile farmland. But the site has probably been deserted since around A.D. 1225, even before the prolonged drought that came in 1276. Trouble from raiders or invaders was probably one cause of its decline. Now Wukoki is an empty shell, standing like a castle in an arid desert.

Travel to this spot has been restricted in order to protect the ruin from damage. Permission must be obtained from the Monument Superintendent.

▼ A VIEW OF THE ENTIRE RUIN. The western or righthand end is almost totally destroyed. Areas formerly farmed were on the surrounding flats, but the ground has lain fallow for centuries.

ONE summer morning in the year 1900, on the wind-swept dunes of North Carolina's Atlantic coast, two men intently studied the motions of a kite, which they were controlling by means of four slender wires. These men were Wilbur and Orville Wright, and they were learning some of the techniques that were later to be applied to the first heavier-than-air vehicle to carry a man aloft under its own power.

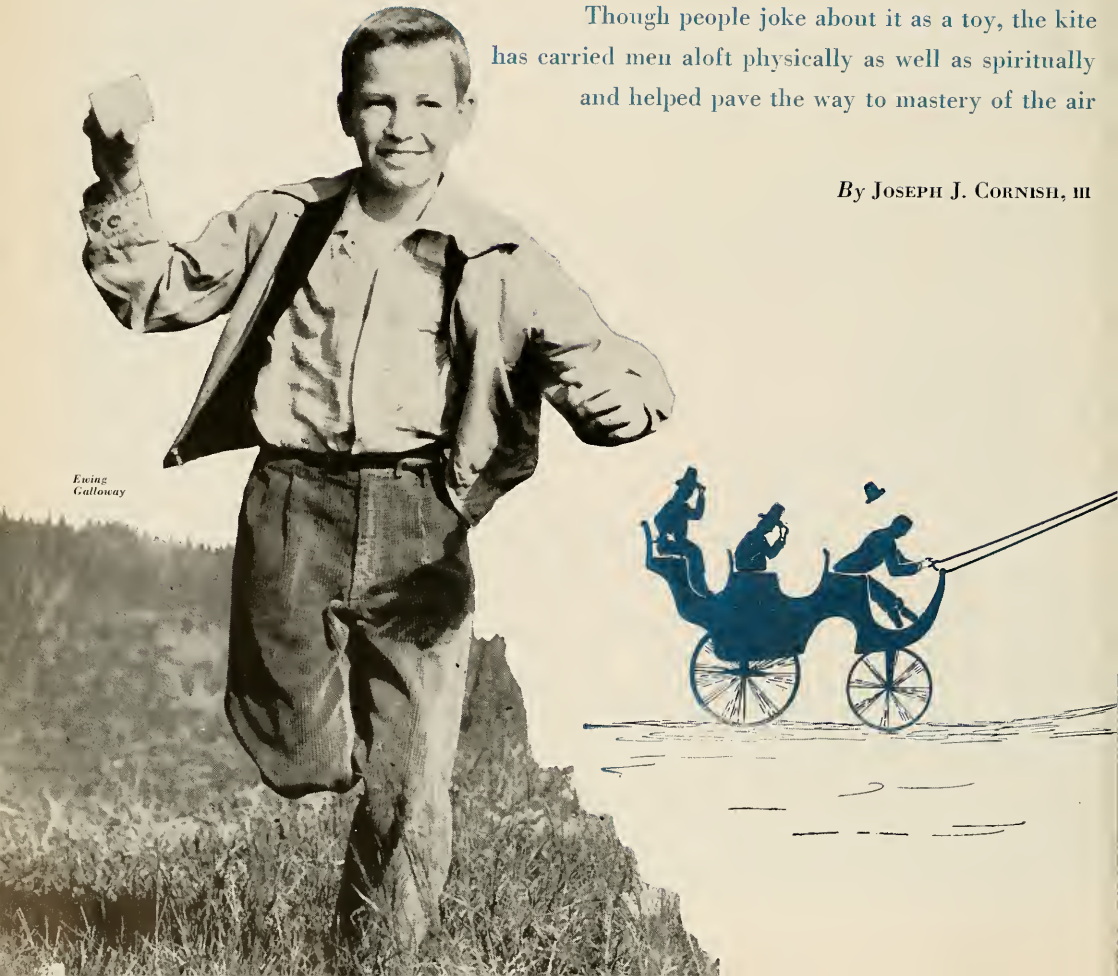
Perhaps earlier that same morning on another shore halfway around the world, an anxious South Sea fisherman was watching a somewhat different kite and waiting for it to tell him that a fish had taken the lure hanging from its tail.

These are but two examples of the many ways in which kites have helped men in their quest for knowledge and their struggle for survival since ancient times. Even though

Go Fly A Kite

Though people joke about it as a toy, the kite has carried men aloft physically as well as spiritually and helped pave the way to mastery of the air

By Joseph J. Cornish, III



Ewing Galloway

the kite is generally considered to be only a toy, it has provided men with a wealth of knowledge.

It is believed that the kite was invented in the Malay Archipelago. From that area comes the familiar Malay kite, formed in the shape of a diamond so that it requires no tail but balances itself in the air. The Maoris of New Zealand have flown kites since before recorded history, and the kite is firmly embedded in their lore. Today, they often fly kites to the accompaniment of ceremonial chants.

The triangular fishing kite that is used around Bougainville is usually made from five leaves of the sago palm. A line is attached to the lower edge to support a lure that dangles in the water. This lure is itself unique, for it employs no hook. It is merely a sticky wad of spider web gathered from the jungles on a forked stick. If an unsuspecting fish takes this lump in its mouth, its teeth become so entangled that it cannot escape. The fisherman then reels in the kite and removes the fish. The spider web can be used again and again. However, the natives believe this astonishing equipment is not alone sufficient to catch the fish. A magical injunction, "*Seo, nikiniko botot me vavatoa,*" is used to urge the fish to catch hold of the line and shake the kite.

Records of kites are found very early in Chinese history, and it is prophetic that they were first used in warfare, specifically in military signaling. When messages had to be sent over dangerous country, brilliantly colored kites were flown high enough to be seen. The Chinese general Han Sin used the kite as early as 200 B. C., when he was tunneling beneath the walls of his target — the Wei-Yang palace.

From Korea, too, come tales of kites in war. Once, on the eve of a particularly critical battle, a Korean general attached a lantern to the tail of a kite and raised it into the air at night. His soldiers, believing this light to be a token of divine assistance, took new strength and courage. A later Korean general, when barred by a river across his route, flew a string to some people on the opposite bank, and thus drew across the ropes for a bridge.

Our earliest record of the kite as a man-lifting affair comes from ancient Japan. Two golden images of fish high atop the castle of Nagoya-Gyo are said to have motivated this feat. The golden fish attracted the greed of a bandit named Ishikawa Goyemon, but the baron who occupied the castle 400 years ago kept it heavily guarded. The bandit seated himself in a trapeze attached to the tail of a huge kite. In the dead of night, his cohorts maneuvered him into the air, and he flew to the rooftop. Once there, he stole many of the golden scales from the ornaments, then descended and escaped undetected.

Another legend from Japan is about two rival villages that had long competed in an annual contest to determine which excelled in the art of building and flying kites. Each year the kite-masters offered larger and more elaborate entries, but finally it turned into a personal battle between the two leading kite-masters. A meeting was arranged one evening to settle the issue once and for all. What had started as a friendly contest of the winds became a war of words, as

Pitt-Rivers Museum

A SOLOMON ISLANDER with his fishing kite and the gar it has just caught. Spider web is usually used in place of a hook.

IN 1827, GEORGE POCOCK traveled about England in his Kite-Carriage, or "Charvolant."

JOSEPH J. CORNISH III is an aerodynamicist in the Aerophysics Department of Mississippi State College, where he received his M.S. in Aeronautical Engineering. A former aerial navigator in the Marines, he is at present engaged in research for the Air Branch of the Office of Naval Research. He has published technical and popular articles, and his hobby is the study of natural flight and man's early attempts to fly.

the two wizards of kite-craft huddled with their supporters around a small Japanese stove called a *hibachi* — a porcelain urn filled with ashes and a few burning sticks of charcoal. When it seemed that no conclusion could be reached, one of the kite-masters produced a tiny kite about the size of a postage stamp and unreeled a gossamer line like a spider web. By using only the meager heat from the charcoal stove, he flew and controlled his doll-sized kite so well that he won the honors.

First Scientific Uses

The use of the kite as a tool gradually spread from the Far East to the western world, and others soon took advantage of this opportunity to reach into the heavens. Among the first to use the kite scientifically were Dr. Alexander Wilson and Thomas Melville of the University of Glasgow in Scotland. In 1749, they hoisted thermometers aloft on six kites, with fuses attached to each kite so that the instruments could be dropped from different altitudes. They were the first persons to record temperatures above the surface of the earth.

Three years later in the United States, Dr. Benjamin Franklin made his epic experiment. Constructing a small kite from a silken handkerchief and using a thin wire for a line, he flew it into the fury of a thunderstorm. The wire allowed a discharge from the clouds to flash down and spark to the earth through a key suspended at the end of the line, thus proving that lightning is a form of electricity.

The kite, not the gasoline engine, also made possible the world's first horseless carriage. The Englishman George Pocock in 1827 developed a four-wheeled buggy which was towed along by two kites with lines about 1,500 to 1,800 feet long. These kites were similar to the Malay kites but had circular tops. The Kite-Carriage, or "Charvolant," made many trips between Bristol and Marlborough at speeds as high as 20 miles an hour. It once sped past the London mail coach. A group of three Kite-Carriages, each carrying several passengers, made a 113-mile trip.

Before inventing the "Charvolant," Pocock designed man-lifting kites and once used them as a means of gaining the top of a steep cliff 200 feet high. Pocock also proposed that kites be used to tow vessels and to carry life lines to wrecked ships.

The idea of using a kite to haul a line to an inaccessible spot was

Joseph J. Cornish, III

Jurio Tsoohiza

▲ WITH HIS TRADITIONAL "YAKKO," or Sentinel Kite, this boy of Japan enjoys a sport shared by children the world over.

▶ KITE-FLYING AT HAE-KWAN, on the Ninth day of Ninth Moon.

put to practical use in the United States in 1849. A group of engineers were considering methods to span the Niagara River with a bridge just below the famous falls. One of them, T. G. Hulet, offered a prize of ten dollars to the first boy who could fly a kite with a stout string across the rocky, ice-choked river. After several unsuccessful attempts, a lad named Homan Walsh won the money. This string formed the beginning of a bridge that linked the United States and Canada.

Riding up with Kites

About 50 years after Pocock's experiments, man-lifting kites began to appear all over the world. Lawrence Hargrave was among the first to begin working in earnest. He made many attempts at flight, mostly with the birdlike, flapping-wing ornithopters, and he is credited with inventing the box kite in 1885. But it was in 1893 that he built three large kites and attached them at intervals to a long line. The combined weight of his body and this rig came to 208 pounds, but he managed to raise himself 16 feet above the ground. At that point, he decided that he was quite high enough and returned safely to the earth.

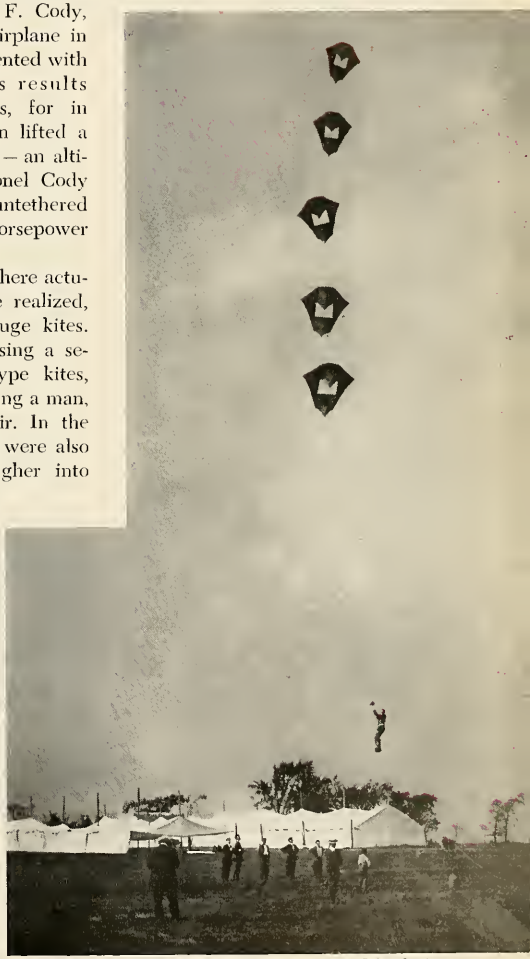
Other man-carrying kites were being flown in England. At Pirbright camp in 1894, Captain B. F. S. Baden-Powell of the Scots Guards constructed a huge kite 36 feet tall, and it got him off the ground. But later that year, with five smaller kites only 12 feet high, he raised his 150-pound body to an altitude of 100 feet. Baden-Powell's kites were also put to use in transferring mail from the destroyer *Daring* to another ship.

In the Boer War in South Africa, English soldiers were hoisted aloft in kites to spy on the enemy. Also in England, Colonel S. F. Cody, the first man to fly an airplane in the British Isles, experimented with man-lifting kites. His results eclipsed previous efforts, for in 1905 a kite of his design lifted a man to — hold your seats — an altitude of 1,600 feet! Colonel Cody also made flights in an untethered kite powered by a 12-horsepower engine.

In the United States, where actual flight was soon to be realized, men were also flying huge kites. One Lieutenant Wise, using a series of four Hargrave-type kites, lifted 229 pounds, including a man, over 40 feet into the air. In the same year, manless kites were also reaching higher and higher into

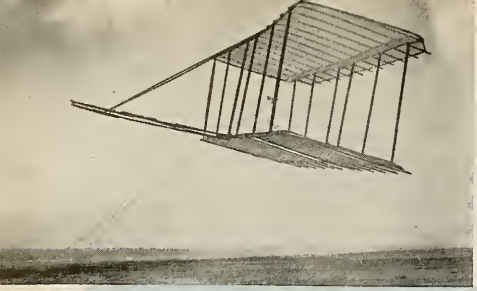
Royal Aeronautical Society

▲ MAN-LIFTING KITES came into vogue toward the end of the last century. This is a rig designed by Captain B.F.S. Baden-Powell, who on one occasion rose to a height of 100 feet.

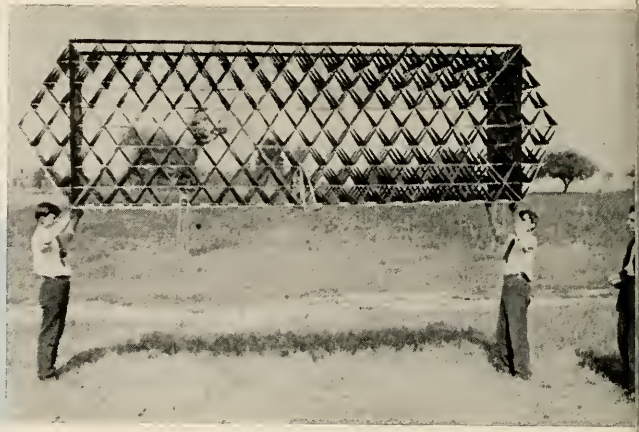


Culver Service

▲ SAMUEL F. PERKINS flying a group of man-carrying kites.



Brown Brothers



↑ THE WRIGHT'S tethered glider at Kitty Hawk October, 1900. For lack of suitable winds, it was flown unmanned. Balancing was controlled from the ground by cords.

→ ALEXANDER GRAHAM BELL and one of his huge kites.

American skies. W. A. Eddy made up a train of nine Malay kites attached to a cord two miles long. The top kite of this fantastic rig soared to an altitude of 5,595 feet and remained aloft for 15 hours.

Men had floated aloft in balloons, glided on fabric wings, and risen on kites. All that remained was to sever the slender string that bound them to the earth. For this, the world looked to the Wrights.

The Kite and the Airplane

As children, the Wright brothers were avid kitefliers. Later, their interest in flying led them to read the accounts of the aeronauts of their time, and they pondered over methods of flying and controlling a vehicle in the air. A clue came to Wilbur while selling a tire tube to a customer in the small bicycle shop the Wrights owned. As he absently twisted the carton in which the tube came, he noticed its similarity to a box kite. He reasoned that if the box could be twisted, so might the kite, and in this manner some control might be exercised over it in flight.

Within a month, the brothers had built a kite with wings five feet long. It was equipped with four lines, by means of which they were able to warp it in the air. This device was flown in Dayton. The next year they flew a larger tethered glider at Kill Devil Hill near Kitty Hawk, North Carolina. These tests, made in the year 1900, were witnessed by the famous aeronaut Octave Chanute, who gave the Wrights much encouragement. Their epic flight some three years later was possible mainly because they had succeeded in controlling the aircraft in the air, a feat not previously mastered.

During this critical period in aviation, kites all over the world were contributing to the storehouse of knowledge that is the necessary foundation of any new science. A Lieutenant Bassel of the French army gained great skill with man-lifting kites, and C. H. Lamson invented and developed a kite shaped like the early biplanes of that time. In Germany, Perseval combined the balloon and the kite and evolved an efficient "kite-balloon," while in Russia, as early as 1898, kites were used in army maneuvers.

In the United States, kites were making spectacular flights around the turn of the century. In October, 1901, Almenia Rice, a circus tightwire and trapeze artist, flew for several minutes with a kite from the roof of a building at 144 Tremont St., Boston, and landed safely. Another American, Dr. Charles Zimmerman of Maryland, built a large kite in 1902 and got his wife Ida about ten feet off the ground.

Of course, all kites flown during this period did not carry people, but some made contributions of far-reaching consequence. For instance, on December 12, 1901, Guglielmo Marconi, the inventor of the wireless telegraph, hoisted a wire attached to a kite at St. John's, Newfoundland, and with this an-

U.S. Marine Corps

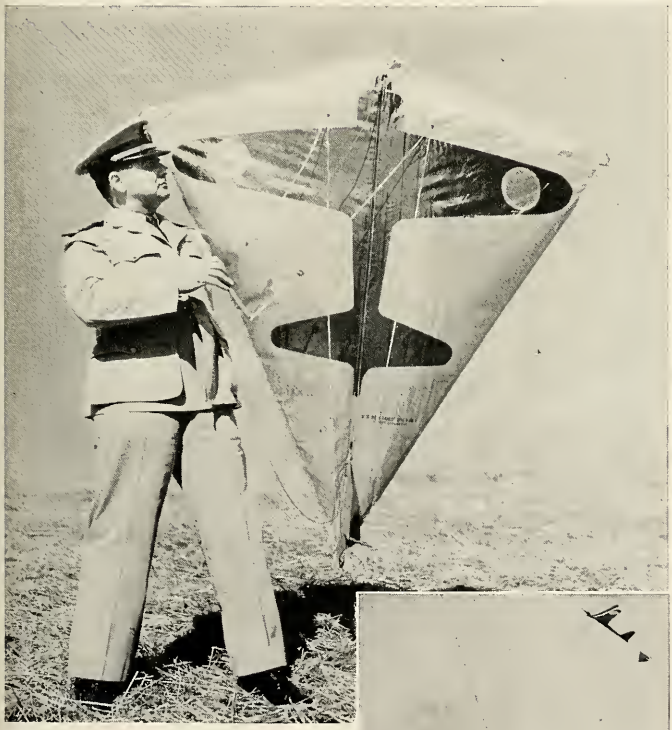
→ LIFTING THE ANTENNA of a "Gibson Girl" transmitter with a box kite: an application that gives radio signals better range and increases chances of rescue.

tenna received the first wireless signal to be sent across the Atlantic Ocean.

Even after the Wrights flew their powered airplane in 1903, the man-lifting kite was still the subject of much research. In 1907, the renowned Dr. Alexander Graham Bell conducted experiments with a mammoth man-lifting kite at his summer home in Nova Scotia. Even by today's standards, this was a flying machine of immense proportions. One of Bell's kites had a span of well over 50 feet and stood over 12 feet high. The kite consisted of a multitude of tiny triangular wings, each about ten inches on a side. These little triangles were arranged as the sides of regular pyramidal shapes, and Bell therefore called the entire assemblage a "Tetrahedral" kite. All in all, there were over 12,000 miniature triangular wings in the entire kite. Bell often flew this giant kite over the beautiful waters of the Bras d'Or Lake in Cape Breton Island. He and his helpers gained such a mastery of the kite that the famous aviator Glenn Curtiss came to investigate the possibilities of installing an engine in it.

The most notable flight of this tremendous kite took place on December 6, 1907, when Lieutenant Thomas E. Selfridge of the U. S. Army was carried aloft to a height of about 150 feet and remained up for 7 minutes. A grim shadow lay over this flight, however, for shortly afterward, Selfridge was making a demonstration flight in one of the Wright airplanes and the ship's propeller caught in a loose wire, causing the plane to plunge to the earth. Selfridge was killed, the first man to die in an airplane crash.

Smithsonian Institution



▲ COMMANDER PAUL GARBER, Head Curator of the National Air Museum, with his famous target kite, so controllable that he can write his signature in the sky with it.

➤ COMMANDER GARBER showing how his maneuverable kite is used to train aerial gunners.

As a Photographic Vehicle

Besides carrying men aloft, kites were enabling men to look at the earth through the eyes of cameras. Though sober-minded citizens joked about these experiments, one of them brought sudden wealth. In the early 1880's, E. D. Archibald of England and A. Batut of France had taken many pictures from cameras mounted on kites. But in 1906, George R. Lawrence took one of the world's largest pictures from a kite. Immediately after the San Francisco earthquake, he grouped seventeen huge kites to form a train to lift a camera that was longer than some automobiles. It took fifteen men to handle it on the ground. The picture it made measured about 30 square feet. With this camera, Lawrence took a giant-sized picture of the San Francisco earthquake and fire. Prints from this photo earned him a fortune of almost $15,000.

Perhaps it is because kiteflying allows a fulfillment of man's inborn desire to fly that it is a universally popular sport with both young and old. The Chinese in particular, who first used the kite in warfare, have developed it as a toy. They make kites in the form of animals, kites shaped like fish and birds, and of course kites like dragons. The dragon kites are actually many small kites attached to the same string. The first in line is the head, then several form the body and tail of the monster. The Chinese even have a special Kite Day — the Ninth Day of the Ninth Month.

In Japan, kiteflying is especially popular during New Year's celebrations. The kites are usually

square and are marked with symbolic characters. A favorite figure is the "Daluko"—patterned after a roly-poly toy weighted so that it always returns to an upright position. The picture of the "Daluko" on the kite is a sort of good-luck symbol; its use is traditional, and it is supposed to be an image of the god Buddha. Another interesting Japanese kite is shaped like a man and is named "Yakko," after the sentinel who preceded the local baron or "Daimio" when he went on excursions through the countryside. The "Yakko" went out ahead of the column to see that the people were properly prepared to greet the lord as he passed by. Besides these shapes and markings, many of the square kites are decorated with the Japanese symbols of good luck.

The square Japanese kite is also flown in Korea, but a more popular type is the diamond-shaped Malay kite. These kites are equipped with a cloth tail and are called *Yunn.* This type is likewise flown in the Philippine Islands, along with Chinese kites. In the Philippines, the flying of kites serves a unique practical purpose. A great number of water buffalo are used in this area and are vital to the economy of the people. When the buffaloes are grazing in the open fields, they require an attentive and alert herdsman to prevent them from straying. They also begin fighting if left untended for long periods. So, the herdsmen need some preoccupation that will keep them awake but not tire them excessively. Kiteflying serves the purpose, and throughout the fields you will see many bright dots in the sky where the well-chaperoned buffaloes are calmly grazing.

Kites are popular also in the Middle East. In Lebanon, for instance, two kinds of kites are generally flown. The more elaborate ones are usually made of bamboo and paper in the form of a regular hexagon, with a conventional cloth tail. The lower three sides are decorated with a paper fringe "... to make them fly better ..." This kite is called *tayara kasab,* literally "airplane of bamboo." An older kite in Lebanon is the *koubh,* which is folded from a single sheet of paper and rigged so that it needs no sticks at all. This kite uses a tail made by tearing a sheet of paper in a continuous spiral.

Kiteflying is widespread in Europe. Germany has kites in the form of butterflies, birds, and bats, but the two most popular kinds are the Malay kite and a regular octagonal type. Numerous forms and variations of the box kite are flown, as well as a strange kite called the *Rolloplan.* Aerial photographs are often made from kites, and large winged kites are sometimes used to display advertising.

Pitting one kite against another is a popular sport in many countries. The object is usually to see which kiteflier can cut the cord of his opponent's kite. Here in the United States, sharp pieces of glass or razor blades are attached to the kites themselves. These fighting-kites are highly maneuverable, and a practiced operator can cause them to dart all over the sky. To hit and cut an opponent's rapidly moving string with a swift kite requires considerable skill.

In China, a slightly different technique is employed. Instead of attaching sharp objects to the kite, the kite string itself does the cutting. The part of the string near the kite is coated with glue and finely crushed glass. In battle, the strings of the two kites are sawed together until one kite is cut loose. In Iraq, a unique glue is often used to bond the glass chips to the kite string. The thick sticky juice from the okra plant is dried to a gummy consistency and then combined with the crushed glass. This mixture, when applied to the kite string and allowed to harden, holds the glass chips firmly and also affords protection to the string. However, kiteflying is discouraged by some parents in Iraq, for rooftops are a favorite place, and each year, many children, absorbed in raising their kites, fall off backward and are hurt. Kiteflying and kite-fighting, nevertheless, still flourish in Iraq.

Not all kite-fights end with one kite floating away on the wind. In Thailand, two different types of kites, a male and a female, oppose each other. The object is for each contestant to try to bring his opponent down within a certain boundary. The male kite, or *Chula,* is shaped like a five-pointed star and is generally about six feet tall. Several boys are needed to fly it. The male is not equipped with a tail but has a group of bamboo hooks attached to the string some distance down from the kite.

The female kite, or *Pakpao,* is diamond-shaped and much smaller than the male, only about one-sixth its area. It has a long tail of well-starched cloth and is provided with a long loop of string, running from the kite to the kite string. In combat, the male tries to catch the female with his hooks and pull her down by brute force.

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The female must employ a more subtle strategy. Since she is much smaller and can't overpower the male, she must try to upset him by casting her loop over one or more of his five arms. If the female is able to overturn the male in this manner, he falls to the ground and loses.

Inevitably, there is much betting on the outcome, but since the male has the advantage of greater size and strength, its backers must give odds of six to one. The Thai Traditional Sports Association has plans to promote and perpetuate kite-fighting, and every year at the beginning of March a contest is held at the Pramane Grounds by the Grand Palace at Bangkok.

With all its unusual shapes and forms and with its strange and varied past, the kite is often thought of today as an oddity or at best an interesting toy. Actually the kite still serves men in many useful ways. The U. S. Weather Bureau has made extensive use of the kite as a tool to probe the whims of the weather. From 1893 until 1933, the Weather Bureau maintained a system of stations from which kites were flown at regular hours when the winds permitted. At one of these stations on Mt. Weather, Va., on May 5, 1910, a string of ten kites carrying meteorological instruments was launched. The total area of this "train" of ten kites amounted to 683 square feet, and the uppermost kite rose to an altitude of 23,835 feet. In order to accomplish this feat, over 8½ miles of thin wire were needed for the line.

Also in other countries, the kite has proved useful for exploring the atmosphere. In Viborg at the extreme northern tip of Denmark, a permanent station for the flying of kites was established through the co-operation of Denmark, Sweden, and France. Among the many buildings was a 33-foot tower, with one side open so the kites could be tended. The whole affair rotated on a circular track so that the open side could be turned away from the wind, and electric winches were provided to raise and lower the kites.

The Germans built a kite station at Grossborstel and have flown kites at the Aeronautical Observatory of Lindenberg. One German, Valentin Oesterle, has specialized in making various types of kites to serve many purposes, such as photography, advertising, sport, and meteorological work. Most of these kites are in the form of old airplanes, with from one to four wings.

The United States Merchant Marine, fulfilling the predictions of the Englishman George Pocock, has used kites to fly life lines to stranded vessels. The United States Navy has also flown kites. In World War II, a plan was suggested for flying kites over ships to protect them from enemy aircraft. The kites, darting back and forth on the shifting winds, supported steel wires which would form an effective aerial umbrella over the ships. Although never used in combat, the plan was successfully tested at sea.

Many a downed American aviator owes his life to a kite. As part of the standard survival equipment in many airplanes, a small collapsible box kite enables the castaway to carry his radio antenna high enough to summon help. The German submarines often used a sort of "helicopter-kite" for carrying an observer aloft. These observation devices were known as "Sandpipers" and often had lines as long as 500 feet. They actually have rotor blades similar to an autogyro, which rotate and provide the necessary lift. They are now being sold by one of the helicopter companies.

Perhaps the most extraordinary kite of modern times was designed and built by Paul Garber, Head Curator of the National Air Museum. Constructed so as to be completely controllable, it was used by this country's armed forces to train aerial gunners to follow darting enemy aircraft. Mr. Garber's remarkable kite was so maneuverable that he could sign his name in the air with it, so perhaps we now have a kite to end all kites.

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Otis H. Greeson

◄ A FINE EXAMPLE of the Easter Lily, photographed at the U. S. Department of Agriculture's Plant Industry Station at Beltsville, Md., where scientific work on the lily is in progress.

Lilies for Easter – and the year 'round

Constant experimentation is giving the grower greater and greater control over size and blooming time

THE Easter lily had another name back in 1876 when it was first introduced into this country. In that year W. K. Harris, a nurseryman, came into possession of some bulbs from Bermuda, named the plant after himself *(Lilium Harrisii)*, and put the lily on the market.

For a long time, Easter lily bulbs came from Bermuda, but with the introduction of refrigeration, and perhaps also the opening of the Panama Canal, Japan supplanted Bermuda as the chief exporter. By 1940, 23½ million bulbs were being imported on the average each year into the United States, mostly from Japan, but the onslaught of World War II cut off this source of supply. Ever since, the Easter lily has been produced in the United States.

Previous to the war, the lily had been grown to a limited extent in the Pacific Northwest and in Louisiana and Florida. Today the areas of production are concentrated in Oregon, California, Washington, Georgia, Alabama, and Louisiana. The ohief varieties grown are the "Croft," the "Georgia Lily," the "Creole," and the "Ace." The "Ace" is the best American pot lily. Strangely enough, it got its name because its sponsor, Clark Slocum, was found deep in a game of poker when a lily expert from the U. S. Department of Agriculture went to see it, hence its name "Slocum's Ace".

Lilium longiflorum ("lily with long flowers") can be grown from seed, but seedlings vary in height, time of blooming, and size of flowers and leaves. Since a florist wants uniformity, especially in time of blooming and plant height, commercial Easter lilies are usually grown from stem bulblets or bulb scales. Either of these methods yields plants identical with the parent plant.

Even before World War II cut off the importation of Easter lily bulbs, experiments on the storing and forcing of bulbs had been carried on at the U. S. Department of Agriculture's Plant Industry Station at Beltsville, Maryland. As the Easter lily has always actually been in demand throughout the year, the experts at Beltsville have been concerned with the problem of producing bulbs that will bloom when needed. Freshly harvested mature Easter lily bulbs do not contain flower buds. If such bulbs are replanted at once, they may require eight or nine months to bloom, while properly stored bulbs require less than half that time to reach the blooming stage.

 continued from page 175

that more wild seeds were used for food than had been previously supposed.

Archeological shortcomings as well as successes are covered in this book. Professor De Laet does not minimize the daily boredom of culturally sterile sites or the drudgery of post-excavation laboratory work. He also heaps well-phrased scorn on art historians who interpret whole cultures from art objects alone and on archeologists who throw up smoke screens of academic terminology. But his major sting is directed toward well-meaning amateur archeologists who often destroy valuable evidence through ignorance. Excavation is literally the *destruction* of evidence, so careful field techniques must be employed to get a valid *reconstruction* of man's past.

This little volume answers a great need. It introduces the interested layman and the beginning student to the problems as well as the glamour of digging in the garbage heaps of antiquity.

Dr. Dupree is Associate Professor of Middle Eastern Studies at Air University, Maxwell AFB, Alabama. He has participated in various archeological expeditions of the American Museum of Natural History and some of his articles have appeared in NATURAL HISTORY Magazine.

VASTNESS OF THE SEA

- - - - - - - - by Bernard Gorsky

Translated from the French
by Alec Brown

Little Brown, $5.00, 305 pp., illus.

DAHLAK

- - - - - - - - by Gianni Roghi and Francesco Baschieri

Translated from the Italian
by Priscilla Hastings

Essential Books, $6.00, 280 pp., illus.

Reviewed by CARLETON RAY

IT IS lamentable that the authors of these two books, who are brave and venturesome men, are still writing about the natural history of fishes observed primarily on the end of a spear.

As an adventure story, *Vastness of the Sea* is fascinating. Gorsky writes warmly, honestly, with understatement and a masterly turn of metaphor. His meetings with Caribbean, Galapagos, and South Sea Islanders reveal enormous skill in public relations and respect for native customs. Underwater, there is less to be thankful for. Though Gorsky is taken with the beauty of the leopard ray, the coral, and the whole experience, his spear is never still. Often it mutilates fish too big to land and lands fish too unpalatable to eat. Although the spear is less in use toward the end of the book, an interest in the animals for their own sake is still needed to make this exciting story a substantial one. When the second half of his voyage is written up, we shall see if he finally finds, as the translator says, "how to live in harmony with nature."

Roghi and Baschieri, "scientific personnel" of what must have been an exciting Italian expedition to the Red Sea, have written what could have been a fine book but isn't. Again the spear is dominant. The manta is called the "good devil" at one moment and then left with a spear in its back the next — for what scientific purpose I can't say.

One can excuse technical errors on the part of a layman perhaps (as Gorsky's "gorgonian seaweed"), but pretense to scientific knowledge on the part of Roghi and Baschieri is belied by errors so fundamental that they destroy the book's value for anyone who takes his animals at all seriously. Scientific nomenclature remains a mystery to these authors. They discuss the shark to the point of ennui and arrive at poorly thought-out conclusions as to its cowardice, method of attack, and general behavior.

The last chapter of *Dahlak* does contain a commendable description of the rarely observed parturition of manta rays. And one must give the authors credit for favoring here the direct approach, observation on the spot, which too few ichthyologists employ. Similarly, Gorsky and his companions deserve praise for having the guts to make a round-the-world voyage in a 40-foot yawl for firsthand observation.

Gorsky sums up the trouble with both books when he says, "In the barracuda the diver soon sees merely prey and never more than that." More than that the barracuda certainly *is* a fascinating fish, whose habits, aside from its relation to man, are little known. What the underwater world needs is a Thoreau, a Beebe, or a Carr. The adventurers have had their say, but the poet-naturalist has not yet felt the rapture of the depths.

Carleton Ray is author of the recently published Underwater Guide to Marine Life. *He has firsthand diving experience in California, Mediterranean, and Bahamas waters.*

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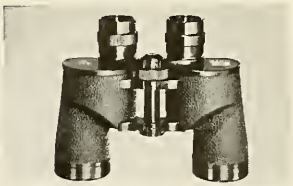

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gigantic proportions often ascribed to the sea serpent. This possibility has recently been supported by the discovery of the Coelacanth fish off southeast Africa which has survived almost unchanged from even earlier in the Mesozoic Age.

But although there is nothing intrinsically impossible in the theory, there is much to be said for a less extreme view. It seems very probable that at least some of the unexplained reports may have had a more prosaic origin.

In his recent book *Living Fossils*, Dr. Maurice Burton has pointed out that in late years eel larvae 3 feet long have been discovered in the sea and that there is no reason why these giant larvae, when full grown, should not reach a length of 36 feet. He next describes a large conger at the London Zoo, which suddenly rose to the top of the tank, turned on its side, and vigorously undulated its body, causing a violent commotion in the water and showing a row of humps above the surface. Such a performance by a really large eel would be much like the New England sea serpent, and several others of its kind.

Yet, a number of apparently inexplicable cases remain. For example, the *Daedalus* serpent showed no signs of humps and, in the captain's words, no visible portion of its body was used in propelling it through the water, either by vertical or horizontal undulation. Nor is there any justification for the view that this animal may have been a seal, since it was far larger than any seal yet known to science. We must also admit that such creatures as that seen from the yacht *Valhalla*, with its serpentine head and neck and crinkled fin, are not explained by reference to any familiar creature.

For such appearances it certainly seems possible—and no more than that can be said—that we may have to invoke the existence of a previously unknown animal. Accepting this possibility, to what natural class would it most likely belong?

The traditional view is that it is a member of the class Reptilia, probably a survival from over 70 million years ago. More plausible is the suggestion that the sea serpent, if it really exists, may be a gigantic aquatic mammal related either to the whales or to the seals, walruses, and sea elephants. Oudemans favored the latter view and devoted 74 pages in *The Great Sea Serpent* to an account of its natural history, including its form, shape, habits, and sexual differences. The mammalian theory has two strong points in its favor. Firstly, the mane which is constantly ascribed to sea serpents would be an unlikely appendage in an aquatic reptile. Secondly, a warm-blooded mammal would be far more likely than a reptile to survive in the cold waters of the north Atlantic where so many sea serpent stories have originated.

I would suggest that at least some of the appearances could be accounted for by an ancient and as yet undiscovered species of whale. For example, the whale known as *Zeuglodon* or *Basilosaurus*, whose fossil remains are well known in the Tertiary rocks, would be a very suitable animal to cast in the role of sea serpent. It was a huge creature with a slim and greatly elongated body, sometimes measuring over 70 feet long. The skull was long and low, and the animal was propelled by a single pair of fins or flappers at the forward end. Smaller members of the group are already known to have survived until the beginning of the Miocene Epoch, just over 30 million years ago, and there is certainly no reason why some of their larger relations may not even now linger in the seas.

To sum up, the age-long enigma of the great sea serpent is still unsolved. Although many of its visitations can be accounted for in terms of seals, giant squids, sharks, and other sea creatures that are by no means unfamiliar, a central core of mystery remains. Whether the sea serpent will ever be identified as a giant ocean reptile surviving from the age of the dinosaurs, or a primitive whale from early in the Tertiary Period, remains to be seen. Meanwhile it still justifies the romantic title bestowed upon it nearly a century ago by Philip Gosse: the Great Unknown of the Seas.

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Letters *continued from page 169*

yard of Australia once clocked a dragonfly flying 60 mph. for a short distance. This, however, was probably an exceptional burst of speed.

Bushmaster Not So Tough

SIRS:

I was especially interested in Mr. William E. Lundy's article in the February NATURAL HISTORY in the light of my personal experience with captive bushmasters. The incident he relates confirms what I have suspected for many years: that the bushmaster is a much overrated snake, and that its reputation for aggressiveness is based on native fears and sensational literature.

We have had, at one time or another, six bushmasters here at Staten Island Zoo, some of them reaching us soon after capture. None of these has ever shown a fraction the spirit of a recently captured diamondback rattlesnake. They always seemed sluggish and slow to anger. It is true that captive bushmasters seem to be without exception parasitized by *linguatulids*, otherwise known as thorn-headed worms (they are not really worms, but highly modified arachnids), and the snakes always die within a few months after capture. It could be that these parasites debilitate them so much that they haven't strength to defend themselves properly.

The "comparatively weak backbone" of the bushmaster is strictly a myth. The backbone of these snakes is no weaker or different otherwise from similar snakes. The same care must be employed in handling any heavy-bodied viperine snake.

CARL KAUFFELD
Curator of Reptiles

The Staten Island Zoo,
Staten Island 1, N. Y.

Rubber Stamp "Branding"

DEAR MR. KRUTCH:

I want to take issue with the final statement in your article on the monarch butterfly in the January issue. You say that "butterflies cannot be banded as easily as birds." Personally I find it a lot easier—although we call it "branding" and do it with a rubber stamp! . . . My only trouble has been in getting enough monarchs to "brand," and for about five years they were woefully scarce in my corner of Bucks Co., Penna. I blamed it on the unlimited spraying of DDT that goes on in Florida, but perhaps I am wrong. Last summer there were more of them, and I released about 75 marked butterflies. I am hoping that Mr. C. A. Anderson, of Dallas, Texas, the specialist on butterfly migration, can send me some live material this spring and get me started breeding them earlier than usual. I have heard a rumor (from some ancient German book on lepidoptera) that the larvae can be raised on lettuce. I am going to see if it will work, to fill in the period before the milkweed comes up here.

At the meeting of the Lepidopterists' Society held not long ago in New York, we heard a very scholarly report from a young woman from Yale on whether the monarch had natural protection from other creatures and whether the "viceroy" imitates it with any degree of success. She did the experiment with eight Florida jays and several thousand butterflies and came to the conclusion that the folklore, rumor, or anecdotes that have built up this belief are indeed true. She did her experiment with butterflies only, and when I asked if the caterpillar is also distasteful to predators, nobody would give me a positive answer.

ALICE LIGHTNER HOPF

New York, N. Y.

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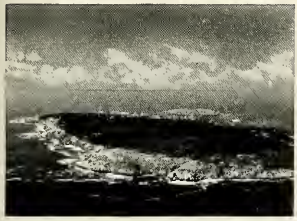

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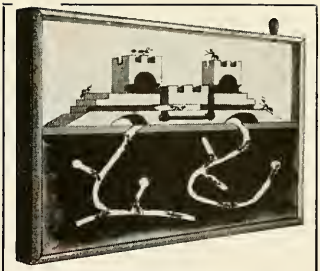

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THE OPOSSUM—Our Only Pouched Mammal

continued from page 209

tail for carrying grasses or leaves into his den for a bed.

The opossum excels in climbing. His feet, with their claws and grasping toes, as well as his prehensile tail, are a great aid in traveling among the boughs of a tree. The use of the tail, however, has been greatly exaggerated, for an old opossum cannot long hold his weight with it as is often pictured. He can do so momentarily but soon slips and falls. A young animal, being lighter, can remain suspended for some little time.

Active Through Winter

Being a product of the South, the opossum does not go into hibernation as do many of our northern animals. He may remain in his den for a few days during very cold or stormy weather but is out again as soon as the conditions are milder. He has not yet fully adapted himself to the rigors of northern winters, as is quite evident from his naked tail and ears. Not infrequently, an opossum that has been through a winter or two in our northern woods will show these parts severely frostbitten.

A few winters ago, I had the opportunity to read a little woodland drama in the fresh snow. I was walking on a wood road when I came upon the unmistakable tracks of a large opossum. The handlike print of the hind foot with its opposable first toe makes this trail one of the easiest to identify. The tracks turned off the road and went down the hill to our garbage dump. Some old apple and potato peelings proved to have been of interest. The opossum then turned up the hillside and back to the roadway.

Presently I discovered that I was not the only one interested in this animal, for the snow disclosed where a red fox had come down to the opossum's trail. He had turned aside to follow it. Soon the opossum's tracks led into the thick underbrush, the fox still following. For about a hundred yards, they continued on their way. Then the fox overtook the slower-moving opossum, and for an area of about ten square feet the snow was a confused jumble of fox tracks.

As I interpret the story, the fox was in a playful mood and was enjoying himself to the utmost at the opossum's expense. He would apparently rush in at the animal and perhaps, nip him, then rush away again. The opossum may have resorted to his old habit of playing dead, but this is conjecture, for I could not be sure in the trampled snow. It was also surprising that the opossum had not sought refuge in a tree, although the fox might have prevented this.

After a time, the fox tired of his play, and his tracks led down the hill. I again followed the opossum's trail, which also led down the hill in a slightly different direction. He did not appear to be hurt, but he had apparently had enough excitement for one night. His trail led directly to a hole under a large boulder. This was evidently his home, because the tracks showed that he had earlier emerged from it. If this had been a lean winter, and if the fox had been excessively hungry, my little play would undoubtedly have ended in tragedy.

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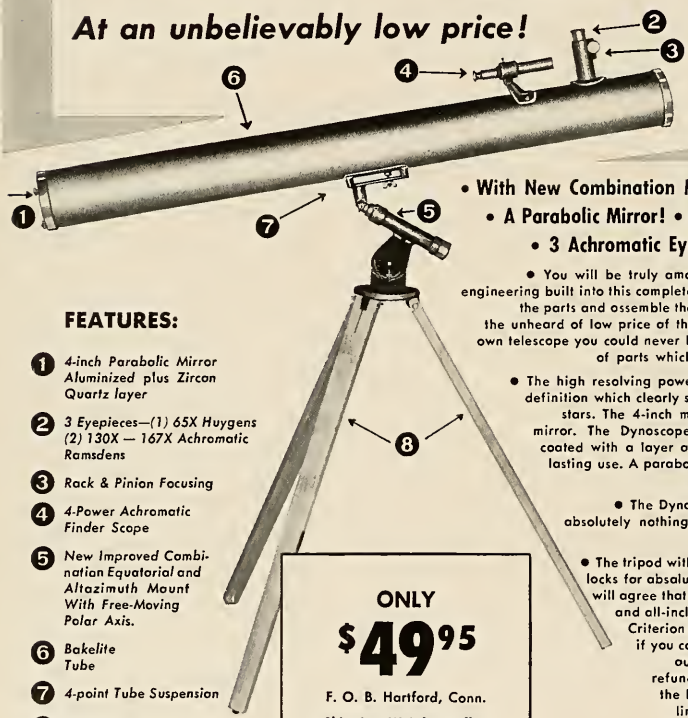

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Letters

Helictites

SIRS:

I was very much interested in the article on the helictites of Timpanogos Cave in the February issue of NATURAL HISTORY, especially since I once visited this cave. In the interest of Texas pride, I am sending you the enclosed photograph taken by W. J. Helmer of the University of Texas Speleological Society.

In the cave where this photograph was taken, there is fairly conclusive evidence that helictites there were formed under water. It is observed that these formations are found up to a certain level, which is definitely an old water level. No helictites were found above this point. I would be interested in hearing other ideas on this subject.

Thank you very much for your excellent coverage of natural history, much of which I consider to be primary authority for geological research, and which also has universal appeal.

HOLMES A. SEMKEN, JR.
Chairman, U.T.S.S.

Austin, Tex.

Dr. Brian H. Mason, Curator of Physical Geology and Mineralogy at the American Museum of Natural History, offers the following comment:

It is generally believed that helictites form in the air, being similar to stalactites but deriving their curious shapes by the action of currents of air. I do not see how these objects would form under water, but would not like to deny the possibility.

Things in Trees

We have received a number of letters on Jack McCormick's article, "A Tree with a Boy Inside."

From I. Harmon Hershey of Rochester, N. Y.:

"I was interested in the account of the picture of a boy inside a tree trunk. I am wondering what kind of tree it was.

"In 1886, as a boy of 15, I carved my initials in Old English script on a beech tree. I had my picture taken beside this tree while visiting the scenes of my boyhood last May."

It was an apple tree that contained the picture of a boy. — ED.

We are indebted to both John G. McCormack of Seattle, Wash., and Edgar P. Wyman, Assistant Professor of Forestry at the University of Connecticut in Storrs, for the following composite account of blazing trees in surveying:

In the rectangular land survey system, it has long been the practice to mark the corners of sections with square-hewn posts. Since these posts can rot away or be destroyed by fire, they were located with reference to "witness" or "bearing" trees near by. With a small steel gouge, these trees were inscribed with a blaze corresponding to the marking on the corner post.

In subsequent years, these marks were completely covered with new growth. Many years later, surveyors looking for old corner posts have come upon "witness trees" and cut in above and below the grown-over blaze to remove the new growth. The new wood would separate cleanly from the blaze and on the inside would be found a raised mirror image of the original inscription. These sections have been admitted as evidence in court to reestablish destroyed corner posts.

Cedars of Lebanon

SIRS:

In the March issue of NATURAL HISTORY Magazine you published an article by Philip Ferry entitled "Where Are the Cedars of Lebanon?" Mr. Ferry states that

continued on page 275

NATURAL HISTORY

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May, 1957 Volume LXVI, No. 5

Tibetan Lamas — Cover Design
From a color transparency by Diane leC. Rawson

Letters — 225

Your New Books — 228

Five Life Zones in 50 Minutes — Morgan Monroe — 232
The American Museum's Southwestern Research Station is a gold mine for scientists

The Snorkel Turtle — Charles M. Bogert — 240
It may have used the snorkel as a concealment device a hundred million years before the submarine was invented

It's All Done with Shellac — Paul W. Kearney — 242
Man's tiniest domesticated animal produces one of the world's most useful materials

I Watch Fiddler Crabs — Roy L. Abbott — 248
These Florida beachcombers are sun-lovers. On cool nights they close the doors of their burrows with two inches of sand

A Rare Bird, Indeed! — Clive Alfred Spinage — 250
The Teita falcon has been sighted only eight times in sixty-two years

To the Land of the Lacandones — Edward Weyer, Jr. — 252
An expedition to the tropical wonderland where modern survivors from Mayan times live a secluded existence

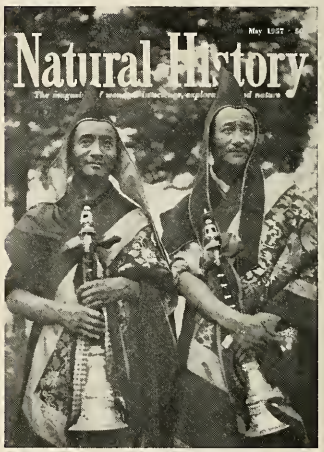
How to Collect Seaweeds — Edwin Way Teale — 260
The delicate and artistic forms of seaweeds lend themselves to a fascinating hobby

The High Octane Pine — W. H. Hutchinson — 265
When you drive up to a filling station and ask for "high test," you are profiting from a strange series of discoveries in which the Jeffrey pine contributed significantly to the evolution of the automobile

The Legend of the Camel — Alonzo W. Pond — 266
Scientific research debunks some of the popular beliefs about the ship of the desert

A Titan of the Tides — Bernard L. Gordon — 272
Basking sharks have reached a recorded length of fifty feet

You will find NATURAL HISTORY Magazine *indexed in* Reader's Guide to Periodical Literature *in your library*



THE COVER THIS MONTH

The "Red Hat Lamas" belong to the Ningma-pa sect, which is the orthodox Buddhist sect of Tibet. The founder was Padmasambhava, who came to Tibet from the Buddhist University of Nalanda, India, in the 8th century, to teach Mahayana Buddhism.

The fusion of Mahayana Buddhism and Pön, the indigenous religion, was the origin of what is today called Lamaism, and Padmasambhava is revered in Tibet as its founder.

The large horns carried by the Lamas are made of copper, brass, and silver and are of beautiful workmanship. Sometimes they are made in three sections, extending as long as six feet, with two or three Lamas to carry each one. These horns are used to herald the dawn and in the temple ritual. The tones are very deep and carry far over the valleys and the mountains.

The cover photograph was taken by Diane Rawson on the border of Tibet. Readers will remember her article "Letter from Nepal" in the October 1956 issue of NATURAL HISTORY.

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Reviewed by HARRY L. SHAPIRO

FOR 50,000 years, more or less, men in Europe have been scratching or painting pictures on cave walls, rocks or stone slabs. Although these pictures have been known to scholars for a century, they were for a long time regarded as the idle graffiti of primitive men whiling away time as more recent ones have done with their whittling. In the last generation or so, the true significance of these precious documents has gradually come to be recognized. No one has done more to bring this about than the Abbé Breuil, a distinguished French prehistorian.

In this book Herbert Kühn, following the lead of Breuil and others, has brought together virtually 50,000 years of this artistic record. The extraordinary thing is how much it can tell us of the life, beliefs, and artistic styles of our ancestors. Kühn has done a splendid job in assembling not only the well-known paleolithic cave paintings, but the post-glacial rock paintings right down to the first millennium before Christ. He has demonstrated how these records reveal the way of life of their creators, how they reflect their religions beliefs, and how their styles underwent change. The record is instinct with life and the pictures are often esthetic creations of the first order.

If Professor Kühn's interpretations are not always acceptable or his analogies with modern art not always convincing, he has, nevertheless, brought light to these ancient sanctuaries and given the reader an exciting vista into a past that still lives.

The reviewer is Chairman of the Department of Anthropology at The American Museum of Natural History and is the author of Aspects of Culture, *reviewed elsewhere in this section.*

SEA TREASURE

- - - by Kathleen Yerger Johnstone

Houghton Mifflin, $4.00, 242 pp., illus.

Reviewed by
WILLIAM J. CLENCH

THIS book bridges the gap between casual and serious interest in the field of shell collecting. It is broad in scope and gives to the beginning student an understanding and appreciation of this fascinating subject.

The book contains a wealth of information on procedure. Suggestions are given for starting a shell collection, as well as procedures for exchanging, buying, and sharing shells. The chapter entitled "What's in a Name" explains the use of scientific names and gives a basis for understanding the terms. Several later chapters deal with the uses of shells by our American Indians and by the natives of other lands.

Running through the entire book, is

Kathleen Johnstone's fine philosophy, much of it based upon her own personal experience. She treats the subject with a free and easy style which adds infinitely to the book's charm. The eight color plates by Rudolf Freund and René Martin of selected specimens are among the best I have seen, in both color reproduction and definition.

Dr. Clench is Curator of Mollusks in the Museum of Comparative Zoology at Harvard. He has done field research in this country, the West Indies, and Hawaii and has been special editor for various papers on mollusks.

Aspects of Culture

- - - - - - - - by Harry L. Shapiro

Rutgers University Press, $2.75, 147 pp.

Reviewed by Thomas C. Cochran

World leadership has forced Americans of this generation to become acutely conscious of differences in culture. It is fortunate, therefore, that the Brown and Haley lecture series at the College of Puget Sound, Tacoma, Washington, led the eminent anthropologist, Harry L. Shapiro, to write a simple but penetrating discussion of the nature of culture and its processes.

After describing the origins of the concept of culture by anthropologists, Dr. Shapiro traces the course of evolution to the point where tool making and tool using gave man the basis for a culture, as distinct from an unorganized individual struggle for existence. Later, as city life enabled certain cultures to develop a "civilization," a precarious balance was established between concentrated power and human wisdom. This idea frames today's great problem: never before in the history of man's culture has physical power been so menacing with no balancing assurance that wisdom has grown sufficiently to exercise control.

The second of Dr. Shapiro's three lectures is a plea to historians to make more conscious use of culture. To one outside the field it is still hard to see that American historians are moving rapidly toward recognition of culture as the best organizing principle for their syntheses. So far only a few books on United States history deal expressly with cultural analysis, but the large and growing interdisciplinary field of American Civilization is coming to have culture as its central focus. It should also be added that many historians of the last twenty years have written fairly good cultural analyses without using the term itself.

The last lecture deals with history on the grand scale—the rise and decline of civilizations. Civilizations do not die in the organic sense implied by Spengler.

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Western Wonderlands

by John L. Blackford. Birds of desert, stream, forest and mountain — all select homesites according to definite patterns, and here is a guide to lead you to them. 18 habitat areas in the American West are described with a comprehensive listing of birds found in each area. Includes 147 photographs. 120 pages. *$5.15 postpaid.*

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by Joseph Wood Krutch. A stimulating book covering the whole spectrum of life from microscopic organisms to giant mammals. The author unfolds the richness and dignity of man's animal heritage. Topics include: creatures who have apparently reversed the process of evolution, comparative "primitiveness" of mammals, potentials of animals. 227 pages. *$3.90 postpaid.*

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They are continuous, always moving in new directions which may represent neither progress nor regress, but simply the fulfillment of certain patterns. Dr. Shapiro also sees the whole of western culture as closely related, divisible only into national phases rather than distinct civilizations.

Throughout the lectures there are many interesting hypotheses regarding culture. Technical development and density are postulated as measures of the power of one culture to survive in conflict with another, and Dr. Shapiro adds that "a case might be made for density alone being the critical factor . . ." While pattern is seen, as usual, as the "essence of culture," his view that "pattern is a tendency rather than an accomplishment" gives a dynamic approach to cultural analysis. By stating that there is an "inherent balance *toward* which the various elements are moving but which they never quite reach," Dr. Shapiro appears to come close to a theory of social equilibrium which seems doubtful to many historians. But since the balance point is never reached, the emphasis remains on process. Some of the hypotheses, such as the assertion that "the borrowing process seems always to involve a branching off at the latest phase of a pattern of development" offer interesting questions for further historical testing.

But this is distinctly not a book for professionals alone. Such knowledge is an everyday necessity, and here it may be acquired with pleasure.

The reviewer is Professor of History at the University of Pennsylvania, Philadelphia.

THE GALATHEA DEEP SEA EXPEDITION 1950-1952

- - - - - edited by Anton F. Bruun, Sv. Greve, Hakon Mielche, and Ragnor Spark

Translated from the Danish by Reginald Spink
Macmillan, $8.00, 296 pp., illus.

Reviewed by FRANK PRESS

THE MEMBERS of the Danish deep sea marine biological world expedition of 1950-52 have prepared a popular account of their voyage in the *Galathea*. In many ways this expedition is unique among the three earlier systematic surveys of oceanic fauna. A principal concern of the *Galathea* scientists was the nature and extent of marine life occurring under the extreme conditions prevailing in oceanic trenches. Other objectives included studies of the large and active animals of the abyss, the density of living animals on the sea bed, and the productivity of the sea. Advanced types of navigation, echo sounding and sampling gear, together with the conveniences of a spacious, well-equipped laboratory on the *Galathea*, were significant factors in the success of the expedition.

Although it is still too early to make a full assessment of the *Galathea* expedition, some remarkable contributions are already evident. They discovered species which live only at the greatest depths and others which occur over an astounding range of depths. The ranges of several animal groups were found to extend downward from 6,000 meters to the greatest depth trawled—10,190 meters. By quantitative sampling of the sea floor, a population density was established of about ten animals per square meter with a total weight of about one gram. This is the more surprising because not so long ago the deep sea floor was thought to be almost entirely barren.

The background, methods, and results of the different phases of the expedition are described by the specialists themselves. Of particular interest are the chapters on Pelagic Fauna by P. L. Kramp, Sea Snakes by H. Volsøe, the Techniques

continued on page 277

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Answers to questions above: The Bluebird is 7 inches long. The Catbird mews like a cat.

Weldon F. Heald

▲ LOOKING DOWN from 8,000 feet, one is able to pick out the various biological life zones surrounding the station.

Five Life Zones in 50 minutes

The American Museum's Southwestern Research Station is a gold mine for scientists

By MORGAN MONROE

All photographs by Howard De Wald unless otherwise credited

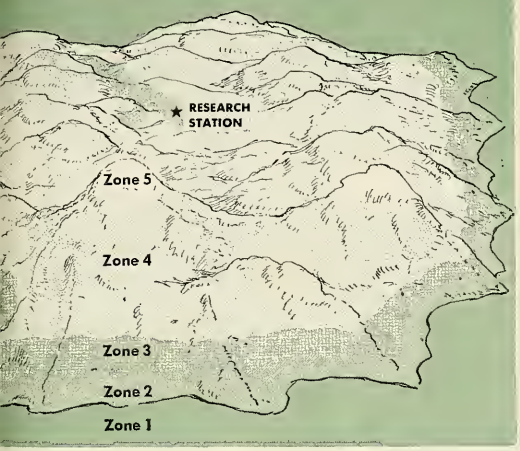
DEEP in the remote Chiricahua Mountains of southeastern Arizona, science has struck a natural history bonanza. Scene of the "strike" is Cave Creek Canyon on the eastern flank of the mountain range that juts from an expanse of desert a few miles north of the Mexican border.

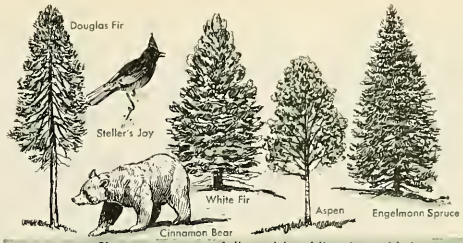
Unlike the strikes of early prospectors who combed the West for gold, this one contained no element of chance. The site was selected with the same kind of careful consideration that major industries give to new plant locations. But the objective was different: the experts in this case were looking for the best site for a research station. Results were immediate and remarkable. Scientists are coming from all points of the compass to observe and study the area's hard-to-find-elsewhere mammals, plants, insects, reptiles, and birds.

The name of this fascinating headquarters is the Southwestern

▲ THE ROAD in the foreground traverses five biological life zones between the desert and the crest of the mountain range. The building is the main residential and administrative center of the station.

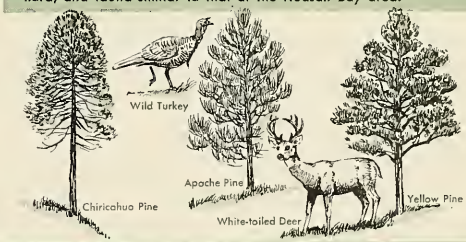
A diagrammatic aerial view of the Chiricahua Mountains showing the distribution of the Life Zones and the station location.





ZONE 5 Since temperature falls and humidity rises with increasing altitude, the highest peaks (Zone V) have climate, flora, and fauna similar to that of the Hudson Bay area.

9000 ft.



ZONE 4 Cool and moist, Zone IV is a remnant of the coniferous forest that covered this whole area in glacial times and still blankets much of Canada.

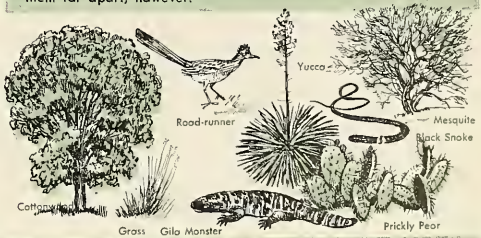
7000 ft.

ZONE 3 Climbing a mountain is climatically equivalent to traveling poleward. Zone III, temperate but dry, marks the transition between southern and northern biotic zones.

5500 ft.

ZONE 2 Also Mexican, but a little less hot and dry, Zone II supports small trees. Competition for moisture keeps them far apart, however.

4500 ft.



ZONE 1 Geologically, climatically, and biotically, Zone I is part of the Mexican Plateau — with its wildly fluctuating temperatures and long droughts broken by violent showers.

3500 ft.

ABOUT THE AUTHOR:

An Arizonan by choice, Morgan Monroe is editorial writer for *The Phoenix Gazette* and former news editor of *The Arizona Republic*, the state's largest daily newspapers. He also finds time to maintain a distinguished reputation as a science writer for North American Newspaper Alliance and as a contributor to national magazines. He has accurately interpreted the major trends and developments in astronomy, anthropology, biology, and atomic and solar energy.

Monroe has carefully observed activity and progress at the Southwestern Research Station since it was established, having spent two of his infrequent "vacations" there. As an Arizonan and a competent interpreter of modern science, he here tells the story of the research station as he has seen it from personal observation.

↑ The Osborn Memorial Laboratory. Southwestern Research Station, Portal, Arizona.

Research Station of The American Museum of Natural History. It is located five miles west of the tiny mountain community of Portal, Arizona. In less than two years since its establishment in May, 1955, it has served as a base for 84 scientists from 16 states, Hawaii, Canada, and Australia. These investigators are working in a dozen fields of science and represent 23 universities, 4 natural history museums, and the federal government.

Such immediate and widespread interest is unprecedented among biological field research stations. The reason, to quote Dr. Mont A. Cazier, station director and chairman-curator of the American Museum's Department of Insects and Spiders, is that: "There is probably no area of equal size in the United States with a more varied and unique natural history."

Such creatures as the coatimundi, Mexican big-eared bat, Arizona twin-spotted rattlesnake, coppery-tailed trogon, and the wild turkey are among the attractions that draw increasing numbers of investigators to what has been termed "a paradise for the natural sciences." Add an enormous variety of insect and reptile life, toss in an array of plants that causes botanists to cheer, whip in an early, mysterious Indian culture, season it all with fossil plants and animals, and you have the recipe that brought the American Museum to Arizona.

A Vertical Laboratory

This fortunate combination of natural circumstances results from the unique nature of the Chiricahua Range. Although only 40 miles long from north to south and a scant 20 miles wide, the up-and-down dimensions are such that this is a vertical laboratory for the field study of natural history. The mountains vault up to peaks just short of 10,000 feet and are flanked on the west by the Sonoran Desert and on the east by the Chihuahuan Desert.

A trip from base to crest traverses five of the six biological life zones found in the western United States. Starting from the desert plateau on either side, one may drive up a winding, unpaved mountain road through constantly changing floral and faunal habitats to the stately evergreens of the Hudsonian Zone, which at sea level extends from Alaska to Labrador.

The entire trip can be made in 50 minutes, but only those blind to nature's wonders would do it that way. The urge to stop and gaze in awe is overpowering. Here is one of the most remarkable natural history "tours" found anywhere. Scientists often spend weeks studying the plant and animal life of an area no

▲ Dr. Mont A. Cazier, station director and chairman-curator of the Department of Insects and Spiders at the American Museum.

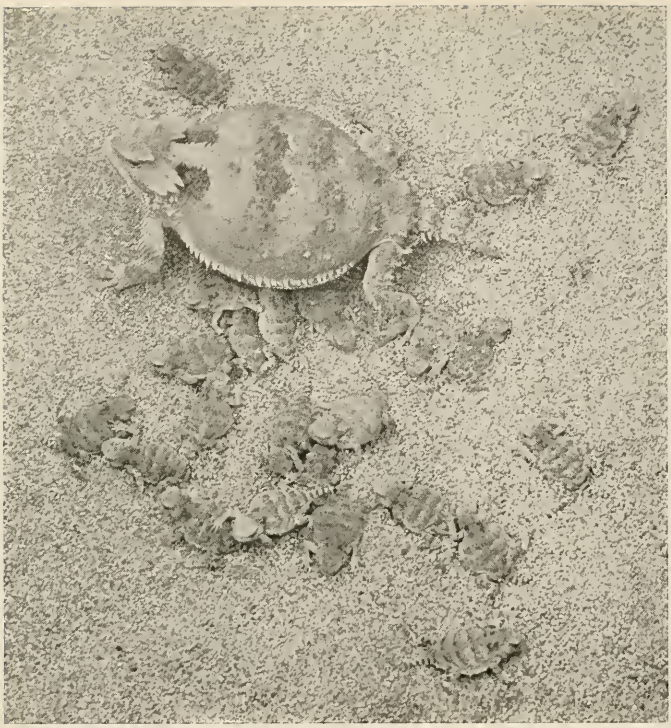
◄ "What do lizards like to eat?" is the question asked by Dr. Frank N. Young, zoologist from the University of Indiana.

▼ Bird feeders at the station attract many "customers." These hummingbirds are feeding from a pop bottle device designed by station personnel.

larger than a city driveway.

Thousands of different types of plants and animals are packed into this comparatively small mountain area. Both floral and faunal associations represent mixtures of elements from the north, from near-by Mexico, from east and west and—owing to isolation from other mountains—indigenous elements.

If the Chiricahuas were laid out horizontally, they would represent, in terms of latitude, life forms that normally extend from Mexico to Canada. This is the key to the Museum's selection of an old ranch site



in Cave Creek Canyon for its research station.

A New Chapter

Scientists have long known that the Chiricahua area contained an abundance of natural history research material. But they were handicapped in the past by its isolation —the very quality which has preserved its natural value. In former years, lack of transportation, accommodations, and laboratory facilities were forbidding barriers to anything short of full-fledged field expeditions.

Establishment of the research station has opened a new chapter in the natural history of the Southwest. And it has been accomplished without disturbing the natural surroundings that make it possible.

The station is an example of a

< A HORNED LIZARD, incorrectly called a "horned toad," and her 26 offspring demonstrate the value of camouflage against a gravelly background.

^ DR. MINTER J. WESTFALL, JR. of the University of Florida, "sweeps" for insects along a tributary of Cave Creek.

^ A RESEARCHER studies freshly-collected larvae of aquatic beetles that live in a nearby creek.

modern institutional trend toward "permanent expeditions" in areas that justify continuing study. But the American Museum and the scientists who use these facilities are not alone in reaping the benefits of the new station. Teachers and students of the biological sciences are always welcome. They find it an ideal base for field work.

And the public is learning that the location is well worth a stop on trips to Coronado National Forest, which surrounds the station property, and to Chiricahua National Monument, which lies on the western flank of the mountains. More than 500 non-scientific visitors have been registered at the station since it opened. Almost invariably visitors leave the station with greater knowledge of the area's fascinating natural history.

The same spirit of helpful interpretation that prevails in the American Museum's New York halls is evident at the station. Though it has no permanent exhibits and no facilities for handling non-scientific visitors, those who stop depart with the same sense of broadened understanding that marks a visit to the Museum in New York.

591,000 More Acres

Arizonans are very proud of what some of them term "*our* branch of the American Museum." This regional pride and public interest takes many forms. Evidence of it is apparent in the station's friendly relationships with Arizona's institutions of higher education, with the press of the state, and with its ranching neighbors. The Museum owns approximately 54 acres of land in Cave Creek Canyon, but ranchers in the area have made more than 591,000 acres of their property available to the station for biological study.

Geologists call the Chiricahua range a "land island." Millions of years ago a large sea covered the area and extended as far north as Utah. When the waters receded, volcanic pressure thrust the mountains out of the earth.

The Paradise Formation of the Upper Mississippi Age, a geological age of the same Carboniferous Period that formed coal deposits in some parts of the nation, left the Chiricahua area with an old type of volcanic rock. This accounts for the varied and unusual shapes of its lower slopes and canyons. Much of the early plant life was covered by silt and fossilized.

▼ A MEADOW among the pine, fir, and spruce forests of the Chiricahua Mountains, one of five biological life zones.

Weldon F. Heald

Evidence of this fossilization may be seen near the research station. The fossilized animal life of the Paradise rocks numbers 155 forms to date. Fossil plants are largely undetermined.

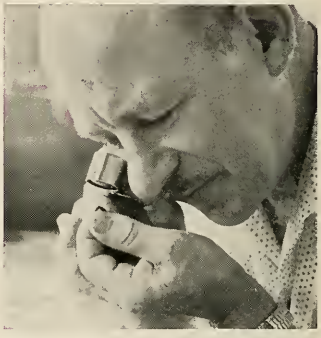
Brilliantly colored canyon walls tower above Cave Creek and its north fork. The station's Osborn Memorial Laboratory stands almost at the junction of the two mountain streams, with residential and maintenance structures fanning out around it in an arc. Throughout the area are many caves. The largest, Crystal Cave, is located just a quarter of a mile from the station. Largely unexplored, this cave is believed to extend several miles into the mountains.

The Cochise Culture

The name Chiricahua, pronounced "cheer-ee-cow-ah," often comes out "cherry-cow" when local ranch hands tell yarns about the old days of Apache Indian raids. The Apaches formerly lived in the mountains and apparently named them with a term which in their language means "the big mountain." Abundant game, including white-tailed deer, probably attracted the Apaches, but they were not the first Indians to inhabit the region.

A pre-pottery and essentially a pre-house culture flourished in southeastern Arizona and adjacent New Mexico many years ago. The Cochise culture, as it is known, developed in three stages. Anthropologists gave the name of the mountains to one of these stages. On the basis of geological occurrence, associated fossils, and cultural evolution, the Chiricahua stage of the Cochise culture is believed to have flourished from about 8000 B. C. to approximately 3000 B. C. Material identified with this stage has been found in association with middens and hearths along the eastern foothills of the range. The pattern for this stage was established through

▲ "Geronimo," an Arizona roadrunner and the station's mascot, eyes a Gila monster (below) brought up from a lower elevation.



▲ A winged army ant male, captured at the station, is examined by Dr. T. C. Schneirla, Curator of Animal Behavior, American Museum.

▼ A research assistant carefully packs insect specimens to be sent to the American Museum in New York.

excavation and study of a large midden found near the mouth of Cave Creek. The site is not far from the research station, although this archeological work was done before the station was established.

Just as early man found the area to his liking, so do those who visit the station and work there in the cause of modern science. The unusual conditions offer new challenges to researchers who have had years of field experience around the world. "I have never done field work in an area that offered me more in such a compact space," a prominent entomologist told me. "It's wonderful to find so many forms of insects."

At the time of my most recent visit to the station, I found Dr. Cazier elated. "We find something that surprises us almost daily," he commented. "One of the ornithologists working here has just discovered an orchard oriole—a bird we would never expect here!"

Such "firsts" have become almost commonplace at the station. A University of Arizona researcher, with the aid of station personnel, has captured five specimens of the Mexican big-eared bat. He uses gauzy nets strung across the station's swimming pool each night. In a recent publication, he termed the flying mammal "one of the rarest bats in North America, whose occurrence in the United States was completely unexpected."

Even the station's pets are unusual, and they do unusual things. A young roadrunner, brought up from its desert home for observation, has become domesticated. It follows station personnel and visitors around like a puppy. They found it in a canyon near one of the famous Apache warrior's former hideouts and named it Geronimo. The bird entertains all who see it. One of its amusing antics is riding atop the head of anyone who will carry it in the direction it wants to go!

Scientists who come to the station to do one type of research often find something so unusual, so challenging, in other branches of their respective fields that they change plans on the spot. This has led to new research projects and programs that are supplying valuable additional knowledge.

Weldon F. Heald

↑ An aspen and spruce stand near the top of Fly Peak.

Important Contributions

Work at the station contributes to more realistic Museum habitat groups, to improved field guides for plant and animal identification, and to expanded educational material in the form of scientific papers and natural history books on subjects about which additional information is needed.

Studies of insect and reptile life were predominant in the station's first year of operation, but other fields of natural history have since received major emphasis. One of these is ornithology. More than 200 species of birds have been collected or identified in the Chiricahua area. The coppery-tailed trogon, a beautiful parrot-like bird usually found in Mexico and Central America, is but one of the creatures being given special attention. A flock of Merriam's turkeys—the true wild turkey—may be seen on the grounds at times. The golden eagle, the band-tailed pigeon, the Mexican chickadee, and the big, handsome Arizona jay are among the readily-identified birds seen frequently.

Floral characteristics of the area reflect the same "scrambled" influ-

continued on page 274

The Snorkel Turtle

It may have used the snorkel as a concealment device a hundred million years before the submarine was invented

By Charles M. Bogert

HOW to avoid being seen by the enemy is an age-old problem. We cope with it every time we engage in war, which implies that we have given it a lot of thought and effort. Yet there is a counterpart in nature for virtually every concealment device we have invented. The snorkel is a recent invention that has long been in use in the animal world.

The *schnorckel,* as its German inventors called it, was developed to enable submarines to recharge their batteries without surfacing. It is a "breather pipe" with one passage to provide air for the engines and another for expelling the exhaust. With only the inconspicuous snorkel at the surface, the submarine can stay out of sight for long periods.

The turtle's snorkel was quite possibly in use a hundred million years before the submarine was invented. We know that ancestors of the snorkel-snouted turtles were contemporaries of the dinosaurs. Judging from their bones, they were much like the soft-shelled turtles of today. They undoubtedly had long necks, and their eyes were at the front of the skull. Such a turtle could rest in shallow water and send up its "periscope" to look over the situation before exposing its body to predators on the bank or in the air. It could also replace the air in its lungs before diving back to the bottom.

Exposing even the whole head must have been hazardous, however. Otherwise it seems doubtful that the long proboscis-like snout would have evolved. This acquisition made it possible for the turtle to breathe without exposing more than the inconspicuous end of its slender snout. In a metaphorical sense, the animal also "recharges its batteries" with this, for it exhausts its waste carbon dioxide in the expelled air and replenishes its oxygen supply when it draws fresh air into its lungs.

John H. Gerard

◄ Only the tip end need be thrust out of the water for the turtle to renew its air supply.

John H. Gerard

↑ LIKE THE MODERN SUBMARINE SNORKEL, the long neck of the eastern spiny soft-shelled turtle enables it to hide from enemies while breathing air through its proboscis-like snout.

However, there is more to this tubular snout than meets the eye. Soft-shelled turtles live in streams, ponds, or lakes with soft bottoms in which they can readily bury their flattened, flexible shells. In clear springs in Florida, skin divers have seen soft-shells almost completely buried in the sand or mud with only the proboscis extended. Submerged in this fashion, the turtle draws in and expels water through the nostrils. One diver demonstrated this by dropping a small amount of silt in front of the snout and noting the existence of water currents. Movements of the throat cause water to be pumped in and out of the nostrils, and the capillaries lining the throat presumably perform the function of those in a gill. A small amount of oxygen thus absorbed from the water supposedly augments the supply in the lungs, enabling the creature to stay submerged for long periods.

The turtle's use of its "snorkel" improves on ours in this respect. Had we been able to devise a way of extracting oxygen from sea water, we'd probably have had our submarines hiding in soft ocean bottoms with only the snorkel sticking up out of the muck.

But there's still another purpose in this circulation of water through the soft-shell's snorkel. To detect odors, we sniff the air. Submerged turtles draw in samples of water for similar reasons. Special sense organs (known scientifically as chemoreceptors) are present in the passages through which the water travels when drawn into the nostrils. These organs enable water-dwelling turtles to detect odorous particles in the water. Just as we use our senses of smell and taste in selecting food, turtles use theirs to distinguish what is edible from what is not. Probably turtles are not only aware of food several feet away but also are attracted to it. So the soft-shell can hide in the mud on the bottom and still not pass up any choice morsel that comes its way.

The soft-shelled turtle may not be the first backboned animal to make use of a tubular snout to get a breath of air without exposing itself. Indeed, the more primitive South American *matamata*, certainly the weirdest-looking turtle in existence, is provided with a similar structure. But it is the soft-shelled turtle that makes maximum use of his snorkel. He not only can charge his batteries without emerging. He can sample the water for odors while hidden in the mud and can even extract oxygen from the water through his throat. When it comes right down to it, the soft-shell has out-snorkeled us.

CHARLES M. BOGERT is Chairman and Curator of the Department of Amphibians and Reptiles at The American Museum of Natural History. He is the author of numerous popular and technical articles. Having recently returned from a year in Mexico on a Guggenheim Fellowship, he is now preparing a report on heat regulation in reptiles.

It's all done with *Shellac*

Man's tiniest domesticated animal produces one of the world's most useful materials

By Paul W. Kearney

Photos by Bern Keating from Black Star

INDIA'S largest domesticated animal is the elephant, *Elephas maximus,* weighing two to three tons. Its smallest is *Laccifer lacca,* which tips the scales at about one-thirtieth of an ounce.

While everybody knows something about the elephant, not one person in a thousand would know the lac bug, even by its common name. Yet everyone in this country comes into direct contact with its product countless times every day. For that product is shellac, which contributes many millions a year to the economy of India, with Americans the biggest buyers.

To any do-it-yourself fan, shellac is something you put on a raw wood floor in the process of finishing it. Yet the vacuum cleaner you use on that floor is held together by shellac, as are the electric lights you turn on before you go to work. The shades on the lamps are finished with it, and your shoes have shellac in their polish. The felt hat that you dutifully hang up is stiffened by shellac, and even the magazine under your arm used a small amount of shellac in its making. The candies in the box you brought your wife may have been coated with shellac, and your TV set used shellac all the way from its gleaming cabinet to its interior tubes. If you enjoy your Hi-Fi record player, you can thank a shellac disc for the remarkable fidelity of tone.

Through its product, this pest of the forests of India is one of our most omnipresent servants. The market for lac steadily increases in the face of sharp competition from modern synthetic plastics, many of which themselves include shellac.

For generations, chemists have tried vainly to "crack" shellac and imitate it. In fact, one of the futile efforts of Dr. Leo Baekeland along this line some 40 years ago resulted in the invention of Bakelite, an entirely different product.

This bug that has long defied chemists is a pinhead-sized parasite, partial to certain varieties of trees in India and especially prolific in the state of Bihar. Although there is believed to be only one male for every 5,000 females, he is quite a male. Breeding is so prolific that the name lac comes from the Hindu word *lakh,* meaning "one hundred thousand."

Attaching themselves to the tender shoots of trees, the insects pierce the bark and feed on the sap. Unless man comes to the tree's aid, it generally dies in a few years. Meanwhile, each lac bug exudes a reddish resinous secretion, which gradually covers it like a tent.

There are two generations a year.

Paul W. Kearney has written for almost every important American magazine since he began free-lancing 25 years ago. Although he writes on many subjects, safety in all its forms is his specialty. His hobby is driving from one end of the country to the other, and he has covered every state in the U. S. at least twice. He lives in Brooklyn and has a summer home in the Catskills.

↑ THE LAC is stretched in front of a fire as far as arms, legs, and teeth will permit. When cool, the sheet is brittle and has become the lac of commerce.

Even one generation can produce a coating from ¼ to ½ inch thick if the insects are close enough together.

However, if a newborn lac bug doesn't find a suitable food supply within about twelve feet of its birthplace, it curls up and dies. Therefore the breeders of this tiny livestock spot the "expectant" females ahead of time, by noting the appearance of orange spots on them. They then move the brood stock to fresh trees, either by putting the branches in the trees or by hanging them in baskets so they can emigrate for themselves.

The lac is harvested by putting the crudely crushed seed lac into a long tube of muslin and revolving it before an open hearth. The hearthman holds the tube in his left hand, twisting it steadily before the fire and wiping off with a stick the lac that melts and oozes through the cloth. This accumulation of half-molten lac is finally put onto a metal can filled with warm water. An assistant spreads the stuff with a palm frond into a fairly thin sheet and then pops it off the can and stretches it in front of the fire. By the time it is stretched to his arm's and leg's length as shown in the photographs, it has cooled and turned brittle. He stacks these sheets, and when broken up, they represent the lac of commerce.

Women winnow the stuff to separate the lac from twigs and other

William Zinsser & Co., Inc.

▲ WORKMEN cut the lac-encrusted branches from the trees.

▼ LAC SECRETIONS result from the lac bug's piercing the tree bark to feed on the sap. The resinous coating is from one-quarter to one-half inch thick.

▲ WOMEN winnow the lac to separate twigs and other impurities.

impurities. The owner will pay only for the lac and not for the impurities they have separated out.

The color ranges all the way from "ruby" to "blonde." The purest grades are light orange-brown, the less refined darker in hue.

Lac does not become a liquid as you and I know it until it has been properly "cut" with alcohol. And it doesn't become "white shellac" until it has been bleached with chlorine.

40 Million Pounds a Year

Lac cultivation is a very ancient trade in India, and the primitive techniques of a "cottage industry" exist side by side with modern methods. The typical breeder of lac insects has two or three open-hearth fires and only produces about a *maund* (82 pounds) of resin a season. He sells it to the local bazaar, and it is ultimately picked up by the agents of Calcutta exporters. Big plants with 30 or 40 fires are few. Yet India's total output of stick lac is about 40 million pounds a year. Refining this as shellac reduces the quantity by about half. The United States and Canada use about one-third of the production. Strangely, we have scarcely a dozen bleachers, several of which have been in busi-

← THE CRUDELY CRUSHED SEED LAC is put into a long tube of muslin and is revolved before an open hearth.

↑ THE LAC melts and oozes through the muslin tube as it is turned before the fire.

← THE HEARTHMAN wipes off the melted lac with a stick until a sufficient quantity is accumulated.

↓ THE ACCUMULATED HALF-MELTED LAC is spread over a metal can filled with warm water. When a fairly thin sheet is ready, it is peeled off and given to the stretcher.

ness for over a century. Yet lac is so important that during the war the whole business was taken over by the government.

It is interesting to see so ancient a product stand toe to toe with modern plastics and more than hold its own. A few years ago, synthetics did begin to make inroads in the phonograph record field, but when high fidelity came along, the lac bug climbed right back into the saddle.

It is interesting, too, that despite all the millions that have been put into the development of new adhesives, shellac is still preferred for joining glass to glass or glass to metal, as testified by its universal use in the manufacture of electric light bulbs, TV tubes, etc. Its high insulating properties also make it valuable in wire coverings and in the protection of motors, armatures, and other devices.

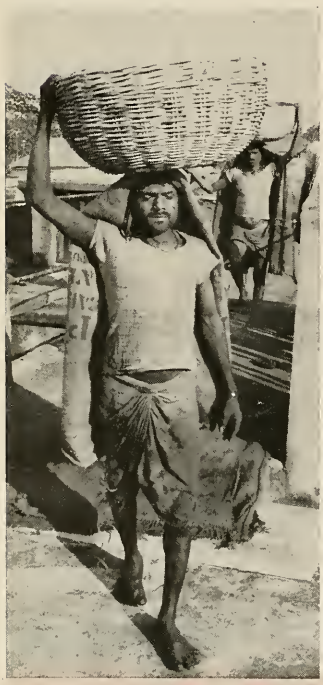
Mothproof cedar chests were almost unmarketable in earlier days because no varnish, stain, lacquer, or other surface coating could keep the potent cedar oil from coming through. Then shellac did the trick. Likewise, without the use of shellac to make printing ink dry quickly, our high speed presses could scarcely have been developed. Coated papers used in high grade printing owe their glossy surface partly to shellac. Photoengravers utilize it liberally in making color plates. And valuable oil paintings are often protected by a coat of "French varnish," which is simply refined shellac.

Still another class of products that can be said to owe their existence to the lac bug are the popular insecticides such as Flit. When they were first introduced, it was virtually impossible to keep the liquid from eating its way through the seams of the cans until somebody thought of coating them inside with shellac. Its ability to resist most solvents is one of this natural resin's outstanding qualities. Only three common things will dissolve shellac: alcohol, borax, and the digestive juices of the upper intestine. The fluids of the stomach can not digest it. Therefore, if your doctor gives you a pill or capsule which he wants to remain intact until it reaches the intestines, he will see that the druggist provides it with a coating of shellac. When the pill reaches the upper intestine the shellac is dissolved and the medicine is ready to go to work.

If an oil refinery wants to protect its tankers against the corrosive action of gasoline on the trip out and against the action of salt water ballast on the return voyage, a red pigmented shellac will be used to paint the interiors. There seems to be something in the iron oxide of red paint that unites with shellac to form a tough combination. This is why refineries also use this red pigmented shellac to paint metal ladders, catwalks, etc., on outdoor structures. It protects the surface and also keeps it from getting slippery under gasoline spillage.

Shellac Has Many Uses

Most of us think of shellac as "white" (clear) or orange. Yet the idea of pigmenting is an old one. Many aniline colors can be added to shellac to achieve a wide range



↑ THE FLAKED SHELLAC is transported in woven baskets.

➤ SPREADING AND RAKING shellac on a roof-top for drying.

of tints. In fact, the do-it-yourself enthusiasts may be interested to know that smart professional painters now tint shellac the same color as the final coat and use it as a primer. A half-hour after this is on, it is dry. In fact, it dries dust-free in ten minutes, permitting application of the final coat without further ado. This same quick-drying feature applies to floor finishes, which can be walked on a half-hour after a *good grade* of shellac has been applied.

This is the use of shellac with which most people are familiar: the finishing of woodwork. The lovely sheen on antique Chippendale, Hepplewhite, and Sheraton furniture testifies to the skill of the old masters at handling shellac. Not so many are ready to praise our modern "antique-makers" when they "age" their modern creations with the aid of shellac. One who knows the trick can convert the cheapest unfinished picture frame into the most convincing "antique" of pickled wood in 30 minutes.

Today about 70% of all new floors are coated with shellac. Its durability is indicated by the simple fact that all championship bowling alleys get six to eight coats before an official ABC match. Crack bowlers like this because it eliminates any accidental slippage of a ball with a hook or a spin on it.

Probably the most graphic demonstration of the superiority of the lac bug's product as a floor covering was made at Brooklyn Polytechnic Institute a few years ago. Sixty-four panels of three varieties of wood were coated with top grades of shellac, resin sealer, varnish, and wax finish. They were then fitted into a corridor through which, day and night, in wet weather and dry, some 2,000 students tramped daily. At the end of the test period (which was equivalent to over six months' wear in the average home), the panels were taken up, dusted with a dry cloth, and photographed in color. In every case, the shellacked panels retained their original color, while all the others showed perceptible darkening. The shellac showed virtually no marks of wear, while all the other surfaces were heavily scarred and scratched.

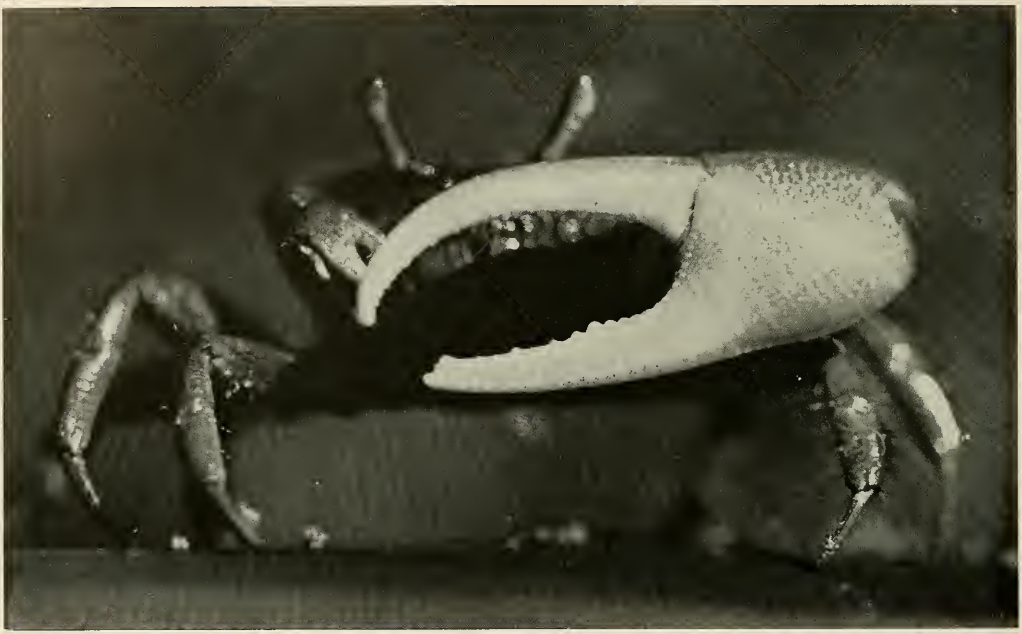
The reason is that shellac has a peculiar affinity for wood. Its ability to unite with wood presumably results from the fact that it is a natural resin originating from the sap of a tree. It actually penetrates into the pores and vitrifies them so that the first coat becomes part of the wood itself. Subsequent coats provide a built-up surface to absorb wear. Shellac is also amazingly elastic. If you dent a shellac-covered floor with a hammer, the shellac will follow the dent instead of "crazing." If you scratch the surface with a knife point and rub the gash lightly with wax, the scar is eliminated. For these reasons, experts have found that a good grade of shellac, properly applied, will remain in excellent condition for at least six years on an oak floor. It is said also to be the only surface coating that dries from the bottom up.

Many are surprised to know that the same covering they use for floors and walls is also used by the Navy to coat shells — and by fireworks manufacturers. Any good piano will carry ten to twelve coats of shellac; most mirrors are backed with it. It is safely used for candy coatings and in cosmetics, and in the manufacture of all lacquers, especially metal lacquers. It forms the coating or gloss for playing cards, printing papers, and the wooden patterns so vital in industry. It is the base of all sealing waxes; it is equally essential in modern aircraft production, shipbuilding, and toy making.

Substitutes pop up and fade away, but the product of the tiny lac bug goes serenely on its way.

▲ THE BUYER OF LAC weighs it carefully, looking to see that the product is pure and of a good color. The purest grades are light orange-brown.

AMNH



▲ THE HUGE CLAW of the male fiddler may occur on either side. Its stalked eyes may be seen behind the upper edge of the claw.

I Watch Fiddler Crabs

These Florida beachcombers are sun-lovers. On cool nights they close the doors of their burrows with two inches of sand

By ROY L. ABBOTT
Iowa State Teachers College

THE fishermen who keep passing in their boats along the narrow channel only a few yards out, all stare at me—rather pityingly, I think—when I chance to glance their way. And why not? For day after day and hour after hour they have seen me, clad only in shorts and a helmet, sitting motionless in the boiling sun on this same bit of sandy beach, my knees nearly to my chin, arms loosely hooked around them, my eyes toward the ground as if gazing intently at something around me and between my feet.

As a matter of fact, I *am* looking at something — a horde of fiddler crabs. I am in the very center of a colony, and there must be a thousand within a few feet of me. To native Floridians and the hosts of tourists who haunt the Gulf Coast, fiddler crabs are as common as sand fleas and of little more interest except, perhaps, to those who want to use them for fish bait.

But to me, a Midwestern scientist, well off my beaten track, these tiny fellows staring at me intently from the mouths of their half-inch wide burrows, or moving jerkily about in sidewise fashion, are fascination itself. For one thing, what variation in size and color they display! So far as I know, they are all of the same kind; the differences in size — from the size of a small pea to that of a nickel — are due to

DR. ROY L. ABBOTT is a scientist and journalist who divides his time between teaching at Iowa State Teachers College and his new home in Florida. He is presently engaged in a study of the desert tortoise. His hobbies include flying, fishing, walking, and writing.

differences in sex and age. But Nature must have been in a whimsical mood when she got out her paint pots to decorate their flattened, nearly circular bodies.

Browns, purples, blues, and yellows are the dominant tones, with queer mixtures or mottlings of these. No two crabs are quite alike, except that all bear the same bizarre design upon their backs: an outline — as I see it — of the front halves of two buck deer standing joined at their middles, with head and horns pointing in opposite directions.

Gazing through the narrowest of lid-slits at these fantastic midgets as they move about my feet, I am momentarily lifted from reality. I am a Gulliver with the Lilliputians seething around me. But there's this difference from the men of Lilliput: these little people are not built after the human pattern — a body with a framework of bones covered with muscles and a soft sheathing of skin and hair. Instead, they lack bones, and their muscles are attached to the inside of an outer coat of cleverly jointed armor. They appear more like miniature tanks than creatures of flesh and blood, more like ingenious mechanical toys to be wound up and set going.

But they're live creatures and not man-made gadgets for all my Gulliverian imaginings. Each keeps manipulating its ten legs, placed five on a side. Each holds its tail, slender in the male and wide in the female, bent forward, flat against its chest, and each peers at me comically from eyes set at the end of quarter-inch movable stalks.

I say they peer at me, but that doesn't mean that they picture me as anything more concrete than a big lump of matter that has suddenly reared itself in their midst. It is easily seen, though, that their tiny stalked eyes function to detect movement. Tired from sitting in my cramped position, I suddenly shift my feet and lift my head, and they know it. Almost instantly, each watchful crab dives into its burrow. Suddenly the few square yards of sandy beach around are seemingly bare of life, the entrance to each hole open and empty.

Aha! I say to myself; with crabs, as with other wild things, movement is a sign of danger. But I have to modify this conclusion almost as soon as the crabs are out again, for not one of them pays the slightest attention when half a dozen tiny sandpipers alight suddenly among them and go bobbing along, picking at this or that. Yet a quick shadow of a Brown Pelican flying overhead drives them to cover again.

Since fiddler crabs are sun lovers, I never have long to wait for their reappearance. Ah! there's one now, close to my foot. There's another yonder—and another; they're popping up all around me. I laugh aloud at seeing them all sitting momentarily at the edge of their burrows like so many prairie dogs. But to my surprise, my laughter doesn't disturb them. Nor do they flinch when I whistle shrilly or yell loudly. Apparently they are stone-deaf to any noises I can make.

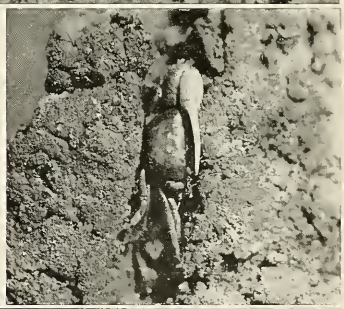
Presently, since the "all clear" signal appears to have been given, each fiddler goes about his own crab-business, one aspect of which appears to be eating. Each spends minutes on end picking up tiny bits of the beach and poking them into its many-jawed mouth.

The females feed with both hands —perhaps I should say with both front legs—which are of equal size and have only tiny two-jawed pincers as hands, a thumb and a finger.

Here's a female feeding within two feet of my face; I can see her every movement. She's amazingly deft; using each hand alternately,

Jack C. Coulter

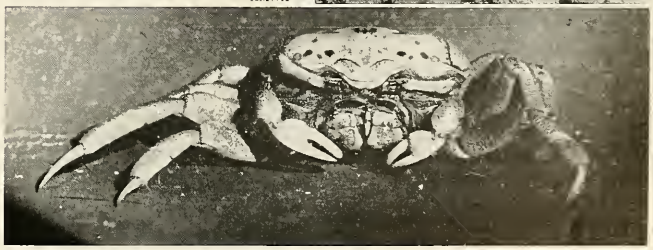
↑ A "RIGHT-HANDED" FIDDLER CRAB near the entrance to its burrow.



➤ FIDDLER CRAB in its burrow, which may go down two or more feet.

↓ THE FEMALE FIDDLER CRAB has small claws of equal size.

AMNH



tidbits enter her mouth at intervals of a second. After a dozen or so such bits have been mouthed and chewed, she reaches up with one hand and pulls away a ball of refuse — mostly sand — sifted free of its algae and other edibles by her bristly jaws. These "table scraps" litter the soil around every door.

The males can't feed as rapidly as the females, because one of their front legs is developed into a great pincers, and this makes them "one-handed," at least when eating. It is this huge claw, commonly held in bent-elbow fashion suggestive of a violin bow, that gives the name "fiddler" to these crabs. Strangely enough, either the right or the left leg may be thus developed, and left-handers are about equal in numbers to the right-handers.

But my fiddlers don't spend all their time eating. Building operations—perhaps "tunneling" or "sapping" would be more accurate terms—are constantly in progress. New holes must be made or old ones deepened. Fiddlers can dig new holes with surprising speed. Some that I captured and placed in a glass jar of packed wet sand sank a shaft eight inches deep in half an hour. On the beach, their holes often go down two feet, and every den has many excavated balls of sand piled near its entrance. If this excavated material gets in the way, the digger momentarily stops digging to push it aside.

My prisoner crabs obligingly sank their burrows down the side of the jar so that I was able to watch their method of digging. All five legs on one side are used, first as a shovel and then as a carrying tool, much as we can gouge out and lift a handful of sand by holding our fingers together and cupping them. As soon as the crab has collected a ball of sand in its "leg basket," it backs out, carrying its load to the surface. On cool nights, my crabs plugged the entrances to their burrows with sand to a depth of two inches and didn't unplug them next morning until the sun was high.

Like humans, fiddlers neither eat

continued on page 280

▲ THE TEITA FALCON resembles the peregrine falcon in miniature.

A Rare Bird, Indeed!

The Teita falcon has been sighted only eight times in sixty-two years

By CLIVE ALFRED SPINAGE

All photos by the autho

THE only Teita (or Taita) falcon in captivity was recently caught in Nairobi, the capital of Kenya, East Africa, by the African gardener of Mr. Justice Rudd, a Nairobi judge. The bird was captured at the bottom of his garden which is next to the Governor's

▲ THE TEITA FALCON, with wings spread.

'sidence. One of its wings had ɜen slightly damaged, but it ap- ɜars to be mending satisfactorily. 'ithin fifteen minutes after cap- ıre, the bird was quite tame and as eating out of its captor's hand.

The Teita falcon, named after ıe Teita Hills and a district of ortheastern Tanganyika, is known ɜientifically as *Falco fasciinucha.* was first discovered in 1895 by ıe late Professor O. Neumann on ne of his African expeditions. Pro- ɜssor Neumann sent the specimen ı the Berlin Museum and published description of it jointly with A. eichenow.

After this, a second specimen 'as captured by A. B. Percival, a 'ell-known game warden. Colonel . Meinertzhagen acquired this 'om Percival, and it is now on eposit in the British Museum.

The Teita falcon was not seen gain for some time. It was rediscovered in the Yavello District of Ethiopia by the well-known African ornithologist C. W. Benson, Esq., who collected three specimens.

Since then, the bird has been observed by different persons on four separate occasions, at places ranging from the palm-fringed coast of East Africa to the practically unknown Crater Highlands of Northern Tanganyika and the wild Northern Frontier District of Kenya.

To recent date, these are the only recorded observations of this extremely rare bird, and nothing is known of its nesting or breeding habits.

The captured specimen has immature plumage, which has hitherto not been recorded. The bird was recognized by a barely discernible rufous nape patch, which is characteristic of the adult. It is judged to have been about nine months old, in its second immature plumage, and to have reached almost maximum growth, its size being about eight inches high. The plumage is predominantly gray, with light blue-gray feathers on the back, a yellow beak, and yellow-ringed eyes. It is thought to be a female.

Mr. John G. Williams, ornithologist at the Coryndon Memorial Museum of Nairobi, identified the bird and stated that it was the fastest bird of prey he had ever seen, surpassing even the peregrine falcon, which it closely resembles in miniature.

Mr. Justice Rudd hopes to be able to train his bird for falconry, being already the possessor of a trained kanner falcon.

Born in England, the author worked for a time at the Atomic Research Station at Harwell. He served in the Intelligence Corps in Egypt and Cyprus and in the Kenya Police. He is a Fellow of the Zoological Society of London and unofficial photographer for the Museum in Nairobi.

A TRUE LACANDON OF THE DEEP FOREST. Though austere in appearance, he proved gentle and rarely spoke above a whispe

➤ THE CASTILLO, Chichén Itzá, with a Chac Mool in foreground. The four stairways of 91 steps each total 364, and one more at the temple at the top makes 365, the number of days in the solar year. The nine terraced steps on each side of the pyramid have 52 panels, which is the number of years in the Toltec cycle. The two pairs of nine terraces on each side total 18, the number of months in the yearly Maya calendar.

To the Land of the LACANDONES

An expedition to a tropical land where survivors from Mayan times live a secluded existence

By EDWARD WEYER, JR.
Formerly Editor of NATURAL HISTORY *Magazine*
Photographs by the author

PART I

EXPLORERS of the last century, stirred by the pyramids and temples of Central America, dreamed of discovering survivors of the ancient Maya Empire still practicing their rites far back in the jungle. When in the 1840's John Lloyd Stephens published his two best sellers on his explorations, popular interest in the Maya civilization increased. One of Stephens' disappointments was in not being able to go ten days out of his way at Palenque. There, according to an old priest, he would find a large stone city in which Maya-speaking people were living exactly as they had done before the discovery of America.

Toward the end of the century, A. P. Maudsley, the British archeologist, came upon a ruined temple deep in the interior of Chiapas in which there were ritualistic objects that had recently been in use. He also remarked how closely the features of the Indians he met matched the distinctive Maya profile seen on ancient sculptures.

Then, in 1902, Alfred M. Tozzer, a Harvard anthropologist in his twenties, began five years of exploration and study, which included living with the Lacandones and learning their language, and his conclusion was an exciting one. These Lacandon Indians of Chiapas actually were the present-day representatives of the ancient Mayas in customs, religion, and language.

When last year a letter from the

EDWARD WEYER, JR., holds a Ph.D. in anthropology from Yale University and had been Editor of NATURAL HISTORY Magazine for 22 years when he left the staff a month ago. He is now compiling an encyclopedia of natural history for the American Museum. In future he hopes to devote more time to the anthropological studies that have always been his chief interest. His book *The Eskimos* is the only work in English that deals with all the tribes of Eskimos. Readers of NATURAL HISTORY are familiar with his other travels, from Greenland to the interior of Brazil. In 1953-1954 he was President of the Explorers Club.

↑ Frans Blom, well-known Central American archeologist and explorer, on a jungle trail in the back country of Chiapas.

↑ Trudie Blom in the field, wife of archeologist Frans Blom.

↑ Harry Little who lives in the Lacandon forest, receives mail from a passing expedition.

↑ The boat that one mule can carry to remote lakes and rivers of the Lacandon country: Frans Blom at the starting rope.

well-known Danish archeologist, Frans Blom, invited me to visit his scholarly retreat in Mexico 60 miles from the nearest railroad, I hoped this might be the chance to make a trip into the Lacandon country. I boarded a plane and was soon in the heart of one of the most exciting anthropological areas in the world. There is no place in the Western Hemisphere where so short a trip can put one into such an exotic land.

Chiapas is Mexico's southernmost state, and it is more than three times the size of Massachusetts. It lies southwest of Yucatan and at Guatemala's back door. Its seacoast is on the Pacific side. A large portion of its three-quarters of a million people are pure Indians, and they are scattered through widely varying zones from steaming lowlands to chilly mountains.

There *is* a Shangri-La

Frans Blom, after years of exploratory research in Middle American archeology, established this science center and library in the highland village of San Cristobal de las Casas, near the center of the state. The driver who sped me up the mountain curves from sweltering little Tuxtla Gutierrez, capital of Chiapas, to San Cristobal at 7,000 feet, stopped twice to adjust his carburetor for the altitude. Near the highest point, we drove past several dozen thatched huts scattered around a mountain tarn in a clearing among tall evergreens. The air had grown chilly in the gathering dusk, and the cedar smoke filtering through the thatched roofs was appetizing with the aroma of the evening meal.

Darkness fell as we came through a notch and looked down upon the sparkling little city of San Cristobal, a pearl of the high Sierra Madre Mountains and cultural center of an early European colony that was al-

ready a century old when the Pilgrim Fathers landed at Plymouth.

After much asking for directions, we came to the head of a lane at the edge of town, and I spotted the Sign of the Jaguar — emblem of Frans Blom's establishment for exploration and research.

A rap on the medieval knocker brought a bedlam of barking and parrot calls. Then silence.

My ears were still ringing with the roar of airplane motors, but when through the creaking door I saw the classic face of Frans Blom, with his clear blue eyes and flowing white hair, care slipped away and I entered a realm where each moment was to be lengthened by the perspective of history and broadened by a timeless sense of leisure.

"Excuse us for not waiting supper," he said, as though I had come from across the road. He was tucking a scarf into the neck of a coarse jacket of native homespun material. The large Afghan hound beside him, with cream-colored bangs neatly parted down the middle, was looking down its nose at me.

Frans Blom's Friends

Across a colonnaded court, dimlit under a starry sky, the flickering light of an open fire revealed a dozen men and women seated at a long dining table. To my left, at the end of the corridor, the walls of a large room were lined with books on each side of a cavernous hearth. This was Frans Blom's remarkable library, of which I had heard so much.

Washing up a few minutes later over a charcoal burner, I shivered and marveled that so frigid a land could lie only 17 degrees from the Equator.

"We're a strange assortment here," said Don Pancho (as all of Blom's friends call him), turning me over to his wife Trudie for introductions.

There were two anthropologists —man and wife—just in from the field, and a former Yale professor with a dachshund, who was camping through the country in a station wagon. An Australian novelist had just come in from the jungle, her legs a swollen mass of tick bites. They were talking about two California geologists for whom the Bloms had just engineered an expedition into the back country to study amber deposits. And the big event, I soon discovered, was the expected arrival of Dr. Pitkin, a 78-year-old woman physician from Congers, New York. Winifred Pitkin had turned to archeology after a full career as a horse-and-buggy and

FRANS BLOM, proving that the jungles of Chiapas produce flowers in the shape of ducks.

THE LACANDON, Antonio, helps the author hold the flag of the Explorers Club. Lacandon men average very little over five feet tall.

THREE LACANDON WOMEN and one young man in a *caribal* in the mountains near Monte Libano. The women wear their hair smooth and braided down the back, with a bunch of bird feathers to signify maturity. The men delight in keeping it shaggy.

A LACANDON WOMAN whose face is reminiscent of parts of Asia, whence her ancestors are believed to have come.

snowshoe doctor and was already a veteran of the jungle trails. She was to accompany us into the Lacandon country.

For two weeks, our days were spent visiting historic spots, browsing in the Bloms' fine library, which included some 3,000 pages in microfilm, and traveling into the country to photograph and record Indian ceremonials. Our evenings were passed around the fire, sharing stories of our lives.

On the morning of our departure for the Lacandon forest, we took our hammocks, machetes, and provisions to the airstrip at 8 o'clock. But the plane that was to fly us 55 miles due east to a hillside landing, failed to show up. These chartered planes are used largely for flying coffee out from remote plantations, and we learned that two of them had recently cracked up in the mountains.

A LITTLE LACANDON GIRL, wearing a necklace made of seeds and an expression that shows her perplexity at the unnatural-looking visitors to her village.

A YOUNG LACANDON WIFE, who rarely smiled. Her child, possibly because of a birth injury, could not walk.

The remaining pilot, who was to come for us, was "incapacitated."

Twenty-four hours later we got off. One has to fly without a seat belt in many parts of the world, but here there weren't even any seats. We braced ourselves on top of our duffel bags and soon were roaring over the deeply sculptured landscape. Seventeen minutes later we could see Ocosingo five miles away on our port beam, the town from which John Stephens set out more than a century ago on his difficult trip to the ruins of Palenque.

Eight minutes more brought us over the landing strip at Yaxoquintela (literally "Green River Running over Stone"), and we sidled in for a tricky landing. An hour away on foot we reached El Real, a ranch where we passed our last night on beds.

Our first march on a journey that was to take us to midway between Palenque and Bonampak brought us to two lonely thatched huts on a small tributary of the Santa Cruz. This was Monte Libano. The Lacandon name for it is Caoba; it is also called Puná. The next day we made our second camp amid towering trees at an elevation of 2,200 feet. Here we met Harry Little, of whom I had already heard much.

Harry was hunkered over a small campfire. He was bare to the waist and had long silken hair. Beside him in a little cardboard box shivered a tiny female spider monkey.

"I have taken the place of its mother in every way," Harry said, "—psychologically, that is."

The monkey had been rescued from an attack by a harpy eagle while riding through the treetops on its mother's back. The mother had been killed.

A Forest Hermit

Harry was from Vermont. He may have been in his late thirties. According to one story, he had fitted out a sailboat to take his wife and twelve-year-old son to a tropical paradise, but she had blown the boat up with dynamite. Another version had it that a mutual friend had forestalled what looked like certain disaster by pouring kerosene on the boat and setting fire to it.

I honored the hermit's right to tell only what he chose and refrained from prying. But I found Harry an interesting and friendly man, whose thoughts were on the future rather than the past.

"I expect to stay here the rest of my life," he stated. Except for Lacandon settlements hidden in the forest, there wasn't a human habitation for miles around.

"This valley should support thousands of people," said Harry, "like Java." He thought the Lacandones should increase and grow strong instead of decreasing as most observers fear. "Wait . . . don't string your hammock there," he warned.

Within moments there was a splintering crash and a ten-foot limb fell 100 feet onto the very spot where Win Pitkin's friend Barbara Deming had been putting her hammock. Harry may have been almost as surprised as we were, but an Indian had warned him of the danger only a day or two before. Harry kept a Navy hammock stretched tight above his sleeping hammock as protection against falling branches—a good precaution in so mighty a forest, where death and decay kept pace with prodigious growth.

A family of Lacandones an hour or two away through the jungle to the south had received Harry well and he was anxious to strengthen the friendship. But he had only become lost trying to find them again. I began to realize how carefully the Lacandones conceal their whereabouts. They avoid settling near clear trails and mislead the traveler by putting branches or brush across the way to their *caribals*.

Harry ate no meat, was opposed to war, found everything in the forest of interest, and wanted to be left to his own resources. I never saw him again. When I came back, there was a note near his campfire: "The owner of this camp has not abandoned it. He returns regularly. To anyone disturbing these provisions —Eternal Purgatory."

Beyond Harry's camp, it was so cold in the hammock at night that I got little rest. We were up at six every morning. Down would go two cups of black coffee and a lump of black beans the size of your fist, and then we would hit the trail.

The only water at Harry's place was stagnant, and we had a long thirsty trip to Lake Ocotal. The miracle of the expedition was Win Pitkin. Once on her horse, she could not be persuaded to dismount. There were gullies and quagmires to be leapt, but Win never let our spirits fall. When finally we would get her to come down and rest on a log, she would light up a big cigar.

We camped several days at Lake Ocotal. There were no Indians here, but Barbara Deming, a writer from Cape Cod and New York State, accompanied me on my jaunts to make

A PANORAMIC VIEW OF THE LACANDON VILLAGE at Lake Najá. Hammocks and food boxes o

tape recordings of the many jungle noises. The howler monkeys were spectacular but hard to get near. Barbara even passed a night alone in a tree hoping to be treated to the full menagerie of jungle creatures, including ocelots, wild boars, and jaguars. Next morning, she reported that she had observed a measuring worm.

Parrots by the hundreds came to roost each night not far from the camp, and there were always fowl for the table. A rubber boat and outboard motor that Don Pancho had contrived to pack on a mule gave us freedom to explore the lake.

After a few days at Ocotal, Mrs. Blom and I took leave of Don Pancho and the others and set out with three Indians and five horses for the largest Lacandon settlement, at Lake Najá. This was a hard two-day journey via Monte Libano. The last day was the most difficult. The trail was so steep, slippery, and overgrown that much of the way I could not bear to make my mount carry me. We had already lost three horses. One was to turn up later at Monte Libano. The second might still be found, but for the third we could assign no happier fate than the stomach of a jaguar.

With all this, the forest was a beautiful place. Its towering mahogany trees have attracted wood experts, and wherever rivers have provided an avenue out of the mountains the exploitation has been severe. However, the only felled tree I saw on the entire journey was a giant about five feet in diameter and over 100 feet long. The Lacandones had laboriously hacked it down to get the honey from a bee's nest in the top. Their method is to build a scaffolding around the base of the tree so they can reach a narrower part of the trunk.

The boughs that span the trail and the logs that litter the forest are fairly dripping with orchids in wide variety. And if you want an oddity in Chiapas, you can find potatoes (*Solanum moreliforme*) growing in trees. But I wouldn't advise depending on them for provisions. The ones I saw were smaller than marbles. However, Chiapas does have a cultivated tuber so large that one of them is enough to feed 50 to 100 persons. These 34- to 40-pound *batatas* are really a species of yam (*Dioscorea*).

This entrancing forest contains ferns with young fiddleheads as big as a bass violin. Every morning the air tinkled with the most beautiful sound I have ever heard in nature:

JOSE MANUEL LOPEZ played the ceremonial flute with spirit.

lition are seen in the center hut. Some of the Lacandon huts are open on all sides. Rounded ends are frequent.

the song of a bird the Aztecs called "Four-hundred voices" (*cenzontle*). We knew it as the clarin, so-called after the trumpetlike musical instrument of the Mexican Indians. The bird's scientific name is *Mimus gilvus*, and its voice is like silver bells. We kept the horses quiet long enough to record it on my portable Magnamite recorder. People whose ears cannot catch very high notes cannot hear the song but the Magnamite caught it.

While we were standing silently, a curious little tayra (*Tayra barbara*) came tiptoeing along a log only 20 feet away. It didn't see us. This "Old Man of the Mountain," as the zoologist Miguel Alvarez del Toro calls it in Spanish, is about the size of a fox but quite different. It has black fur and a light-colored head, hence the Mexican name *cabeza blanca*. To our Indians it was a *Sac-jol*. I am told that it will viciously attack almost any creature in the jungle and that it can even bring down a deer by seizing the throat. The dainty-looking little assassin suddenly stopped on the log, waved its sensitive nose up and down a few times, and hurried away into the shadows.

◄ ONE END of the large god-house at the Lacandon Village at Lake Najá, Chiapas. This is the hut in every Lacandon village in which the religious objects are stored and the ceremonies are held. At times the women cannot enter.

"I would not be here alone."

Just beyond the pass at 3,600 feet, we climbed down into a narrow cleft in the rocks 15 feet deep to quench our thirst from a cool pool. Then, as the sun disappeared over the mountains, the trail forked three ways in a gloomy glade. The middle path ended where a huge tree blocked further progress. Here our leading Indian, who spoke Tzeltal and had never traveled this route before, declared: "I would not be here alone."

The righthand trail took Trudie into a morass, and her horse sank a foot or two into the muck.

Our Indian grew more dismal and said: "At night, I would not be here at all."

But the third fork took us up through a *milpa* and out into bright sunlight at the edge of a thatched village on a shelf above a beautiful lake.

The Indian's face now lit up. "Let's stay here six months," he said merrily. His ardor weakened a bit a little later, however, when he almost stepped on a fer-de-lance in the village.

There were eight huts, large and small, half of them open on all sides. In one, the god-pots of the Lacandones were ranged with other religious paraphernalia. Many sacred arrows stood in a bunch at the far end. Every Lacandon *caribal* has one of these sacred huts, often larger than any of the rest, in which religious ceremonies are performed.

A Lacandon appeared in a doorway and immediately began waving a machete in the air as though sparring with Mrs. Blom. Trudie jumped and dodged. Then they threw an arm about each other. They were old friends.

The Lacandon men, with their long shaggy hair hanging close around their somber faces, are awe-inspiring when you first see them. This is particularly true when you happen to enter a deserted *caribal*, as we did on another occasion. We had been poking around, peering into the god-house, when suddenly we looked up and saw a man standing motionless just inside the clearing. He had a gun in his hand, and he stood without moving for a minute or two. Trudie kept speaking to him, but he just stood there staring. I felt uneasy. Then he stepped out into the clearing, and his manner was gentle and cordial. I have never met primitive people who appeared so austere the first minute and so warm and jovial the next.

Next month, in Part II, the writer will tell of the Lacandones' way of life and their relation to the ancient Maya culture.

AN ESPECIALLY ATTRACTIVE SPECIMEN often makes a nice wall decoration in the library or game room.

how to collect Seaweeds

The delicate and artistic forms of seaweeds lend themselves to a fascinating hobby

By EDWIN WAY TEALE

WHEREVER the sea meets the land, all along the 21,862 miles of the United States coastline this fascinating hobby can be enjoyed. The great variety found among seaweeds and their artistic forms when mounted to form a collection make this pursuit among the most attractive of seaside diversions. Published information on how to mount and preserve seaweeds has been so scarce that most people do not realize how easy it is.

Anyone living within visiting distance of the shore, whether among the rocky headlands of Maine or along the sandy beaches of Southern California, will find a surprising variety of forms to include in his collection. And because comparatively few persons have taken up the hobby, amateurs are able to mount specimens that have scientific as well as artistic importance.

During the past five years, one collector on Long Island, Edmund Morgan, has added more than 6,000 mounted specimens to his collection. He is the Curator of the Tackapausha Museum, Nassau County's natural history center at Seaford, N. Y. Many of his mounts represent the same kinds of algae growing under different conditions, but there is never any lack of variety in shapes. How the specimens are collected and mounted is shown pictorially in this series of photographs.

▲ THE AVERAGE PERSON'S ACQUAINTANCE with seaweed is limited to that which is found high and dry on a beach where no impression of its delicate and artistic forms can be gained. Specimens should be taken from the water rather than from dried or decaying masses on the shore. One of the easiest places to begin collecting is along the low-tide line or among rocks, such as these, when the tide is out.

➤ EDMUND MORGAN collecting at the tide line. Whole, full-grown specimens should be gathered whenever possible: foliage, stem (the so-called stipe), and holdfast. If they are muddy or sandy, they should be washed out. After a gale, many deep-water specimens not ordinarily found will be picked up. The pail must be kept about half full of salt water which should be changed from time to time. It should be placed in the shade so that the temperature will not rise above about 50 degrees F. Smaller specimens deteriorate rapidly in warm water. Heavier rockweeds can be stored temporarily in a sack that is kept wet.

A pail and a few accessories are all that are needed in order to start a collection. An incoming tide is best for floating seaweed. Since the specimens should be taken from the water rather than from dried or decayed pieces thrown up on the shore, bathing or wading togs are in order. When working among rocks, sneakers with heavy rubber soles can be worn. In cold water, the collector will find hip boots more comfortable.

◄ HERE EDMUND MORGAN is preparing to sort a batch of seaweed he has just brought up from the shore.

► THE SMALLER, more delicate red seaweeds should be separated from the heavier green and brown sorts. All specimens should be placed in fresh water for about half an hour before mounting. Excess salt might prevent them from drying thoroughly.

◄ THE FIRST STEP in mounting the specimen is to slide the paper or card beneath it in the pan of water. The gelatinous nature of the seaweeds causes them to stick to the mounting paper when dried. Larger specimens may require strips of adhesive mounting paper or drops of a clear mounting plastic. Normally two sizes of mounting paper are used, 5 x 8 inches and 11 x 16 inches. For permanent collections, paper with at least 25% rag content should be used. Beginners will find sheets of a large loose leaf sketching pad suitable or large white filing cards. The base of the seaweed is held with one thumb while the branches are arranged with tweezers or a needle.

► DELICATE FEATHERY SEAWEEDS, such as this red specimen, need to have their fine hairs separated out by allowing water to flow gently from a medicine dropper. Otherwise they will mat together. After the specimens have been floated onto the mounting paper and drained, it helps to lay them on a slanting board so that they can be drained thoroughly before putting them in the press.

◄ THE MOUNTED SPECIMEN is placed face up on an herbarium-press blotter. A piece of white, unsized, unbleached muslin is laid on top of it. Otherwise the seaweed will stick to the next blotter as well as to the sheet of paper. Waxed paper is sometimes used instead of muslin, especially when dealing with wiry specimens. Cloth is used on the more delicate and slippery seaweeds. Some people use a folded newspaper page in addition, to avoid direct contact with the blotters.

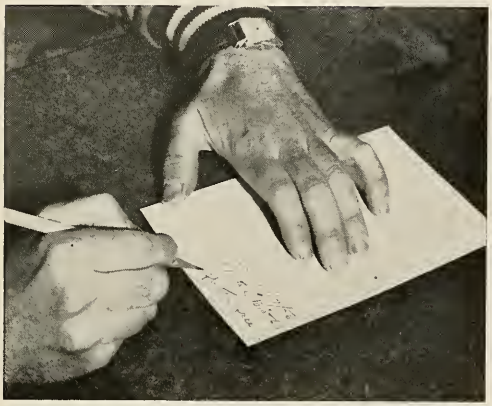
► A SECOND HERBARIUM BLOTTER is then placed on top of the waxed paper or muslin. When many specimens are being prepared in one press, they are stacked between blotters, one on top of another. The lattice-work wooden top is then placed on the stack and weighted down. The blotters should be changed from time to time during the process, as they absorb much water. This is especially necessary to avoid mold in the case of the heavier brown and red seaweeds. Removing the blotters requires only moderate care. As the specimens shrink slightly while drying, the pressure in the press should be gradually increased. When finally the cloth is removed, it must be stripped away slowly and gently so as not to damage the specimen.

Filing and Learning

The sheets are filed and stored in the same manner as the more familiar herbarium specimens. Spring-back binders are better than loose leaf notebooks. If you file them loosely in a file drawer, prevent friction from damaging delicate specimens by affixing a cover sheet over each one.

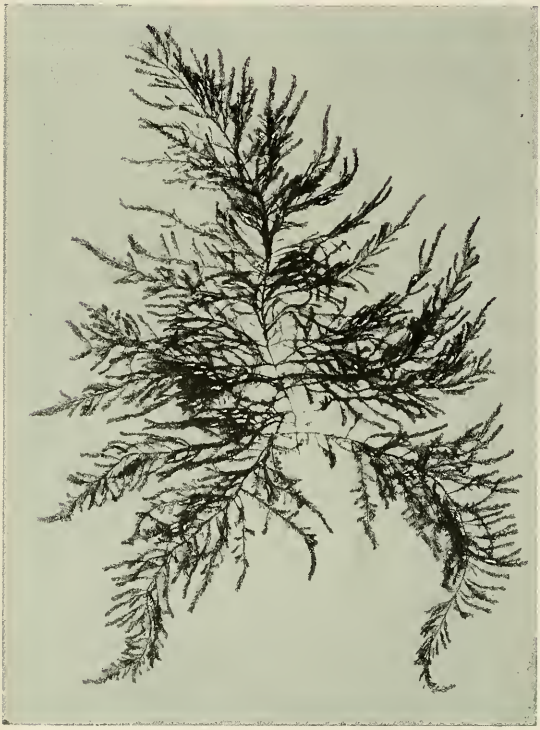
Some seaweeds float freely, others are anchored to the bottom by sucker-like discs. The green forms usually grow nearest the shore, whereas the brown ones range from the low-tide mark to a depth of 50 or 60 feet. All seaweeds belong to the division of plants known as algae, and they reproduce by producing spores or by the union of eggs and sperms.

Those interested in further information about seaweeds and the hobby of seaweed collecting will find a valuable reference book in William Randolph Taylor's *Marine Algae of the Northeastern Coast of North America* (University of Michigan Press). Although it deals primarily with the seaweeds of the Northeast, it contains general information that will be helpful in other parts of the country as well.



◄ MAKE A PERMANENT RECORD of the basic information concerning each specimen in pencil on the back of its mounting sheet. Include such facts as whether the specimen grew above or below the mean tide line and whether it was floating free or growing in place when collected. The more detailed the information is, the more valuable the collection will be from a scientific standpoint.

▼ TRANSFERRING some or all of the information to a label at the lower righthand corner of the mount is the last step in preparing a specimen. The scientific name can be added when positive identification is possible.



◄ THE MOUNTED SEAWEED with the label attached should be stored in darkness. The colors will fade if subjected to much sunlight but will remain unchanged for years in darkness. Pressed seaweeds are not subject to the attacks of small beetles and therefore do not need to be treated with insect repellent as do other herbarium sheets. However, they tend to be brittle and should be handled carefully to prevent damage. With reasonable care, they will remain in good condition for many years.

The High Octane Pine

When you drive up to a filling station and ask for "high test," you are profiting from a strange series of discoveries in which the Jeffrey pine contributed significantly to the evolution of the automobile

By W. H. Hutchinson

TODAY'S motorist knows that the octane rating of a gasoline is a number used to measure its anti-knock properties. But in 1926, the term was little known. Dr. Graham Edgar was then evolving the first system for grading fuels. What he needed was a permanent and dependable "yardstick" with which to measure the performance of a given fuel. Had such a yardstick not been developed, the modern high-compression motor might have been delayed in its development.

The first intimation that the Jeffrey pine had a peculiarity that set it off from other trees came in 1867. A turpentine distiller on the Dogtown Ridge in Butte County, California, had charged his still with what he thought was an ordinary load of pitch. The accepted source in that region was Yellow pine *(Pinus ponderosa)*, but he was dealing with this chemical prodigy among pines, the Jeffrey *(Pinus jeffreyi)*. In the middle of the operation, his still blew up. Luckily, he escaped harm.

Thereafter, he and his fellow-distillers were careful when they used Jeffrey pitch. Their patience with it was not increased when the resulting turpentine runs seemed to be adulterated with petroleum products. The mysterious chemical that gave this effect was identified in 1872 by Professor W. T. Wenzell, of the California College of Pharmacy. It came to be called abietin or abietene, after the name Abietineae, applied to a large group of trees in the pine family.

Apothecaries found uses for abietene in perfumes, insecticides, detergents, and chewing gum. But its most lucrative application was in cough syrups and soothing salves, the popularity of which lasted well past the turn of the century. Then abietene came into its own in the laboratories of the automotive wizards.

Its value to Dr. Edgar of octane fame lay in the fact that 96 per cent of abietene is *normal heptane,* one of the hydrocarbons found in petroleum and fossil fish oils. It remains one of the curiosities of nature that this product possessing the earmarks of a mineral substance should be found in the Jeffrey pine, and also in the Digger pine and a Philippine hardwood tree.

When the Jeffrey pine was first declared to yield this chemical, it seemed so impossible that top-ranking specialists accused those who claimed it of having cleaned their glassware with petroleum products without rinsing the material clear off. That the Jeffrey pine really deserved the honors was clinched by the publication of Bulletin 119 of the U. S. Forest Service in 1913.

It was Dr. Edgar who discovered that the heptane derived from the Jeffrey pine was purer and cheaper than could be produced in any other way. Thereupon, the Ethyl Corporation financed an expedition to the Sierra Nevada to bring out Jeffrey pitch, under the supervision of the Forest Service. As a result, 1,000 gallons of heptane were produced from trees in Lassen National Forest. This was used in refineries for grading fuels under Dr. Edgar's new system of "octane rating." Thus the foundation was laid for one of the most important technological steps in the evolution of internal combustion engines.

Tree lovers will be happy to know that the demands of automotive science do not threaten to exterminate the remaining stands of Jeffrey pine. The fuel engineers in time solved the problem of producing uniform heptane from petroleum. But the Jeffrey pine deserves honorable mention in any list of little-known products that produced momentous results.

▲ HAUGHTY, INSOLENT, OR STUPID? The head of an Algerian dromedary.

The Legend of the Camel

Scientific research debunks some of the popular beliefs about the ship of the desert

By ALONZO W. POND

All photographs by the author

CAMELS look so haughty and sagacious. At least that's what I thought when I stopped on the geographical rim of the Sahara and watched a caravan plod sedately past my motor cars. We were making one of the earliest motor crossings of the Great Desert and as I watched the slow, steady, almost relentless movement of the camels, I actually felt apprehensive about our specially built desert cars.

At that time few of us doubted the legends about camels. Noble beasts, they knew the desert! Unhurried, they had carried the commerce of the Dark Continent for centuries, crossed trackless wastes without food. They drank less water than many other animals and could store up extra water in their humps and stomachs for anticipated drought. They could even outrun the swiftest horse. The romantics claimed that if the camel's master got lost in a sand storm, his loving beast would guide him home. Their broad spongy foot structure, we had been told, was especially adapted to negotiate the sandy world of deserts. Their great endurance shamed all other creatures.

Such were the "truths" about the camel which we believed as we looked down from the north rim of the Sahara. Six months later, after intimate daily contact with the beasts, including nearly 1,000 miles of travel on their backs, some of the

legends crumbled. Each year since then I've gathered more information about camels, and the facts are stranger than the wildest fiction.

It was only a few days after we entered the Sahara that the first camel legend was shattered. We failed to reach our destination before dark one night and lost the trail for our cars. After an hour we were rescued by two men on horseback, who guided us over the sand to the oasis.

"Why did you ride out on horseback?" I asked our rescuers. "Aren't there any camels at this oasis?"

"Oh, yes, there are camels," they replied, "but horses can travel faster over sand than camels can. Then too, if we got lost, we could let the horses have the rein. They would bring us back to the stable, but a camel hasn't that much sense."

Later I used a white riding camel to cross the Western Erg. It stumbled and floundered in the sand like a wallowing ship on a storm-tossed sea. It is true that it has a spongy foot structure which spreads a little under its weight. But in spite of that, it negotiated the Sahara sands less easily and rapidly than the hard-hoofed horses of our escort. Camels trained in the sand areas did better than those brought up on the plains, but none of them did as well as the horses. On rocky and gravelly plains, which are far more common than sand areas in the deserts of the world, the camels' feet are often so badly cut that they have to be patched with pieces of leather sewn to them.

Apparently it is more common for a camel to get lost itself than to rescue a lost master. Among the great herds in the Syrian Desert the Bedouins say that a camel which finds a particularly attractive patch of pasture or a favorite fodder plant will often let the grazing herd move on without noticing. By night it has lost the herd and runs around moaning. Observers say that camels seem to lack entirely the sense of smell or the natural instinct that might enable them to find their herd.

The herdsmen can't leave their charges for long or others, too, would get lost. When they return to camp in the evening, one who has lost a camel goes through the whole encampment singing his special herd song. If the lost camel has joined another herd and hears the song of its herdsman it may walk toward him. Or the missing camel may be returned to the owner by another herdsman. In any case, if a lost camel is found, it is invariably a result of the herdsmen's search, not of any sixth sense belonging to the camel.

In books on the desert there are hundreds of references to the loads a camel can carry, the speed it can travel, and the distance it can cover in a given period. Such statements vary widely, yet each is given with the assurance of established fact, subject to no modification. Actually, loads vary from 200 pounds per camel to 1,200 according to the season, the frequency of water holes on the line of march, the length of the

Anthropologist, archeologist, and explorer, Alonzo W. Pond first became interested in camels in 1926 when he was assistant in charge of paleolithic excavations in Algeria. As Chief of the Desert Branch, Arctic-Desert-Tropic Information Center at the Air University, he now teaches survival techniques to Air Force personnel. In 1956 he supervised Desert Survival Field Test in the Libyan Sahara.

▲ The author up on Ole, his "swift" Saharan riding camel.

↑ THE CAMEL complains bitterly when loaded or unloaded.

journey, and the physical condition of the animals.

Big strong camels introduced into the southwestern United States in 1856 could carry 1,000-pound loads and travel 30 or 40 miles per day without water for six to ten days in winter. However, a report made on July 16 states, "Yesterday the camels drank water for the first time in 26 hours and although the day had been excessively hot they seemed to care little for it. Mark the difference between them and the mules; the same time in such weather, without water, would set the latter wild and render them useless, if not entirely break them down."* Daily distances at this time ranged from 24 to 30 miles. It should be remembered, however, that these camels were the biggest and strongest animals that could be found in the eastern Mediterranean and that southwestern vegetation, although inedible for horses and mules, was luxuriant camel fodder.

*Report of Edward Fitzgerald Beale, No. 23, 1857.

Caravans of The American Museum of Natural History in the Gobi of Mongolia used to load about 400 pounds per camel and travel 12 to 15 miles per day in June and July. Even under these circumstances, two or three camels were lost a season. Of course they had been on the trail since March and because the territory was unknown, all travel had to be in daylight. On regular well-known routes, the caravans would have traveled at night and let the camels feed by day.

Camel Rider Records

There are records of camel riders in emergencies who covered 50 miles in a day and even 250 miles in five days, but these are exceptional cases and usually represent winter journeys. Five miles per hour is a good pace for a riding camel in the Sahara. The average speed for caravans is 2½ miles per hour, and a five- or six-hour day gives the animals time to rest and forage.

Unfortunately, there are no official racing records or radio sportscasters to settle arguments on camel speeds, loads, or distances traveled. Sahara military men will argue that in a race between horse and camel, the camel wins if the distance is long enough, the horse on a short course. Personally, I think it depends also on the individual horse and camel. When the Bedouins of the Syrian desert went on raids, they held the camels in reserve and used horses for the initial surprise. This seems to indicate agreement with the Saharan belief that horses are faster on a short course.

Although camels are often given credit for great endurance, you will find that caravan owners in the Sahara, Arabian, or Gobi deserts are most reluctant to load their animals heavily. Left to their own time, they travel at a very leisurely pace and rest whenever they find a little pasture. In the Sahara, each member of the camel corps must own two riding camels, one ready for use and one to keep at pasture. They say, in fact, a camel is the most fragile of domestic animals. It either gets

a six-month furlough every year or dies to spite you.

Perhaps that is where the expression, "the straw that broke the camel's back," started. This is about the only camel legend with some truth in it. The creatures go and go and finally just collapse—the "one-hoss shay" of the animal kingdom.

Legends of the camel and its water-drinking habits were the most recent to give way to facts. The Drs. Schmidt-Nielsen, husband-and-wife team of physiologists, have investigated these legends with results that only controlled scientific experiments can give. For several months they worked with camels in the Sahara, weighing them before and after feeding, before and after drinking. They kept records of body temperature, tested blood and body fluids, and finally dissected dead animals. Their findings explain the camel's way of life and account for the wide variation among the claims made about the beasts.

Camels do not store up water. They only replace the quantity lost since the last drink. The Schmidt-Nielsens have records of one camel which drank over 27 gallons of water in ten minutes, nearly one-third of its own weight. In less than 48 hours, this water was evenly distributed to restore blood, body fluids, and cells to their normal water balance. The Schmidt-Nielsen studies also showed that unless it was dehydrated, the camel would not drink at all, even if it had gone for months without drinking.

A TWO-HUMPED OR BACTRIAN CAMEL of the Gobi.

3 Months Without a Drink

In Egypt the camel can go for three or four months without drinking between November and April if it is in lush pasture where the vegetation is kept green by dew and showers. If it is on dry feed, the camel will get thirsty in a couple of weeks, even during January. One animal which did not drink for 17 days in June was so dehydrated that its abdomen was drawn in, its muscles sunken, and its legs scrawny.

It is evident, then, that the length of time a camel can go without drinking is much affected by the time of year, force of wind, heat in the air, intensity of the sunlight, amount of reflected heat from the desert floor, dryness of the feed, kind of feed, weight of the load carried, speed the animal travels, and the hours spent in travel each day. These same conditions bear on the need for water in human beings, horses, and donkeys. Nevertheless, it is the camel that can best adjust to the extremes of the desert.

Like man, the camel must keep its body temperature within certain bounds through perspiration, but

TYING FRONT FEET TOGETHER or hobbling one foot, as below, keeps a camel from wandering too far.

for the camel there is more leeway. Its temperature in the morning may go as low as 93° and rise in the daytime heat to more than 104°, representing a daily range of 12 degrees. Man must keep his temperature within a degree or so of 98.6°. The camel has another advantage, too: it can tolerate dehydration to more than 30% of its body weight, while man is in trouble when he has lost water equal to 10% or 12% of his weight.

Dehydration does not impair the camel's appetite, so it keeps eating and restoring its energy. Its woolly coat keeps out the heat of direct sunlight, reflected heat from the sand, and heat in the surrounding air. The wool also allows sweat to evaporate slowly and so cool its body more efficiently.

Its wide temperature range is one of the camel's most important assets. This is because heat moves faster on a steep gradient than on a slow one. Air at 110° gives heat faster to a body at 98.6° than one at 104°. So, the camel doesn't get as much heat from its environment as man would because its body temperature is closer to the temperature of the desert air. Also, when its temperature is rising, the camel is storing heat for the cool night. Its body functions somewhat as do the new solar houses which store the sun's heat to warm the rooms after dark.

So, it is not storage of extra water that allows the camel to go without drinking but rather its tolerance of great dehydration and its wide range of body temperature.

No Water in Hump

The Schmidt-Nielsens found that the camel's stomach and rumen sacs, which desert legend credits with water storage, do contain liquid and sometimes solid food. This liquid, however, has as much salt in it as the blood or other body fluids. Furthermore, the capacity of the little sacs is insignificant compared to the amount of water the camel needs.

No doubt there is some truth in the stories of drinking the contents of camel stomachs in desert emergencies. As recently as 1920 various Bedouins of Syria had done exactly this. Unappetizing as these normal digestive juices must have been, they did restore the energy and prolonged the lives of these dehydrated men. But they did not represent extra or stored water.

There is no water in the camel's hump, either. It is fat, stored energy, like the hump on Brahma cattle now so common in the southern United States. Some students have reasoned that when the fat of the camel's hump is utilized it produces more than its weight in water and that the hump, therefore, does in-

▼ Tourists are enticed to ride camels wearing colorful saddle blankets.

▲ Women ride in elaborate shawl-covered camel saddles while the children perch on the baggage.

directly store water. The physiologists disproved this. They have shown that it takes a lot of oxygen to combine with fat and transform it into usable energy. Since oxygen comes through the lungs, this necessitates increased breathing and, consequently, more moisture evaporated in the exhaled breath. As a result, extra water produced from metabolized fat escapes from the body. Even though the hump isn't a water tank, it is quite a remarkable feature: a light, easily carried form of energy that keeps the camel supplied after the feed bag is empty or the pasture dried up.

How to Live in Deserts

The camel did make history in Africa by making commerce feasible between white North Africa and black Central Africa. It almost made history in America but was superseded too quickly by the railroads. It may still make agricultural history in the Near East as a meat animal because it can thrive on little water and on desert plants that few other animals will eat.

The camel has taught me the basic principles of desert living: keep out heat by wearing clothes that cover the body and still let sweat evaporate efficiently; travel slowly to keep down the production of body heat; drink water when you are thirsty to stay within safe water balance limits; take long vacations to fatten up and restore energy.

I still don't like the critters. Their stare is haughty, their manner insolent. They complain constantly, they don't know the way home, and their breath smells. But although they are a holdover from the zoological past, they get a lot of mileage on a gallon of water and have a most efficient heat-control system!

▲ Baby camels, too young for a day's march, may ride in a woman's saddle.

Bernard L. Gordon

↑ THE PROBOSCIS or snout of the basking shark is frequently red in color and its teeth are only about ⅛ inch long.

A Titan of the Tides

Basking sharks have reached a recorded length of fifty feet

By BERNARD L. GORDON

TOWARD the end of last September, a 28½-foot basking shark (*Cetorhinus maximus*) became ensnared in a herring weir near Weymouth, Nova Scotia. It was the largest of its species to have appeared on our Atlantic coast in the past 20 years. The fishermen had to use extraordinary methods to remove so large a creature from their fish trap, and hundreds of curious persons flocked to the shore to view it.

The name "basking shark" comes from the fish's habit of lolling at the ocean's surface, with its dorsal fin and sometimes portions of its back showing above water. On various occasions it has been observed with its white belly turned up to the warm rays of the sun. It is a sluggish fish and is not too wary of boats. Small craft sailed right up alongside the Nova Scotia specimen.

In some localities, the basking shark is called the elephant shark or bone shark. It is recorded to have reached a maximum length of from 40 to 50 feet in northern European waters and is exceeded only by the whale shark (*Rhineodon typicus*) of tropical waters.

The basking shark is easy to recognize. Its numerous teeth are extremely small (about one-eighth inch long); and it has an elongated proboscis or snout, which is frequently a red color. Its gill openings are unusually large, extending almost completely around the neck.

The basking shark is cosmopolitan, being found on intermittent occasions in the temperate and boreal seas of both hemispheres. It has

been pointed out that the spectacle of two large basking sharks swimming one behind the other in tandem fashion could be mistaken for a "sea serpent." One can easily visualize how seamen would get a false impression, especially if the lead shark were swimming with its mouth open and its snout above the surface.

On several occasions when the carcass of a basking shark was washed ashore, the first reports described it as a "sea monster" from the depths. In January, 1937, a supposed sea serpent drifted ashore near Provincetown, Massachusetts, on the outer coast of Cape Cod. The creature was given wide publicity, but it turned out to be nothing more than the skeleton of a 25-foot basking shark. When a basking shark rots, the fins, jaws, and skin are washed away, leaving the oblong skull and a long ridged backbone.

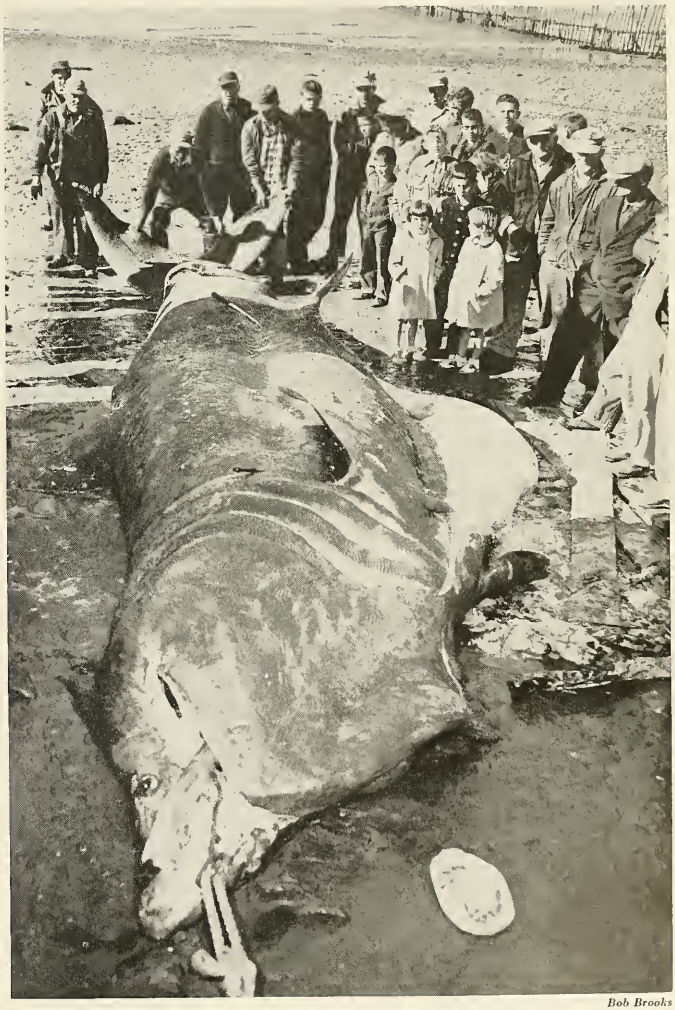
In several recorded cases where the basking shark happened to be a male, the remains of its claspers and pectoral fins gave the appearance of front and back feet and caused a mistake in identification. One such monster was found beached at Stronsay in the Orkney Islands at the beginning of the nineteenth century. This specimen was actually described in a leading scientific journal as an unknown species of animal and given a technical name, *Halsydrus pontoppidiani*. Later investigation showed the vertebrae of the new sea serpent to be those of a large basking shark.

The reason the basking shark is sometimes referred to as bone shark is that its gill rakers and gill arches show some resemblance to the baleen plates of the whalebone whale. The gill rakers of the shark and the whalebone plates of the whale perform the same function of filtering food from the sea water in the form of tiny plants and animals. It is an example of parallel development of a similarly functioning apparatus in two widely different groups of animals, a case of convergent evolution.

The way that the basking shark satiates its appetite is an example of extreme piscine laziness. With its gaping mouth wide open, it swims slowly along, swallowing into its gill cavity large quantities of water containing the minute creatures of the sea. As the gulped-in water is forced out through the gill slits, the plankton are filtered out by the fine gill rakers, leaving the next meal on the interior of the gill arches, to be swallowed at leisure. An interesting sidelight is that as the food-filled water passes through the gills, oxygen is removed and taken into the bloodstream. Thus it can be said that the basking shark eats and breathes with the same mouthful.

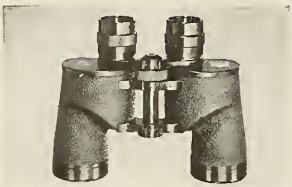
Off North America, the basking shark has been reported from the outer coast of Nova Scotia down to North Carolina. It is also found off

Bernard L. Gordon is an instructor of Biology at the Rhode Island College of Education. He has written previously for Natural History, and is now working on a book about marine fishes.



Bob Brooks

↑ This 28½-foot basking shark was caught in a herring weir near Weymouth, Nova Scotia.



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California on the Pacific coast. During the first half of the eighteenth century, these sharks were very plentiful in New England waters, and they were widely pursued for their livers. Basking shark liver is about 50 per cent oil, and the oil was frequently used for illumination purposes. Whenever whalers encountered these sharks, they harpooned them for their oil.

Since the flesh of the basking shark is soft and flabby, it is not used for human consumption. Sometimes fertilizer is made from it.

Today the basking shark is still pursued commercially by harpoon on the west coast of Ireland. Here the fish is found in large numbers and taken for its liver oil. It has a liver of tremendous size. The weight of one from a 30-foot basking shark was reported to be 1,800 pounds. And a basking shark 28 feet 10 inches long, taken off the Irish coast, yielded 102 gallons of oil!

Some very vivid scenes of hunting basking shark appeared in the motion picture *Man of Aran,* which was made on the west coast of Ireland during the mid-1930's.

During the summer of 1956, basking sharks were present off the Rhode Island coast. Four medium-sized ones, averaging between 15 and 20 feet in length, were captured at intervals in the fish traps off Point Judith. These fish were all taken out of the traps and then released, as they have very little market value for fishermen and are difficult to get aboard a vessel.

Five Life Zones in 50 Minutes *continued from page 239*

ences that typify Chiricahua's remarkable biota. Grassland at the lower elevations is interspersed with such typical desert plants as mesquite, palmilla, and yucca. The upper limits of desert growth intergrade with the chaparral belt or oak-woodland cover. Here are found mountain laurel, several species of oak, manzanita, and mountain mahogany.

This growth in turn grades into the piñon-juniper cover of the Upper Sonoran life zone to elevations of almost 7,000 feet. The Douglas fir-yellow pine association then takes over, marking the Canadian life zone, which extends virtually to the two major peaks of the Chiricahua range. On top are the firs, aspens, and spruces of the Hudsonian zone. Because of the surrounding desert, the mountains are usually free of heavy winter snowfall. This permits the station to operate throughout the year.

Dr. Cazier selected the site after an extensive survey of several southwestern locations. In the process, he invited comments from research workers in 30 states. These scientists represent 46 universities and colleges, 70 public and private institutions, 11 museums, two zoological gardens, and several agencies of the federal government. The survey revealed so many needs that could best be served by a field research station in a southwestern location that, with the initial aid and support of Dr. David Rockefeller, the station was established by the American Museum.

Like the Museum's other field research facilities—Archbold Biological Station at Lake Placid, Florida, and the Lerner Marine Laboratory at Bimini in the British West Indies—the Southwestern Research Station deals only in "pure science." It is a non-profit establishment with no commercial aspect, seeking solely to extend man's knowledge of the world.

Neither Dr. Cazier nor those who have done field research at the new station have had cause to regret the choice of location. As a "permanent expedition" into a little known but highly rewarding area, it has exceeded expectations, and an increasing number of scientists are looking to it for the answers to basic questions in the natural sciences.

Don Knight

↑ THE SLOPES OF MT. RAINIER, highest peak in the Northwest, are covered with a blanket of multicolored wildflowers throughout the summer.

Letters

continued from page 225

the grove of cedars above Becharre is essentially the only grove of cedars remaining in Lebanon, or at least that it is the largest. However, this is not at all the case. The Becharre cedars contain, it is true, the oldest cedars known in Lebanon, but there are at least four other groves of considerable extent, the largest not many miles from Becharre, and a real forest. Two large groves exist in southern Lebanon. Of these the grove near Barouk is of special interest. This group of trees, covering a considerable area on the seaward slope of the mountains, is a preserve in the sense that the village to which the land belongs has neither pastured goats nor cut trees (beyond the small needs of the village) in this forest since about the time of the first World War. The results, although little known because of the relative remoteness of the grove, have been the growth of young cedars in regular thickets, often barely penetrable in places. In a country where goats and wood-cutting have been the scourge of the forests, this cedar forest stands as a tribute to the regenerative ability of the cedars under favorable conditions.

In addition to the four cedar forests mentioned, there are other stands in the Lebanon, the smallest of which probably contains more cedars than the grove above Becharre. Although the cedar is now much diminished from its former abundance, it is by no means a rare tree in Lebanon.

DAVID A. WEST
Dept. of Conservation
Cornell University

Ithaca, N. Y.

More Sea Ball Treasures

SIRS:

In your November issue, Elsie Parry tells about the sea balls she found on the shores of the Mediterranean. I wish to tell you of a find made on Del Mar Beach, east of Brownsville, Texas, on March 12, 1955, and again on March 7, 1957.

On both occasions we found four miles of beach literally covered with these mysterious balls. We brought back hundreds of them, and I am sending some to you. They become sandy gray when very dry, but when freshly washed and wet they are a dark brown.

Mrs. D. C. RING

Alamo, Tex.

We turned over Mrs. Ring's sea balls to Dr. Jack McCormick, in charge of Vegetation Studies at the American Museum. The "microcosm" he found upon dissecting several of them proves what a great variety of living things may be discovered if one examines patiently even a small mass of organic material:

The array of construction materials and the chance inhabitants in Mrs. Ring's sea ball bonanza eclipse all similar discoveries that have come to my attention. Grass and sedge leaves, culms, rhizomes, and roots form the bulk of the structures. Plant-like animals, called bryozoans, were a minor but constant inhabitant. Occasionally, fronds of green and red algae were present. Feathers of shore birds were woven into several of the balls.

Newly hatched snails were the most abundant residents, but there were also

numerous small crustaceans called amphipods, an occasional bivalve shell, a scattering of young barnacles, and a few foraminifera, the tiny animals whose remains form chalk and some limestone deposits.

Apparently, the vegetable balls are built around a nucleus of calcareous algae. A few leaves get entangled in the rough-textured mass, and the entire conglomeration is rolled into a ball by the action of the waves.

The Del Mar balls are composed of stiff fragments, few of which exceed three inches in length. Mrs. Parry's Mediterranean balls, on the other hand, were made up of longer, more flexible pieces and were consequently more compact than the Del Mar balls.

Stories on Roots

SIRS:

The accompanying photographs show how tenaciously trees cling to life in the face of extremely adverse conditions. I took these three photographs in a mountain wash in the Organ Mountains in New Mexico. Through the years, these trees have been exposed periodically to rapidly moving water resulting from flash floods.

CLARK CHAMPIE

El Paso, Tex.

A CLUSTER of hackberry trees holding up tons of rock after looser material has been washed away from their roots.

RUSHING WATER has removed several feet of earth from around the roots of this oak, leaving it on stilts.

IT IS a bit more difficult to explain these intertwined trunks, no more than 100 yards from the other trees. This location is out of reach of the main floods.

NOTICE — Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $5.00 each.

 continued from page 231

of Trawling by B. Kullenberg, Animal Life of the Deep Sea Bottom by A. F. Bruun, The Density of Animals in the Ocean Floor by R. Spärk, and Bacteria in the Deep Sea by C. E. Zobell and R. Y. Morita. Chapters describing calls to the Seychelles, the Nicobars, Pennell, and Campbell Islands may appeal to travel enthusiasts.

How the *Galathea* expedition originated in a lecture on sea serpents and found financial support from government and private subscription makes interesting reading. The book has an attractive format with numerous drawings, photographs, and charts. That it does not suffer from the incoherence and clash of styles often found in collections is a tribute to the editors and authors.

The reviewer is Professor of Geophysics at the California Institute of Technology, Pasadena.

Animal Friends and Foes

- - - - - - - by Osmond P. Breland

Harper, $3.95, 259 pp., illus.

Reviewed by Harold E. Anthony

THIS is an interesting collection of short accounts ranging the whole animal kingdom from Protozoa to Mammalia. Its purpose is to show in what respect animals are friendly or antagonistic to man.

The reader is prepared at the outset to consider that our existence is inescapably related to the activities of animal life about us. Man is predatory, he considers himself master of the earth, and he conditions the very existence of other animal life on this planet in terms of friendship or enmity. Thus it is important to man to discover just which course his own best interest may dictate with regard to a given kind of animal. The reader may be surprised at the short shrift given to some popularly accepted traditions about animal characteristics and perhaps disturbed to learn of some lurking menace that was hitherto unknown to him.

Headlines with dramatic impact help to fix important items in the reader's mind. "What insect is glorified by a monument?" introduces the boll weevil as a public benefactor and the reader will naturally want to know why. "What is the most dangerous animal in the world?" Here is a topic for debate and the author nominates his candidate with rather justifiable claims.

Mammals have been given substantially more space than other classifications of animals, and many interesting incidents and behavior patterns are cited. Other headlines to intrigue the reader include "What mammal is the greatest mankiller?" and "What animal helped to settle North America?" And not to ignore the lower echelons of animal life—"How poisonous are spiders?" and "Should oysters be eaten only during the R months?"

This book can be recommended as a well documented compendium with very few factual lapses.

Dr. Anthony is Chairman-Curator of the Department of Mammals of The American Museum of Natural History and has observed animal life on four continents—North and South America, Africa, and Asia.

The Home Aquarium Handbook

- - by Griffith and Lillian Borgeson

Arco, $2.00, 144 pp., illus.

Reviewed by James W. Atz

IT is natural to make comparisons among books in a competitive field such as the hobby of home aquaria. At first glance, this book seemed an unusually good buy, with its modest price, many illustrations, and readable text. Even after discovering its errors, one can still say that it surely offers better-than-average value.

But how much better a book it could have been, had its authors, or publisher, been a little less hasty, a little more conscientious. There is little excuse for the scores of misspelled names, the misidentifications of fishes, the placing of some fishes in wrong families, and the inaccurate life-history data that mar this do-it-yourself volume. Even less excusable are some of the poor photographs, which reveal a slipshod technique most unworthy of a book that includes a section on how to photograph fish in aquaria.

On the other hand, the general explanatory text is good: it shows that the Borgesons have had their hands wet, their eyes open, and that they know how to write. This part of the book can hardly be compared with the inadequate accounts of many species of fishes. I have more than once been amazed to find such drastic contrasts in aquarium books. Is it possible for authors who are obviously intelligent and industrious to be utterly ignorant of the rudiments of scholarship? Or, can it be that they just don't care?

Mr. Atz is Associate Curator of the New York Aquarium. He is a contributor to magazines on tropical fish and home aquaria and wrote "The Myth of the Balanced Aquarium" for Natural History.

Snakes and Snake Hunting

- - - - - - - - - - by Carl Kauffeld

Hanover House, $3.95, 266 pp., illus.

Reviewed by Charles M. Bogert

CLUBS organized by amateur herpetologists, many of whom conduct organized field trips or snake hunts, have recently sprung up all over the country. The advent of such clubs has undoubtedly been stimulated by the excellent handbooks now available for the identification of amphibians and reptiles. However, the absence of suitable game animals in the more densely populated areas of the country probably explains the shift to the reptiles in the quest of the hunter for something to hunt. Snakes are more often

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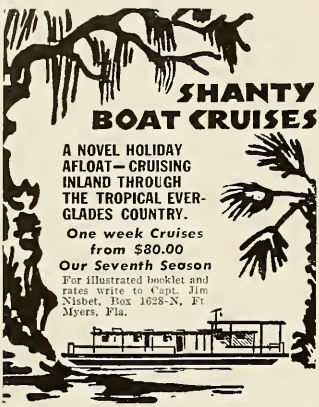
hunted than other reptiles and there is a fair amount of sport involved in finding and capturing such reptiles, particularly the larger venomous species.



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FLYING "U" CARAVAN CAMP
Harold N. Cohn, Dept. of Biology
University of Colorado, Boulder, Colo.

The various aspects of the sport are discussed in this book by the Curator of Reptiles in the Staten Island Zoo who recounts his experiences as a snake hunter in the United States. Soft-pedaling the sensational aspects of his work as a professional collector, Kauffeld tells exactly how individual snakes were discovered and captured in the Pine Barrens of New Jersey, the wilds of Dutchess County, New York, the swamps of Florida, or the Huachuca Mountains of Arizona. His well-told tales are interlaced with herpetological information, most of it accurate.

Snake hunting, like all pursuits, requires practice before the hunter knows where to look or how to distinguish a snake from its surroundings under natural conditions. As an old hand in the business, Kauffeld offers many bits of advice that the amateur hunter will find both entertaining and informative. The style is marred somewhat by the over-use of quotation marks for vernacular expressions, but the book provides an honest, down-to-earth account of snake hunting and snake hunters. Those who engage in such pursuits for the fun and recreation involved will perhaps find Kauffeld's enthusiasm contagious.

The reviewer is Chairman-Curator of the Department of Amphibians and Reptiles at The American Museum of Natural History. He is the author of "The Snorkel Turtle" which appears in this issue of NATURAL HISTORY.

MY FAMILY AND OTHER ANIMALS

- - - - - - - - - by Gerald Durrell

Viking. $3.95, 273 pp.

Reviewed by MARSTON BATES

GERALD DURRELL has written several delightful books on his experiences in collecting animals in various parts of the world. In these he has shown not only a keen interest in the characters and habits of his animals, but also an amused and amusing tolerance of the idiosyncrasies of his fellow men. In *My Family and Other Animals,* he turns back to his boyhood to tell of the five years he spent with his family on the Greek island of Corfu. Those must have been marvelous years for a growing naturalist, and the fun of that period can now be shared by the reader. "Here in Corfu," as Theodore Stephanides remarked, "*anything* can happen." And almost everything does.

The book is mostly about the Durrell family: mother; sister Margo, with her acne and her love problems; brother Larry, the budding writer and his intellectual friends; and brother Leslie, who had a passion for guns; and, of course, Gerald himself, with the animals he accumulated. There was a very engaging tortoise named Achilles, and a pair of magpies who (not always with the best of intentions) caused endless trouble. Alecko, the independent gull, was the gift of a kindly convict (he had murdered his wife, but that wasn't considered very serious in Corfu). An assortment of toads, water-snakes, geckos, and other creatures completed the zany household.

Mr. Durrell has a great talent for characterization and description, and he brings his boyhood back to vivid life. Mother, alas, finally decided that something had to be done about their education, so the family—complete with pets—moved back to England. To her indignation, she later found the notation of a Swiss frontier official in her passport: "One traveling circus and staff." But the Durrells had fun—and so will the reader.

The reviewer is on an exchange fellowship as professor of zoology at the University of Puerto Rico. He has written widely on natural history and related subjects.

THE LIVING SEA

- - - - - - - - - by John Crompton

Doubleday, $3.95, 234 pp., illus.

Reviewed by WILLIAM BEEBE

AFTER perusing a dozen books on skin-diving, of terrifying combats with mantas, moray eels, and especially sharks, I looked with suspicion on *The Living Sea.* In vain I searched for spearfishing, for pleas of scientific value of the use of dynamite, lances, and arrow-guns. Mr. Crompton has produced a book quite free from these overdone activities and weapons. He has marshalled hundreds of facts not one of which is new. But he has clothed them in such excellent prose that even the best-known fact takes on a new impelling interest, arousing a persuasive desire to go on reading.

The diction is smooth and effortless; it is punctuated with many similes and "as ifs," parentheses are abundant, and the style is subtle and pleasing.

The range of the book is extensive, from the making of the earth and formation of the seas, to consideration of the marine creatures which have gone ashore, and those which have returned, and on through a survey of organisms from mammals to plankton.

Here and there an oblique realistic angle gives a fresh slant on a well-known fact: "Whales for their blubber, seals for their coats, sharks for their liver, and the rest of the carcass discarded. Over the centuries man has wasted enough riches from the sea to have made his arable land twice as fertile as it is. These riches after a few days stink to high heaven, but if a thing is good enough to stink, it is good enough to eat, after nature has put it

through her careful processes. We throw back into the sea (which does not need it, having inexhaustible wealth of her own) stuff that we need, nasty stuff for a time but of far more intrinsic value than furs and oil."

The author is not afraid to admit our ignorance of many phases of sea life, and frequently presents several of the more probable theories. A brief appendix is concerned with Time Periods and Fossils. The few illustrations are unobtrusive line drawings, linear continuations of the text. The absence of an index is not wholly to be regretted, as re-reading is pleasant.

The reviewer is Director Emeritus of the Department of Tropical Research at the New York Zoological Society. He is currently engaged in a study of the ecology of the Anima Valley in Trinidad.

FLEAS, FLUKES AND CUCKOOS

- - - - - - - by Miriam Rothschild and Theresa Clay

Macmillan, $5.00, 304 pp., illus.

Reviewed by DEAN AMADON

THIS book, which was first published in 1952, is one of the British series known as "The New Naturalist." About fifty volumes of this undertaking have now appeared, and, taken as a whole, they represent the best and most important contribution in modern times to sound and yet popular natural history. The republication of the present volume in the United States and England is ample evidence of its excellence.

This is a book about parasites — those most interesting and yet at times most repulsive of living things. Miss Clay, a member of the staff of the British Museum (Natural History), is a world authority on the feather lice of birds, while Miss Rothschild, who has pursued her studies as "an hobby . . . approached scientifically," is a student of the fleas of birds.

Because of these special interests, the parasites of birds serve in this book as representatives of the entire group. Nevertheless, the subject of parasitism is approached from the broadest possible point of view. Some, indeed, have thought that that concept is stretched too far by the inclusion here, under the title of "cleptoparasites," of birds which steal food from other birds; and of "brood-parasites," cuckoos and cowbirds which lay their eggs in other birds' nests. Be that as it may, by far the major portion of this book is given over to a sound and, at the same time, lucid and most interesting discussion of the typical internal and external parasites, such as fleas and flukes, ticks and tapeworms.

The many excellent photographs and enlarged drawings make amply dramatic the formidable equipment parasites bring to the task of securing their livelihood at the expense of the comfort and, sometimes, the health of their hosts. This account of how parasites fit into the scheme of living things, of how they reflect the same evolutionary forces of selection and competition that produced their hosts and victims, can be recommended without reservation to anyone interested in natural history.

Dr. Amadon is Chairman of the Department of Birds and Lamont Curator of Birds at The American Museum of Natural History.

BUTTERFLIES

- - - - - - - - - - - by E. B. Ford

Macmillan, $6.00, 368 pp., illus.

Reviewed by FREDERICK H. RINDGE

THIS stimulating book, originally published in England as one of "The New Naturalist" series, is highly recommended reading for anyone interested in natural history. While one part includes discussion and illustrations of all the British butterflies, a much larger proportion of the book is devoted to butterflies in general, and how genetics, evolution, and distribution can be studied by means of these insects.

The book includes chapters on their structure and development, senses and colors, habits and protective devices, and relations with other insects. One section discusses the relationships of certain caterpillars with ants. That the collector needs a good knowledge of the life history and habits of the different species is emphasized by a discussion of the ecological and geographical preferences of the butterflies themselves. Backing all this is a history of British butterfly collecting, with a specimen that was caught in 1702 illustrated in color. It is still as bright and fresh as a butterfly newly caught!

The author's background in genetics is reflected in this chapter and in the one on evolution. Various characters in wing pattern and color are analyzed and explained, and the need for more work along these lines is stressed. The author suggests a number of different experiments and observations that would be of real value and which can be performed by anyone.

This edition, the third, seems identical with the preceding volume, except for the addition of an appendix. The color plates are excellent, although not quite so good as the earlier ones; on the other hand, the black and white plates are clearer and better. This volume shows that butterflies can be both an interesting hobby and a vital part of biology.

Dr. Rindge is Associate Curator of the Department of Insects and Spiders at The American Museum of Natural History.

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I Watch Fiddler Crabs continued from page 250

nor work all of the time. They do a deal of aimless moving about, so far as I can see. At times, in the heat of the day, great droves of them will wander yards from their home — for what purpose, I cannot say. At such times, they fall easy victims to the bait-collector, for they seemingly become confused when caught away from home. Hundreds at a time can be driven upon a tarpaulin spread in their path and then quickly dumped into a can.

It sometimes seems hard to explain the antics of individual crabs. What, for example, is back of all the claw-waving of the males? William Beebe speaks of the male fiddlers he watched as waving their great claws in apparent salute to the passing females. But one huge purplish fellow I recently watched never stopped waving his claw for half an hour and saluted old and young, males and females, alike. So far as I could determine, none of those saluted paid any attention to him. Another male, apparently a sour-tempered fellow, would rush fiercely toward a busy little female who kept depositing balls of excavated sand near his door. But he always checked his rush before touching her, and she kept steadily on with her task, seemingly unmindful of his actions. However, the behaviorists tell us that this claw-waving is a courtship gesture, even if the females ignore it; and it is also believed that the males use it in defending their territory against other males.

A New Situation

Having watched my fiddlers for some five months, I can see that they are able to make appropriate responses to the everyday happenings in their environment. Perhaps their commonest response is that of diving into their holes at the least sign of danger. But how, I ask myself, will they respond to a totally unusual situation, such as, say, finding their doors closed when they hurriedly attempt to enter them?

It is easy to put them to a test. I procure a two-foot stick and, holding to one end, place the other within an inch of a big crab's door. When he emerges, I give a quick thrust with the stick and his door is slammed shut behind him. I have done this with dozens of different individuals, and the initial reactions have been almost invariably the same. After the first quick dash toward the door, each crab seems momentarily frozen into inaction—some for a minute or more. Many have allowed me to pick them up. All, however, came out of their trance on being handled and quickly attempted to pinch my fingers.

After overcoming their inaction, these dispossessed crabs behave in different ways. Some, if I remove my stick slowly without frightening them, dig out the sand from the door and repossess their homes. Others start to run rapidly, in a few cases even going hurriedly into the water. Some enter the homes of other crabs. One that I watched dived into another crab's tunnel but quickly came out again with the owner at his heels—although there was no sign of fighting. Still others entered the homes of other crabs and remained there without being ejected. It's usually okay to enter a neighbor's house in case of trouble.

Curious creatures, these fiddlers. They haven't told me many of their secrets, but I have had great fun watching them.

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Letters

Purple Martins and Fossil Echinoderm Stems

SIRS:

I wonder if you can supply the answers to two questions. The first concerns purple martins. We erected a large martin house and were successful the first year in attracting several of these beautiful birds. At first we thought that all of them were females, since there was none that fitted the description of the male. All seemed to have grayish underparts. We checked available references, and all said that the males have black breasts. However, the martins were seen carrying nesting material into the house, and as far as we could observe, they raised young. My question is whether or not the males get gradually darker as they grow older. Or were our observations at fault?

My second question concerns some objects shown to me by a friend who lived formerly in southern Illinois. These objects are cylindrical in shape, about three-quarters of an inch long. Encircling each one are parallel grooves, and running through each is what appears to be a hole. He says that in Illinois they are called Indian beads and are plentiful in the southern part of that state, especially along streams. They seem to be fossils of some kind. What do you think they are?

I have been a subscriber to NATURAL HISTORY for three years and look forward to each issue.

JOSEPH F. FISHER

Rhinelander, Wis.

Dr. Dean Amadon, Curator of Birds at The American Museum of Natural History, answers Mr. Fisher's first question:

At the time they leave the nest young male Purple Martins are grayish, especially on the under sides, and hence resemble females, rather than being glossy purplish black all over as are the adult males. The following spring they are fully mature sexually, and mate and nest even though they are still in the immature plumage, sometimes with a few of the adult glossy purple feathers mixed in with the grayish immature ones. The young males retain this immature plumage for more than a year.

It is unusual, of course, to find a colony of martins in which all the males are in this immature plumage. The colony described by your reader, however, was a new one, and there is some reason to believe that, among colonial birds, which include this member of the swallow family, new colonies are often founded by young birds nesting for the first time. This may explain the fact that all the males in this colony were in the immature plumage.

Don Knight

▲ MT. MORAN—12,594 feet, Grand Teton Park. Jackson Lake, Wyoming.

Dr. James A. Ford, Associate Curator of North American Archeology at the Museum replies to the second question:

The objects described in the second paragraph are almost certainly sections of fossil echinoderm stems. These were sometimes collected by Indians and holes drilled through, so that they served as beads.

In southern Illinois they were doubtless eroded from the St. Louis limestone of the Mississippian geological age.

Red-Face Department

SIRS:

Could it be that the beetle illustrated on page 181 of the April, 1957, issue is a scarabaeid rather than a chrysomelid as stated in the caption and accompanying article?

WILLIAM H. LOERY, M.D.

New York, N. Y.

Dr. Loery is right. Although every effort is made to check and recheck each article, occasionally something slips by. Our thanks to Dr. Loery and several other readers who brought this to our attention.

—ED.

John C. Pallister, Research Associate, Department of Insects and Spiders, the Museum, enlightens us further as to the ways of ants and beetles:

The writers of these letters are correct in their observations. The picture does not show a chrysomelid beetle but a scarabaeid beetle, family Scarabaeidae. It belongs to the subfamily Cetoniinae. From the picture it is impossible to determine the exact species.

Nearly 2,000 species of insects and other invertebrates inhabit ant nests. About 1,000 of these are beetles. This is actually

continued on page 334

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>
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June, 1957 Volume LXVI, No. 6

Kiowa Dancers ..... Cover Design
From a color transparency by Josef Muench

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Your New Books 284

Wild Blow the Winds ..... Ann and Myron Sutton 288
"Many can brook the weather that love not the wind . . ."—Shakespeare

Quick as a Flash! ..... Walker Van Riper 294
High speed photography reveals hitherto unknown facts about the way a toad uses its tongue

The Rainiest Place in the World ..... Robert Bruce White 297
When it rains in Cherrapunji, it pours!

Artificial Color Has Been Added ..... Walter Henricks Hodge 298
Butter and cheese owe at least part of their color to the shrub called annatto

The Fish that Made History ..... Gary Webster 302
For four centuries the codfish played an important part in the development of the New World

They Glide by Night ..... Leonard L. Rue III 308
The "silver-gray mouse that flies" may live in your attic

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This expedition returned to the United States with the first living specimens of the Amazon River dolphin

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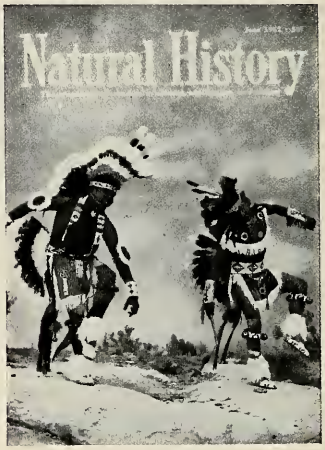

THE COVER THIS MONTH

This month's cover shows two young Kiowa boys from Oklahoma, dressed in their vividly colored costumes, with bright feathered headdresses and gaily patterned beadwork. Photographer Josef Muench caught their picture as they showed their dancing skill at the Inter-Tribal Indian Ceremonial held annually at Gallup, New Mexico.

The Kiowas lived east of the Rocky Mountains out on the dry plains. They were called marginal tribes because their homelands were where the great desert country meets the buffalo plains — a strip of dry plains in Oklahoma, Colorado, Wyoming, and western Kansas.

They were a fierce hard-fighting people, and other Indian tribes feared and avoided them as implacable enemies. It was not until 1874, after the United States government was forced to send out its troops, that the Kiowa people agreed to settle down peaceably on their reservations and stop their raids against the new states of New Mexico and Texas.

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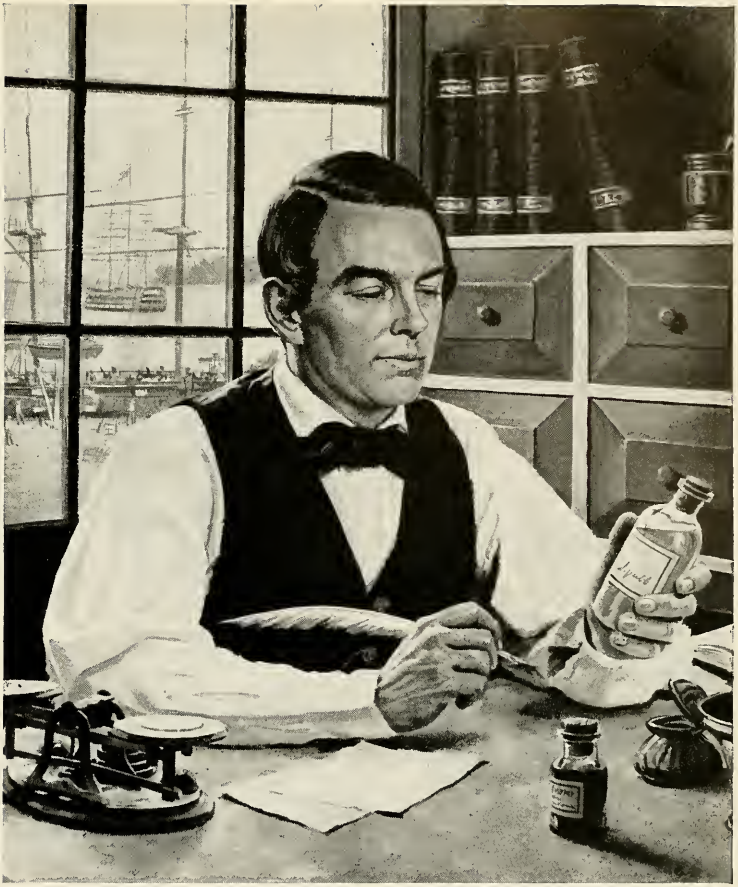

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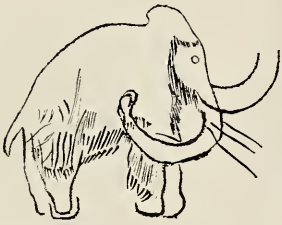

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287 pp., illus.

Reviewed by LOWELL THOMAS, JR.

The title doesn't do justice to this splendid account of man's first overland journey from the top to the bottom of the Western Hemisphere. It doesn't hint at the real story—the experiences and adventures shared by this young American husband-and-wife team as they pioneered their way from the Arctic Circle in Alaska to Ushuaia, Argentina—the world's southernmost town. For a year and a half their constant companions were Dinah, their German shepherd, and "La Tortuga," their amphibious jeep.

With no more reason for this undertaking—and none needed—than that it had never been done before, Helen and Frank Schreider, with Dinah barking encouragement, drove, pushed, pulled, and sailed "La Tortuga" southward until they just plain ran out of land.

They have wasted few words on the easy portions of their journey. Instead, the authors tell us how they overcame obstacles like the mountain range that rises along the Mexican-Guatemalan border—one of many missing links in the Pan-American highway. Here for days their progress was measured in tenths of a mile as Frank axed a crude trail up the forested slopes and down again, rolling boulders aside, and winching "La Tortuga" (the Turtle) ahead inch by inch while Helen worked the controls. At night, exhausted, they slept on narrow bunks inside the jeep's cabin, with Dinah curled up on the front seat. Their skimpy meals came from cans, cooked over a tiny primus stove, and their water from wherever they could find it. No wonder Helen had a close call with typhoid fever later on.

The best of this book is when "La Tortuga," blocked by impenetrable jungles and mountains, puts to sea at a place called Dominical on the Pacific coast of Costa Rica. Penetrating the line of breakers on that maiden voyage was quite an experience for the Schreiders, but so was their first landing about which Frank writes: "With the accelerator floored we entered the breaker line. . . . The bow nosed down—we surfboarded out of control. Standing almost on her nose, La Tortuga rushed forward, caught on the crest with the trough twenty feet below. I felt as if we were in the front car of a roller coaster. . . . Terrified, I let up on the gas, hoping the comber would slip under us and we would straighten out. Instead, we lost the last bit of control. La Tortuga spun broadside to the waves, keeled over on her side. The engine sputtered and died."

It took a miracle to get out of that one. There were other miracles, too, on the way to Ushuaia, like their survival of a tropical storm at sea, or the time they just got away from a boatload of hostile gunrunners by sending "La Tortuga" splashing up onto a beach and dashing away on her wheels. Miraculous is also the best word for their crossing of that graveyard of ships, the Strait of Magellan, where a ten-knot current was nearly too much for "La Tortuga's" maximum of six.

20,000 Miles South is sprinkled with humor; and it is well-written. Seventy-three black and white illustrations are a big plus, as are 29 sketches by Helen, and a route map. But one could wish there had been a little color.

All in all, though, this is a first-rate tale of adventure. It's also a testimonial of the courage and endurance of the Schreiders, including Dinah and "La Tortuga."

Mr. Thomas is the well-known explorer, lecturer, and writer. His book Our Flight to Adventure *describes a similar odyssey over three continents by himself and his wife in a small airplane, "Charlie."*

AMERICA'S NATURAL RESOURCES

- - - - - - - by Charles H. Callison

Ronald Press, $3.75, 211 pp.

Reviewed by HAROLD E. ANTHONY

THE public is becoming increasingly conscious of legislative activity planned to do something with our natural resources. The intent may be to conserve them but all too often it is directed to exploit them, and it may very well be that the exploitation is not in the best public interest. Sometimes it is not an easy matter to decide, upon the first inspection of these present-day massive projects concerned with natural resources, just what is the wisest decision to make. Man has now achieved such mastery over his physical environment that he can change the very face of the earth. Furthermore, he has decided that the earth exists to be used as he sees fit, and we may as well realize that all the human elements of greed, selfishness, lust for power, and living only for the present will play a large part in planning the use of natural resources.

That is why this comprehensive, authoritative, and well-written book can serve a useful purpose in supplying the reader with basic information dealing with the natural resources of America. There are eleven sections, prepared by eminent students in their fields, which deal in turn with Conservation: An Ecological Approach; Renewable Resources and Human Populations; Soil; Water; Grasslands; Forests; Wildlife; Fish; Parks and Wilderness; Land Use Principles and Needs; and Needed: A Natural Resources Policy. An appendix outlines briefly A Policy for Renewable Natural Resources.

The United States has reached the stage where serious consideration must be given to the constantly mounting demands upon our natural resources, both renewable and non-renewable. Unfortunately, the country has passed the stage where early abuses may be rectified. Some of these wasteful practices were tolerated because the public had no way of learning what this book discloses. It is certainly the duty of every

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public-spirited individual to acquaint himself with the menace presented by every wasteful demand upon natural resources. The present volume will be most helpful in this respect.

Dr. Anthony is Chairman-Curator of the Department of Mammals, American Museum of Natural History. He has been active in conservation for over 30 years and served on the Advisory Board on National Parks, Historic Sites, Buildings and Monuments from 1946 to 1954.

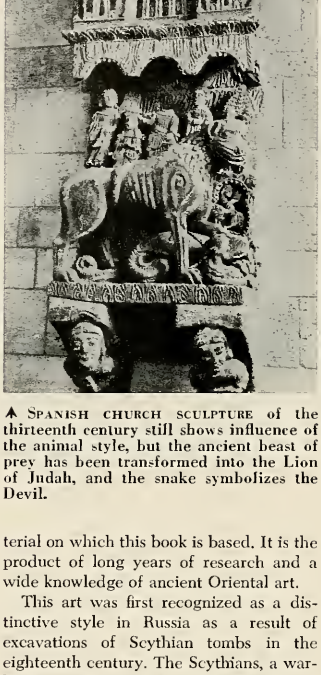
THE SYMBOL OF THE BEAST: The Animal-Style Art of Eurasia

- - - - - - - - - - by Dagny Carter

Ronald Press, $8.50, 204 pp., illus.

Reviewed by FLORA S. KAPLAN

SCYTHIAN art is the subject matter of *The Symbol of The Beast* by Dagny Carter. The author circled the globe twelve times, visiting China, Mongolia, Siberia, Russia, Norway, Sweden, and other European countries in her search for the material on which this book is based. It is the product of long years of research and a wide knowledge of ancient Oriental art.



▲ SPANISH CHURCH SCULPTURE of the thirteenth century still shows influence of the animal style, but the ancient beast of prey has been transformed into the Lion of Judah, and the snake symbolizes the Devil.

This art was first recognized as a distinctive style in Russia as a result of excavations of Scythian tombs in the eighteenth century. The Scythians, a warlike nomadic people, invaded southern Russia in the first millennium B.C. and exerted strong influence upon the art and technology of neighboring peoples whom they subjugated. After their own defeat about the second century B.C., they scattered widely. Objects of Scythian origin have been found as far west as Hungary and as far east as the borders of China.

The author distinguishes a number of characteristic elements in the conventionalized animal art of the Scythians. One of these is an animal curled up in a manner suggestive of an embryo; another shows predatory beasts attacking and devouring their prey. Many animals are represented with elongated bodies and with their heads turned backwards or extended forward in a typical mating pose.

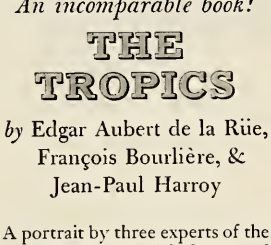
Objects in animal-style are known from other regions in Eurasia, and all were formerly called Scythian or Sino-Scythian because of their stylistic similarities with Scythian art. Many parallels with the Middle East, Far East, Siberia, and Europe are also given in the book. Experts in the field have suggested that the art as a whole be known as "Eurasia's animal-style art."

In the latter part of the book, the author discusses European animal art which has generally been thought to be of European origin. It is her belief that there is a fundamental relationship with Eurasia's animal-style art either through a paleolithic origin or the symbolic significance which both had in common. In the history of the style, the author points out an overall decrease in the symbolism of the beast and an increase in the symbolism of man, geometric designs, and plant motifs as a result of the influence of settled civilizations upon the nomadic tribes of the steppe regions.

As a general survey of various special investigations, the book is designed for the art student, the archeologist, and anyone else with an inquisitive mind. Mrs. Carter reviews the major finds in each region and attempts to give a picture of the people associated with particular groups of ornaments. She tells what is known of their history, way of life, burial customs, and beliefs. She presents in a clear and easy style a wide variety of material which is not readily available in the United States nor easily understood because of linguistic difficulties.

Many excellent photographs illustrate animal-style objects now in collections all over the world, including some in the author's personal possession. A comprehensive bibliography lists plentiful source material. The volume is attractive in appearance and can be recommended as a worthwhile contribution in a little-known field.

Mrs. Kaplan is Acting Curator of Primitive Art and New World Cultures, The Brooklyn Museum.



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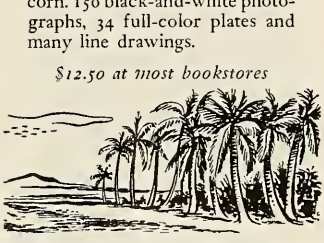

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MODERN SCIENCE AND THE NATURE OF LIFE

- - - - - - - - by William S. Beck

Harcourt, Brace, $5.75, 302 pp.

Reviewed by
GEORGE GAYLORD SIMPSON

THIS excellent book by a doctor turned biochemist contains both more and less than its somewhat pretentious title may seem to promise. Among its main preoccupations are, first, the nature of science, its philosophical bases and implications, its relationships with other intellectual pursuits, and the characteristics (including the failings) of its practitioners. Second, it expounds the current status of some biological research, with emphasis on biochemical aspects related to genetics. Along the way, it touches on almost innumerable other topics: relativity, information theory, the origin of life, and a host of others.

The book is beautifully written, clever without being flippant, profound without being stodgy, clear without being condescending. It is as attractive and easy to read as a good novel, more interesting than most, and more rewarding. Students of the humanities, to whom it addresses

some cogent remarks, might well examine it as proof that writing about biology by a professional scientist can be as high art as writing by a professional author about, say, infidelity.

The book is smoothly and logically articulated, yet with all its range and variety it is hard to outline briefly. Part one deals with the place of science in culture and with the historical origins of biology as a science. The next part, labeled "The First Great Modern Synthesis," deals quite briefly but evocatively with the cell theory, evolution, and the issue of vitalism *versus* materialism. "Twentieth Century, the Age of Analysis" comprises four chapters on such disparate but related topics as the decline and fall of the absolute, the true nature of noise, and the creative act. Finally, part four deals variously with the perhaps imminent break-through of research on the physical basis of life, with some major biological problems that elude our grasp, and with possible future triumphs.

More hard-headed than some of his colleagues and franker than others, the author suggests that the crash program in cancer research is not the best way to tackle the problem and is much farther from its goal than the journalists would have us believe. For the future—the very distant future—he holds out the promise of literally eternal life, the least convincing conclusion of a most convincing book.

Such weighty subject matter does not, in Beck's hands, produce a heavy treatment. You will not find it dull to meet a rat named Peter, who followed the right scientific method, or a biologist named Sigmund, who benefited his University with a bang.

It would be easy enough to object to some statements and even to point out a few errors. But we must grant to the author what he claims for other scientists: he, too, is human. He is also both witty and wise. What more can one ask?

Dr. Simpson is Chairman of the Department of Geology and Paleontology, American Museum of Natural History. He is the author of The Meaning of Evolution, *which has been translated into many foreign languages.*

MERMAIDS AND MASTODONS

- - - - - - - by Richard Carrington

Rinehart, $3.95, 251 pp., illus.

Reviewed by BRIAN H. MASON

RICHARD CARRINGTON is a British writer in the best tradition of natural history—a man who takes the world for his parish—not only the surface, but the air above, the rocks beneath, and the seas between. The versatility of his interests is manifested by his belonging to diverse

continued on page 333

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Wild blow the winds

"Many can brook the weather that love not the wind . . ."—*Shakespeare*

By Ann and Myron Sutton

▼ Windswept fire rages through forests, destroying wildlife, watershed, and valuable timber.

U. S. Forest Service

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↑ THE NAVY'S HURRICANE HUNTER, with two F2H-2P Banshee photo jets, patrols the skyways for storm data.

IN all the world, few natural forces are as turbulent, pervasive, and disastrous as the wild, wild winds. Wherever they blow—in the stratosphere, around the gray crags of mountain peaks, in the deepest canyons—they swirl and eddy in a global circulation pattern of tremendous power. Scientific researchers, studying the obstreperous winds, know better than most of us the enormous force and complexity of the world's rampaging gales.

Weathermen have managed to ferret out a vast amount of meteorological data about the wind. In so doing, they have made some tensely dramatic discoveries and saved much human life and property.

Until recently, for example, high-flying aircraft have occasionally rammed into mountainsides in broad daylight during good weather, on flights over familiar terrain. There seemed to be no good reason why such flights should have met disaster. The crews were well-trained. The planes were in top condition. Even after exhaustive investigation, no immediate answer was found. In desperation, the bewildered investigators resorted to the only solution open to them—Pilot Error.

But pilots don't miscalculate mountain peaks. As other disaster reports piled in, the weathermen swung into action to see if there wasn't some strange force that grasped a plane and flung it against a jagged cliff. There *was* such a force and they found it.

What they found was the "mountain wave," a deadly layer of treacherous air, hovering at times over mountain ranges, stirring up air currents, creating downdrafts, and putting aircraft altimeters out of kilter. High-speed winds produced instrument errors by which a pilot believed he could squeeze over an approaching mountain peak, when actually he was below its summit. The unexpected turbulence then sucked the plane into its clutches before the pilot knew what had happened—and kept it there until it was too late to pull out.

Today, scientists compare mountain waves to waterfalls. Air catapulting down a mountainside sets in motion the same types of eddies, vortices, and currents as those that occur in water going over the brink in a thundering cascade. As a result, pilots now know what to look for and how to swing clear of mountain wave conditions.

The pushing of the altitude frontier continuously upward has lately given mankind a fantastic new knowledge of the great family of winds. Seven miles up, there are no trade winds, no dulcet sea breezes, few gentle zephyrs. Instead, super-powered gales zigzag out of the west and roar along at hundreds of miles per hour.

B-29 pilots raiding Tokyo in World War II were sometimes shocked to find that, on high-altitude bombing runs, their ground speed suddenly dropped nearly to zero. As flak began bursting outside, they found to their horror that their powerful planes were standing almost still in mid-air, with relation to the ground.

At first, the weathermen found the reports hard to believe, as if the crews had fueled on *sake* before taking off. But the reports persisted, and out of the war came our first calculated look at that mysterious and wandering river of air—the jet stream. Experts have found that the winds of the jet stream flow in narrow, three-dimensional "rivers" of air in the 10,000- to 40,000-foot altitude range. Though they bear little relation to surface wind patterns, evidence now points to the jet stream as having a considerable effect upon weather.

No one knows for sure how the jet stream works, or why. Some say that it results from widespread mingling of middle-latitude storms. Others think that large masses of

ANN and MYRON SUTTON are another husband - and - wife team among NATURAL HISTORY'S authors. Myron is a museum planner for the National Park Service. Until recently, Ann was a geologist with the U. S. Geological Survey, but she is now taking care of a brand new addition to the Sutton family.

U. S. Forest Service

▲ THE NEW ENGLAND HURRICANE OF 1938 left red and white pines permanently bent.

equatorial and polar air reach great heights and that when they collide, there is sufficient difference in their temperatures to set the jet stream screaming.

Whoever is right, one thing is sure. Riding this maverick gale offers rodeo-like thrills. Its velocities change suddenly. Temperatures jump and zones of turbulence strike hammer blows on unsuspecting aircraft. Yet early this year, a B-47 bomber, guided by an AN/APN-66 navigational dead-reckoning device, succeeded in flying the jet stream from March Air Force Base, California, to Hanscom Air Force Base, Massachusetts, in 3 hours, 47 minutes—an average ground speed of 714 miles per hour.

The complexities of the jet stream and of the mountain wave are but two spectacular phases of the ubiquitous wind. No place in the world is free of it. Some localities, such as dense tropical forests and sheltered mountain valleys, have very little wind. Other locations, as residents point out, have too much.

But whether we like it or not, the winds go right on blowing, spawned by the heat of the sun, nurtured by the moisture of the sea. Since earliest times, man has regarded the winds with awe. The Romans dedicated temples to the *Tempestates.* Aeolus, the Greek god of the winds, kept them in a bag. The Ainus worshipped typhoons. Iowa Indians revered the wind as one of seven great gods, and Sioux tribes made sacrifices to the four winds.

In almost every form of belief, the winds were great powers to whom worshippers offered special inducements for moderation. To make the wind behave, Alaska's Tlingit Indians talked kindly to it. If that didn't work, they offered it a piece of fish. If that failed, they advised their brethren not to talk about wolverines, since wolverines were supposed to control the frigid north wind.

With the advance of science, men began to wonder if there might be some more rational explanation for the winds that blew around them. They began to observe more closely the interconnecting natural forces that added up again and again to the same answer. Their beliefs were very much in error at first. For example, they thought that tropical winds originated from the respiration of sargasso weed (*Fucus natans*) because sargasso was abundant in tropical latitudes. Over land, the winds were believed to have resulted from the unequal distribution of trees and forests. But when truth began welling up out of the murk of ignorance, the sun's true influence on the air became more clearly known.

The Windmaker

As the sun's radiation warms the land, the layer of air that hovers just above the earth becomes hotter than the air overhead. Heated air expands, becomes lighter in weight, and rises. For every mass of air that rises, other masses of air rush in to occupy the original space. The result—wind.

No two regions on earth receive

the same amount of sunshine at the same time. The manner in which the Greenland Ice Cap obtains and radiates solar energy is far different from that in which the Mato Grosso of Brazil operates. Cities become hotter than suburbs; deserts hotter than oceans. Almost all landscapes slant away obliquely from the sun. Even tropical isles are not always hit squarely by the sun's rays. Everywhere, differing amounts of radiation are absorbed. The sea reflects less heat back into the air than the land, and air layers on mountain tops remain cooler than valley breezes.

The result of this worldwide unequal heating is a gigantic movement of air up from the Equator (hottest) toward the poles (coldest). It is the in-between activity of these convection currents that makes weather in the Temperate Zone so intemperate.

Superheated air rising high into tropic skies bends over toward the North or South Pole, as the case may be, and flows at high levels toward polar regions. Were things no more complex than this, the air would circulate toward the Poles, come down to earth, and flow monotonously across the land back to the Equator, there to rise again. Such a simple pattern would give rise to no storms, no balmy summer days, no autumn hazes—in short, no stimulating changes in weather.

However, the spinning earth's momentum, its gravity, and the differing relative speeds of rotation on the surface—from 1,000 miles per hour at the Equator to virtually none at the Poles—all pull and push and whirl the air into varied motions. These motions bring changing weather.

As to the highest velocities winds attain, no one knows. Most wind-measuring devices are blown away before they can record maximum gales. On the earth's surface, the highest speeds occur inside tornadoes, where winds swirl at an estimated 400-500 miles an hour.

In the stratosphere, they may blow even faster. Ionospheric winds of almost 700 miles per hour have been detected by radar 65 miles up. Joint U. S.-British-Canadian investigations have revealed that the world's record winds speed along in the ionosphere as high as 100 miles. On October 28, 1949, Dr. G. J. Phillips of the Cavendish Laboratory, Cambridge, England, measured the winds during a magnetic storm and clocked a record-breaking 1,000 miles per hour.

The blustery tempests that do the most damage hover more closely to terra firma, sweeping across the face of the earth, invading geographic and linguistic borders. A wind that brushes Europe becomes a *labech* in Marseilles, *libeccio* in Corsica, Grenoble wind at Combe-de-Savoie, a Geneva wind on the shores of Lake Geneva. Another wind, in its travels, changes from Lombarde to Galise to mountain pass to little St. Bernard wind. Others take on village names, as the wind of Arsine, wind of Montmélian, wind of Armenaz. One researcher, delving into the various Moroccan names for the winds, found fifty altogether; a single *sirocco* goes by the names *arifi*, *irifi*, and *rifi*. What Costa Rican has not heard of the *Tehuantepec;* or Hawaiian, the *kona;* or Spaniard, the *levanter?*

Even the beneficent sea breeze, tender as it may seem, can blow like a screeching nor'easter, given half a chance. Chileans call it the *virazón*. On summer afternoons in Valparaiso, it rises to wind force, picking up pebbles from the walks and whirling them into the streets. People seek shelter, business stops, movement between shore and city diminishes, shipping is tied up, and even the Almandral is deserted. Then, suddenly, the winds abate and a calm settles over the coast. The sky clears, the air is crisp and pleasant, and the land breeze, the *terral*, drifts dreamily down from the mountains. Night settles on Valparaiso and the city's festivities get under way.

At the other end of the earth, out of the shivering north, come cold and icy gales that bury the countryside in whirling snow. France's *can-*

U. S. Forest Service

↑ THIS COTTAGE was wrecked by a wind-felled tree.

↑ PROPERTY DAMAGE is heavy when the wind blows hard.

talaise, Italy's *tramontana,* Rumania's *crivetz,* Yugoslavia's *kochava* —all turn into ferocious northers that kick up 60-mile-per-hour winds, tear off roof tiles, blow down chimneys, and uproot trees. Fruit crops, nipped by a late-blowing norther, can be withered on the vine.

One of the world's iciest blasts is the *mistral,* a cold and violent wind that rages across France in spring and autumn. Plummeting down the Rhône Valley, it doubles and re-doubles in force until it rams through mountain gorges at 90 miles an hour and bursts across Provence with terrifying strength.

Not only does it wipe out flocks of animals; it has also been known to blow stagecoaches into the river. Edgar de la Rue ascribes to the mistral power enough to throw a man off his horse, upset a haycart, loft pebbles into glass windows, rip branches from trees, blow tiles from roofs, stall river traffic, and even tie up shipping at Marseilles. Sometimes the mistral rages for weeks, freezing and drying out the soil, or damaging grainfields and orchards. The Abbé Portalis, history records, was blown from the summit of the Mountain of St. Victoire and killed in the fall.

Occasionally, the mistral proves beneficial, but those instances are soon forgotten. Frenchmen say that the town of Avignon is unpleasant when the wind is blowing and unhealthy when it is not.

Channeling down a valley can magnify a wind's force and shoot it out across the land as if it were fired from the muzzle of a cannon. The *bora,* cooling Italy and the Adriatic Sea in winter, is as power-packed as the mistral and has blown trains off their tracks. Where the bora strikes the sea, it swoops up a freezing spray of foam and icy water that all but hides the coastal islands. Farther on, with all the ocean on which to spread out, the gale loses force and dissipates.

The Famous Foehn

A little farther north, in European mountain country, blows the *foehn,* one of the strangest of Nature's calamitous gales. Air masses ascending the southern slopes of the Alps become cool, drop their moisture as rain or snow, push over the summit, descend the northern slopes, warm up by compression, and bring on odd temperature inversions. As early as 1866 the foehn was explained thermodynamically.

The foehn, heating up independently of the sun, becomes so dry that it dessicates everything in its path. If this goes on long enough, houses, furniture, and other items made of wood become tinder-dry—ready to be touched off by the smallest spark into a flaming conflagration. Whole villages declare a state of emergency and set up stringent regulations from which there is no deviation. Special guards see that all fires are extinguished, bar none. Smoking is *verboten.* So is cooking. Aware of the many villages that have burned as a result of this crackling danger, every citizen complies with emergency orders to safeguard against the foehn.

For all its dangerous capacities, the foehn is a wind of benefit as well. It melts the snow and touches Europe's countryside with the magic of spring. Without the foehn to dry their hay and ripen their fruit, the farmers in their hemmed-in high valleys would have a harder time cultivating crops than they do. Yet so suddenly can the warm foehn blanket the land, that snows are sometimes avalanched and melted with excessive haste, resulting in disastrous floods. Or the foehn may plunge down mountain slopes with such force that whole forests are devastated. Boats and steamers on lakes must race for shelter or be swamped.

Warm winds like the foehn are not limited to the Continent. The *chinook* sweeps down across Canadian plains from the Rockies, making Alberta's climate intensely vari-

U. S. Forest Service

↑ In Mount Hood National Forest, Oregon, fierce winds have forced these pines and hemlocks to hug ground.

Federal Power Commission

▲ SKETCH of a giant twin-wheeled wind turbine to produce 6,500 kilowatts. Such a machine is possible but costs are prohibitive.

able and permitting the extension of farmlands far into the northern plains.

Still other winds, less varied and less benevolent, provide the wings on which winter arrives. The world's worst blizzards rage across the antarctic, where camps buried in the ice—with anemometers sticking out to record wind speed—have tallied an average velocity of 107 miles per hour for eight solid hours, including intermittent gusts of up to 200 miles per hour.

Winds Blow Hot or Cold

The *pourgas,* the world's bitterest winds, sweep over the deep frozen tundra of Russia's Kamchatka peninsula. Everything blows away unless tied down. Snow is driven into the air, the temperature spills below zero, and a bitter damp cold drives clear to the bone.

By contrast, in balmy tropic climes, the warm breezes are not always sleepy, palm-scented zephyrs. Hot and scorching winds, baked beneath an equatorial sun, lay down a withering trail of disaster and burn tropic and sub-tropic deserts to a crisp.

These fiery winds—*siroccos, simooms, haboobs, kharifs,* or other names according to locality—are

continued on page 330

U. S. Weather Bureau

▲ BOILING CLOUDS sweep in with the *kona* in Hawaii.

▼ IN THE ARID SOUTHWEST the wind helps polish and sculpture magnificent landscape features such as Double Arch, in Arches National Monument, Utah.

George Grant, Nat'l. Park Service

▲ The toad's tongue, stretched to over half the length of its body, makes contact with the bait.

▼ Barely 1/50 of a second after contact, the tongue is grasping the meal worm and pulling it away from the holding clamp.

High speed photography reveals hitherto unknown facts about the way a toad uses its tongue

Quick as a flash!

By Walker Van Riper
Denver Museum of Natural History
Photographs by the author

THE scientific method has been defined as "man working with his hands and thinking about it," thus emphasizing the two human features—mind and hand—which serve to set man apart from and above the other animals. The hand, especially, is significant not only because it limits and insures the soundness of scientific method, but because, of all the anatomical mechanisms so far evolved, it is the most adaptable, versatile, and useful. From throwing a knuckle-ball to the dissection of a single living cell, the hand of man appears to be almost limitless in the mechanical acts it can be trained to do.

Yet the animal world has produced a vast number of specialized organs able to do things directly which the hand of man can only match in some roundabout way through the use of tools or other apparatus of his construction. The pseudopod of the lowly amoeba, for example, can flow around and engulf a microscopic food particle which we can only handle by means of some elaborate mechanism invented for the purpose.

And the tongue of the toad can do a simple thing in an interesting way that is difficult or impossible for human fingers. Put a common meal worm on a smooth surface and try to pick it up between thumb and forefinger with a quick action like a bird pecking. A bird can pick up the worm with no trouble at all but for the human hand to do it as described is very difficult. Forceps solve the problem.

The tongue of the common toad does the thing in another and unsuspected way which takes a little work to analyze. The books all say that the toad's tongue has a sticky surface, that it is hinged at the front of the mouth, and can be extended with a sort of rolling motion its full length so that the tip comes down on top of the prey. The prey sticks to the tongue and is thus picked up

▼ Just 2/50 of a second after contact, the tongue is being drawn into the mouth with the tip of the tongue surrounding and grasping the worm.

and taken into the toad's mouth.

When the toad is a snapper-up of unconsidered trifles, such as an ant or other small insect, this description of what takes place is no doubt correct. But for bigger prey something else happens—the tongue proves itself to be a truly prehensile, grasping, holding organ with a function not unlike that of the human hand in a comparable situation.

The action here is too fast for the eye of man to see, and it can best be analyzed by one of our most original and valuable photographic inventions—the high-speed electronic flash invented by Dr. Harold E. Edgerton of M.I.T.

If we consider the accompanying illustrations in order, it is possible to explain clearly both the method of analysis and the results.

One of the features of Dr. Edgerton's device is what is called the "trigger circuit," the circuit which controls the flash and sets it off when closed. This is ordinarily attached to the camera in such a way that the camera shutter acts as a switch to fire the flash at the moment when the shutter is fully open. But the trigger circuit is adaptable to a variety of other arrangements of which the one used here is a good example.

In this instance the toad is placed on a pad of damp earth over a square of hardware cloth to which is attached one lead of the circuit. The meal worm bait is then placed on a glass base (to insulate it) and held there by a spring clamp to which is fastened the other lead of the circuit. The toad and its tongue are thus a part of one side of the circuit, the meal worm of the other, and, when tongue meets worm, the flash is fired.

Electrical characteristics of the circuit are such that the voltage is high—200-300 volts—and amperes almost nil, hence a great deal of resistance can be penetrated, as in this case, with no shock or spark when contact is made. You can actually place the two leads on your tongue and fire the flash, or hold one lead in one hand, the current passing through the body, and set the thing off by touching the second lead with the other hand. No sensation results in either case. What all this means is that our subject, the toad, can perform the operation without any reaction harmful to it or likely to condition it against repeating the performance.

Now let us look again at our first illustration. This shows the instant of contact between tongue and worm. The room is made semidark. When the toad seems to be ready, the camera shutter, on "Time," is opened. The toad does its stuff; the flash occurs, exposing the film; the shutter is closed. This is called the "open-flash-close" method. The duration of the flash in this instance is 1/5000 of a second which, as is evident, stops the motion perfectly and records the first step in the action being analyzed.

Note the stretch of the tongue—nearly two inches—a little better than half the length of the toad's body. It looks as though an even longer stretch might be possible for our subject, and a French authority states that a large toad (ours is fairly large—*Bufo woodhousei,* the Rocky Mountain Toad) may project the tongue a distance of four inches.

WALKER VAN RIPER is Curator of Spiders and Insects at Denver Museum of Natural History, but says his "most enjoyable work has been in photography with the high-speed electronic flash." Readers will recall his last article "Unwinding the Sidewinder" (NATURAL HISTORY, November, 1955).

The system of analysis being employed is designed to give us the same information which might be had with a motion picture taken at, say 500 frames per second and projected at 24—a slow-motion picture. What we have is a still picture in slow motion. Next we need a photo showing what the tongue is doing an instant after contact with the bait.

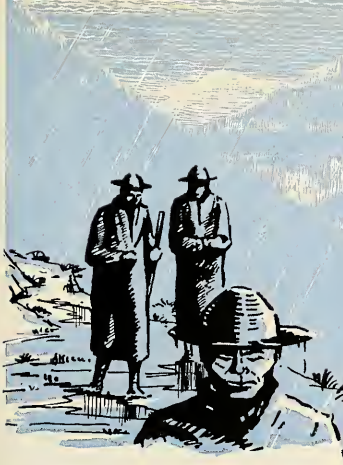
This is what the second picture shows. It is taken 1/50 of a second after the tongue touches the worm. There are various ways of timing the delayed flash. The elegant way is by means of an electronic circuit. Ours was an improvised trick which served the purpose very well. The flash occurring on contact was placed beneath the table. Against it was an electric-eye relay which, when actuated, fired the picture-taking flash. This delayed the taking of the second picture by 1/50 of a second.

The picture shows clearly that the toad's tongue is wrapped around the meal worm, grasping it and pulling it away from the spring clamp.

The third picture, 1/50 of a second later than the previous photo, shows the worm being drawn into the mouth. The arrangement resulting in a delay of the picture-taking flash by 2/50 of a second was similar in principle to that just described. I hope I have made it plain that these pictures are not rapid-fire shots of a single action, but rather of successive stages of a repeated action. Happily our subject is being pictured at what it likes to do best, and it will repeat it to repletion.

A part of science, it is said, consists in the investigation of small and unimportant questions, such as the one studied here, to which good answers may be found. Large and important questions, with answers mostly determined by the preconceived ideas of the askers, lie in another field.

Aristotle noted that the tongue of the toad was fastened at the front of the mouth, and subsequent observers have been unanimous in describing how the prey is picked up by the tongue's sticky surface. The action is obviously too fast for analysis by the naked eye, but an apparatus designed to photograph such unseeable things reveals what actually takes place. The tongue is found to be a highly flexible and versatile grasping organ—truly prehensile. The total time of the action may also be estimated from our pictures. Jean Rostand, the noted French authority, gives it at 1/15 of a second. We see that it is slower than that—a little more than 4/50, or about 1/12 of a second.



The Rainiest Place IN THE WORLD

When it rains in Cherrapunji, it *pours!*

By Robert Bruce White

WHEN moist tropical air from the Pacific jet stream freakishly swept over California and Oregon in December, 1955, a tremendous downpour began. By month's end, the floods, worst in California's history, had cost $170 million in property damage and no less than 74 lives; yet at no time was the rainfall greater than 10 inches a day.

The following August, torrential rains accompanying hurricanes "Connie" and "Diane" produced devastating floods in New England. Rain amounting to 10 inches a day fell in parts of the Blue Ridge Mountains and in the Poconos. The greatest downpour was at Windsor Locks, Connecticut, where in one 24-hour period 12.05 inches fell. In all the 90-year records in nearby Hartford, this flood had no equal. The worst previous storm, in 1897, produced only 6.82 inches of rain.

Recalling the damage done by those record rains, try to imagine what it is like in Cherrapunji, India, where for five consecutive days, 30 inches have been known to pour from the sky *each* day. In one month (July, 1861), 366 inches of rain—30½ feet—fell in Cherrapunji, and for a century the annual average has been 450 inches. The word "deluge" doesn't describe it. Yet this is routine, and it causes no havoc. The only comparable spot on earth is Mount Waialeale in the Hawaiian Islands, where 624 inches have fallen in one year, and where for 28 years the average has been 489 inches, though distributed more evenly throughout the year.

Cherrapunji, one-time capital of Assam, northeasternmost province of India, is at the southern extremity of the Khasi Hills, an east-west spur paralleling the Himalayas for 150 miles. The Khasis are from 4,000 to 6,500 feet high, and they meet a northward continuation of the Arakan-Yoma, the mountains of western Burma. Between these great rugged hills is a broad funnel-like depression. Southward 200 miles from Cherrapunji lies the Bay of Bengal, with vast swamplands in the delta of the Ganges. Heavily laden with moisture, the monsoon sweeps northward from the Bay, meeting no obstruction in East Pakistan until it is forced vigorously upward as its passage through the funnel narrows. The immense precipitation occurs when these winds strike the cool 4,000-foot cliffs and plateau of Cherra.

The phenomenal downpour is curiously local. At Dacca, capital of East Pakistan, just outside the mouth of the funnel, the annual rainfall, as in Calcutta, is less than 60 inches. At Sylhet, only 30 miles below Cherra but on low ground, rainfall seldom exceeds 100 inches a year. The same is true at Silchar, in the narrowest part of the funnel. At Shillong, the delightful hill-station that is now the capital of Assam, 33 miles north of Cherrapunji, it is only 80 inches. Even at Mawphlang, 15 miles inland, rainfall seldom reaches 200 inches.

Yet in this wettest spot on earth, 1,041.8 inches, or 83 feet, of rain have poured down in a nine-month period. And on the record day of June 14, 1876, 40.8 inches fell. Little wonder that the people of Bengal say that this is where Mother Ganges enjoys her daily shower bath.

Direct result of the deluge is the flooding of the plateau on which the village is placed; and the little streams around it may rise as much as 14 feet in as many hours. From the plateau, however, natural drainage is so complete as to render much of the area quite sterile. There is little soil for trees or even rice cultivation. The plateau, about three miles long and two miles wide, dips sharply in front and on both sides, and rises behind toward the main range of which it is a spur. Everywhere its surface is intersected by shallow rocky gorges. Rushing streams and ribbonlike cascades provide a beauty otherwise lacking in this strange place.

The villagers are used to it, but would you like 30 feet of rain a month in your home town?

Col. Robert Bruce White has had an "intensely active career of military flying in three wars," plus a successful business life. He has clocked up 1,700,000 miles of travel in 81 countries, and has been in Cherrapunji three times. "I have taken to writing to escape the boredom of retirement," he says. His articles have appeared in numerous national magazines.

Paul Allen

↑ An Indian girl of Darien in eastern Panama displays one of numerous designs for face paint used today.

Artificial Color HAS BEEN ADDED

Butter and cheese owe at least part of their color to the shrub called annatto

By Walter Henricks Hodge

Did you ever think when you buttered a piece of bread or sliced cheese for a toasted sandwich how uniform the color is in standard brands of these dairy products? Yet, by nature, butter and cheese vary considerably in hue, depending upon the milk from which they are made. Since the public likes butter and cheese to be uniform in color, the manufacturers standardize the hue of their particular brands by the addition of natural yellow

↑ Young "palefaces," playing Ind beneath an annatto shrub, show how c

dye. Hence the statement on most dairy products—"Artificial color has been added."

Until recently, the color added has been almost exclusively annatto, obtained from a small shrub native to the American tropics. As a dye, annatto is as American as our Indians—in fact, Amerindians first discovered it.

No one really knows just when primitive man first used annatto. The records of European contact with this colorant begin with the first voyage of Columbus. It was during the first days of December, 1492. The place was a Taino Indian encampment on the Honey River (Río Miel), near the eastern tip of Cuba. Columbus said of the numbers of natives who crowded around his men, "They were very many, all painted red and as naked as their mothers bore them. . . ." Obviously another case of an artificial color having been added!

W. H. Hodge

to put on "war paint" directly from halved pod, using a straw as a brush.

From what we know today, it is pretty certain that the bodies of these Cuban aborigines were painted with annatto dye. Columbus didn't say so, for he could hardly have been too interested in a simple new pigment when he was looking for "gold and spicery" for his sovereigns. Yet, had he or his men spent more time in the Taino settlement on that December day they might have found, among the domesticated dooryard plants, lilac-sized shrubs with heart-shaped leaves and spreading branches, their tips brilliant with clusters of pink or rose-colored flowers or with spiny red pods. Inside these could have been found the source of the red body paint of the Tainos. For each soft, prickly pod contains about 50 seeds, of grapeseed size, each with a thin, waxy red covering called an aril. When rubbed on oily human skin, the seed readily transfers a bit of the scarlet color from its arillate palette. Using modern techniques, man has learned how to extract this natural dye and to utilize its vivid hue to produce the familiar yellow colors in demand by our food industries.

On subsequent voyages, Columbus found this red body paint widely employed throughout the Caribbean. Later, other Europeans added to his observations reporting the cultivation and use of annatto by Indians throughout the mainland tropics from Mexico to Paraguay. To the scientist this important pigment-yielding plant is known as *Bixa orellana*. Still a prime favorite as a dye plant, it is grown today wherever Indians live and is nearly always found planted close to their dwellings.

As might be expected with a utilitarian plant that ranges so widely among so many tribes, it has a number of native names. In the West Indies, it was called *bija*, a Carib or Arawak word Latinized by Linnaeus when he formally bestowed the generic name *Bixa*. *Roucou* and *urucú* represent variations of another native name widespread among the Indians of South America. The name *achiote* comes from the peoples of ancient Mexico and is used most frequently perhaps by Spanish-speaking Latin Americans today.

Although a number of other vegetable dyes have been important to Indians of tropical America, annatto has always been this hemisphere's most important aboriginal pigment. Since the plant source was easily cultivable in the home garden, annatto pigment could be collected and used as desired to fit the need or occasion. Members of Indian war parties were accustomed to stain their whole bodies red in order to terrorize their enemies. Carib warriors taken by Columbus are recorded to have had ". . . their eyes and eyebrows stained circularly around . . . for ostentation . . . and also because it gave them a ferocious appearance." On the other hand, the waxy coating, mixed with various natural oils, has served the Carib and other tribes as a serviceable body paint that would repel insects and would protect the skin against exposure from sun or wind.

But the primary function of this splashy color has been basically that of a simple decoration, sometimes for everyday use but more often for special festive occasions. In

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short, annatto has served as a kind of cosmetic, an aboriginal rouge or lipstick, used (as Columbus noted) to ". . . paint . . . faces . . . the whole body . . . the eyes only, (or) only the nose."

Today, practically all West Indian aborigines have disappeared, so that the use of annatto for body paint may no longer be seen in those islands. However, elsewhere in tropical America, lowland Indians still daub their bodies with annatto dye. The pigment is generally applied only to localized parts of the face or body. But even today there are a few tribes—for example, the Tsatchela Indians of western Ecuador—who smear annatto over the whole body including the hair, which is regularly coated with a heavy paste of this brilliant coloring.

For quick use, the Indians can get the pigment in jig time. All that is needed is to rub fresh seed between the hands and enough wax is obtained for immediate application to the face or body. However, in order to concentrate the pigment for future use, seeds are simply boiled in water. This process serves to separate the waxy coat from the seeds which are then discarded. The seeds may also be allowed to ferment in water, after which they are thoroughly mashed. In either process, there is a suspension of red pigment in the water. Eventually, the suspended particles of coloring matter settle out and the water can be drawn off. The material can then be dried or, if mixed with oil to give it body, can be formed into smaller cakes or balls that are stored indefinitely.

Caribs Painted Their Dead

Annatto paint has served certain Indian tribes even after death. One eighteenth-century chronicler states that the Caribs used to preserve the bodies of their dead for several months by painting them heavily with annatto. The naturalist, von Humboldt, traveling on the upper Orinoco River, found a cave full of skeletons, 600 in all, with many of the individual bones dyed red with annatto.

It is not surprising that a pigment that is so useful as a body paint should also prove useful to the Indians as a vegetable dye. Even though annatto is not noted as a fast dye, cotton and other native threads were frequently colored with it as were objects such as pottery, weapons, and various domestic implements. Over the years the Indians learned that this vermilion pigment was edible, though almost tasteless. It is this characteristic which has made annatto so outstanding in this day and age for coloring foodstuffs, for it can add attractiveness to food without altering the flavor.

Centuries ago, Mexican Indians may have been the first to use *achiote* in their cookery. In the countries of Middle America this dye has been more important as a food adjunct than as a body paint. The frothy chocolate drink to which Montezuma was partial, was flavored with vanilla and tinted with annatto.* Tamales, meats, and other native dishes were also colored with this red dye. Some investigators even link Aztec and Mayan use of a red food colorant with the blood rituals associated with human sacrifice as practiced by these Indian tribes of Mexico. Especially since the dye is tasteless, they reason that its use was blood symbolism and nothing more. It is certain that many other Indian tribes in Latin America will not consider food properly prepared without the coloring obtained from a handful of the seed.

It was probably the observation of food coloring practices south of our border that brought annatto into eventual use as an important vegetable dye for dairy products. Substances used for this purpose must be oil-soluble, a characteristic which made annatto so valuable to its Indian discoverers. For many years, annatto was used exclusively

Paul Allen

A LOWLAND INDIAN of the Colombian Vaupes, preparing for a ceremonial dance, gets an application of body paint from a member of the family.

*See "Make Mine Vanilla," by Jennie E. Harris in NATURAL HISTORY Magazine for September, 1955.—ED.

W. H. Hodge

▲ THE CRIMSON PODS OF ANNATTO, looking somewhat like chestnut burrs, cluster at the ends of the branches.

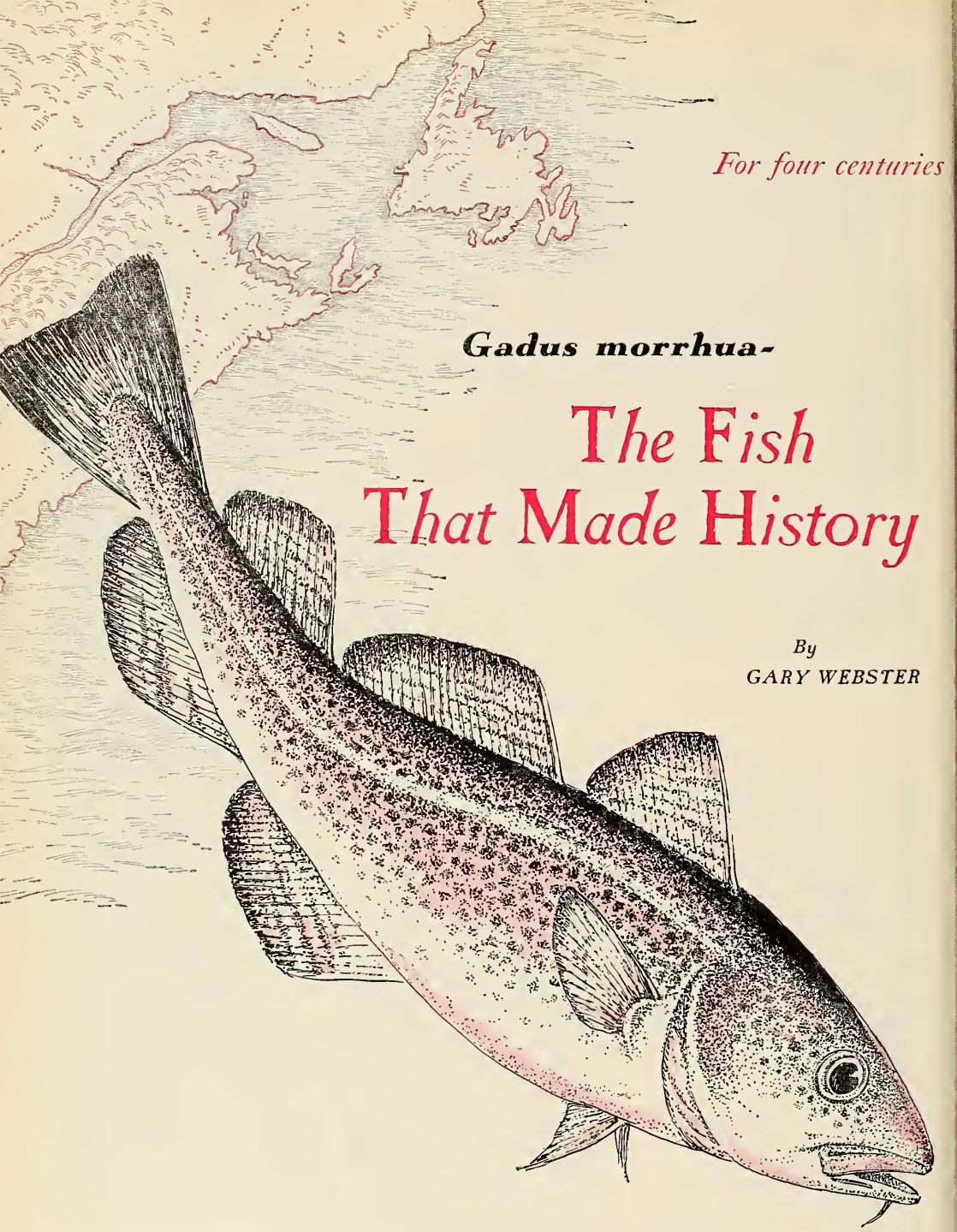
▼ THE GLISTENING RED WAXY COAT of annatto seeds, seen in a freshly-opened pod, is the source of an important natural dye.

Hampfler, Longwood Gardens

as *the* coloring for butter. Although still employed, it is being displaced gradually by synthetic substances or by carotene—the familiar colorant in the garden carrot—which bears a close chemical relationship to annatto. The cheese industry, on the other hand, has failed to find a substitute for annatto, which is regularly added to cheese vats to standardize the shades of the curds.

Although the annatto plant was carried by man long ago to all parts of the tropical world, the Western Hemisphere is still the principal source. Today, countries like the West Indian republics (where Columbus first observed annatto-reddened Indians), Brazil, and the Guianas (the ancient heartlands of the *urucú*-using Carib and Arawak tribes), and Mexico (whose Aztecs and Mayans inadvertently demonstrated the food coloring properties of *achiote*) are the leading producers of commercial annatto.

Just as the men of Columbus' time may have observed annatto plants in the dooryards of the Tainos of Cuba, so the modern visitor to southern Florida may also find residents beginning to grow these plants in their home gardens. They are now popular as ornamental shrubs, with their evergreen foliage, attractive pink flowers that bloom several times a year, and clusters of bright red fruits. But if you mention the name "annatto," the Floridian may not recognize it. Nurseries selling this colorful shrub have nicknamed it the "lipstick tree." Though new, the name is perhaps good enough. Lipstick, body paint, food colorant — what's the difference? They all add up to one common fact — artificial color has been added.



For four centuries

Gadus morrhua-

The Fish That Made History

By
GARY WEBSTER

Drawing by Matthew Kalmenoff

fish played an important part in the development of the New World

BLUE whales, killer sharks, giant squid, and their exotic fellows have played their parts in many an adventure tale. *Gadus morrhua,* the common cod, seldom figures in a yarn of heroism and danger. But this soft-finned denizen of northern waters has shaped the course of history to a greater extent than has any other creature of the sea.

Captain John Smith, fresh from a voyage of exploration along the New England coast, grew rapturous as he described the "pretty sport" of pulling up two or three hundred cod in a day. "Honorable and worthy countrymen," he urged, "let not the meanness of the word *fish* distaste you, for it will afford as good gold as the Mines of Guiana, with less hazard and charge, and more certainty and facility."

Most folk at the court of James I succeeded in restraining their enthusiasm. This barren land of which Smith and his comrades prattled did not deserve a name so fair as that of New England. It had no gold, silk, spices, or wool. Only rude savages roamed its rocky shores. Religious malcontents might eye it as a possible place of refuge, but diplomats were too busy with important matters to give it more than passing notice.

So the Pilgrims who settled Plymouth in 1620 didn't bother with the formality of getting a royal charter. They governed themselves under the Mayflower Compact until absorbed by the Massachusetts Bay Colony in 1691. By then, England's rulers were beginning to realize that in finding a refuge, the sturdy Pilgrims had stumbled on something big.

There are persistent tales that cod saved some pioneer settlers from starvation. Soon fishing passed from an emergency measure to a fast-growing industry. The Old World constituted a colossal market, ready to exchange precious metals and manufactured goods for dried cod. So the first product exported from Massachusetts was a cargo of fish.

By 1634, an early merchant prince had a fleet of eight vessels at Marblehead. Twelve months later, Portsmouth alone boasted six big fishing shallops, five smaller boats, and thirteen skiffs. Governor Winthrop solemnly recorded the fact that, just a generation after the colony was established as a tiny, wavering beachhead on a hostile continent, one season saw 300,000 dry fish shipped to market.

World demand for cod was at a level seldom attained by any commodity. According to an early description, its flesh was recognized as "different from other fishes like the salmon and herring: rich and gelatinous without being fatty." Sun-dried or cured by salting, it kept indefinitely under almost any conditions.

Remember that this was still the epoch B.T.C. — Before Tin Cans. Ships going below the Equator could take only a few food items. Many staples that resisted rot were likely to yield to mold or maggots. Lacking the tough fish that was known as "beef of the sea," many a long, equatorial voyage would have been impossible. Cod was also in great demand by soldiers, planters in tropical lands, and the great number of people whose religion specified abstinence from meat on certain days. Small wonder that fish became to New England what wool was to Britain and coffee is to Brazil.

Rapidly pushing out from coastal waters, seamen from the colonies challenged European powers for control of the greatest cod-fishing region on earth — the Grand Banks of Newfoundland. Wealth and skill gained in the trade boosted the growth of a colonial merchant marine. Young ports like Salem, Bristol, and Boston began to vie with old ones in Spain, France, and England.

The cod made indelible impressions upon New England. It appeared on the corporate seal of the Plymouth Land Company prior to 1661. Many legal seals, including those used in witchcraft trials, bore the codfish emblem. A carved replica of the cod still has a place of honor in the Massachusetts State House, and the fish was long depicted on coins, bank notes, and revenue stamps of the colony.

Familiar in the waters of northern Europe since very early times, the cod soared to global prominence after Cabot's voyage to North America. Waters off Iceland had supplied most of Europe's salt fish; now the center shifted far to the west. Long before anyone thought of establishing colonies in New England, fleets from European ports began making the long voyage to fishing grounds not far from Canada.

Portugal and France led the movement. Both nations were weak

GARY WEBSTER is a frequent contributor to NATURAL HISTORY, his most recent article being "The Destructive Rat" (January, 1957). Natural sciences are his chief interest. He is the author of the companion books, "Wonders of Science" and "Wonders of Man."

in agricultural power — but had plenty of salt with which to cure fish. So when Jacques Cartier made his voyage of 1536, he found his countrymen already established as fishermen on the island of St. Pierre. With its companion, Miquelon, the tiny bit of land just south of Newfoundland comprises the oldest of French colonies.

England was not yet competing for mastery of the region. She had no navy of importance, and her commercial vessels were greatly outnumbered by those of her rivals. Although it required a six-month voyage to fill the hold with cod, French, Portuguese, and Dutch ships of 50 to 250 tons rushed to enter the Grand Banks trade. One seaman estimated that in 1630, there were 300 French vessels scrambling for wealth from these "silver mines of the sea." With their rivals, he noted, they brought home countless tons of cod "wherewith they feed nearly all Europe and supply all seagoing vessels."

Lack of enthusiasm on the part of political leaders did not deter Britain's fishermen. Some of them entered the competition for the new cod banks about 1600. Fleets from Bristol and Devon multiplied so fast that soon they could supply the home market and have an excess for export. Their activities were complicated by the need for cheap salt, produced in Mediterranean regions by the evaporation of sea water. Demand for fish and for salt created a need for more seagoing vessels and the crews to man them.

A school for sailors

So the shipping industry of Britain expanded in several directions at once. Preoccupied with the gold of South America, Spain neglected other interests. English ships began making direct voyages from fishing grounds of the north Atlantic to ports of cod-hungry Southern Europe. By 1634, an estimated 18,680 British tars were engaged in the Newfoundland fishery. They not only brought gold to England, but also their fleets gave ideal training to men destined to sail armed vessels of the expanding Royal Navy.

It is not possible to measure the extent to which her interest in the cod contributed to the sudden rise of England as a sea power. Too many other factors were involved to warrant an estimate of the precise influence of New World fishing. But it was a potent element in the build-up of ships and sailors in numbers sufficient to challenge the supremacy of Spain.

Many who fought under Sir Francis Drake gained their sea legs in the cod trade, and after the defeat of the Spanish Armada in 1588, England almost monopolized this most important of food fishes. She retained control for some fifty years, then lost out to New England ports that had the advantage of proximity to the Banks.

Having boosted both Britain and her colonies to new power, the Atlantic fishing grounds assumed major importance about conference tables. John Adams represented New England in final peace negotiations after the War of Independence. He received a barrage of letters from regions as far distant

THE GRAND BANKS OF NEWFOUNDLAND swarmed with fishing craft flying the flags of many nations.

Culver Service

Brown Brothers

Captain John Smith, Admiral of New England, grew rapturous about cod fishing.

Jacques Cartier found his countrymen established as fishermen on the islands of St. Pierre and Miquelon in 1536.

John Adams was petitioned from all over the nation to hold out for title to the cod fishing grounds.

as North Carolina, urging that he hold out for title to the cod grounds.

One such plea suggested: "The fishery of Newfoundland appears to be a mine of infinitely greater value than Mexico or Peru." Adams agreed with that judgment, noting that cod were already being exchanged for gold and silver of Europe, plus rum and molasses of the West Indies. "In addition," Adams said, "the fisheries have been the nursery of seamen and source of naval power, indispensably necessary to the accomplishment and the preservation of our independence."

While statesmen gravely discussed treaties in which the cod figured, scientists investigated its life history and habits. A member of the genus *Gadus,* one of its most remarkable features is its set of asymmetrical fins—three along the back and two under the belly. Guided by its nearly square tail, the cod moves leisurely. Fishermen have little regard for its fighting ability, for a sixty-pound specimen, hooked only through its rubbery lip, is likely to yield without a struggle.

Present-day ships equipped with large nets catch multitudes of cod before they reach maturity. The majority of cod entering commerce range from about 10 to 30 pounds. One patriarch caught in 1895 was more than six feet long, weighed 211½ pounds.

Prizes found in cod

Big cod, formerly much more abundant than they are today, have yielded some of the sea's strangest prizes. A bunch of keys was found in the stomach of one, while others have contained such oddities as a long piece of tallow candle, a white turnip, a partridge, and a heavy book bound in calfskin. Stones and pieces of glass are found in many specimens; a few rare fishes and shells were unknown until they were found in the stomachs of captured cod.

Like many other bony fishes, the cod has strong teeth with which it seizes and sometimes tears its prey. Mollusks, crustaceans, and small fishes are usually swallowed whole. Six dogfish averaging nine inches in length were found in the stomach of a single cod. Digestive juices are so strong that bones and shells present no problem; after a brief soaking in the gullet of its big foe, a crab becomes so soft that its legs may be twisted around one's finger.

Lacking familiarity with mature specimens, one knowing the early stages in the cod's life cycle would think the fish to be among the most vulnerable of creatures. In many waters, spawning females may be taken over a period of from three to four months. Frequently an individual is so ripe that clear eggs will run from her body without application of pressure.

Eggs released into the sea are so tiny that seventeen of them laid side to side will measure only one inch. Because they are lighter than water, transparent ova float on or near the surface, according to a precise pattern. Each minute egg hangs in such fashion that its micropyle, or aperture for admission of the fertilizing male cell, is turned downward. Males encounter bobbing clusters of eggs which trigger reactions in milt glands. Streams of spermatozoa are released into the water; swimming upward, each has a chance of reaching and entering a waiting egg.

After about twelve days of development, the mature embryo pierces the egg capsule with its tail and emerges into the sea, tail first.

Culver Service

▲ HAND-LINE FISHING ON THE GRAND BANKS always was a hazardous occupation.

◄ TARRED LINES WITH MANY HOOKS were used to haul the cod out of the stormy waters of the Banks.

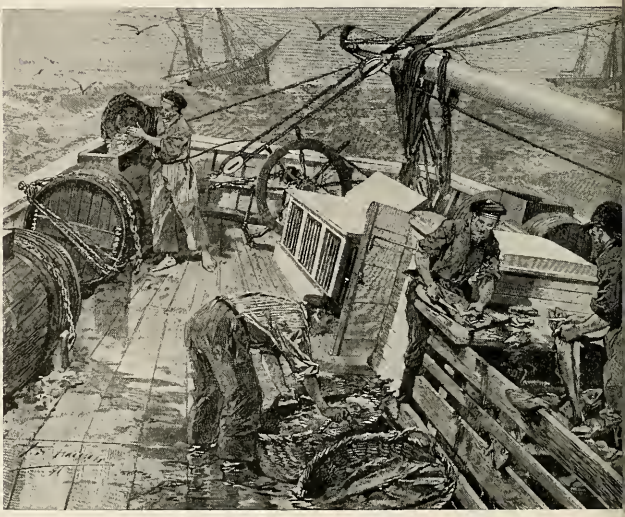
About one-sixth of an inch in length, the codling still has with it a store of unused yolk from the egg. At once, it begins feeding upon organisms smaller than itself. For two or three months it remains so fragile that it is transparent—and colorless, except for blue-black eyes and a few minute spots on body and head.

An ocean full of cod

Preyed upon by hosts of enemies, the codling does not have a great life expectancy. Out of each million eggs, perhaps a single fish may live to be caught in a net and used for human food. That it survives as a species is at least partially due to its prodigious fertility. A typical twenty-pound specimen will produce more than two million eggs each season. David Starr Jordan once estimated that if all progeny of a single cod should survive and grow to maturity, they would fill the entire Atlantic with a solid mass of fish! Actually, codlings face so many dangers that only a few grow to catching size from an individual spawning.

Application of modern machinery to fishing has threatened the future of the species. As late as 1883, it didn't seem possible that man's inroads could ever affect the prolific

▼ FISHERMEN CLEANED THE FISH and split them before storing them away for the voyage home. Nearly every part was saved.



cod. Thomas H. Huxley advanced that view in the address with which he opened the International Fishery Exhibition. Development of steam trawling later showed that the organic wealth of the sea is by no means inexhaustible. So, cod were the first ocean creatures to be hatched artificially and released in huge numbers in an attempt to preserve the world supply.

Well over 2,000,000,000 pounds of cod now enter commerce each year. No one has sufficient information to hazard an estimate as to the total catch during the past four centuries. But this special source of food clearly played a major role in the modern period of expanding civilization.

Literally millions of cod went down the gullets of explorers, adventurers, seamen, and soldiers. Casks of salt fish were carried into the interior of South America by mule train. Whole fleets laden with sun-dried cod helped to provision European cities whose population was increasing faster than food supplies. As a cheap source of protein that would keep indefinitely even in the tropics, the cod was a small but real supporting factor in the development of a slave culture in the colonies of the West Indies.

Among other biological side-effects was the contribution to extinction of an unrelated species. Unable to bring meat from Europe to the Grand Banks, many sailing vessels depended upon the great auk as a major source of bait for their hooks. On the way to cod waters, ship after ship stopped to permit the crew to feast and fill bait barrels. Unrestricted raids upon the auk, continuing for more than three centuries, led to its disappearance about 1884.

Cod liver oil valuable

Still another repercussion occurred with respect to human health. Early in the history of cod fishing, tough fishermen who patched their weatherbeaten cheeks with tar developed the practice of saving nearly every part of the fish. Few parts were discarded, although the split bodies were most important.

Cod tongues, which for a long time had been cut out at the moment of capture and strung on wires to serve as a tally of each fisherman's daily catch, were salted in barrels. Air bladders, or sounds, were important in the isinglass trade. Cod cheeks were used for the crew's midnight "soup of sorrow"—so called because the man who once tasted it could expect to spend his life on the Banks. Skin was salvaged for the glue trade. Livers were thrown into barrels and permitted to rot, yielding several grades of oil useful in tanning and in the manufacture of soap.

As the tempo of the industry was accelerated, cod liver oil became a standard item of commerce—for a hogshead of the heavy stuff is a by-product of each four or five tons of fish. Fishermen used the oil as a poultice for wounds; as early as 1770, uneducated folk of North Atlantic ports were experimenting with it as a food supplement for the sick and aged.

After 1820, numerous physicians of Holland and France employed cod liver oil in treatment of rickets — the comparatively new malady that was affecting more and more children reared in cities. Increasing concern with scientific medicine led to repudiation of folk remedies. Fish oil was challenged along with herb and bark teas.

It remained in use as a general tonic, but not until E. V. McCollum proved its merits in 1921 did cod liver oil win recognition as a specific cure for rickets. Later research showed its action to be due to vitamin factors. On the basis of understanding won from study of the "sunlight from the sea," other treatments were developed with such effectiveness that rickets can now be fully controlled.

Neither the fish nor its by-product is so vital in contemporary life as it was in the past. New laboratory processes have made the oil almost obsolete in medicine, and advances in agriculture have yielded fresh sources of cheap protein.

Today, we could doubtless make certain necessary adjustments if the cod were to disappear completely from the sea. But, had it not been abundant and available during the formative years of our nation, one wonders whether we would yet have developed our vast potential to its present stage.

▼ GREAT QUANTITIES OF SALT were required to prevent the catch from spoiling until it could be gotten home to be dried.

They

The "silver gray mouse that flies" may live in your attic

A FLYING SQUIRREL peers from its nest hole in a tree.

HAVE you seen a flying squirrel lately? Chances are you haven't, although they are far from scarce. In fact, probably not one person in a thousand has caught a glimpse of this small creature, since it comes forth at night and, even then, prefers the tallest treetops to the ground. Despite these elusive habits, it is far from antisocial by nature.

The flying squirrel is aptly named *Glaucomys volans,* which, freely translated, means "silver-gray mouse that flies." It is the smallest squirrel native to the United States and is found throughout the eastern half of our country. Its northern cousin, *Glaucomys sabrinus,* is slightly larger and is primarily an inhabitant of Canada, though it, too, is found in the northern parts of this country, in both east and west. The two species are similar in habits and characteristics. Their thick glossy fur is gray-brown on the back and white on the belly. All have enormous melting black eyes, like shoe buttons. An adult is about nine inches long, of which at least 3½ inches is tail.

Does it really fly, people often wonder. And the answer is no, strictly speaking, it doesn't. Actually, the flying squirrel leaps and glides, but it does this with such remarkable proficiency that the action is much like flight. Its equipment for this feat is a loose lateral fold of skin on each side of its body which is fastened fore and aft to the ankles. When the limbs are extended, this skin stretches taut and functions like a parachute or, more accurately, the wings of a glider. For even greater spread, the squirrel has a movable piece of cartilage fastened to each foreleg at the ankle, which can be extended for gliding. With its legs stretched, the flying squirrel has a span approximately eight inches long and from five to six inches wide, plus the tail. This adds up to about fifty square inches of surface to support a weight of 2¼ to 3½ ounces. With such proportions, it is no wonder these aerial acrobats can land like thistledown.

The squirrel cannot gain altitude in a glide, as a bird does in flight, but can only lose it. So it starts from a high point, like a treetop. It gathers itself into a ball, feet together, and leaps into the air with a tremendous spring, spreading out its hind feet at right angles to the body. This action stretches wide the flying membranes which

LEONARD L. RUE III is a Camp Ranger at a Boy Scout Camp near the Delaware Water Gap. When he was about 8 years old, he wrote his first nature article—about a "woodpecker"—which, he says, wasn't even a woodpecker, but a flicker. Since then he has published articles and photographs in leading magazines, and lectures frequently on nature subjects.

Glide by Night

By Leonard L. Rue III
Photographs by the author

↑ A SQUIRREL soaring directly overhead.

▲ One of the flying squirrels that lived in a neighbor's bird house.

will allow the squirrel to glide as far as 150 or even 200 feet. Sailing downward at an angle of 40° or 50°, its course is controlled by the tail and possibly by turning the body. Just before landing, it checks its speed with an upward sweep of both body and tail and alights at the destination hind feet first, belly facing the tree trunk, and head up. The longest glide I have seen was about 80 feet and carried the squirrel across a stream into a stand of hemlocks.

In addition to this talent, flying squirrels are able to run up straight walls and also to hang head downward by one toe. Yet, because of their encumbering webs, they are one of the few mammals that cannot swim.

Since these furry mites are strictly nocturnal in their habits, the coming of darkness is a signal to them that it is time to get up and start

◄ Flying squirrel soaring or in "free flight."

▼ Soaring or "free flight."

the day's activities: eating, drinking, and playing. Their diet consists of nuts from such trees as the oak, hickory, beech; seeds from the pine; tree buds; wild fruits; mushrooms; sugar maple blossoms; grain, of which, in true squirrel fashion, they eat only the germ. Occasionally carnivorous, they will eat insects and even prey on birds, nestlings, and eggs. These predations, however, are not numerous enough to be a serious danger to any bird species. In addition to feeding hugely, the flying squirrel consumes nearly two jiggers of water a night, the equivalent of two gallons for a human.

They Romp by Night, Too

From dusk till midnight is the time of greatest activity. These small creatures are highly sociable among themselves and like nothing better than cavorting in the moonlight through a game of aerial follow-the-leader. Bachman, the naturalist, tells of seeing about 200 flying squirrels, on one occasion, frolicking in the treetops on the outskirts of Philadelphia. About midnight, a three-hour recess is taken, and then the fun begins again. By dawn they are ready to go back to their nests for a good day's sleep.

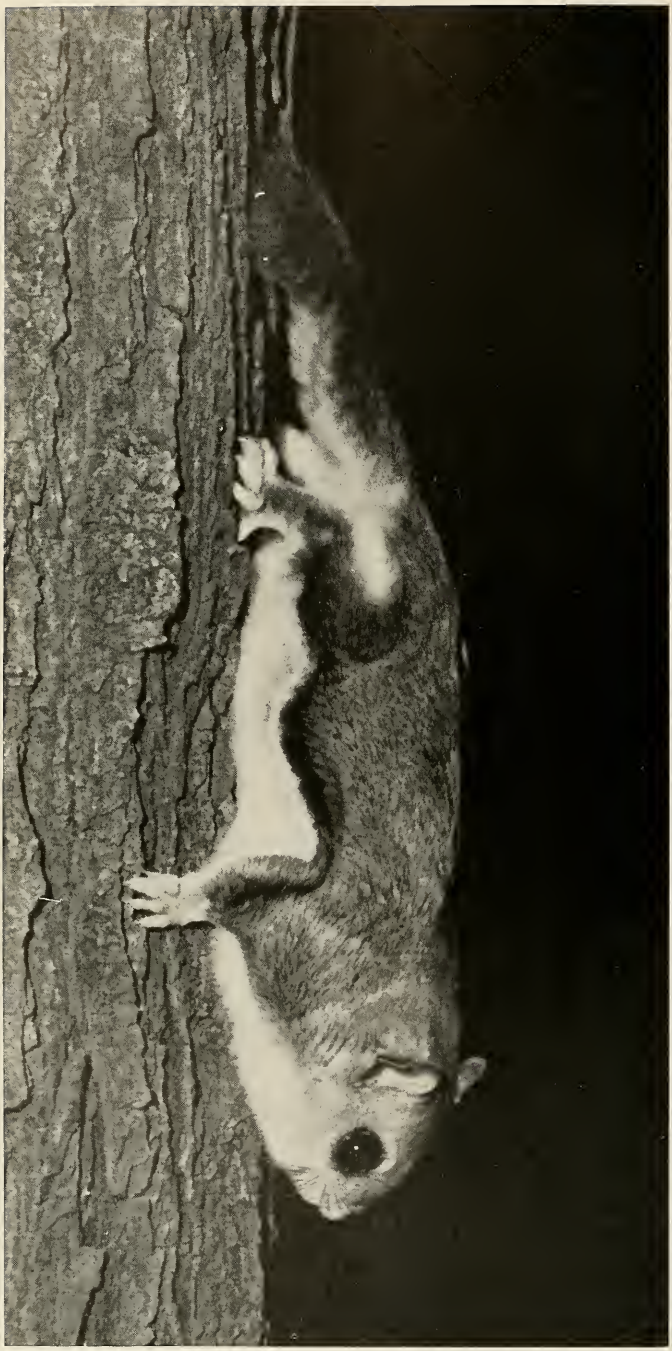
The flying squirrel's nest may be almost any kind of cavity. Though it is especially partial to holes abandoned by woodpeckers, it seldom overlooks any small cave that can be adapted to its needs. It will frequently take over a bird house in winter while the regular tenants are away. If the entrance hole is small, it soon remedies that by a little judicious gnawing. It furnishes this home with shredded bark, dry leaves, moss, and other soft materials. Being a gregarious

▲ The tail is jerked up to advance the hind legs and to act as a brake when landing.

▲ Just landed!

type of creature, the flying squirrel often holes up with others of its kind in winter. This not only provides company but also supplies additional body heat. I once found nine squirrels living in an old martin house, and there are records of even larger groups. As many as 50 have been discovered in a single large stump.

Perhaps the best way to see a flying squirrel in the daylight is to rap on old hollow trees with woodpecker holes in them. Curiosity will soon bring out any squirrels in residence to see what is making the noise. Once satisfied that there is no real danger, they usually withdraw from sight and go back to sleep. If you frighten them, how-



↑ In running down a tree, the hind feet are reversed from the climbing position (right).

ever, they will soar off to another spot some distance away. Usually, they have several such havens picked out in advance.

Flying squirrels are often dispossessed by tree-felling operations. Even at these times, it is hard to get an accurate count of them because they scatter from the trees with such speed and agility. Being on the ground is quite another matter. Here, a flying squirrel is out of its element and hops around with ludicrous little jumps.

My first acquaintance with flying squirrels came about when I was a boy living on a farm. My mother, who fears little except a mouse or rat, suddenly began to be awakened at night by a great commotion in the attic. Occasionally, the creatures upstairs would drop a nut down the attic stairs, which resounded through the quiet house as if it were a bowling ball. Finally, we examined the attic and discovered the nuts as well as a nest that one of the squirrels had made in the pocket of an old apron that was hanging on a hook in the stairway. Once we realized that our visitors were neither rats nor mice but flying squirrels, we made no further effort to get rid of them.

For that matter, I have them living in the attic of my present home and have often seen them gliding from the house to a large oak that stands in the yard. Not long ago, while doing some repair work in the attic, I disturbed a flying squirrel that had built its nest under the floor boards. The surprised little creature ran over my leg, up my body, and leaped off the top of my head in making its getaway. It never did return to that particular nest.

Delightful Pets

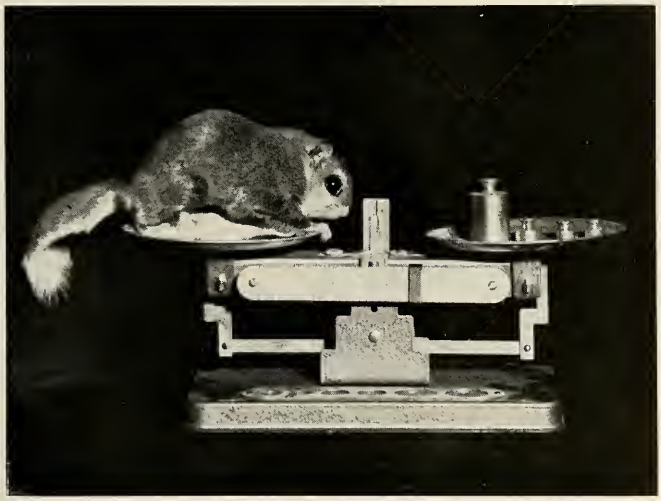
One flying squirrel gained entrance to my home by coming down the chimney at night. In the morning I found my desk in wild disarray with papers scattered all over, three pictures knocked down, and two vases broken. It was difficult to explain until we discovered our little visitor, who had unfortunately drowned in the toilet. Evidently, it had gone there to drink and then was unable to get out.

This willingness on the part of the flying squirrel to share a house with humans is often its undoing. Not only does the toilet constitute a hazard; the animal also runs the danger of being poisoned or trapped by humans who, until they happen to see the visitor, usually believe their household is infested with rats. Very recently I was about to set a mousetrap in my own home and discovered just in time that our visitor was actually a flying squirrel. This one I managed to catch before it fell prey to any household hazards. It is still with me and makes a fine companion for another *volans* that I have had for some time.

Flying squirrels make delightful pets, since they are clean, neat, and extremely gentle. Even in the wild state, they are among the gentlest of all our native mammals. As pets, they do have one drawback: their rigidly nocturnal habits. No matter how tame they become, they still continue to sleep all day and play at night. So one can enjoy their company only in the evening. There are several farms in the country devoted exclusively to raising flying squirrels for pets.

Kept indoors, the squirrels breed at odd times of year. In the natural state, they generally begin breeding in late winter and produce the first litter in April. There may be more than one litter a year, each consisting of three to six young. They are about the size of a quarter at birth, naked and wrinkled, and do not open their eyes for about 20 days. The mother squirrel raises the young herself, without help from the father. She does not need to teach them to fly, since this skill is apparently innate. The young squirrels acquire their adult coat at three months of age, but they are not fully mature for about a year and a half.

The greatest enemy of the flying squirrel may well be man himself, who constantly dispossesses this small creature by felling trees. Owls, cats, raccoons, martens, weasels, bobcats, and tree-climbing snakes also take a toll. However, indications are that flying squirrels are holding their own. And, who knows, that noise in your attic may mean that you, too, are playing host to one or more of these appealing little animals.



▲ Weighing in at 1,120 grains or approximately 2½ oz. and 41 grains.

to
the land
of
the Lacandones

Editorial Foreward:

In the last issue of NATURAL HISTORY, Dr. Edward Weyer, Jr., began an account of his expedition to Middle America to study the Lacandon Indians, who bear a striking resemblance to the ancient Mayas.

In Chiapas, Mexico's southernmost state, he joined the Danish archeologist Frans Blom and his wife Trudie. With several guests who were visiting the Bloms' science center at San Cristobal de las Casas, they proceeded through the forest to the *caribal* or village of the Lacandones.

In Part II, Dr. Weyer concludes his narrative with more of the history and way of life of these "Modern Mayas."

part II MODERN MAYAS

A visit with the Lacandon Indians surviving in the jungles of Chiapas, whose ancestors may have helped build great pyramids and temples of Middle America

By EDWARD WEYER, JR.
Formerly Editor of NATURAL HISTORY *Magazine*
Photographs by the author unless otherwise credited

ONE'S reception in the country of the Lacandones, or in any other, depends a great deal, of course, on whether one is known and trusted. Mrs. Blom had helped the Lacandones on several occasions. Being with her, I was tolerated from the beginning and soon received their full friendship.

The faces that looked so coarse and awesome at first now showed nuances of melancholy and humor. The eyes of the Lacandones swim sadly beneath drooping lids, and their voices, except in the urgency of a religious ceremony, are soft. One also gets an impression of greater size from their loose, sack-like garments and from their erect bearing and general shagginess. I was not carrying measuring instruments, but I could estimate that their stature was probably not much greater than the average for the Indians of Mayan derivation in Yucatan, which is 5 feet 1 inch for the men and 4 feet 8 inches for the women.

So far as I can find, the Lacandones have not been studied carefully by physical anthropologists, but it is interesting that their relatives of lowland Yucatan are among the broadest-headed people in the world. The cephalic index is 85.8 for the men and 86.8 for the women. The pulse rate of the Yucatan Indians, for unexplained reasons, is only 52, or 20 points lower than ours.

Some of the Lacandon profiles we saw were certainly reminiscent of the classic Maya type as represented in the ancient sculptures, but no more so, in my opinion, than those sometimes seen in the more heavily populated lowlands of Yucatan.

A day or so after we had strung our hammocks under one of the thatched huts, I heard an unfamiliar sound and, turning, was astonished to see a Lacandon chipping a flint arrowhead just like a man out of the Old Stone Age. I never thought that I should witness this ancient art in the world today, yet the man was going about it as a matter of course, following a method that has presumably been passed down from father to son in unbroken sequence since the Paleolithic period.

Near by, old Mateo was performing a ceremony in the god-house to get rid of a toothache. With two flaming pots in front of him, he was burning the sacred copal *(Protium heptaphyllum)* of the Mayas, replenishing the flame with nodules of the resin exactly like the ones that have been excavated by archeologists.

The clay pots in which the Lacandones always burn the incense bear grotesque faces of deities that are reminiscent of the ancient Mayan iconography. These are important religious objects in every village. They are made in a special shelter, and women are not allowed to see the process. The pots are said to be baked in hot coals for a few hours and decorated afterwards with soot and the red of the achiote pod. Tozzer, whose treatise on the Lacandones is our best source of information, ascertained that the making of new pots takes four weeks and that the men sleep in the ceremonial hut throughout this period. The old pots are replaced by the new ones during a seven-day ceremony.

The faces on these pots represent lesser personalities of the spirit world, who apparently serve chiefly as messengers to carry prayers and offerings to the deities, of which there are a great many. Morsels of corn paste and other foods are placed on the lips of the pots. The worshipper is even said to hold a lighted cigar to the mouth, but I did not see this done. As the pots grow old with use, they become black with soot.

Worship in the ancient manner was a daily occurrence in the village where we were. There was no evidence of Christian influence, which in practically all other parts of the

▲ THE LACANDONES are short of stature and have very broad heads. Their beard and mustache is sparse and their hair is sometimes slightly wavy.

A SHY LACANDON CHILD gazes wistfully into the distance.

A LACANDON FAMILY GROUP in their hut.

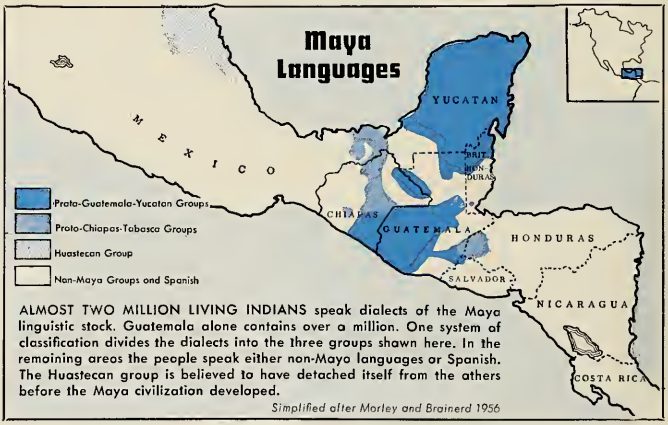
Maya area has greatly modified the original rites of the Indians. The fervor with which Mateo pursued his devotions was stirring to hear, and we wished we could do something ourselves to relieve his toothache.

At a neighboring settlement below the brow of the hill, we were permitted to hear and record also a ceremony by Jorgé (pronounced Hor-khé), in which he invoked a spirit at Lake Itzanocú a few miles to the east. Though a young man, Jorgé complained grievously about his shoulder, which improved when he slept with a certain piece of wood near it. Psychologically, he appeared to be the farthest thing from the carefree son of nature. He was ridden with anxieties.

I saw no dancing in the Lacandon village, though a feeble sort is said to be practiced and to be pleasing to the gods.

Farming is Hard Work

The Lacandones all keep to the dense jungle and live by clearing small areas in which they grow corn, sweet potatoes, cassava, beans, sugar cane, piñas, papayas, lemons, tomatoes, chayotes, bananas, tobacco, and cotton. They hunt animals ranging from small birds to mountain lions. Two kinds of deer, as well as jaguar, tapir, and armadillo are found in the forest. A peccary that the hunters of the village brought in soon after our arrival provided welcome meat.



ALMOST TWO MILLION LIVING INDIANS speak dialects of the Maya linguistic stock. Guatemala alone contains over a million. One system of classification divides the dialects into the three groups shown here. In the remaining areas the people speak either non-Maya languages or Spanish. The Huastecan group is believed to have detached itself from the others before the Maya civilization developed.

Simplified after Morley and Brainerd 1956

Their cultivated fields are sometimes scarcely recognizable as such, so difficult is the task of clearing the ground by fire and machete. Because the soil becomes exhausted, new lands have to be broken about every three or four years. This work is done a few weeks before the rainy season, which extends from May to January or February. At the time of our visit, they were clearing a new location across the lake and had to make the trip by dugout. Seven mahogany *cayucos* provided ready ferry service to the fields and back.

It took a bit of coaxing to get the men to sing ceremonial songs for my portable tape recorder. The tunes recorded well on tape, although the men kept their voices so low that the microphone had to be held within an inch of their lips. A few feet away you could scarcely know they were singing. But it was with real gusto that José Manuel Lopez, at another settlement, blew one tune after another on his ceremonial flute. I saw nothing of the clay drums Tozzer mentions.

It is remarkable that the Lacan-

➤ THE CELEBRATED CARACOL at Chichén Itzá: an astronomical observatory which bears testimony to the high intellectual achievement of the Mayas. One of the square openings through the thick walls of its chamber bisects the setting sun on the vernal equinox. Other lines of sight coincide with the moonset on the same date, etc. Present-day Lacandones retain virtually nothing of ancient Mayan lore and cannot read the hieroglyphics.

▼ ANTONIO poling one of the large *cayucos* on Lake Najá. There were seven of these dugouts for the village.

dones have changed so little during the centuries of European influence elsewhere in Middle America. Tozzer speaks of seeing some old muzzle-loading muskets among them. Today they have a few guns of different sorts, for which it is difficult to get the proper ammunition. As a result, the bow and arrow is still in use.

The Lacandones are probably the surviving core of a culture that once extended over a much larger territory. While the Spanish Conquest brought one group after another under the complex influences of European civilization, the Lacandones still remained unconquered.

The first group of white men to meet Maya Indians were castaways from a ship that sank near the island of Jamaica, in 1511. The nineteen men drifted for fourteen days without food. Seven of them died before the survivors were cast ashore on the east coast of Yucatan. There they were seized by a Maya lord, who sacrificed their leader, Valdivia, and made a public feast of four others.

The remaining seven men, being thin, were put into a coop for fattening. But before a second cannibalistic meal could be prepared, they escaped and fled to the land of another lord. There all but two died. One of these, Gerónimo de Aguilar, was found eight years later by Cortez in another tribe.

The other, Gonzalo de Guerrero, married the daughter of Nachan Can, Lord of Chetumal, and became an influential person in Maya life. Messengers from Cortez discovered him but could not persuade him to go back with them. His love for his wife and children was too great. Also, he had had his ears, lips, and nostrils pierced and his hands tattooed and, as his surviving companion Aguilar remarked, the embarrassment of this may have prevented him from rejoining his own people.

Spanish Penetration

Because Gonzalo de Guerrero taught the Indians how to fight the Spanish, Cortez put a price on his head, and he was finally killed in a battle with the Spanish.

Both these men served as interpreters and thus can be said to have influenced the course of history in various ways. The influence of Gerónimo de Aguilar is noteworthy because without him, some of the earliest information about the Mayas might never have been recorded.

There followed numerous Spanish expeditions seeking gold and converts, and there was great bloodshed on both sides. The rapidity with which the Spanish penetrated inland is startling. By 1529, only eighteen years after the first contact, explorers seem to have swung around the present Lacandon territory to its southernmost part and reached Lake Miramar (also called Lake Bellavista and, by the Lacandones, Chan-Kak-Na), at approximately 16½°N. and 91¼°W. At that time, a strong attempt was made against the Lacandones. Many of them were driven before the con-

← Jorgé applying himself earnestly to the invocation of one of his gods. The stick in his hand is used to add copal, the ancient Mayan incense, to the flaming god-pots.

↓ After making his invocation for relief from a sore shoulder, Jorgé was quite interested in hearing how the message sounded when I played it back on my portable tape recorder.

↓ The author playing back some of José's flute playing to him.

Gertrude Duby de Blom

querors, but in the end they resisted all efforts toward subjugation.

Over the border in Guatemala, in Peten and the province of Vera Paz, the conquest proceeded more effectively though with serious loss of life. In 1955, in Vera Paz two priests and 30 Indians who had yielded to the teachings of Christianity were killed by arrows. In 1618, two other missionaries went to Peten and barely escaped with their lives two years later. A Franciscan was put to death there the same year.

The last substantial effort to subjugate the Lacandones was launched in 1695, with advance from three directions. One group marched from southern Guatemala (Huehuetenango), the second from central Guatemala (Vera Paz), and

Ancient are their methods

↓ A youngster of the tribe practicing the time-honored method of hunting.

↑ Manufacture of bark cloth is still an active industry. Antonio tears the inner bark away while a woman (right) beats the bark cloth with a special mallet.

➤ Ball court at Chichén Itzá, 545 feet long and 225 feet wide. The stone ring near the middle of each side was used as in our game of basketball, but the solid rubber ball was struck only by the elbow, wrist, or hip. This was the first use of rubber seen by Europeans. The winning stroke is said to have obliged the spectators to forfeit all their clothing and jewelry. But a relief sculpture in the Ball Court shows the leading player of one team cutting off the head of an opponent.

the third from Comitan, which is now on the Pan-American Highway in Chiapas. Barrios, commanding the latter group, followed the same route we traversed to Monte Libano, taking with him a party that is said to have numbered 3,000, including women and hog drivers. He rounded up as many Lacandones as he could and met the other two groups near Lake Miramar at a place called Dolores de Lacandones by Fray Antonio de Marjil. There they tried to establish a Lacandon town. But family after family gradually slipped away, and the settlement has long since disappeared except for a few mounds. The last effort by Spanish missionaries to convert the Lacandones took place some time during the 1700's.

The Lacandones of today number between 200 and 250, as they did in 1900. They live in three separate localities, among which there seems to be little or no contact. Over the border in Guatemala, there are other Lacandones, but they have been strongly influenced by civilization and even wear overalls. In Chiapas, the northern group, among whom we were camping, is known ethnographically as the Pelja group. A plausible theory is that these people have been out of touch with the other two groups since about the time of the invasion under Barrios, who broke up the original settlements in 1695 and drove a portion of the people south to near the junction of the Jatate and Perlas

The Lacandones weave serviceable baskets, but gourds are more commonly used as containers.

▲ These Indians still use the Paleolithic method of chipping stone arrowheads.

▼ Making fire by twirling a stick, a method understood by many primitive peoples.

rivers. This separation is consistent with preliminary report of language studies carried out by the CIAM Expedition of 1955, among the so-called San Quintín group, near Lake Miramar. These Lacandones apparently split off about 50 years ago from the third group, the Lacanja Lacandones living between Lake Lacanja and the ruins of Yaxchilan. Quarrels over women are said to have caused the break.

In the effort to survive under extreme isolation, the numerically small San Quintín group has even abandoned the rigorous ancient rules and resorted to brother-sister marriages, according to the expedition's ethnologist Donald John ("Juan") Leonard. A recent communication from Fredrick Peterson, who was the archeologist on the expedition, informs the writer that the San Quintín group has abandoned this region and drifted toward Rancho El Real. By now probably half the group is dead from dysentery and malaria. In 1950 they numbered 24; by 1955 there were only 12 as a result of these diseases.

Shortly before Tozzer's visit around the turn of the century, mahogany cutters began entering the northern part of the Lacandon country. Desire to procure salt brought the Lacandones into contact with them, and it has been from these people that they have occasionally taken Spanish names. But there does not appear to have been any extensive racial intermixture. The Lacandones never let the intruders see their sacred things, and Tozzer reported no perceptible effect on their culture.

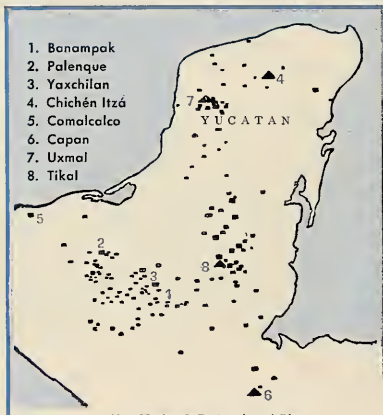
From Ancient to Modern

The present Mexican government does not permit evangelism among the Indians, but Linguist missionaries, who specialize in the study of languages and in the translation of the Bible, have been in the Lacandon country for more than a decade. They have made no conversions.

Since the Lacandones preserve more of their original culture than any other people in the Maya area, it is interesting to inquire whether they can help us piece together the story of Maya glory and decay. What in their daily life can give insight into the customs and beliefs of the ancient Mayas?

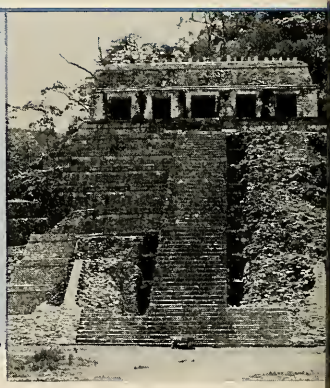
Their language is probably less altered from the original Maya than any of the other dialects. In addition, many little things link them with the life of the Mayan civilization. The nodules of copal that Mateo, in his ritual, had arranged on a platter are identical with the ones excavated. And the pots in which he burned the incense were decorated in a style reminiscent of Mayan art. Bernal Diaz, one of our best sources of information from the early Spanish period, relates how at Campeche in 1517, Indian priests burned this copal in pottery braziers and that they fumigated the white men with the smoke.

In the early Spanish period, certain educated Mayas were taught by the Catholic missionaries to write their language, using the Spanish alphabet. These records were probably copied directly from surviving manuscripts in the Mayan hieroglyphic writing. Tozzer points out that religious rites described in these accounts are identical with ones practiced in our time by the Lacandones.



After Morley & Brainerd, and Blom

SOME OF THE MAYAN RUINS. Their relative importance is shown by size. Many smaller sites are not shown, and new ones are still being discovered.



THE TEMPLE OF THE INSCRIPTIO at Palenque, which the ancestors the modern Lacandones may ha helped build. In 1952 the burial-cry of the Priest-King was discovered l neath its base, proving that the pyr mids of Middle America, like those Egypt, were sometimes used as toml

A CUT-AWAY VIEW of the Pyramid at Palenque, showing the stairway to the crypt where the Priest-King had been interred. It was filled with rubble and took three seasons to excavate. The burial is one of the most elaborate ever discovered in Middle America. A small tube of stone had been built to the surface at the Temple above so that the soul could come and go, or so that spirit messages could be sent to the Priest-King.

From a drawing in the National Museum, Mexico City

A number of the names of Maya gods have apparently survived in the Lacandon religion, though their attributes may have undergone change. For example, the culture hero of the pre-Spanish natives of Yucatan, Kukulkan, seems to be retained among the Lacandones in the name of a mythical snake with many heads, living near the most important and powerful deity, Nohotsakyum. Tozzer also cites modern counterparts of the ancient custom of piercing the ear with a stone arrow point and letting the blood drip into a pot containing idols.

A sacred intoxicant that was used by the ancient Mayas was being brewed outside our hut in a hollowed-out log. The Lacandones call it *baltché*, after the bark of a tree by that name, which is its distinctive ingredient. The bark has a vile taste and smell, and this has to be overcome by adding honey or sugar cane juice. The trough is covered from sun and rain by putting sticks and leaves across it, and the mildly intoxicating drink that results is sour and milky. It is supposed to have a beneficial effect on the health, we learned, and is more ceremonial than social in its significance.

Until very recently, the Lacandones actually made pilgrimages to the ruined temples for worship, and they may still do so to some extent. But the many little points of connection that their religion shows with the past are of interest chiefly to ethnologists. Still, I should say that a bit too much has been made of their Mayan religious traditions.

We were talking with them in a simple Spanish, which the men have grown to understand through contact with chicle gatherers and mahogany cutters. The Lacandones do very well with a few words. For example, when setting the price for a hammock or other article, they may express a preference for silver money instead of paper by saying, "Paper money dies in the forest,"

continued on page 335

▲ Tomb of the Priest-King beneath the Pyramid at Palenque, as seen in a replica of the burial at the National Museum, Mexico City. A mosaic mask of more than 200 pieces of jade is in place above an effigy of the Priest-King, which is adorned with lavish ornaments of jade. Archeologists found that the body or clothing had been colored red. The sarcophagus was perhaps the largest ever discovered —a massive block 9 feet long, 6 feet wide, and 3 feet deep. Exquisite carvings had been incised on the lid. This is surely one of the greatest artistic treasures in the Americas and one of the most sublime exhibits in all archeology.

◄ FEMALE CRAYFISH with eggs. Because of the appearance of the eggs, she is said to be "in berry."

Crayfish are like that

With tongs on its "front feet," the crayfish puts the "squeeze" on its prey, but often gets caught

By JOHN H. GERARD

Photographs by the author

DRIVING past a stream in the country, you may see a small boy, fishing pole leaning against a convenient tree, carefully lifting a flat stone and taking up a creature with wildly waving claws. This would more than likely be nothing less than a crayfish.

The boy might call it a "crawfish," since this is the common name in many parts of the United States. But "crayfish" is preferred by zoologists.

The crayfish belongs to a group of animals called decapod crustaceans that also includes shrimp, lobsters, and crabs. It is a formidable-looking animal, with eyes on stalks, long antennae, and large claws. It is famous for being able to walk forward, backward, and sideways, and to swim backward rapidly, if disturbed, by quick flips of its tail.

The sexes can be recognized easily by the shape of the first pair of abdominal appendages. Crayfish breed from spring to fall, with different times for different species. In mating, the male deposits a packet of sperm in a skeletal pocket on the under side of the female. When about to lay eggs, she cleans the abdominal appendages (swimmerets) thoroughly, exudes a sticky substance over them and attaches the eggs, as they emerge, to these appendages. A female carrying eggs on the under side of the abdomen is said to be "in berry" since the eggs resemble small berries. By rhythmic movements of the swimmerets the eggs are kept aerated. They hatch in about two weeks into baby crayfish which cling to the mother for some time, leaving after the second molt.

As evidence that the crayfish often gets into fights, its feet and hind claws are often missing, a fact known to anyone who has hunted

Photographer JOHN H. GERARD has been interested in natural history since his early teens and specialized in natural sciences in college. He says, "There must be easier ways of making a living than by . . . photographing crawfish in the hot, humid mosquito-infested mud of an Illinois swamp, but I like it."

▲ Burrowing crayfish are found in low areas where ground water seepage keeps them moist.

▼ Crayfish after molting. The old exoskeleton lies in two sections.

▼ The claws of the crayfish can pinch with considerable force.

crayfish. However, these parts can be regenerated. The crayfish has no vertebrate skeleton but has a hard protective outside covering instead. It feeds on both vegetable and animal matter and its claws serve in defense and offense as well as eating. It first grasps food in its claws, then passes the morsel back to smaller "feet," which tear the food into little pieces and put them in its mouth. It does not drink but water is diffused into its blood.

In the north, the crayfish spends the winter in an inactive state. Its life span is about 20 months, but a few survive the second winter. Although some young crayfish may be active in the daytime, the adult is nocturnal. Most of its feeding is done in water, although it may leave the stream at night to come out and feed.

A crayfish must always remain moist. The burrowing species have solved the problem by making an enlarged chamber at the bottom of the burrow. This chamber, called a cell, contains a little water. The burrowing types are found in low areas where water enters the cell as ground water seepage.

As the crayfish grows, its exoskeleton becomes too small and is cast off. A new exoskeleton has already formed underneath before the molting, but it is softer than the old one. Therefore, the newly-molted crayfish is less able to pinch and otherwise defend itself and is more easily captured by an enemy.

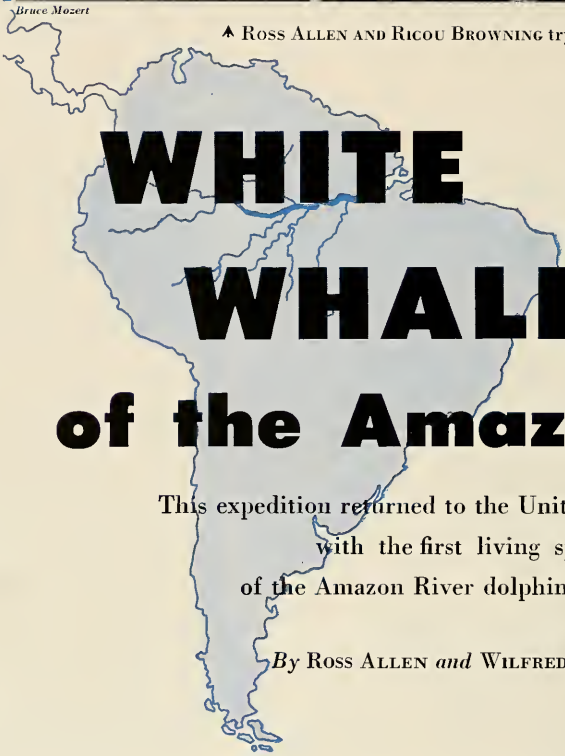
Immediately after molting, the creature is lighter in color, but becomes darker as the next molt is approached.

The crayfish is an important source of food for fishes, birds, turtles, minks, raccoons, otters, frogs, and salamanders. Some states have more than two dozen kinds of crayfish, and almost everyone has seen them in the shallow water along the edges of streams.

Very little has been written about crayfish in popular literature, but you can study them more closely by lifting that flat rock and groping around. Just watch out that you don't get your fingers pinched!

Bruce Mozert

↑ Ross Allen and Ricou Browning try their hand at



WHITE WHALES of the Amazon

This expedition returned to the United States with the first living specimens of the Amazon River dolphin

By Ross Allen *and* Wilfred T. Neill

Mike Freeman, Miami Herald

ian technique of capturing the bufeo.

SOUTH America is the home of many bizarre animals, not the least of which is the Amazon River dolphin. Everyone is familiar with marine dolphins and porpoises, commonly seen about harbors and shallow coastal waters, but few people know that some dolphins inhabit freshwater lakes and streams. Actually four different species are known from the Amazon alone, and three of these have been found more than 1,500 miles above its mouth.

Three of the Amazonian dolphins are offshoots of marine stocks and have near-relatives in the sea. A fourth species belongs to a family that is largely freshwater in habitat. This family, the *Platanistidae,* was once widespread, judging from fossil remains. The surviving platanistids, four in number, are curiously distributed.

One, the white flag dolphin, is found only in Tung Ting Lake, 600 miles up the Yangtze River in Hunan Province, China. It escaped discovery by scientists until 1914, although it was well known to local residents.

A second species, the La Plata dolphin, lives in coastal waters and river mouths along the Atlantic side of South America, being named after the Río de la Plata, the great embayment separating Argentina and Uruguay.

A third is the *susu* or Ganges River dolphin, a nearly blind, mud-grubbing species of northern India.

The fourth surviving species is the *bouto* or Amazon River dolphin, *Inia geoffrensis.* It inhabits the greater part of the Amazon drainage, following the tributaries upstream, even into Peru and Bolivia. It goes up the Río Negro of Brazil to the Casiquiare of Venezuela, and so enters the Orinoco drainage.

Ross Allen majored in engineering in college, but soon left that profession to open the Reptile Institute at Silver Springs, Fla. He has written many papers on reptiles and other wildlife.

Wilfred T. Neill taught zoological sciences for a while, then joined the Institute as Director of its Research Division.

Together these authors have explored many remote areas, and between them have contributed nearly 400 research papers to various technical journals.

Bruce Mozert

▲ Local Tucuna Indians watch the dolphin hunt with interest.

In spite of its wide range, few specimens of the Amazon River dolphin have ever reached museum collections, and the Amazonian Indian tribes provide much folklore but little fact about this aquatic mammal. Living examples had never been displayed in any zoo or aquarium, so in 1956 we decided to set out from Silver Springs, Florida, to study this rare cetacean and to bring back live specimens, if possible.

We decided to camp near the

▼ The dolphin is lifted into the boat.

Bruce Mozert

▼ Expedition camp on a tributary of the Amazon, near Leticia, Colombia.

Bruce Mozert

▼ Head of a young bufeo from above, showing the blow-hole.

Warren Prince

community of Leticia, on the upper Amazon of Colombia, where we had previously observed dolphins. We went through the usual formalities—passports, "shots," birth and vaccination certificates—and made arrangements with Aerovias Sud Americana to transport collecting gear in and dolphins out—if we got any.

We left on February 3rd and went to Havana, Cuba, thence to Panama and Colombia. From Medellín, Colombia, our plane climbed higher and higher as the country became more mountainous. We saw glimpses of great waterfalls and ravines, and at one point, the lonely wreck of a plane on a mountainside.

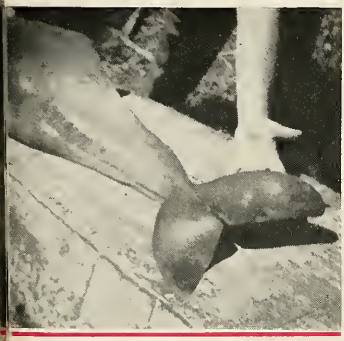
From Bogotá, Colombia's capital city, we flew a little more than three hours, setting down at Leticia, our destination.

Leticia was established by the Colombian government as a military outpost some twenty years ago and has since grown into a sizeable community, with an airport, a government building, churches, a park and playground, and wharves where large and small vessels can tie up. Leticia is nearly 2,000 river-miles upstream, but even here the Amazon is a mighty flood, 2 miles wide, 75 to 100 feet deep, with a current of about 5 miles per hour.

In and about this great stream dwell some remarkable forms of aquatic life, including the arapaima, largest freshwater fish in the world; the pirahýba or giant catfish, which attains a weight of 880 pounds; the electric eel, which can deliver a 500-volt shock; the notorious piranha or tiger fish; the candiru, a tiny fish that occasionally parasitizes man and large animals by entering the urethral canal; the anaconda, bulkiest snake in the world, if not the longest; the spectacled cayman and the black cayman, related to the alligator; the capybara, an aquatic rodent weighing as much as 165 pounds; the manatee or sea-cow; and the freshwater dolphin for which we were looking.

▼ Tail of a young bufeo, showing paddle-like flukes.

Warren Prince



Some Tall Tales

We set up camp about three miles from Leticia, on a small stream which ran through four lakes and thence into the Amazon. We were gratified to see several dolphins in the lakes, rolling like their saltwater cousins and snorting and blowing as they surfaced.

The local name for the dolphin was *bufeo* and the Leticians told some wondrous tales about it. The bufeo could not be captured, they said. If penned, it would sprout legs and walk away, or even grow wings and fly off. Its eye, they told us, was an excellent love charm and one of its teeth would cure toothache. Anyone who burned its oil in a lamp would soon go blind. Sometimes, they said, the dolphins would leave the water and sing sweet melodies to lure humans to the banks. If they refused the dolphins' advances, they would soon be afflicted by a nervous disorder "sent" by the vengeful animals!

Nearly a hundred years before, the great naturalist and explorer, Henry Walter Bates, had heard similar legends, but he thought they stemmed from the Portuguese settlers rather than from the Indians.

Certainly, the appearance of the dolphins is strange enough to inspire a few legends. Some of the larger specimens were at least 9 feet long and must have weighed close to 300 pounds. They resembled the familiar marine dolphins but were more slender, with a long tooth-studded beak. The adults were pale-whitish, faintly tinged with bluish-gray above and pinkish below.

From time to time, several would poke their ghostly heads out of the Amazon water, exhale with a loud "whoosh!" and then roll out of sight. When blowing, they sent a misty jet at least eight feet into the air.

Once, a large bufeo rose almost half its length out of the water and glided directly at our little dugout canoe. It approached so close that its bulging forehead, small eyes, and cylindrical beak could be seen plainly. Its speed and silence and the power and directness of its approach—within fifteen feet of the boat—would frighten anyone not familiar with the species.

We spent several days reconnoitering the area and studying the behavior of the dolphins. The Indians thought that three different species occurred in the vicinity but actually there were only two. The supposed third species proved to be the young of *Inia*. The second was the much smaller *Sotalia pallida*, which is not closely allied to *Inia*, but has relatives in the sea.

The river dolphins were more common in the lakes and smaller streams than in the Amazon proper. They traveled in pairs, although two adults were sometimes accompanied by a single young one. Apparently the bufeo, like other cetaceans, rarely has more than one baby at a time. We sighted from 15 to 45 a day but the same animals were probably encountered several times over, for they seemed to cruise back and forth in a regular and fairly predictable fashion.

It was interesting to note that *Inia* could turn its head to right or to left and even rotate it slightly to look upward. Such actions are not possible for most cetaceans since their neck vertebrae are fused for streamlining. *Inia* has separate neck vertebrae like most mammals, and is thus primitive or unspecialized in this regard.

On February 17th and 18th, the other members of the expedition arrived and work was begun the next day on a dolphin corral. Near the camp, just over the Brazilian

border, was a village of Tucuna Indians, whose drumming we had heard one night. A number of them soon appeared and showed great interest in the camp, the corral, and the impending dolphin hunt. Two of the Indians helped to build the pen, bringing poles and splitting them skillfully with their machetes. The labor was wasted, however, as the dolphins were much too wary to be corralled.

Several members of our party were experienced skin-divers who had hoped to catch the dolphins with underwater gear. But the water was so murky that the animals were invisible even a few feet away. Seines and nets also proved ineffective. Obviously, the dolphins had some means of detecting small objects in the dark water. Often they would dash by at full speed, leaving a wake like that of a motorboat, swerving just in time to avoid a snag or one of our collecting devices.

Navigation by Echo

Certain marine dolphins, like some bats, are known to give out high-pitched sounds and to locate nearby objects from the returning echo. The behavior of the fresh-water species suggested that it, too, was capable of echolocation. This remains to be proved, but we were left in no doubt as to the dolphins' vocal abilities, since we heard them squeal loudly, like pigs.

The local Indians were in the habit of harpooning the manatee and the arapaima, and we decided that our dolphins would have to be taken in the same way, if at all. We had observed bufeos in a nearby lake during the day but not at night. Apparently, they moved back and forth from the lake to the Amazon. We tried to discover the time when they entered the lake.

On February 27th, two of our party rose before dawn and concealed themselves at the entrance to a channel between the river and the lake. Two kinds of dolphins soon made their appearance. Some were the small, blackish species while the others were the white bufeos we were after. We could easily distinguish between the two not only by color but also by shape. The bufeo lacks the high dorsal fin of the smaller blackish dolphin. Eight bufeos entered the lake before 9:30 A.M., after which time no others appeared. They were evidently feeding, for they chased fishes about, sometimes venturing back into the flooded jungle, shaking the partially-submerged bushes as they passed.

With the assistance of one of the Indians, we harpooned a bufeo in the tail. It escaped but we found it again, three-quarters of a mile away. The harpoon line had fortunately become entangled in some

▼ THE BUFEOS, on exhibition at Silver Springs, Florida, often swim belly up.

Pamela Cheatham

bushes. We placed a noose over the animal's tail and half-dragged, half-lifted it into the boat.

The specimen was placed in the park pool at Leticia, where it attracted a great deal of attention. The Leticians made dire predictions that it would walk or fly away during the night, and to forestall this, the military commandant of the town generously stationed soldiers about the pool. Later, the residents saw that the bufeo was harmless, making no effort to bite when handled and seeking only to escape.

Eventually, we harpooned four bufeos. Two of them, babies under five feet in length, were sent to the University of Florida for dissection and study. Two larger ones, however, were destined for display at Silver Springs—if they could be successfully transported.

Dolphins are, of course, warm-blooded animals, members of the same mammalian order as whales. They could not be carried in a tank, for as long as they felt water about their bodies, they would make swimming motions, soon become exhausted, and be unable to lift their heads above the water to breathe.

We decided to carry them back in canvas or plastic slings, packed with wet cloth. Since the dolphin's great weight is supported by water in its natural environment, we could not place a captive specimen on its stomach for long, lest its weight compress its lungs or other organs. As the animals habitually rolled onto their sides when out of the water, we placed them on their sides in the slings. They appeared to ride comfortably in this position.

A Quick Trip Back

The trip to Leticia had been leisurely, with stops for collecting en route. But the return flight, with our precious cargo, was made as rapidly as possible. We had some tense moments at high altitudes, giving the dolphins oxygen by fitting a mask over their blow-holes. The hardy beasts withstood the long flight from Leticia to Florida, and the shorter trip by truck to their present headquarters.

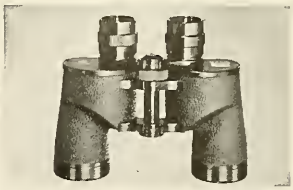
The two bufeos have now been on display at Silver Springs for about a year. The harpoon wounds have healed and the animals feed voraciously on fish, thrown to them several times a day. The smaller one even permits a skin-diver to ride it. Both dolphins display the same animation and intelligence that characterize the marine species. They will play with an inflated inner tube or pass a rubber ball from one to the other.

In January, 1957, we feared that the captive bufeos might be adversely affected when the thermometer fell to 18° F. But the flowing waters of Silver Springs maintain a constant temperature of about 72°, and the animals weathered the cold successfully.

We also had a few anxious moments when we observed the dolphins rubbing their backs, sides, and bellies against submerged logs, as though they had a skin itch. But a friend familiar with captive dolphins of other species, felt that such behavior was quite natural, pointing out that the bottle-nosed dolphin and other cetaceans customarily rub and scratch themselves much as hogs and other terrestrial animals do.

We have had only one serious difficulty with the captive bufeos. Both are males, one a good bit larger than the other. After months of peaceful coexistence, the larger began biting its erstwhile friend, inflicting a number of small gashes. Now the two are penned separately.

The trip to Leticia yielded much scientific data on *Inia*. Dr. James Layne, of the University of Florida, went with the expedition and will soon publish his findings on this interesting mammal. We have made observations on the two captive specimens and hope to publish additional data accumulated during the course of another and longer visit to Leticia during the fall and winter of 1956. This more recent trip afforded an opportunity to compare the behavior of *Inia* with that of *Sotalia*, in addition to the successful transportation of two living specimens to the United States.



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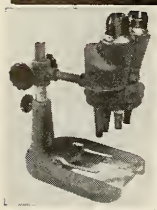

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Wild blow the winds

continued from page 293

sometimes as devastating as a wildcat grass fire. The capital of Somaliland Protectorate, in fact, was once moved from Berbera to Hargeisa because of the sweltering *kharif*. Under Ottoman Empire law, murder was more pardonable if committed during the blowing of the baleful *khamsin*.

In more temperate climates, the wind can be just as intemperate. An end-of-January gale in 1853 blew down 47 million feet of timber in Scotland. In Austria and Czechoslovakia, vast acreages of timber have also been downed by severe blows.

The "Wind of 120 Days"

The pathological effects of wind take a more subtle toll. In eastern Iran's basin of Seistan, the summertime "wind of 120 days" blows so wildly and so steadily out of the north that trees grow only on the lee sides of buildings, and the wild melon bunches its branches uniformly in a single direction. Europeans who have endured it claim that it is one of the most trying experiences imaginable.

Depending on the conditions and on the individual, persistent winds have been known to bring on headaches, irritability, epileptic attacks, rheumatism, oppression, fever, heat stroke, and asthma, and have even unsettled the nervous system of some victims to the point of suicide. The wind is also responsible for the widespread dissemination of ragweed and other pollens which plague a multitude of hay fever sufferers.

Polar explorers know that men can endure temperatures far below zero, but the moment a wind rises, the cold cuts like a knife. Intense cold in a sudden blizzard may even explain why antarctic explorer Robert Falcon Scott, after traveling 625 miles to and from the South Pole, perished scarcely a dozen miles from a provisioning base.

Because the wind, whatever it carries, is capable of doing considerable damage, men have contrived some ingenious techniques to protect themselves from it. The Navy's "Hurricane Hunter" squadron has been performing low level weather reconnaissance in the Atlantic, Gulf, and Caribbean since 1946, and has helped lower the calamitous results of tropical storms.

In some localities, house roofs reach completely to the ground on the side of the prevailing wind. In Switzerland, and in other parts of the world, roofs are held down by heavy slabs of stone. Some winds are so severe that houses have to be braced and reinforced. Since ancient times, specially-planted hedgerows and tree lanes, as well as brick, stone, and brush walls have helped to break the wind's force. Planks, canvas, and glass protect delicate garden crops. Holland tulip beds are covered with straw. Michigan farmers sow sheltering rye strips in fields of onions.

However, defense is only a passive measure. Since time immemorial, man has not only defended himself against the wind, but has used it to advantage. Natives once drifted from one South Sea island to another, spreading civilization across all Polynesia. The trade winds brought Columbus to America, Cabral to Brazil. In 1486, Barthelemeu Diaz was violently driven around the Cape of Good Hope (he named it the Cape of Storms). The

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Germans since Otto Lilienthal have been masters of the sport of gliding.

For centuries, the winds have been continuously in the service of mankind. Windmills, first used by the Egyptians as early as 3600 B.C., came down through the centuries in varied shapes and sizes, grinding corn, pressing oil, drawing drinking water, draining and irrigating lands, and even pumping water out of ships' holds.

Windmills for Power

Though windmills may never be used widely again, one fact remains. The energy of the wind is practically inexhaustible. It follows, therefore, that windmills, made large enough, ought to produce electric power. For decades, power from the wind has intrigued mechanical experts. It was once estimated that a series of 300 wind wheels, spotted along the French Atlantic coast, could supply that nation with fifteen million kilowatt-hours of electric energy every year.

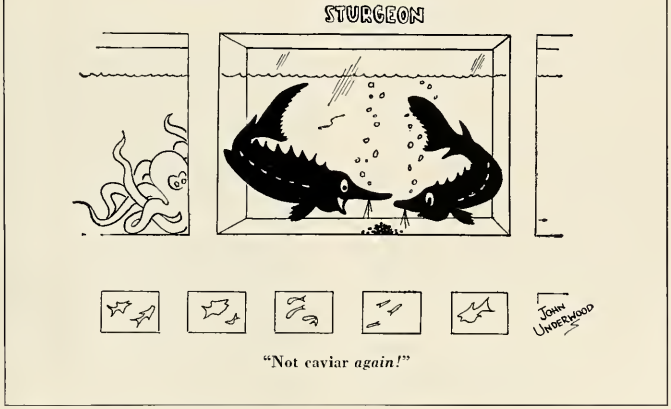
Although wind and water alike have varying velocities, only water can be penned up by dams, yielding constant power. Wind is an invisible force, whose intangible qualities elude the grasping hands of industry. It cannot be funnelled readily, nor can its energy be held in place except in compressed air tanks. On prairies and seashores, where almost no elevation impedes it, the wind blows at constant speeds and for long periods of time. Yet under the best conditions, it varies. And these variations constitute the problem with which wind engineers have had to grapple.

Inevitably, there will be gales and, inevitably, calms. To provide power during calms, a large and expensive storage battery is needed. But battery life diminishes when the discharge is too great and battery damage may result when overcharged by high winds.

Giant wind-turbines, mounted on peaks, are capable of delivering more than 1,000 watts, yet such towers, subject to lashing winds or even hurricanes, must be tremendously reinforced, running up the expense prohibitively.

With an ever-rising world population, the demand for electric energy will doubtless continue on the upswing for as far into the future as man can see. No one yet knows the limits of atomic energy and until plans for long-range power sources become more definite, imaginative engineers will probably keep trying to utilize the elusive energy of the atmosphere.

Meanwhile, the all-powerful wind, blowing wildly across vast regions of the earth, spreading havoc and damage, will also brush softly the bronze-skinned natives of South Sea islands, who tell you as you sail away, "Goodbye, we shall sit together again in the caress of the wind."



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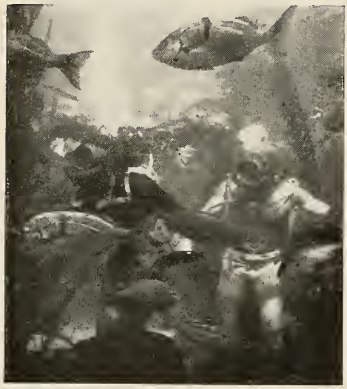
➤ In "Boy on a Dolphin," the archeological treasure of the title is brought back to the island of Hydra. The statue is on the bow of the boat in right foreground.

▼ Sophia Loren and Alan Ladd in one of the underwater scenes.



The Screen

Authoritative comments on films in the field of nature, geography and exploration

Boy On A Dolphin

20th Century-Fox
(CinemaScope-De Luxe Color)

Reviewed by Myron Gordon
Geneticist, New York Zoological Society

THE opening scenes in "Boy on a Dolphin" are magnificent. These dramatically beautiful shots alone are worth the price of admission. Spectacular views arouse a tingling sensation of actually being afloat on the Aegean Sea and enjoying the sights on its many islands.

Hydra is the specific locale for this motion picture which is based upon the novel by David Divine. It tells a tale of how, while sponge-fishing, a girl chances to find a 2,000-year-old archeological treasure—a remarkable statue of a boy riding a dolphin. Since much of the story is devoted to the intrigues of cashing in on the find, the script turns out to be but a variation on the familiar theme of "cops and robbers." Nevertheless, Natural History readers will enjoy seeing "Boy on a Dolphin" for its warm photographic portrayal of a little-known area of the Mediterranean.

Never have the countrysides and the people of the Grecian isles been photographed in more beautiful colors and projected so dramatically on the wide screen. The brilliant sun spotlights the dazzling white houses along the steep sides of the islands that rise as stark mountain peaks against the blue of sky and water.

The scenes of Athens and the national archeological treasures have been photographed before, but never with greater skill and appeal. One experiences a strong spontaneous emotional impact on seeing the display of these works of art in their native land. Through the courtesy of a generous plot, the audience is treated to a "tour" of the Acropolis, the ancient and almost inaccessible monastery at Meteora, and the amphitheatre at Epidaurus—complete with a demonstration of the latter's amazing acoustics. There are also sequences of folk dancing, and the title song is based on Tinafto music.

Advance notices for "Boy on a Dolphin" highlighted its scenic beauties of Greece, of its seas, and of the waters below the surface of the sea. I must confess that the underwater scenes are disappointing. Being limited in scope and variety, they contain very little that would excite the skin-diving naturalist. Although a few drab fishes were permitted to pass by the camera's lenses, the coral and algal growths, so far as I could tell, were arranged from questionable material. But then my eyes could easily have wandered from the task of appraising the aquatic flora and fauna because, constantly in the foreground, Phaedra, in the lovely form of Sophia Loren, was busily swimming through the gray-blue haze of Aegean waters.

Cast includes: Alan Ladd, Sophia Loren, and Clifton Webb.
Running time: 111 minutes.

Blue Men of Morocco

A "PEOPLE AND PLACES" Featurette

A Walt Disney Production
(Print by Technicolor)

Reviewed by Jane R. Orttung
Scientific Assistant, Department of Anthropology, American Museum of Natural History

IN the rocky deserts of Morocco to the east of the Atlas Mountains live small bands of Berbers, moving about in search of water and pasturage for their camels upon whom they depend. They breed camels and sell the surplus animals in the market in order to obtain flour, tea, and other trade goods. Many of these people wear long robes of indigo cloth, and with the rubbing of daily wear the blue dye of the cloth tints the wearer's skin. Thus they are sometimes called the "Blue Men."

In its bare essentials this is a simple tale, the story of one group of these nomadic folk and their trek to market to sell their surplus camels. But the basic theme is a structure on which the myriad details of the daily life of these people are twined, deftly and logically, so that as the story unfolds it gives a well-rounded portrait of how these people live.

In the opening scene, children are playing about a few scattered tents, as the women go about their chores. The camp is awaiting news of the market prices of camels. We are given glimpses of weav-

ing, cooking, and household arrangements. All cooking is done in one pot, and all eating is from a common bowl, for nomads must travel light. The men gossip and drink tea, while the women braid bits of coral and silver into their hair and ornament their hands with fine-line patterns drawn in henna.

At last messengers ride in with news from the market. It is not good; local prices are low, too low to yield even a minimum of profit. After much discussion the group resolves to cross the Atlas Mountains to the ancient city of Marrakech where they can get better value for their beasts. The decision is the occasion for celebration. The men start singing with a repetitive rhythm reminiscent of tropical Africa. A girl begins a dance, done entirely on the knees with gestures of the head and shoulders, harking back to the days when such dancing was done in the confinement of a tent. Early in the morning they move, but not before praying as good Moslems, facing east, and observing ritual cleanliness by washing with clean sand in lieu of water—a substitute permitted in the desert where water is scarce.

The journey is a long one. They pass from their stony desert terrain into upland thicket where goats graze in trees. Then in windswept dune country they are forced to detour to an oasis village for water. Ancient and ingenious methods for the extraction of water are shown here as well as patterns of water distribution set centuries ago. On they go, through the high mountains of the Atlas, until they reach the city of Marrakech. It is a city of mud brick walls with alleys shaded by festoons of wares. Here is the camel market, and places to buy rugs, pots and pans, and foodstuffs . . . and entertainment by sword-swallowers and snake-charmers.

The movie is enjoyable, and presents an interesting picture of the life of the camel nomads.

Running time: 32 minutes.

▼ A "Blue Man" on his camel—one of the herd on which the tribe's livelihood depends.

YOUR NEW BOOKS *continued from page 287*

societies, including the Royal Anthropological Institute, the Royal Geographical Society, and the Institute of Archaeology. To these he should add membership in the Zoological Society and the Geologists' Association, because his real interests seem to lie in these fields, to judge from this book.

Mr. Carrington writes accurately, engagingly, and often wittily about animals and plants, living, extinct, and imaginary. His book is divided into four parts, dealing with topics which at first glance are little related. Part I, Behind the Legends, discusses such fabled animals as mermaids, sea serpents, dragons, and the roc or rukh. He tells some fascinating tales of human inventiveness and of human credulity, but carefully points out that these legendary beasts all have some small basis in fact; behind the poetry of symbolism (and the tall tales) some actual creature has existed to give rise to the romantic elaborations. Part II deals with fossils, an admirable layman's introduction to paleontology, illustrated by the story of the mammoths preserved in the Siberian tundra, the geological history of the elephants, and the discovery of the dinosaurs.

Part III links the past with the present through the "living fossils," the most famous being, of course, the coelacanth fish, *Latimeria*. Mr. Carrington also discusses the strange and primitive *Peripatus*, an unattractive beast possessing characteristics linking it both with the worms and the insects; the marsupials of Australia; and the ginkgo or maidenhair tree. In Part IV he turns to describe some animals which man has turned into fossils — the quagga of South Africa, the passenger pigeon of this continent, and Steller's sea-cow of the Bering Sea.

This is an utterly fascinating book. Even familiar stories are retold with freshness and vigor, and the lesser-known ones are illustrated with quotations from original sources and interesting drawings from old and obscure publications. The author does not conceal the sources of much of his information; on the contrary he provides a fine bibliography for the reader who wishes to go deeper into any of these subjects.

Although written in England, the book is cosmopolitan in scope and includes many interesting items from this country. It is refreshingly free from errors—the few that this reviewer noted were inconsequential (a confusion of dates on pp. 34 and 35, another discrepancy in dates between original publication and republication of Beringer's book on fossils (pp. 102-3), and Petovsky for Petoskey on p. 213).

This book can be read with pleasure, amusement, and intellectual refreshment by layman and scientist alike. Anyone who enjoys Natural History will enjoy *Mermaids and Mastodons.*

Dr. Mason is Curator of Physical Geology and Mineralogy at The American Museum of Natural History.

Operation DEEPFREEZE
- by Rear Admiral George J. Dufek

Harcourt, Brace, $5.00, 243 pp., illus.

***Reviewed by* Serge A. Korff**

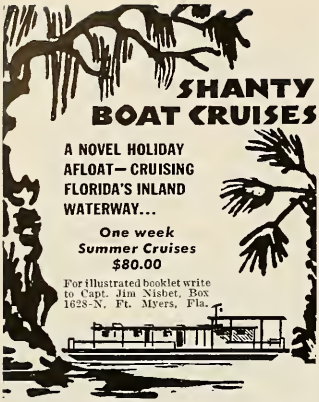
Operation DEEPFREEZE is the story of the current Antarctic Exploration, told by the Commander of the Navy Task Force assigned to the operation. This is, therefore, the next good book in the now long series describing the work of opening up this great continent.

The extent of our ignorance about the antarctic is one of the most amazing phenomena of the present day. Here is a continent, almost as large as the United States and Europe combined, most of which, up to the beginning of Operation Deepfreeze, had never even been seen by modern man. True, it had been circumnavigated, and the original expeditions in the early days of the century had determined the routes to the Pole and the fact that the Pole was on a plateau at an elevation of about 9,700 feet. But, except for the flight by Lincoln Ellsworth from the base of the Palmer peninsula to Little America, nothing was known about the interior.

Again, with the exception of some ice thickness measurements at Little America, and an excellent section obtained by the combined British-Norwegian-Swedish expedition of 1949, almost no data on ice thickness existed. We did not know whether the ice under the South Pole was 9 inches thick, or 9,000 feet. Although rock mountains stick up through the ice at places, we still know almost nothing of the areas between.

The great antarctic plateau, much of it at high elevations, appears to be the dominant single factor in Southern Hemisphere weather. Yet just how it operates we do not know. We do not know much about the pressure waves apparently emerging from Marie Byrd Land. Until now, no seismic observations had been made in Antarctica. We do not know whether the aurora, geomagnetism, and cosmic rays are symmetrical about the South Geomagnetic Pole as they are about the North Geomagnetic Pole; we have merely assumed this to be so.

The International Geophysical Year 1957-1958 was conceived and organized to allow us to make an internationally coordinated attack on some of the great areas of ignorance about our planet. One



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phase of this involves extensive and intensive exploration of the antarctic, including a plan at least to have a look at the great interior areas. Today, when superb planes with long ranges are available, it has been possible to plan a program of flights from such bases as that at McMurdo Sound. Large machines can be flown directly from New Zealand to these bases from which they can make carefully planned overlapping flights over the unknown parts of the continent. *Operation Deepfreeze* is the story of the beginning of this great adventure.

In this book the author tells about the heavy work to establish the bases, and then of the first set of reconnaissance flights, during which more than a million square miles of territory were seen for the first time.

Admiral Dufek also describes the first airplane landing at the South Pole itself, and the establishment of the base which at this writing is fully manned and operating. He himself was in the first landing, which proved a hair-raising experience. Because of the intense cold, the skis froze to the ice so that they had to blow most of their JATO bottles just to get unstuck to start their take-off. This reviewer, who himself has made a plane landing on skis miles from the nearest other human beings, can fully appreciate the fine understatement of Admiral Dufek when he wondered whether they would get off again after the first successful landing.

The overall plan of the IGY and the antarctic exploration is the most comprehensive program of scientific exploration ever undertaken by man. *Operation Deepfreeze* is the account of the first two years of this operation and recounts the many important new discoveries made thus far. This excellent book will give the reader the background to understand the next moves in the exploration, which will be filling the newspapers during the next two or three years.

Dr. Korff is Professor of Physics at New York University and Executive Secretary of the Cosmic Ray Technical Panel of the U. S. National Committee for the IGY. He is also President of The Explorers Club.

THE MONKEY KINGDOM
- - - - - - - by Ivan T. Sanderson

Hanover House, $6.95, 200 pp., illus.

Reviewed by HAROLD E. ANTHONY

IF the reader of this handsomely illustrated quarto volume does not emerge from the operation with a greatly broadened outlook upon his "poor relations," it will be because he does not have much interest in monkeys. The author has gone into the subject at great length, he aligns the very many varieties in their proper systematic order (which may be of some significance to humans but doubtless of low priority on real monkey business), and then tells something of their behavior and their tolerance of man. He has had wide experience with these creatures in their natural habitats and has kept many of them as pets.

The text takes up the topic of the Primates in systematic fashion beginning with the early types of a long evolutionary series and progressing through to the higher specializations in the anthropoid series.

At first glance the format of the page and the over-all impression of a taxonomic treatment could discourage the layman who would think the going might be heavy for him, or that the book had been planned for those who frequent museums. It is true that the systematic classification which Sanderson has compiled from the most recent and authoritative sources will be a frequent reference for those who want to see that a monkey is properly labeled. But there is so much of human interest in the accounts of habits, the comments on monkey psychology, and the development of the subject after the label has been written out that the layman will find it difficult to lay the book down after he has fairly sampled it.

Sanderson writes fluently and with a keen sense for the dramatic aspect of the subject. "At dawn and at sundown they make the mountain valleys literally ring with their tremendous, prolonged, barking hoots that, led off by one and taken up by all others within hearing, mount to a deafening crescendo that makes your eardrums ring and reduces every other jungle creature, even the most raucous birds, to abject silence." This description of the calling of the Siamang might appear exaggerated to one who has never heard the magnificently vocal members of the monkey kingdom, but having once heard them, he will agree that no words can exaggerate the effect. The Siamang of Sumatra has a vocal competitor in the Western Hemisphere, the howling monkey, which was once given the name of Stentor in recognition of such terrific outbursts of sound.

The illustrations are exceptionally well done. The color plates average excellent on color and for registration. The maps and the black and white drawings, all by the author himself, are very helpful.

Letters *continued from page 281*

a very small percentage of the nearly 350,000 species of beetles known. Only a very small number of the inhabitants of ant colonies are actually parasites. Most of them live with the ants as scavengers, guests, satellites, or commensals.

A few scarabaeid beetles live in ant nests, but seldom as parasites. Usually

they act as scavengers feeding on waste material dropped by the ants, or other waste vegetable or animal matter. They thus serve a beneficial purpose in cleaning up the nest and are usually tolerated by the ants.

Some species, particularly of the genus *Cremastocheilus,* are not only tolerated but are looked after and protected because they have glands near the front and rear angles of the prothorax which produce a secretion that the ants like to eat. The European scarabaeid *Cetonia floricola,* passes its larval and pupal stages in the nests of *Formica rufa,* and in the United States the closely related species of *Euphoria inda* and *Euphoriaspis hirtipes* live in the nests of several species of ants.

On the other hand, although most of the species feed on foliage, a few chrysomelid beetles do enter and live in ant nests. These also cannot be considered as parasites because they feed upon waste vegetable material and molds that grow in ant colonies. The chrysomelid beetles that live in ant nests are largely of the subfamily Clytrinae. In Europe species of the genus *Clythra* and in the United States, species of the genus *Coscinoptera* have been found in ant nests.

The larvae of *Coscinoptera* construct cylindrical clay cases in which they live. The hard head effectually closes the opening protecting the tender larvae from the ants. It has been stated that an ant will sometimes place an egg in the opening of one of these clay cases as they will in any convenient crevice. With an ant egg at hand on its doorstep, the little chrysomelid larvae will undoubtedly devour it. If this is a regular procedure, the chrysomelid larvae, instead of being a scavenger would then become a parasite. A great deal of further study of these inhabitants of ant nests is needed.

MODERN MAYAS *continued from page 321*

meaning that it deteriorates.

I recorded a Lacandon vocabulary on my tape recorder, using a wordbook I prize very much for this work, which contains more than 1,500 pictures in color. Some interesting discoveries came out of this. For example, the same word was used for purple, green, and blue. And though I could get the word for each part of the face, I could not draw out a word for the face itself.

It has been proved that the Lacandon language is a form of ancient Mayan. Recent statistical studies indicate that the similarity may be very close. Comparison of Lacandon word lists with a vocabulary compiled sometime within the first century after the arrival of the Spaniards shows about the amount of divergence that might have occurred if the ancestors of both groups spoke the same language 910 years ago. This implies that the ancestral Lacandones may have had close cultural ties with the Mayas of, say, Palenque, when that classic center was at its peak, in the eighth century.

That the jungle Lacandones should have survived with so much of their culture intact is indeed remarkable. On the other hand, we must remember that, whereas there are only 200 Lacandones, there are almost two million other Indians who speak dialects identifiable as Mayan. These dialects extend over Yucatan and parts of Guatemala, Honduras, Chiapas, and Tabasco, as shown on the accompanying map. An outlying "island" of Mayan language is found as far north as Veracruz. This is supposed to have split off from the Mayan stock before the development of the Maya civilization.

The ancestors of my Lacandon friends Jorgé, Mateo, and Chan-Kin may well have helped to build the great pyramid at Palenque, where Mayan art reached its zenith around 692 A.D. Only 40 miles of rough country separated this primitive village from Palenque. But in the surviving art of the Lacandones there is no hint that they could have created the sculptures for which the Maya artists are famous.

Of the remarkable mathematical and astronomical science that the Mayas developed, the Lacandones show not a trace. Nothing remains of the written language, or of the intellectual greatness that found expression at Chichén Itzá. The Lacandones know nothing of the system whereby the Mayas dated every event, actually using as the starting point an astronomical occurrence that they reckoned must have taken place more than 3,400 years before their earliest recorded history.

Animal-collecting adventures in a tropic wilderness

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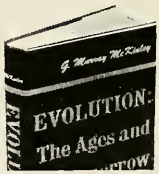

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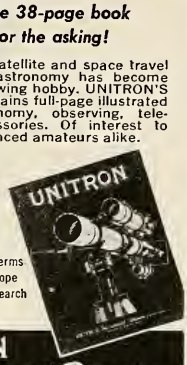

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In the collapse of the Mayan Empire the best suffered most. The Spaniards were not the cause of the fall. It had happened before they arrived. They only Europeanized the remnants.

In about 800-900 A.D., Chichén Itzá bloomed in what archeologists call the Late Classic phase of Maya history. Probably not long after 900, the Toltecs came from Mexico, bringing gold and copper to a stone culture. The Toltecs introduced many of their artistic modes and religious ideas, including the cult of the Feathered Serpent and the practice of human sacrifice by tearing out the heart. Some of the most impressive buildings at Chichén are the outgrowth of this blending.

Then in 1204 A.D., the rulers abandoned Chichén Itzá, and the power shifted to Mayapan, not far to the west. This capital fell in turn in 1441, a full 70 years before the arrival of the first Spaniards. The great Maya centers such as Tikal and Yaxchilan had long since been abandoned and were overgrown with jungle when the first Europeans saw them in 1696.

The Spanish Conquest of the Maya area had been practically completed by 1546, but one stronghold held out at Lake Peten in northern Guatemala. When this fell in 1697, only the Lacandones remained unsubjugated. And thus they have lived ever since. They follow a primitive existence in the mountains, with the husband helping the wife to bring forth her baby on a bed of leaves in the forest, and with the widow burying her husband quite simply, head-west feet-east, with a lock of hair in each hand and a bowl of corn paste between the thighs.

I thought of my Lacandon friends two weeks later when, by a roundabout route, I reached Palenque and climbed down into the Pyramid to gaze upon the recently discovered "Royal Tomb"—surely one of the most sublime spectacles of ancient America. The archeologist Alberto Ruz had excavated for three years in the depths of the pyramid before he finally broke into it.

We know not who the young Priest-King was. His people had dressed him in scarlet and placed over his face a mosaic mask of more than 200 pieces of jade. A broad pectoral of polished beads lay upon a shoulder-collar that was trimmed with green parrot feathers. His bronze legs were wrapped in strips of jaguar skin, and on his toes he wore polished globes of jade.

They had laid him in a solid block of stone, 9 feet long, 6 feet wide, and 3 feet thick, hollowed out in an oblong hole in the shape of a fish's tail, and they had fashioned a recessed stone lid that closed the sarcophagus hermetically. Onto this they lowered a five-ton slab of stone, its surface engraved with what may have been a likeness of the man himself. Above his head was carved a tree in the shape of a cross, decorated with serpents. And he was guarded over by sculptured figures of the Nine Lords of the Night, on the walls of the crypt.

The chamber was closed by a massive triangular block of stone, and they filled the stairway of 67 steps with rubble. But up the whole length of it they had built a little tube of stone, so that the great man's soul could come and go or so spirit messengers could keep the living in touch with the dead.*

Many explanations have been offered for the downfall of the Maya civilization, including climatic change, earthquake, epidemic, civil war, invasion, social and political decay, and exhaustion of the soil. No single cause seems adequate. Whatever the explanation, when adversity came, the leaders lacked the will or the wisdom to preserve their learning, and the "shaggy ones" who have been content to find security in the forest have saved almost nothing of that great culture. Leaf-cutting ants by the millions have taken over the mountains that were once tilled intensively; and if the soulful Lacandones were not so hard to reach, even they might long since have been "modernized."

*The Royal Tomb at Palenque is rather remote for many tourists to visit, but a replica of the chamber as it would have appeared the day of the burial has been reconstructed with consummate artistry in the National Museum in Mexico City, and the jewelry is on exhibit there.

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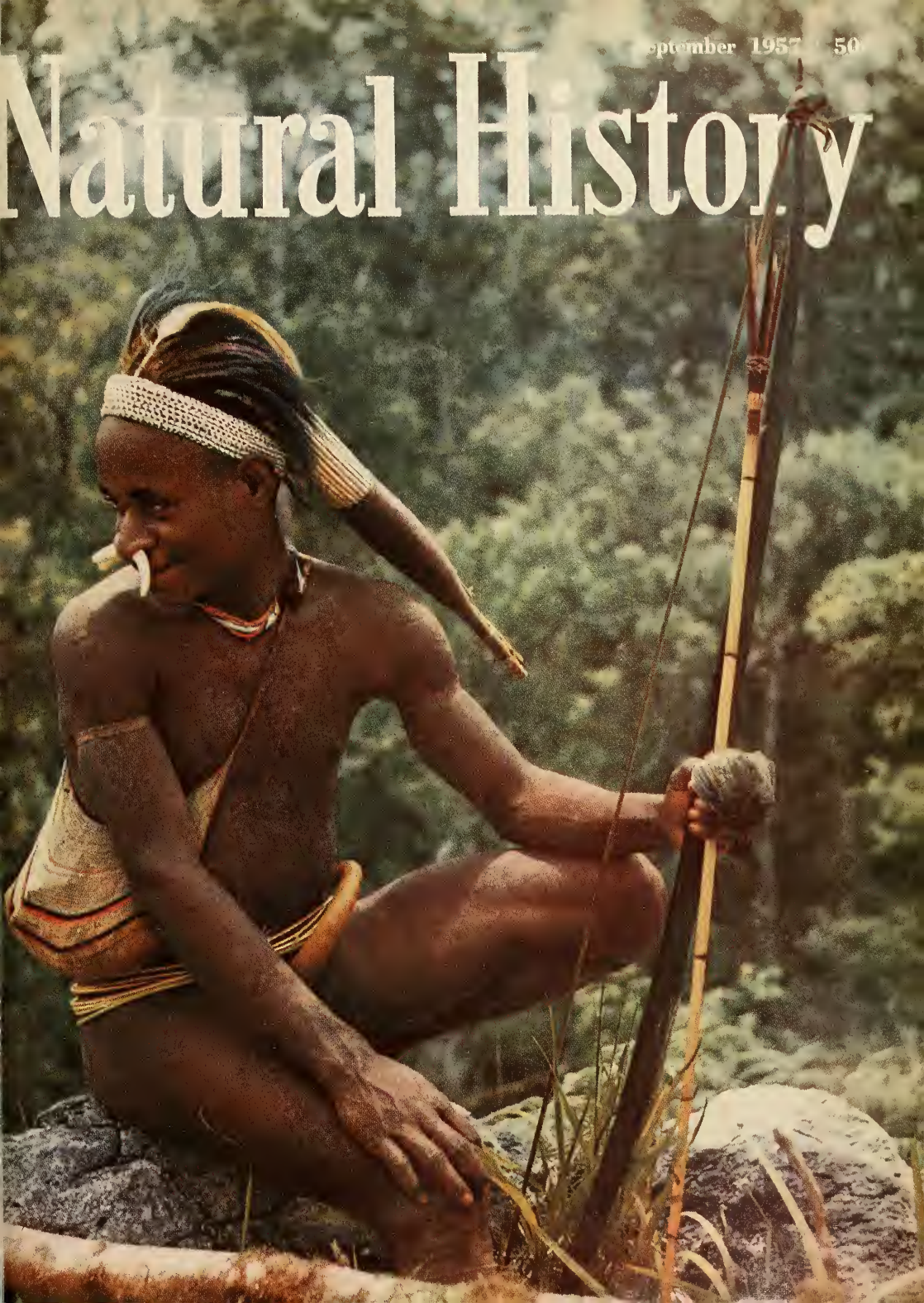

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Letters

The Cortez Skeletons

SIRS:

In 1951, a Mr. Charles Rippetoe, of Cortez, Colorado, came upon some desiccated bones in a shallow, hillside cave some six miles northwest of the town, near the site of an abandoned coal mine. He brought them to the curator of the local museum, Mr. E. F. Roelfs. As may be seen (photo), the find consisted of a section of backbone, pelvis, and a left leg and foot.

In December 1956, two young Cortez men, exploring the tunnels of this same coal mine, came upon a somewhat larger but essentially similar skeleton, which they also brought to Mr. Roelfs, together with some additional bones.

I first saw the two "Cortez skeletons" late this spring when I happened into Mr. Roelfs' one-room museum in the basement of the city hall. Although I have some modest familiarity with fossil finds, I was at a loss to recognize these obviously fresh bones, rat-gnawed in part, but still held together in many places by shreds of cartilage and dried flesh.

I soon discovered that Mr. Roelfs and many of the interested people of Cortez were at an equal loss and that their effort to identify the specimens had led only to confusion.

One of Mr. Roelfs' first actions had been to send a snapshot of the larger specimen to an institution, that shall remain nameless here, with a request for identification.

The expert who framed the reply took note mainly of the described locality of the second find: ". . . in a coal mine." With nothing but the snapshot to work from, the expert concluded that the specimen represented some Cortez amateur paleontologist's painstaking assemblage of fossil bones. Checking the age of coal deposits in the Cortez area, he concluded that such a specimen could well be a diminutive dinosaur of the Cretaceous period and so informed Mr. Roelfs.

Because some local people, struck by the "reptilian" appearance of the restorations, had already thought about dinosaurs more than once, this apparent, but actually false, confirmation of their hunch—coupled with the obvious freshness of the bones—conjured up an image of the nearby desert as a present-day home for cute little survivors from the Cretaceous!

The West is still the West, and it was not long after this misconception was launched that stories began coming into town. In the early morning hours, the tales would go, old so-and-so spotted just such a creature jumping around through the brush on its hind legs, near McElmo Creek, while someone across the Utah line, near Recapture Canyon, had seen the same thing.

COMPARISON of Museum's Western Porcupine (top) with first Cortez skeleton (below).

I have always enjoyed NATURAL HISTORY's explanations of the "mysteries" of nature. Perhaps your other readers will share my interest in any light the American Museum is able to shed on this "Mystery of the Cortez Skeletons."

CRESSON H. KEARNY

Montrose, Colorado

The Department of Mammals replies:

While positive identification is difficult without actual inspection and measurement, the bones of the smaller specimen are definitely those of a present-day medium-size mammal. In restoration, the attachment of the ribs is inaccurately close to the pelvis. All the anterior parts of the skeleton, including the skull, neck, and forelegs, are missing, but the remaining group of bones (to judge from only the photograph) appear a perfect match for the foot, left leg, pelvis, and part of the spinal column of the Western Porcupine, *Erethizon epixanthum* (see matching photo). The restoration of the limbs in the larger specimen is inaccurate, but all the bones of the lower leg and foot fit the same interpretation.

Warning on Bats

SIRS:

Can you help me identify a bat which I recently found near my home in Louisville, Kentucky? The creature is formed like the common brown bat, but its coat is specked with silver gray hairs, and it has a blond face crossed by a badger streak. The eyes are set wide apart and to each side, while the ears are somewhat like those of a very young rabbit. The bat has a pug nose, but not the nose-flag common to some varieties. Its wings have patches of blond hair near the bones.

In measurement, this bat is about three-

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The Magazine of the American Museum of Natural History

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September, 1957

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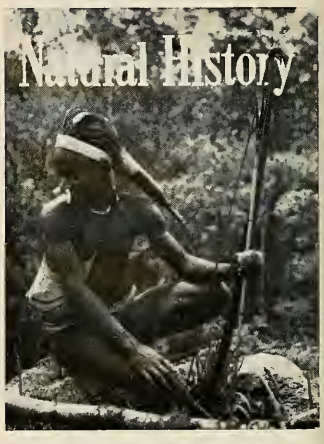

The brown-skinned New Guinea hunter on the cover was photographed by Thomas Gilliard, a staff ornithologist of the American Museum of Natural History. A native of the remote Telefolmin area of central New Guinea, this young warrior is armed with a black palm bow, and his arrow is of the special multi-pointed kind used for birds. Together with bow and arrow, he is holding a fresh-killed small flycatcher, the skin of which is now a part of Mr. Gilliard's study-collection in the Museum. The narrow yellow bands wrapped about his waist are rattan "fire-starters". The marks on his shoulders come from the rope of a burden he has just set down. He wears a boar's tusk in his nose, a band of small cowrie shells as a crown, and a long sheath of cane windings covers his hair. For the story of Mr. Gilliard's New Guinea trip and of a remarkable native student of bird life he met, see page 344.

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Reviews-

THE TROPICS

by Edgar Aubert de la Rüe, François Bourlière, and Jean-Paul Harroy

Knopf, $12.50, 208 pp., illus., maps

Reviewed by
HOBART M. VAN DEUSEN

THE tropics have always been a source of wonder and delight to naturalists, but today these lands are assuming an ever-increasing importance in man's maturing economy. The authors of this beautifully illustrated book have given us a most important view, both in word and picture, of our earth's extraordinarily diversified and complex torrid zone. Of even greater importance is their success in bringing understanding and appreciation to the reader, not only of the varied resources and conditions peculiar to the equatorial countries, but also of the problems raised by the impact of our temperate-zone industrialism on the tropics.

No region of the earth is so little understood as the tropics. E. Aubert de la Rüe, a geologist by profession, but a keenly observant botanist and a photographer by avocation, competently discusses the physical factors that control the type and distribution of plant communities, and then describes with enthusiasm the richness of these habitats. These natural areas are a major part of man's heritage, and should form an important part of his endowment to future generations.

François Bourlière, the author within recent years of two widely-read books on mammals, focuses our attention on the almost incredible variety of vertebrate and invertebrate life in the tropics' myriad of available niches. In turn, Jean-Paul Harroy, Secretary of the International Union for the Protection of Nature, is primarily concerned with man's utilization of the four categories of renewable resources: soils, water, wild plants, and wild animals.

Indeed, it is with the interdependence and delicate balance among these factors in the tropics that this book is primarily concerned. Man's disruptive pattern of activity is upsetting this balance. The soils of these tropic lands are peculiarly vulnerable to denudation of natural cover by the extension of modern agriculture, and by the great increase in stock-raising made possible by advances in veterinary medicine. Water resources fail rapidly as a direct result of man's exploitation of the soils.

The imperative message of this book is that mankind must come to a complete understanding of the tropical environ-

ment if this vast and potentially productive area is to be retained for future centuries.

Mr. Van Deusen, *a member of the American Museum's Department of Mammals since 1945, has taken part in two Museum expeditions in the tropics: one to Cape York, Australia, and one to Papua.*

Easter Island

A Stone Age Civilization of the Pacific

by Alfred Métraux

Translated from the French by Michael Bullock

Oxford University Press, $5.00
249 pp., illus.

Reviewed by
Alphonse Riesenfeld

FEW anthropological popularizations are viewed with so much skepticism as books on Easter Island. Hardly any other spot in the world has had more fantasies spun about it than this forlorn little island in the Pacific. All this changes, however, when the writer is Alfred Métraux, one of the foremost authorities on Easter Island culture, whose present volume is based on his own field work at the Island—material which was published in full in a scientific monograph in 1940.

Starting with a well-written history of the Island's discovery and leading to its more recent experiences with slavery and race mixture, Dr. Métraux unfolds the whole cycle of native life. He analyzes the problem of the Island's famous wooden tablets (with their carved designs) and the attempts by such scholars as de Hévesy, Heine-Geldern, and others to interpret them as a script. Métraux follows Peter Buck in the belief that the tablets probably represent memory aids for Easter Island bards in the recitation of chants.

One chapter is devoted to the stone statues of the Island, which have given rise to so many speculations. Métraux points out that their weight and antiquity have been greatly exaggerated and that we need not postulate a very ancient and hypothetical people as their builders nor volcanic cataclysm as the hypothetical destroyer of this hypothetical people. Like Peter Buck, he divests the statues themselves of any "mysterious" quality, so often wrongly ascribed to them, by showing that they are well integrated into other forms of Polynesian plastic art and are the result of the local abundance of soft volcanic tufa, so perfectly suited to the carving of statues.

Métraux takes a firm stand against Heyerdahl's theory that the Polynesians came from America. This he does by emphasizing the totally different stylistic qualities of the stone statues of Easter Island and Peru and by summarizing a number of other arguments previously mentioned by several other authors.

Thus, Dr. Métraux's book goes beyond a mere local reconstruction of Easter Island culture and assumes the scope of a wider Polynesian culture, which makes fine reading for expert and layman alike.

Dr. Riesenfeld *was educated at the Universities of Berlin and Vienna, receiving his Ph.D. in anthropology at the latter in 1937. He is an expert on cultural influences and the varieties of physique to be found among the peoples of the Pacific.*

Great stone heads of Easter Island have been subject of speculation for decades.

Wooden statue reflects parallel style.

Lascaux and Carnac

by Glyn Daniel

Macmillan, $3.00 127 pp., illus.

Reviewed by
Carleton S. Coon

FRANCE is one vast museum of ancient and modern art. Glyn Daniel has selected two outstanding prehistoric periods as his subjects for this charming and well-illustrated work. These are the cave paintings and sculptures of the Dordogne, dated at somewhere between 20,000 and 10,000 B.C.; and the massive megalithic architecture of the Carnac region of Brittany, dated more precisely between 1800 and 1400 B.C. The cave dates are beginning to come out of Carbon 14 analyses; the megalith dates were established years

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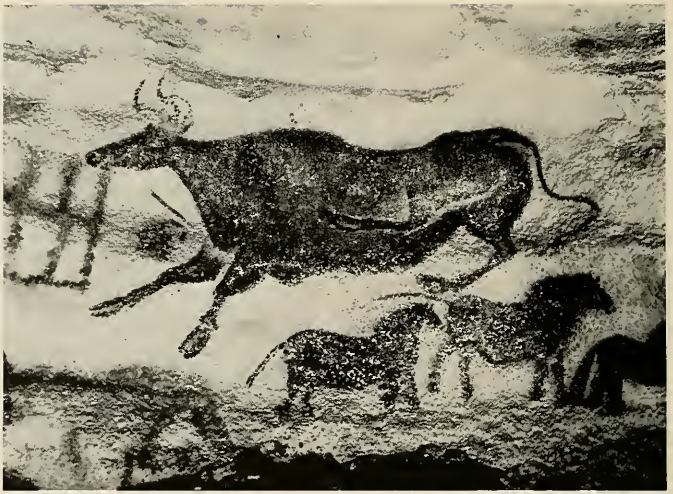


PALEOLITHIC cave painting, at Lascaux, depicts spirited ox, trio of shaggy ponies.

ago by the presence in the tombs of trade objects of known date.

Our guide tells us exactly how to get to both regions by train or car, where to stay, and what foods and local wines to expect. He also tells us the hours when local sites and museums are open, and even where to park our cars and honk our horns to rouse the curator–guide of one of the caves. For those who cannot make the trip, Dr. Daniel's selection of illustrations are as well chosen and well reproduced as any outside a de luxe color album.

The paintings in Lascaux, the most recently discovered and greatest of the cave sites, are mostly of animals, rendered in colors so fresh they might have been laid on last week. This is great art. While most of the paintings represent single beasts, some show groups of animals, particularly one frieze of horses so brilliantly executed that they seem gay. In this sense, Daniel compares them to some of Disney's work.

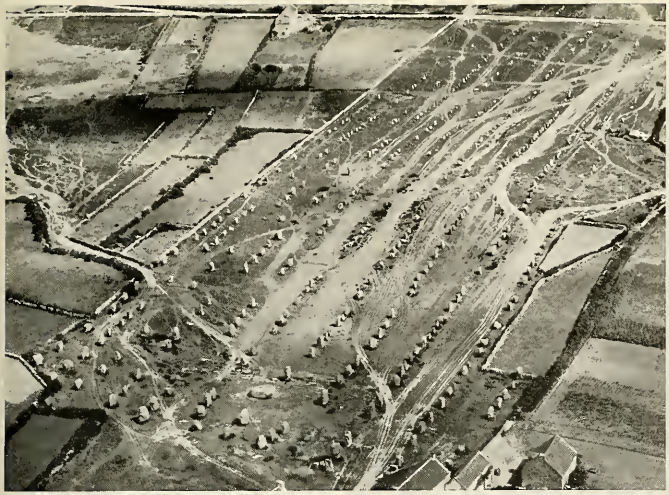
Great art can be created only in time of economic plenty. The hunters who fed the artists killed thousands of reindeer. The bones and antlers of these animals show that they were so plentiful that the hunters could pick and choose individual beasts of just the tenderest age and condition. Their production-line technique must have provided a surplus of excellent meat, permitting specialization in art and the creation of schools of artists, capable of criticizing and copying each other's work. Although human figures are rare and sketchy, enough detail is shown to warrant the conclusion (borne out by their bones) that the artists were just as European as the present inhabitants of the valley of the Vézère.

Turning to Carnac and the megalithic monuments of the early metal age, we shift from full color to black, white, and infinite shades of gray. We see a procession of menhirs marching into the sea, the level of which has risen since the ancient people erected them; a double stone circle like a figure eight; the majesty of a broken stone shaft, once rising sixty-seven-and-a-half feet high and weighing 330 tons—almost as tall and nearly twice as heavy as an Egyptian obelisk; the eleven parallel rows of erect stones at Carnac itself. All these scenes are even more awe-inspiring than the scented gloom of a great cathedral, if for no other reason than that, at these open shrines, we have no idea of the religious meaning that lies behind the monuments, and our imaginations can have full play.

These megaliths were built, apparently, by or through the inspiration of adventurers, traveling from the Mediterranean in search of metal. But local styles and concepts also developed, for the *alignements* of Brittany have no parallel across the Channel; the great stone circles of Stonehenge and Avebury are purely British.

Daniel's book has just the right mixture of erudition and sparkling good humor for easy and pleasant reading. Compared with some recent books dealing with discoveries of the past and the appreciation of ancient art, it is a ripe, red mango amid a basket of turnips.

DR. COON *has been active in anthropology for over thirty years, ranging, in search of information, from Morocco through the Near East to Persia and Afghanistan. His* Races of Europe *and* Story of Man *are classics in their field.*



MEGALITHIC *alignment* at Carnac, in air view, shows eleven parallel rows of stones.

THE SUN

by Giorgio Abetti

Translated from the Italian
by J. B. Sidgwick

Macmillan, $12.00, 336 pp., illus.

Reviewed by

THOMAS D. NICHOLSON

ORIGINALLY published in 1934, this authoritative work appears now in its first English translation, from the Italian edition of 1954, but with still further additions and revisions. In this form it provides an ideal review of solar astronomy from the time of Galileo, and is an excellent addition to the basic science library of the English-reading layman.

The Sun describes in detail the discovery, classification, means of investigating, and structure of the several kinds of solar features, summarizing the significant studies that have been made and the basic theories of their formation, appearance, evolution, and contribution to the physical nature and properties of the sun.

Methods of solar research have come far since the primitive telescopes of the seventeenth century opened up this field of study. It was then that many solar features first became known—sunspots, darkening of the limb, granularity of the surface, the bright faculae. Early research was largely concerned with the classification and description of the phenomena observed and their progressive changes.

Within the past century, however, major changes in the objectives of solar study have followed from the development of highly specialized instrumentation. Such instruments have permitted research into the physical and chemical states of matter in the sun, conditions in the layers of its atmosphere, and distribution and brightness of hydrogen and calcium gas. Signor Abetti reviews the history of these accomplishments and describes accurately the methods and conclusions solar investigators have reported up until 1955.

The book is exceptionally well illustrated. Unfortunately, some of the figures have been reduced too greatly for their details to be clearly followed. This, of course, applies principally to those taken from other sources; the charts and diagrams original in the work are quite clear. The plates are generally excellent and provide a fine pictorial record of the sun in its various aspects and the institutions and methods that have been devised to study it.

EXHIBITIONS OF INTEREST:

WHITE ART MUSEUM, Cornell University (through September 27): watercolors by Louis Agassiz Fuertes, including a previously unshown group of hawks, owls, and eagles.

NEW YORK STATE MUSEUM, Albany (September—October): animals in miniature; selected works of Louis Paul Jonas, notable sculptor of many museum dioramas.

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↑ AUTHOR'S WIFE HEADS COLUMN ON COLLECTING TRIP INTO MOUNTAINS. IN CENTER: STROBOSCOPE FOR PHOTOGRAPHS.

A Stone Age Naturalist

In a mountain valley near the center of New Guinea, an American ornithologist meets a Neolithic fellow student of birds, whose land was first entered during World War II

By E. THOMAS GILLIARD

A FEW dark worlds still remain hidden among the remote inland areas of New Guinea, and the scientific treasures they hold are among the most enticing in the South Pacific.

New Guinea is the hub of a constellation of some 500 islands, and the fount from which they have derived most of their plant and animal life. From its hot mangrove swamps to its perpetual snow peaks, it includes all the earth's climatic zones from tropical to arctic. Unknown birds, mammals, plants, insects, and other creatures await investigation deep in its mountain recesses, where men still live a Neolithic life.

Looking back over my visits to this naturalist's paradise, one experience in particular seems especially interesting, because it ties the past

E. THOMAS GILLIARD, who is Associate Curator of Birds at The American Museum of Natural History, is also well known as an author and lecturer. On one of his many expeditions, he discovered a complete skeleton of the extinct Great Auk.

to the present and, indeed, to the future. It has to do with one of the most unusual ornithological assignments I ever undertook and with a strange personage who played an important part in it — a Stone Age bird expert.

My chance of penetrating the biologically unexplored heart of New Guinea — the region of the Victor Emanuel and Hindenburg Mountains — came when Mr. Fred Shaw-Mayer, a veteran collector for Lord Rothschild and the British Museum told me of a secret wartime airfield built high in the very headwaters of the mighty Sepik River. In a valley between these two mountain ranges, at a place called Telefolmin, paratroopers had been dropped and an emergency strip prepared. Shaw-Mayer said Telefolmin had recently been reoccupied by two patrol officers of the Australian Division of Native Affairs.

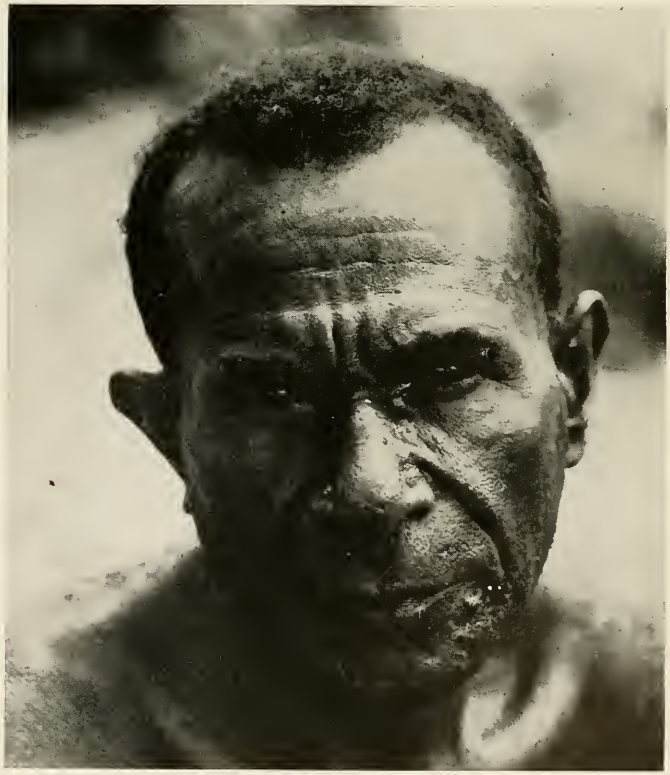
I immediately began to organize an expedition to attempt to collect the animal life — chiefly, the birds — of this remote region. This undertaking was backed by The American Museum of Natural History, the National Geographic Society, the C. R. Vose Exploration Fund of The Explorers Club, and the Frank M. Chapman Memorial Fund. My wife Margaret, a veteran of previous expeditions to the Philippines and New Guinea, set out with me in October, 1953.

But on our arrival in New Guinea, we found our path temporarily blocked. On November 8, we learned that one of the two patrol officers in the Telefolmin area, Geoffrey Harris — who had been keeping bird-lists in expectation of our arrival — had been killed in an ambush. A day later, another bulletin told us that the second patrol officer, Gerald Szarka, and two native policemen, had also been killed.

The Australian authorities quite naturally held up their approval of our visit to the area. It was more than four months later, in March of 1954, that we made a stormy voyage along the north coast of New Guinea and landed at Wewak to make a final plea to the District Commissioner for permission to enter the region. We were delighted to find that the District Commissioner could think of nothing better than to have a naturalist and his wife go to Telefolmin. It would help convince the natives, he felt, that normalcy was soon to replace the martial law that had been enforced since the murders. Of course, we would have to follow some special rules. Foremost: I was expected to take five armed men with me and, in addition, accept a police escort that would accompany us day and night. Obviously, a most unusual collecting trip!

The next day, Margaret and I, with our team of Sepik natives, boarded a Norseman monoplane and were soon laboring across the ridges of the Prince Alexander Mountains. Here the aborigines had cut huge "windows" 30 to 50 feet wide in the mountain forest, causing the sharpest ridges to resemble upended saws. Across the openings they had stretched intricate nets to catch the flying fox, the world's largest flying mammal. Soon, the braided Sepik River came into view below, and we flew southwest toward a distant line of peaks projecting jagged edges through a sea of cotton cloud.

After two hours in the air we came close to a tremendous Matterhorn of a peak and turned east around a heavily forested bluff of the Mittag Range marking the westernmost end of the Victor Emanuel Cordillera. There, at 6,000 feet with walls of mountain on either side, lay the Telefolmin clearing. We hit the grass strip and stepped out to find three native-style houses, a



↑ Hair cropped in prison cut, Femsep sits for his portrait, unadorned with usual tribal finery. Soon after, Femsep and author were deep in birdlore.

stockade, and a dozen little sheds, with the Australian flag waving from a pole just under the mist.

We set up base camp in an abandoned mission house about a mile from the patrol post. But explore and collect we could not, because Frank Jones, the Assistant District Officer, would not let us out of his sight. Beyond the Telefolmin perimeter were uncontrolled natives still smarting from their defeat at the hands of 100 police and a team of white officers — natives who had nearly succeeded in throwing the white men out of their mountain fastness. The police guard stuck to us like glue, and we were forbidden even to go to the latrine without a loaded weapon.

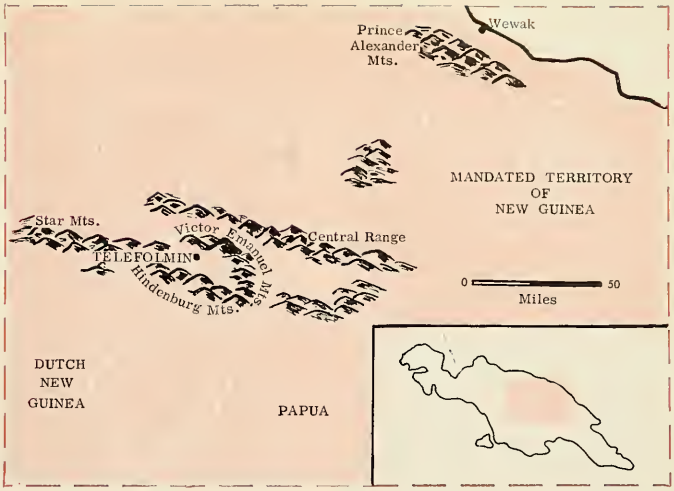
As the days at Telefolmin wore into weeks, the local natives became acquainted with our collecting and began to come into our camp. We offered matches and salt for specimens brought in, and children began calling early in the morning for small transparent envelopes in which to bring us butterflies.

We hear of Femsep

Using sign language and a "turnie talk" (interpreter), we paid generously for specimens and gradually amassed quite an assortment from an ever-widening range. More important, the older men began to come.

Often they repeated the name "Femsep." Clearly, this Femsep had an exceptional reputation as a local naturalist. If I showed a picture of a rare bird, my pidgin-speaker was apt to say, "Femsep e savy dispela (Femsep knows this one)."

When the natives realized that we had nothing to do with the Government or the Mission, we felt ourselves "accepted." Gradually, our interest in the animals important to them formed a bond such as the men at the patrol post had probably never enjoyed. At last, Mr. Jones granted us permission to call on the famous Femsep—a permission necessary to obtain because this local naturalist was implicated as one of the murderers—perhaps the leader—who had ambushed the two patrol officers in 1953. Taken mortally sick after his arrest and imprisonment at



TELEFOLMIN valley (map) lies in a mountain knot near headwaters of Sepik. Panorama (left), from shoulder of Hindenburg Mountains, looks out across cloud-shaded Telefolmin valley to crest of Victor Emanuels (left: Mt. Ifal).

Wewak, he had been returned to his native valley by the Australian authorities so that he might die in his home district.

We found Femsep in one of the little villages we had flown over. Sitting in the round entrance to his dwelling, he was a tiny man, emaciated by dysentery and fever. His eyes were yellow and dull, his strength at low ebb. He was totally naked, and the holes in his nose lacked the slender decorative cassowary quills other men wore. His hair was shorn in a prison cut—the strands that had once intertwined in a great horn of carefully wrapped cane shafts were gone.

Mournfully, a harem of women helped him forward, and we squatted on the ground between the houses. Femsep accepted my tobacco but quickly handed it to a full-breasted girl. One by one, I turned the colored pictures of birds: the Superb Bird of Paradise with its great cape extended, the Queen Carola Bird of Paradise, with its six-flagged hatpins and violet chest shield, and the rest.

He names the birds

At sight of each, the old man's hollow voice uttered the name. High and low on the mountains, near and far, he knew them all and where they lived. He seemed to know more about New Guinea birds than is contained in the books and reports of a century of exploration. His knowledge extended from the tropical forests of the Fly River to the headwaters of the Strickland. It even reached over the Mittags into the tropical lowlands of the Sepik. Most important of all, his knowledge included the stunted mountain moss forest that scraped the sky all about us — home of a birdlife little known to white men.

Then, pictures to one side, he and I talked of Paradise birds of the highest mountain forest, the so-called Astrapias — represented by amazingly different species on all of the isolated ranges thus far explored. One that he named the *Dan* lived in the "place cold," and with a shudder he wrapped his frail arms around his shoulders and shivered. Others there included the rare *Inem*, the fabulous King of Saxony Bird of Paradise. I could not identify some he mentioned, including one that he named over and over—the *Kondimkait*.

Like veteran naturalists, Femsep and I were soon lost in the atmosphere of scientific ornithology. Our "turnie talk" was left far behind, for we invented our own language —a hodgepodge of grunts, hand signals, and broken pidgin. It was not long before I knew I was not only safe but welcome in his realm. Ornithology had bridged the gap between a Neolithic naturalist and his modern counterpart, even as it crosses racial and political boundaries in our more troubled and bloodier modern societies.

Although his hollow abdomen clung to his backbone, Femsep was nevertheless still a monarch in the Victor Emanuels. Despite the ominous charges against him, one understood why, when he was near death in jail on the coast, Govern-

▲ Young girl of Telefolmin brings a Bird of Paradise to author's camp.

ment officers, doctors, and pilots had rushed this man of prestige and power back to his mountain retreat to die among his own.

I could easily imagine Femsep young and lithe, with legs like a mountain goat. His childhood would have accustomed him to the semi-nomadic life of his family, never staying long at any one of the huts his father built of split timbers here and there in valleys far apart in the forest.

His youthful nights would have been spent behind the little barred opening of a fortified hut, warmed by a smoky fire, the boy curled up among the big sows and the women.

At dusk, he would have watched his father join the other village men to pass the night in the large "house of mystery," about which many strange tales were whispered. A place of eerie voices and sounds, the "house of mystery" was heavily protected against attack, with arrow portholes in the walls and surrounded by a barrier fence beyond which children never strayed and women could not pass.

During his family's many journeys to mountain gardens and on nights spent in the forest, Femsep would have noted his father's equipment—bow and arrows, fire-starter, and two little string bags, one worn under the chin, and the other behind like a tiny knapsack. In these were his father's treasures: tobacco and a few bird plumes, a string of dog teeth, some cassowary quills, and a crown made of red feathers from the flanks of a large parrot. When entering a village not visited for some time, he would have seen his father put on his greatest trophy, a headdress of King of Saxony Bird of Paradise plumes.

Femsep's mother would have traveled naked except for two whiskbroom-sized fans at the waist, one in front and one behind. She would have carried a large string bag, its top forming a tumpline over her forehead, while its lower parts bounced against her buttocks. Following on the rough trails, Femsep the boy would have emulated his parents, rarely whimpering even in the face of bitter weather.

Anything edible found along the trail was quickly captured and eaten raw – tree frogs, lizards, insects, grubs. Often a lizard would be stunned and carried half-alive in a net bag to provide a needed snack. The tender hearts of palms and tall grasses were eaten, as was a kind of watercress found beside the few streams. Occasionally, a *kapul* or rat would be spied, and everyone would take after it hastily like a pack of hounds. The confused animal would dive into shelter under

▼ Bird joins array of prepared skins collecting on expedition worktable.

▼ Police (left) stand guard over line of handcuffed suspects, who are to be flown to Wewak for trial after slaying of two Telefolmin Patrol Officers.

forest debris and be easily caught.

The most daring expeditions involved long trips across the "death-lines" — territorial boundaries between tribes, that almost no stranger may pass without risking his life — into no-man's land to search the highest forests for the oily nut of the wild pandanus. These palms grew in a fairyland of moss- and orchid-festooned forest, usually buried in gray mist. Their kernel-bearing fruits resembled giant pineapples, growing one to a palm.

Mountain betrayal

On one such journey, I learned, Femsep's family had visited a peak in the Hindenburg Mountains, called Ilkaveep, where the boy helped to build a low shelter from wild banana and split palm leaves. There the little tribe shivered in a mass of naked humanity each night. For many days, they searched for pandanus nuts, eating them raw or after burning the huge composite "fruits" to release the kernels.

Again and again on this Ilkaveep sojourn, Femsep's family saw signs of other wandering tribes. One afternoon they met a group of strangers. At first, there was a very careful interchange of talk. Finally, the strangers gathered around the Telefolmin fires, drying their wet bodies and exchanging news. The newcomers were Fegelmen people, from the Isam River — one of the headwaters of the Fly.

Later, when everyone had been lulled into a state of good fellowship, the Fegelmen warriors suddenly slashed the throats of ten of Femsep's group. The more agile Telefolmin women and children escaped, racing down the precipitous trail in terror, Femsep among them.

The Fegelmen group hacked off the heads and extremities of their victims and carried the trophies back to the Isam River amidst great laughter. A joyous feast was held, and soon thereafter ten new skulls decorated the walls of the Fegelmen "house of mystery."

Such was the environment in which Femsep grew to manhood. Sometimes long periods would pass without killings, but always there loomed the "death-line" at the edge of Telefolmin territory, and always there was a score to be settled—a payback, a life taken — for tribal memory was long. Femsep's fame spread. He became a sage, and he alone among the tribes—the Hitamin, the Minyamin, the Feramin, and all except the Fegelmen—could cross the "death-lines" and smoke with neighboring tribal leaders.

From Femsep's viewpoint, World War II was a time that brought white men with guns and tools into his quiet valley to appropriate the driest part of the flat land for their own purposes. The missionaries who followed the soldiers were, to Femsep, other unimaginable strangers who mocked his ancestral beliefs. His own faith held firm, but the conviction grew among the Telefolmin youth that Femsep's ancient teachings were as out of date as the stone ax he carried.

The departure of the whites after the war was a time of brief joy for Femsep and the other old people of Telefolmin. It proved a brief respite. By 1949, Femsep had to face another invasion from the sky. That year, a noisy little plane came with two white men in uniform and some foreign blacks with rifles. These new whites were friendly, but their presence meant inevitable change: soon, each healthy man found he must work four days a month for the "Government."

During those five years that passed before I met him, what had gone through Femsep's mind as he clung to ancient ways? Had he been a leader in the steps to regain his sovereign land? No one knows for sure. But one day the airstrip had been furrowed when the bothersome little plane came in to land. And someone among the Telefolmin had decided that the two patrol officers should be ambushed, even as the Fegelmen had ambushed Femsep's father.

The blow came one day when the two officers were on separate patrols, far from the post. Both were approached by seemingly friendly natives. There was laughing and

▲ Bearded hunter's double-crown has shell-band, teeth, animal-tail top.

▲ Cassowary quills through nostrils and tooth collar make this décor.

▼ Parrot plumes top crown of shells.

↑ Femsep's patronage allowed author to visit "house of mystery" (right). Men are part of armed escort.

↑ Typical village house has oval hole for door: pigs live underneath.

then bartering of pigs and food. Even the native policemen confidently left their rifles standing in the camp. Suddenly arrows flew and stone axes flailed.

Norman Draper, a Baptist missionary—the only other white man in the 70,000-square mile wilderness—happened to be at the patrol post when an escaping native policeman returned to give the alarm. He rallied the police and radioed Wewak. Within a few hours, planes brought reinforcements from the coast. Twenty suspects, including Femsep, were rounded up and sent to Wewak for trial.

I have related how Femsep, taken sick, had been sent home to die. The other nineteen who stayed behind in Wewak for trial were sentenced to death. The Australian authorities later decided that such wild people could not be held accountable by white men's law and sent the nineteen back to their home district to serve out sentences of ten years at hard labor.

Femsep's help

My meeting with Femsep made possible the series of explorations that my wife and I thereafter undertook into the magnificent moss forests and mountains around Telefolmin. It was Femsep who supplied the carriers and directed them to guide us over hidden trails. There, among the pandanus, we were at last able to study the birds he knew so well—the Astrapias—the Magnificent Bird of Paradise, the King of Saxony, and 124 others. Femsep's huntsmen brought down many of our scientific specimens with arrows. All, that is, but the *Kondimkait,* a bird so rare that Femsep had seen only a few in his lifetime. I am sure that some day it will be found where Femsep said it lives.

After we came back down from the forests, Femsep was strong

↑ VILLAGE MEN climb ladder to house's single entrance.

↑ FIGHTING shield stands by wall covered with pig jaws.

enough to visit us. Day after day he would shuffle into our camp to examine the bird-skins and to tell me what he knew. He pantomimed with his body the dances of the Birds of Paradise. He formed the nests with his hands; he imitated their calls. On the ground he scratched the shapes of their plumes in full display. He even drew good maps and understood the scale and orientation of mine. When forming a map, he often stopped to gaze into the distance and to point, describing range after range surrounding the Telefolmin region.

Thus an important part of my ornithological map of New Guinea has been filled by the words that flowed from Femsep's lips—eagerly spoken, razor-keen words—transmitting a lore which is almost certainly doomed. Criminal or history-crossed patriot, Femsep of Telefolmin is a naturalist with whom I am proud to have worked.

↑ PROUDEST trophies in "house of mystery" are human skulls, like this one (in net bag). Patrol raid in 1957 turned up 35 new skulls in house nearby.

▲ THIS TOWER IN WASHINGTON IS LOOKOUT AND DWELLING

TOWERS in the Sky

At the peak of summer, more than two thousand men and women stand guard among our national forests to report the first signs of a fire

By WENDELL SMITH

ABOVE a wooded ridge in the Sierra Nevada a great steel tower shimmers in the brilliant sunlight of an August afternoon. Through the open windows, a slight breeze blows in from the west, bringing with it a suggestion of the heat radiating from dark green slopes.

The young lookout keeps close watch on the expanse of forest that stretches in every direction. His eyes systematically scan the familiar view around him.

Suddenly his gaze is arrested by a thin column of white rising above the crest of a mountain far away. Instantly he raises his binoculars. Yes, it *is* smoke! He swings the alidade, or fire finder, around for a reading. Then, lifting the mike of the two-way radio, he reports to the fire dispatcher at forest headquarters miles away.

With his glasses trained on the smoke, the lookout listens to the radio conversations his call has started: the cross-reading from another lookout; the call to a suppression crew to head for the fire; the message to a neighboring lumber camp for more men.

There is a fire in the forest, *his* forest, but at least he has the satisfaction of knowing that he has discovered it – and in time.

This scene, with variations, is enacted thousands of times every summer and fall, in all sections of the country, on more than 5,000 lookout posts guarding our forests.

It's lonely work, manning a tower, which is one reason the U. S. Forest Service frequently hires married couples for this job. Still, in many cases, it is the chance for peace and solitude that attracts people to this seasonal, hermitlike occupation. Some lookout stations are easily reached by car or jeep; other posts are located in remote mountain areas where the only transportation is by shanks' mare or horseback. For every lookout there is a different panorama, and his tower may be quite unlike the one on a neighboring lookout.

Structurally, lookout posts are built according to the dictates of the terrain. Many lookouts, especially those commanding a wide view from a high open spot, are little more than glass-enclosed cabins. Others are steel towers, some of which rise to well over 100 feet above the ground. This type of tower is especially common in the level woodlands of the South.

The U.S. Forest Service maintains some 2,082 lookout posts in its 149 national forests. Not all of these posts are manned simultaneously, however; many are occupied only during times of extreme fire hazard.

In addition to these Federal stations, over 3,000 others are situated in state forests, and many more are operated by private companies that own wooded tracts.

WENDELL SMITH and his wife spent their honeymoon on a lookout in Stanislaus National Forest, Calif. A frequent writer on natural history, he says this is his first article since moving to a "treeless development" near Philadelphia.

↑ Bearing on smoke column is taken with alidade atop lookout tower, and reading reported by radio to forest headquarters.

↑ Two readings from adjacent towers give cross-bearing, which pinpoints area of outbreak.

In the East, lookouts are posted as a rule only in the spring and fall, while in the West, lookouts may be on duty from May or June through October or November. Western forests are in more serious danger from fire in the late summer.

Some lookouts may make several calls a day to report suspicious smokes. This is especially true if their posts also overlook settled areas, railroads, or lumber or construction operations, since no chances can be taken as to the origin of the smoke. Other lookouts may go weeks, even an entire season, without seeing the slightest suggestion of a fire. Minutes count in reporting fires, and lookouts must remain ever alert. If suppression crews can reach a fire soon enough, the blaze can be controlled before serious damage is done to the forest and before the fire can spread.

Though more fires are started in national forests by lightning than by man, those caused by man are usually more devastating. For one thing, lightning usually strikes high on ridges, starting a small fire that spreads slowly. Then, too, lightning is ordinarily accompanied by rain. On the other hand, man-caused fires are most often started along roads, trails, streams, or on the lower slopes of ridges, from where they may spread rapidly uphill. Fires that are deliberately set often occur at the peak of the danger season.

Watersheds, wildlife, soil, grazing land, dwellings, and recreation areas all fall prey to fire. On New Year's Day, 1934, a flood ripped out of Pickens Canyon, California, and destroyed 400 homes in the town of Montrose, taking 34 lives and causing damage amounting to five million dollars. The flood waters came from a few hundred acres of watershed above the canyon where, about a month earlier, a forest and brush fire had destroyed the cover of grass, leaves, and other plant litter which helps absorb falling water.

Often the fertile forest soil, centuries old, is so badly damaged that it can grow nothing but weeds. Seeds that should replant the barren acres are roasted, and every seedling is killed.

On April 10, 1948, near Holyoke, Colorado, a farmer was burning rubbish in a wheat field when an unpredictable wind came up. Soon it was blowing at 50 miles an hour. The rubbish fire spread over the farmer's own grazing lands and roared through neighboring ranges. Five hundred men fought that fire. Four farmers were killed and scores of others were injured.

(continued on page 386)

↑ Flatlands of Florida need these extra-tall towers: this one is in the Apalachicola National Forest.

↑ Mountain-top in New Mexico has a lookout built of native stone. This is Lincoln National Forest.

SAIDU SHARIF, CAPITAL OF SWAT, LIES IN GREEN VALLEY BETWEEN BARREN HILLS

SWAT—Where yesterday walks side by side with tomorrow

On Pakistan's northwest frontier, a progressive ruler brings a new way of life to his people

By DIANE LEC. RAWSON

Westerners have found fascination in accounts of remote parts of Asia since the days of Marco Polo. Here is a visit to the legendary land of Swat, including an audience with the ruling family. The author, with whose writings the readers of NATURAL HISTORY are already familiar, is surveying the lands to the south of the Soviet Union.

HOW easy it is to recognize a frontier state, I thought, as I rattled along in a lorry toward Swat. The men invariably carry guns on their shoulders; the landscapes are dotted with fortresses; and the moment you see a village you also spot its "burg"—that fortified watchtower where keen-eyed sentries keep a sharp lookout for unwelcome guests.

Yet the instant I crossed the levy gates and entered Swat, I realized that my blueprint would have to be revised. The road was smooth and well kept; I stretched my legs and relaxed my grip—without fear of bouncing through the roof. Ahead neither man nor beast blocked our path; instead, pedestrians walked single file along both sides of the road.

Swat—nearly 4,000 square miles in area—lies on the northwest frontier of Pakistan. Officially a part of West Pakistan, it is a self-contained unit of half a million people.

We soon reached Saidu Sharif, the capital. Here again, surprises were the order of the day. To our right was a large sport field; next, a hospital; then, a school. A little farther on, my driver identified a large building.

"The Wali college—200 pupils—no pay," he remarked.

I was a bit confused by this telegraphic description, but my first guess turned out to be right: here education was free for undergraduate students. And if they chose later to do advanced work, they received special grants to study at universities outside Swat.

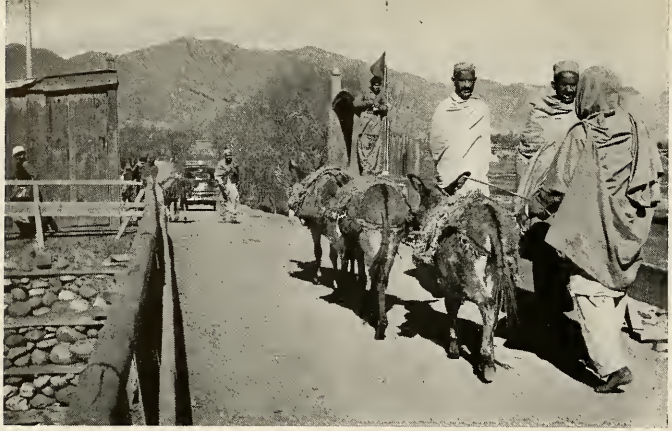
This was only the first of many times I was to hear the Wali spoken of as the benefactor of his people. Although he is an absolute ruler who could, if he chose, have a subject's head cut off without answering to anyone, he does not do so. Swat is an example of how benevolent an autocracy can be.

Miangul Badshah, or Gulshahyada, founded the state and became its first wali in 1917. Deeply religious, progressive, public-spirited, and ruthless, he welded the people of the Swat River valley into a whole. They prospered, and

▲ MAIN MARKET STREET of Saidu runs along stone retaining wall that curbs seasonal high waters of the Swat River.

▲ HILLTOP FORT (top), a typical Swat police station, was built to withstand attacks by nomad tribesmen in past.

▲ SINGLE ROAD to Saidu runs through fertile terraced valley that supports Swat's half-million population.



▲ WOODEN BRIDGE across Swat River is guarded by policeman (center), who knits placidly as pedestrians and donkeys are approached by oncoming car.

▲ ON UPPER RIVER, north of Saidu, timber-balks are floated downstream.

▼ HUMPED CATTLE of Swat feed on grain stalks, spread out in adobe manger.

the state was recognized by India in 1926. The Wali encouraged education, opened public institutions, improved agriculture, and built decent roads. Then in 1949 he retired to a life of contemplation, relinquishing temporal sovereignty to his son, Jahan Zeb.

I received another indelible impression of progress in this state one afternoon when, in the course of a hike, I came upon one of the fortresses I had expected to find here on the frontier. It was a formidable structure with four solid towers. I described it later to an official. He smiled indulgently and explained that, although they had not done much to change the exterior, this building housed one of their newest dispensaries.

"I thought you supplied medical aid to your villages through mobile dispensaries," I remarked.

The official was full of apologies. I must have been reading *last* year's report, he said; since then the three mobile units had been replaced by a number of village dispensaries.

I was speechless. In America, such a development might not have surprised me, but here in this distant corner! What was the reason for all this? Were the people of this region completely different? No, replied several men, it had all happened because of their wali.

By now, my one desire was to meet this extraordinary man, so I spoke to his secretary. An interview, he answered, couldn't possibly take place. "The Wali is visiting your country now," he said. He searched his desk and pulled out a list—"I am mistaken," he apologized. "Yesterday he was in America. Tomorrow he will be in England."

But the next morning I went to see Gulshahyada, founder of the state and father of the absent wali. At the palace gate a guard took my name. I expected a long wait and so was interested in what the secretary had to show me. There was the ruler's private mosque, although anyone could go in and pray, my companion explained;

next, his simple but spacious residence; and to the left, the swimming pool.

Just then, the guard returned to conduct me to the Batcha, or "king," as many still call him. We entered a large rectangular room with many unadorned windows and two rows of caned armchairs. At the far end, near a telephone, sat the Batcha, reading. The moment I entered, he rose and, coming forward, greeted me warmly in the manner of all Pathan tribesmen by placing my hand between his. One of his sons was coming to act as interpreter; he was sorry to keep me waiting.

View of a "King"

The next few minutes, spent in silence, permitted me to observe the Batcha. He was an old man, with white beard and weather-beaten face, his eyes partly hidden by horn-rimmed glasses. I liked his expressive hands—they were the hands of a man who has seldom rejected the tasks before him—though his fingers were long and tapering. I glanced at his feet and could hardly believe my eyes! His white tennis shoes were spotless and perfectly laced—but where was the knot? I was fascinated—how did he get them on and off? At that moment, the Wali's brother, Sultan Room, entered. Quickly I looked down again—it was then that I spotted the zipper! With that modern convenience, the "shoeing" operation would present no problem at all.

Sultan Room was dressed more conventionally than his father. Like most young men of Saidu Sharif, he wore loosely-draped cotton trousers topped with a *khalqa*, or loose shirt, and an embroidered pillbox cap. He was a handsome man and spoke English fluently.

What was I interested in, he asked. I wanted the Batcha to tell me about those early days when the things I now saw were only beginning to come about. Asking a warrior to recount his exploits is like asking a collector to show you his treasures. It was evident that the Batcha relived every moment as he told how, out of utter chaos and constant tribal warfare, he had succeeded in creating a state. His face was all animation; and more than once he chuckled over some remembrance.

He had been born more than 70 years before, the son of a holy man named Akhund Sahib.

"In those days," said the Batcha, "there were no roads, only a few trails. We have an old saying, 'Everything went in the wrong direction except the river,' and it describes the country as it was then." Indeed, the Swat River had been the only barrier at first to the tribes pushing in from Dir State, where most of the trouble came from at that time.

I recalled Dir State as a beautiful mountainous country where I had pitched my tent in 1950. There were scattered villages gripping its sharp inclines, and one single road forging northward. Every man I had met there was carrying a gun and cartridge belt. But now, Gulshahyada indicated, the border of Swat had been stabilized and fighting as such had died out, though the old feud spirit had not completely vanished.

Gulshahyada's amazing feat was the creation, with only a few supporters, of a state under one head, himself. One other man, he said, had done it before him. But this man, though he had led a victorious army, had not lasted. He was an outsider from Amb, the Batcha explained, who belonged to a different religious sect, and the people would not support him.

There had been hard times for Gulshahyada. For weeks, he and his followers had to live in the forest, eating whatever they could find. To regain power, he admitted, it had been necessary to use devious methods, but he insisted that popular support had finally defeated the enemy.

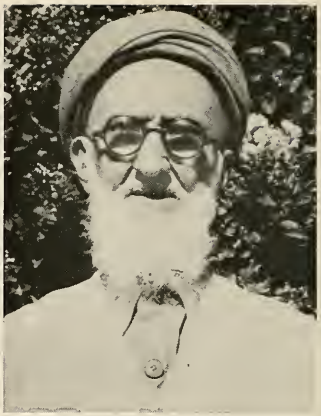
"When I went to the villages," he told me, "I took only a few men. I did not want to frighten the people or be a burden to the villagers. When you learn to walk, you cannot be arrogant. I talked to the people and slowly won them over."

In the 1920's, the British, finding Gulshahyada the strongest and most popular tribal chief, asked him to consolidate his territories into one state. Those first years were hard.

"I was known as a tough ruler," he said, "and now I had to convince the people that I was not. So, like a father with children who are too young to understand, I let

▲ Tribal children, in town for day, stay warmly dressed against wind.

▲ Merchant, in plaid blanket, offers a caged quail to bypassers.



↑ FIRST RULER of modern Swat was Miangul Abdul Wadud Gulshahyada, who passed rule to son in 1949.

← BUDDHIST STUPA stands ten miles south of Saidu: today, people of Swat are almost entirely Moslem.

them run free, even to the point of mischief. Then they grew, and I had to make them understand. When the first school was opened, I had to bribe the parents to let their sons attend. I had to buy the books, push the children into the classrooms, and then put guards outside to keep them from running away. Now they come on their own, and parents ask my son for more schools." The old man was visibly pleased by this turn of affairs.

In 1949, Gulshahyada turned the government over to his son, Major General Miangul Abdul Haq Jahan Zeb. He knew a younger man than himself should take the helm, for after the partition of India, the country had to work at top speed.

Before leaving, I asked the Batcha about his people, whose appearance intrigued me.

"They are Yusafzai Pathans," he explained, "and many of the older men will tell you they are descendants of the Jewish race. When I traveled to Jerusalem as a young man, I was surprised to find that those people wear costumes almost identical with our own."

Later on, during my wanderings through Chitral, Dir, and Gilgit, I was repeatedly reminded by their rajahs that the state of Swat had come into existence only 30 years ago and that the term "wali" was not a title. But the people of Swat are proud of the youthfulness of their nation and of the fact that their "king" is one of them.

"Who owns the Land?"

A few days after my visit with Gulshahyada, I met his grandson, Captain Aurangzeb, who in the absence of his father, the Wali, was handling the government. Unlike his small, sturdy grandfather, Aurangzeb is tall and powerfully built. His manner is quick and decisive, and his answers direct.

"Who owns the land here?" I asked. "The State?"

"We are not Communists!" he gasped. "The people own it, of course. They pay seven per cent of their crops in taxes. But since you ask, my grandfather owns 2,000 acres — less than many of your Texas ranchers — and I personally own no land at all."

He spoke of the 350 miles of fine roads, of the cultivated fields of corn and rice, and of the many orchards. "The people's holdings are generally small," he said. "Because of that and because of the large stretches of rocky land, we need to push back the mountains — we need bulldozers rather than tractors."

Two nights later, I was invited to dinner at the palace, which looks like a small, attractive country estate. The younger brother of the Wali-ahad (heir apparent) was there, as well as another male guest and his wife. This man said to me, "I hope you will forgive my wife; she talks little . . . but only recently she gave up the *burqa*."

Laying aside the *burqa*, that all-enveloping shroud worn by many Moslem women, may seem simple enough to us, but actually it is much more. For the first time in her life this woman had stepped into a world of men and women who exchange ideas, laugh together, and even look into each other's eyes. She had never had to cope with this type of situation before, and I imagine she was a little frightened. Yet without uttering a word, she managed to look charming and interested throughout the entire evening. Just before she left, I heard her voice for the first time as she thanked her host for his hospitality.

I had expected a Pathan dinner, but many of the dishes were Western — a polite concession to my presence. The cream of mushroom soup was delicious, the melba toast crisp, and the chicken was offered in the form of tender morsels with fresh, green vegetables. There was a large dish of *pulao,* a mixture of rice, meat, and dried fruits. The frozen pudding was mixed with fresh fruits, and the water was tinged with lemon extract. After dinner we were served *qahwah,* green tea with cardamom seeds, though I was first asked if I preferred coffee.

It was not long before the melodies of "South Pacific" and "Oklahoma" came drifting to my ears. The Wali-ahad explained that he liked ballroom dancing and only Western music was suitable for that.

I noticed a graceful vase of bronze and brass on a side table which, the Wali-ahad explained, had been unearthed barely ten miles from where I was standing. That marked the beginning of great excavation works, for this area had once been a center of Buddhist culture. I now understood the Buddha I had seen carved out of the mountain wall, as well as several ancient *stupas,* or shrines.

During the evening I mentioned my visit to the hospital, where I had been told that the patients often came for treatment only after their diseases had reached an advanced stage. The Wali-ahad agreed.

"We have only one woman doctor," he explained, "and that is not enough. Female patients here do not like being examined by men. We must have more women doctors."

This was the first time I had heard a man here show any concern for women, and I suddenly realized how few women I had met. Under their heavy *burqas,* they seem to fade into the background. And if work in the fields prevents them from wearing the *burqa,* they still always manage to be unobtrusive. I wondered how deeply the modernism of two dynamic personali-

Continued on page 388

▲ SPIRAL STAIRWAYS DECORATE MODERN JAHANZEB COLLEGE. INSTRUCTION (INCLUDING VETERINARY STUDY) IS FREE.

▲ Miller's son began listening at age 4 in a California eucalypt grove

Listen

I ONCE spent a week flat on my back in a Los Angeles hospital —but through the open window fourteen species of birds spoke to me about the pleasant, sunny outdoors. I've heard coyotes bugle a perfect motif from Handel's "Elijah," and listened to sandhill cranes beat out the rhythm of a samba. Once, in Arizona, what I thought to be the yapping of a mountain lion turned out to be an Arizona spotted owl.

Nature speaks loud and clear if we will but keep our ears open. Hearing is a sense that has been too long neglected by those of us who love the woods, the prairies, the seashore. By listening more purposefully, scientists can better understand the world, and the average person can increase his enjoyment of the outdoors.

"Yeah?" a friend once jeered. "What about that darned mockingbird that wakes me up at 2 A.M.?"

"If you'll only listen to it, instead of burying your head in a pillow," I replied, "you'll find the mocker a most delightful chap."

Careful listening will demonstrate that rarely as much as seven percent of the mockingbird's musical mosaic is stolen from other birds. Rather than being a plagiarist, he is an artist like Anton Dvořák who is said by some to have used snatches of Negro melodies in his New World Symphony to give interesting variety to his own creations.

Luckily, I learned the virtues of listening at an early age. As a youngster I had poor eyesight and maybe that accounts for a keen interest in the sense of hearing. But I also learned how to make it work.

Nature is speaking to You

The world around us speaks with many voices. Here, a noted biologist relates what he has learned during a lifetime of keeping his ears, as well as his eyes, open outdoors

By Loye Holmes Miller, *as told to* Andrew Hamilton

When I was a teen-age boy in Riverside, California, I spent several weeks crawling through the brush along the Santa Ana River, trying to discover a bird that made a weird, skyrocketing spiral of song. I never did find him that summer.

Next year, I reversed my tactics. Instead of pursuing the sound, I sat quietly in a clump of willow, listened and waited. Slowly and softly I whistled an imitation of the mysterious bird's call. Almost immediately the skyrocket of notes shot up again. Another call, another shower of musical notes—this time closer. Finally, a bird hopped out on the limb across the little glade. It was a russet-backed thrush. Those are things that one doesn't forget. Time and again in later years I have listened for this thrush and called it to me for the sheer joy of re-living that discovery.

Listening to nature has many advantages. It equips you with "eyes in the back of your head," so to speak. The human eye can see through only a narrow visual angle. But the ear can hear through the whole 360-degree sweep of the horizon. Moreover, it can penetrate through a leafy tree or the sedges of a pond, "radar" through the darkness of the night or periscope around a rocky cliff.

How, you may ask, does one learn to listen?

Simply by *listening*—or, I should say, by discriminate or analytical listening. For years I have carried a small notebook in which I jot down the cries of birds, the thumping rhythms of rabbits, the odd snorts and wheezes of deer. Since the ordinary musical scale is somewhat inadequate, I have developed my own system of hieroglyphics to record the sounds of nature (below). You may wish to develop something similar yourself.

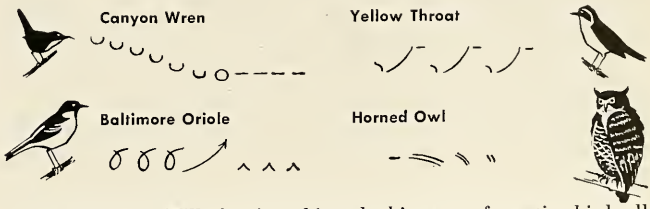
Do birds talk or sing? Talking is usually thought of as an expression of ideas, an exercise of the intellect. Singing, on the other hand, is an expression of emotion. In all probability, birds both talk and sing. I used to feed and "talk" to a flock of California quail in my back yard. They had several basic expressions—"Come!" "Look out!" "All right!" and "Get away!" In addition, there was a pure singing call made by an old cock quail who seemed to say, "Oh boy, oh joy! Where do we go from here?"

I'm sometimes asked if there exists one language for all birds or all animals. The answer is no—as surely as there is no universal language for the peoples of the world. The poor-wills understand the poor-wills and the robins understand the robins. But it probably doesn't go farther than that.

Of course, certain cries of alarm or of distress are universally understood by all creatures. For example, an Anglo-Saxon-reared pack mule reacts to a series of cuss words from a Mexican driver as readily as if he understood fluent Spanish.

All sounds have definite characteristics. Some of these peculiarities are so delicate they can be recorded and analyzed only by the sensitive instruments of the acoustical laboratory. But many of them can be distinguished by the human ear after a little practice.

A scientist picks things to pieces so that his mind may grasp how they were made originally. This is a constructive process if we don't stop with just the pieces. A monkey or a small child can tear things apart, but an adult's intelligence can put together in his brain a restoration of the thing destroyed. Let's pick apart some of the sounds of nature, to see if we can understand them better, learn more readily to recognize them, and know the birds and animals who made them. I used to tell my university classes that the sounds of nature can be analyzed by what I



Samples of Dr. Miller's private hieroglyphic system for noting bird calls.

Dr. Loye Holmes Miller, a retired ornithologist and avian paleontologist, taught at UCLA for 24 years. His book *Lifelong Boyhood* describes "the odd and humorous adventures that befall a naturalist."

* * * * * *

Andrew Hamilton is manager of the Office of Public Information at UCLA. He majored in political science but also had two biology courses with Dr. Miller—"the most enjoyable of my college classes."

call the five "T's"—time, tone, tune, timbre, and touch.

Time implies rhythm. Listen and you can hear the rhythm of the wild creatures all around you. If you are a drumming enthusiast, listen to nature's drummer boys—the rattle of a woodpecker on a tin drainpipe or the tap drumming of a spotted screech owl.

The spring crowing note of the California quail is repeated at intervals of about six seconds. The single hoot of the pygmy owl is repeated with almost metronomic regularity at about 60 notes per minute. A slightly different race from the mountains of southern Arizona steps up the rhythm to 70 or more per minute and raises the absolute pitch. Tree crickets chirp at a quick, throbbing tempo in the warmer hours of early evening, but slow down as temperatures fall later in the night.

Tone may mean the difference between a pleasant sound and a harsh sound. A series of regular vibrations produces a tone, whereas irregular vibrations result in noise. The mourning dove and the great horned owl produce beautiful tones, the crow utters a harsh cry that is not a tone at all. A coyote's bark is nothing but noise, but when it raises its muzzle and bugles the rising sun, it produces a tone that some people swear is heavenly music.

By listening to bird and animal calls, Tin Pan Alley's tunesmiths might find a new source of melodies. The meadowlark, for example, may sing in a major key that can be noted on a musical staff without much distortion. The song of the mountain chickadee includes a minor interval. The golden-crowned sparrow starts off with the same interval as the chickadee, then wanders off-key and stops—as if abashed by its mistake.

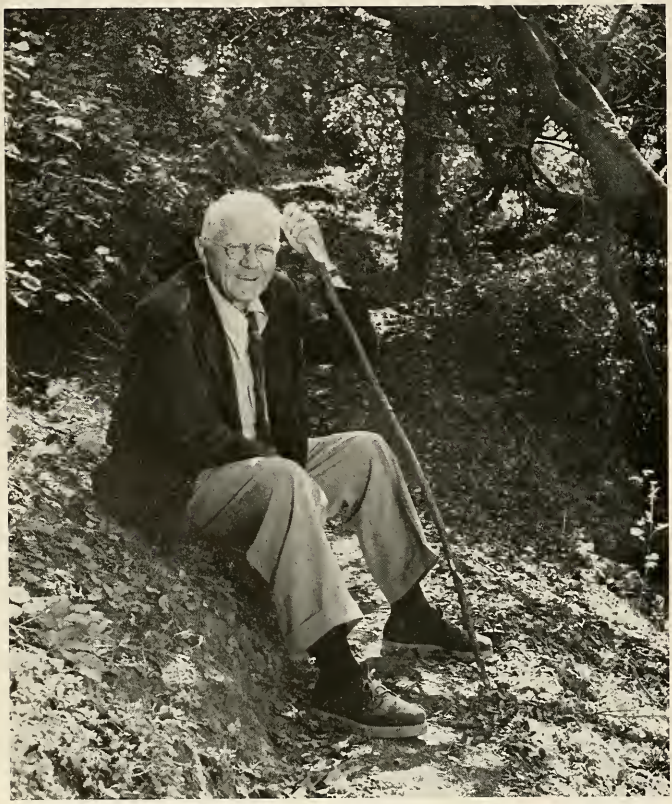
Tune involves pitch. The pitch of a sound differs with the length of its waves or frequency. In a pond or lake, short waves come lapping up to the shore with great frequency, while on a sea beach great waves roll in at long and pounding intervals.

Similarly, the unseen waves of the atmosphere burst upon the eardrum and arouse wondrous stimuli. A series of short or frequent sound waves produces a high-pitched tone. Less frequent impulses produce a lower tone. Even a tone-deaf person can distinguish between a child's voice and a man's voice by the pitch. After some experience outdoors, he could probably tell a timber wolf from a coyote or a horned owl from a spotted owl.

If you are musically inclined, try carrying a pitch pipe with you the next time you go on an excursion. You'll be surprised to learn that birds possess remarkable fidelity in the matter of absolute pitch. There is some variation with respect to the age or sex of the individual, but the variation is surprisingly slight. In general, large birds have bigger windpipes and their voices are pitched lower than are those of small birds.

Timbre makes the voices of the outdoors recognizable, not by what they say but by how they say it. Timbre, or voice quality, soon becomes familiar. Suppose you watch a meadowlark high on its singing post some bright spring morning. It will produce the same sequence of notes for a variable number of times, then will "put on a different record" with a totally different sequence. But it will still be a meadowlark song and nobody can mistake it.

I have watched a single bird sing three different patterns, all within five minutes. One of my students recorded eight different



▲ Retired from teaching, Dr. Miller still finds pleasure listening to nature.

↑ FIELD CLASS picture, in 1913, shows youthful Miller (right) with students.

songs within a 20-acre area one spring, yet they were all unmistakably meadowlark songs.

The mountain quail has a smoothly-rounded whistle, the golden eagle a harsh scream, the California quail a reedy tone, the blue grouse a muffled, hollow boom, the green-backed goldfinch a thin and wiry piping, and the California thrasher a bit of a Scottish burr-r-r in its song notes.

Touch is that unique quality of sound—mostly accent and inflection—that individualizes birds. Some sounds that we would call "chip," turn down; others like "tweet," turn up. How birds are able to make certain sounds, I frankly don't know. The varied thrush, for example, has both a low and a high sound that results in a weird vibrating whistle. The sandhill crane combines a tongue-flutter sound with a whistle and a grunt—all three at the same time.

In addition to the five "T's," volume is a factor in classifying the sounds of nature and locating the creatures that make them. The origin of sounds coming over a plain, over quiet water, or from the sky are often difficult to establish. Additional confusion is created by echoes from cliffs, rocks, and trees.

I've developed a crude but effective kind of triangulation that can be applied to sounds on the ground. At the spot where you first hear the sound, determine the direction you think it comes from and draw an imaginary line to it. Now move at right angles to this line as far as practicable and draw another imaginary line. Where the two lines intersect, you'll probably find the source of the sound.

This device has proved of great value to me in locating owls at night. Their voices are often most elusive during darkness because of a muffled quality and a varied loudness. The whispered songs of birds in autumn or winter are sometimes so ventriloquistic that they can be located in no other way. A hermit thrush may sing full-throated from the deep woods, or it may whisper from a point less than ten feet away.

Talking Back

Once you have learned to listen to the feathered and furred creatures of the wild, the next step is to try to talk to them. I recall that my father whistled to the owls when we went tramping through Temescal Canyon near Riverside, California, and that a cousin used to "talk back" to a raven that flew over as he worked on his farm.

My first attempt at imitating birds occurred when my brother and I played together in bed. He cheeped like a baby chick and pretended to have one in his hands under the covers. I took to cheeping also. In later years, as a biologist, I found that I could understand the creatures of the mountains, the deserts, and the sea better when I listened and talked with them.

I've had goldfinches drop down from the sky and chickadees hop out of the trees and peck crumbs from my open hands. I've teased baffled horned owls in the desert and in the mountains by imitating their calls. At the zoo I've set sandhill cranes to trumpeting by reproducing their tribal call.

Once I conducted an interesting experiment in trying to teach a pair of linnets to sing. A student had brought a pair of three-day-old linnets into my laboratory. I placed the raisin-sized birds—named Nip and Tuck—in a clean ice cream carton lined with cotton and fed them bread and milk. Here was a unique opportunity, I decided, to determine whether bird songs are inherited from feathered ancestors or are learned from their mother's twitterings. Heredity or environment?

Every day for six weeks I whistled the sharp, ringing note of the canyon wren to Nip and Tuck. It seemed like quite a trick to play on them. But if they learned to sing like canyon wrens, instead of twittering like linnets, it would be evidence that the sound waves beating on their tiny ear drums were more powerful than their inherited chromosomal patterns.

One day Nip woke from a post-breakfast nap and settled the question at once. He opened his tiny beak and cheeped his first note—the true and unmistakable sound of millions of his linnet forebears. Heredity had won!

The poet William Cullen Bryant once wrote, "To him who, in the love of Nature, holds communion with her visible forms, she speaks a various language." He might just as well have used the expression "audible forms," for nature is full of many kinds of delightful sounds. It will pay you in moments of enjoyment to listen to them.

▲ PLODDING STEADILY ACROSS THE DAMP SAND FLATS OF MONOMOY, A SOLITARY HORSESHOE CRAB SEARCHES FOR THE SEA

THE Oldest Migration

The leathery shells you saw in this summer's sea wrack may have been remnants of an annual tryst that predates not only man but also the birds and flowers

By EDWIN WAY TEALE

EACH year in the spring and early summer, the oldest migration in the world occurs at the edge of the sea all the way from Maine to Yucatan. Instinctively choosing the highest tides of the month, creatures out of the remote past—the last survivors of prehistoric animals that are known to us only as fossils—come swimming and creeping up from the shallows to deposit their eggs in the tide-washed sand. Thus the horseshoe crab engages in a mass movement that antedates the earliest migration of the birds, antedates even the birds themselves. It was a yearly occurrence long before the world knew flowers or bees, infinitely long—perhaps as much as 200 million years—well before the coming of man.

Standing at the water's edge, surrounded by the smell of the sea and the sound of the waves, we witness the event with a sense of awe. What happens before us forms one link in a chain of life that we can follow in imagination back and back across almost immeasurable reaches of time. To the tide line where they themselves were born, on sheltered beaches of bays and river mouths all down the Atlantic Coast, these primitive creatures make their annual return. I have seen it many times but never so spectacularly as once along the western edge of Monomoy Island, at the elbow of Cape Cod.

With Henry B. Kane and David Garrison I had camped out the night before among the low dunes. High tide came early in the morning, bringing with it thousands of the horseshoe-shaped creatures. Some advanced singly, others in tandem, as they massed together and jostled each other all along the shallows of the western shore. On rare occasions, three were linked together—once even four—moving like a small train with the larger female pulling in front. The coupled males and females were not, as is generally supposed, actually mating. The females deposit the eggs unfertilized—hundreds at a time—in shallow depressions scooped out of the sand. The males merely attach themselves to the shells of the female instinctively so their presence will be assured when the eggs are laid. Then they spread their fecundating milt. This gland secretion contains the sperm cells that enter and fertilize the eggs.

Observers have reported that the males usually begin to move toward the shore first and then wait below the tide line to attach themselves to the females as they pass. If unsuccessful in this, they follow the general movement and swim ashore singly.

Wherever we found the creatures most thickly concentrated along a half a mile or more of tide line, we saw that greenish eggs had collected in the troughs of innumerable ripple marks. Each tiny globe was about one-twelfth of an inch in diameter, smooth and slippery to the touch. The slow churning of the water over the nests had carried away these eggs. At the same time, it had covered most of the rest with sand, leaving them hidden to incubate in the warmth of the sun. The nests are usually made at or near the high tide line. Each is an inch or two deep, and in scooping them out, the female uses the curved front edge of her shell as a plow. Each female deposits 200 to 300 eggs, of which only a small proportion survive.

On Monomoy that late-May day we saw thousands of shorebirds dining on the eggs. They were mainly semipalmated sandpipers. Hungry fish often swim into the shallows where the horseshoe crabs have congregated. And eels are so ravenous for the eggs that they sometimes push, several at a time, beneath a female to devour them as they are laid.

Within the eggs that survive, embryos slowly develop. A month later, the waters of another high tide wash away the sand and rupture the shells. If you are there, you will see them emerge—tiny creatures suggesting Lilliputian trilobites,* those extinct animals whose fossil remains are found in Cambrian limestone. The currents of the receding tide carry them down into the shallows.

Because of their external resemblance to trilobites, the newly emerged horseshoe crabs are sometimes called "trilobite larvae." And according to the most recent authoritative treatise, there is a direct relationship between the horseshoe

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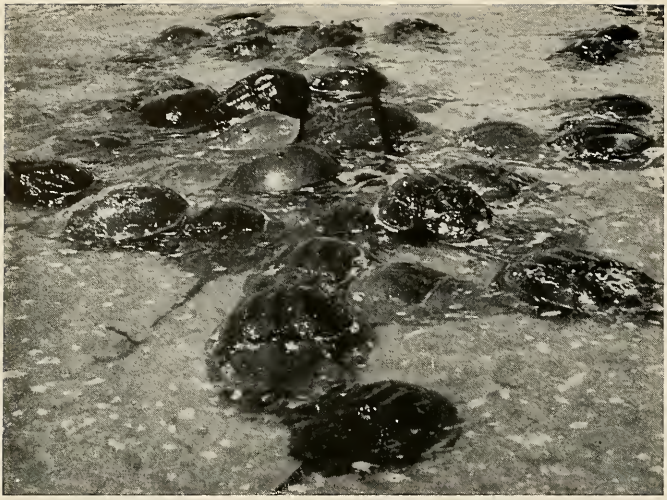
EDWIN WAY TEALE has spent the summer gathering material for his third book in the American Seasons Series. *North with the Spring* has now appeared in England, Germany, and France. *Autumn Across America* is being published in England.

*See "What is a Trilobite?" by John H. Gerard in NATURAL HISTORY for May, 1956.

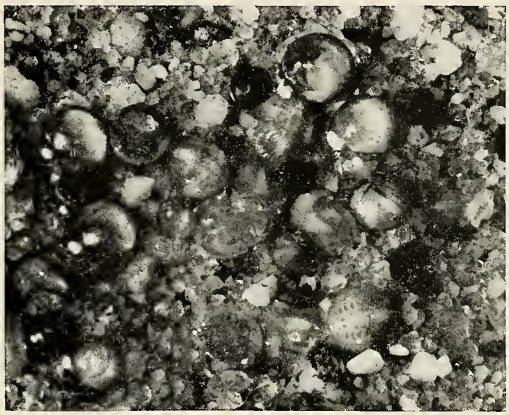


◄ JOURNEY'S start, in tidal water, sees males hitched to partners. Coupling is to assure presence of male when female lays her eggs.

▼ NEXT STEP for the pair is to dig underground in the tide line sand. Female's "nest" will be an inch or two below surface, where eggs will then be fertilized by male milt.

▲ FEMALE of this pair has now buried herself in the sand and only male horseshoe crab, tail thrashing, is in sight.

▼ FERTILE eggs, in exposed nest, show embryo growth.



▼ CLOSEUP of tailless horseshoe larvae, ready to emerge.

crab and the trilobites. Nor is it to be classified as an arachnid with the spiders and scorpions, as has been done previously.

At first, the "trilobite larva," top-heavy, swims on its back like the fresh-water fairy shrimp. It has no need to hunt food. Portions of the egg yolk remain in its digestive tract and supply it with nourishment. Usually it remains close to shore. After the last of the nourishment remaining from the egg has been consumed, the young creature goes through its first molt and emerges horseshoe-shaped, resembling the adult in every respect. Previously it had been tailless; now it possesses a slender swordtail.

From then on, it continues to molt and increase in size from year to year. Dr. Carl N. Shuster, Jr., who has been studying the life of this long-enduring creature at the zoology laboratory of Rutgers University, reports that each molt makes it about 25% larger. Even after becoming an adult, the animal continues to molt for several years. The discarded shells, cast up by the waves and caught in the stiff beach grass, appear in many sizes. The smaller ones are light yellow; the largest are so dark a brown that they look almost black.

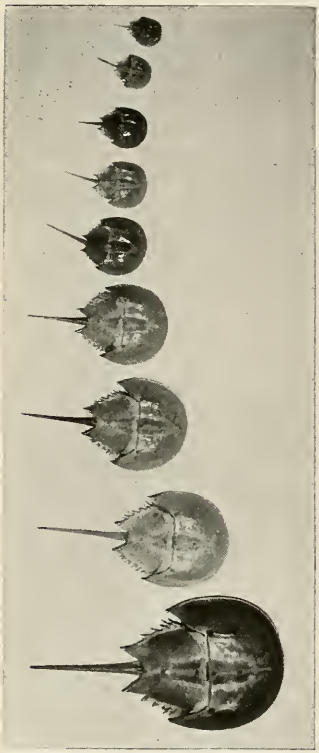
Scientifically, this animal is now known as *Xiphosura polyphemus*, but you will still hear it called by its earlier scientific name, *Limulus*. It is also known as the horsefoot, the horsefish, the king crab, the turtle crab, the panfish, and the swordtail.

When very young, it feeds on minute organisms in the ooze; as it grows, it depends upon larger and larger prey. Marine worms and soft clams make up the bulk of the diet in adulthood. It never chews its food. It has no jaws. Instead, a special projection at the base of the first four pairs of "legs" enables it to tear its food up before stuffing it into its mouth. It feeds mostly at night.

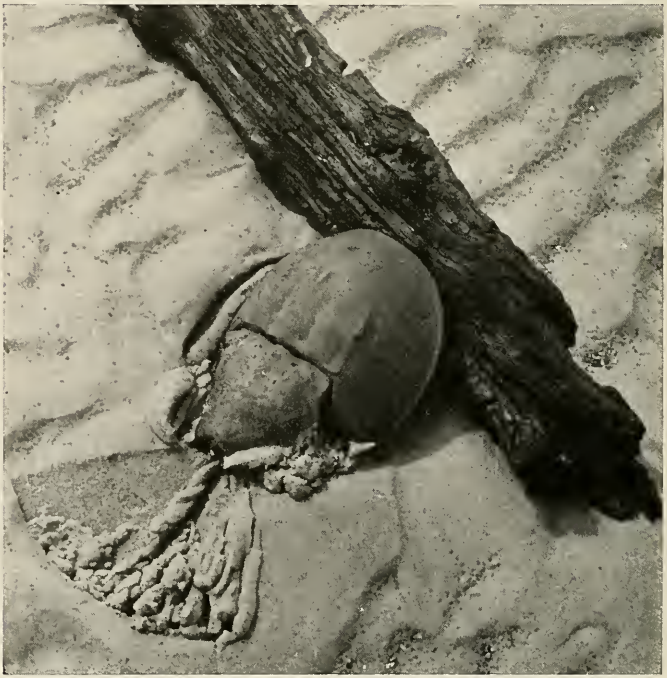
How long a horseshoe crab lives, nobody knows. At Monomoy we saw some ancient mariners covered with barnacles and limpets. One had a hole the size of my fist near one eye, but this didn't bother it at all. The animal's body occupies only a small space near the center of the pan-shaped shell that forms its armor. Through the hole, we could see its legs moving.

H. G. Wells once described the horseshoe crab as resembling a small boy crawling about under a tin bathtub with a broomstick trailing behind. The long swordtail has a special use. When a wave upsets the animal, the tail is used as a lever for regaining an upright position.

Ordinarily a horseshoe crab stays within a few miles of the place where it hatches and prefers water from 6 to 35 feet deep. As it swims close to the bottom, it is aided by five curious gill-books formed of parchment-thin leaves totalling as



↑ Molts show growth to adult size.



↑ Off-course horseshoe crab works vainly to surmount driftwood obstacle.

many as 200 leaflets. These serve a double purpose. They extract oxygen from the water and also help propel the animal forward. The oxygen thus obtained is carried through the creature's body by blood which, as seems fitting for an animal of such ancient lineage, is tinted blue. Some students of evolution have even suggested that it was from some ancestor resembling this "blueblood" that all the vertebrates of the world have descended.

Some Unknowns

It has recently been discovered that the horseshoe crab can see ultraviolet and infrared rays that are invisible to us. And like the honeybee, it can see polarized light. Dr. Talbot H. Waterman, who has made these discoveries at the Osborn Zoological Laboratory at Yale, is now seeking to determine whether the horseshoe crab can utilize polarized light as the hivebee does to orient itself.

Still a mystery to scientists is the curious distribution of horseshoe crabs. Aside from the single species that ranges down our eastern coast, these creatures are found nowhere else in the world except in the East Indo-Pacific area, where there are four species. Fossils reveal that the horseshoe crab was once common in Europe. But there it apparently disappeared 60 million years ago. Inasmuch as it can live in tropical waters and survive if frozen in northern ice, it is strange that it should be restricted to two such widely separated habitats.

Watching this archaic creature on the beach, we saw a number wandering erratically over the sand. One horseshoe crab made eight complete circles in a distance of less than 100 paces. Another wanderer met a stranded log head-on and minute after minute clawed the ground in an effort to push it out of the way. But laboratory tests have shown that horseshoe crabs have a delicate sense of gravity. They head almost invariably downhill, the direction that would take them to water—except when they are engaging in the important business of reproduction. It would be interesting to know what curious change takes place in their simple nervous system that inverts their normal gravitational instinct long enough for them to lay their eggs at the high point of the tide line.

It doesn't last for long, this inclination to go uphill instead of down. As the waters retreated, we watched the thousands of horseshoe crabs edging slowly back down the slope of the strand. They had reached and passed the climax of their shoreward movement for this year and had added another link in the long chain of their evolutionarily monotonous existence. Just as birds cross thousands of miles to nest where they were born, the horseshoe crabs had, in a shorter journey, come home to lay their eggs in the region of their birth, where land and sea meet.

↑ JOURNEY'S END: MANY OF THESE HORSESHOES, UNABLE TO RIGHT THEMSELVES, WILL DIE WHEN GILL-BOOKS DRY OUT.

▲ TRUNK OF KARRI (*E. Diversicolor*) RISES 100 FEET WITHOUT A BRANCH

THE WIDESPREAD EUCALYPT

An Australian native, this useful tree is now grown in over twenty other lands

By JOHN SIDNEY

IN April, 1947, County Forester Spence Turner of Los Angeles sent to Western Australia for seeds of a eucalypt tree called the jarrah. A Western Australian newspaper reported the item and headed it facetiously: HE WANTS TO GROW FIREBRICKS! Its readers understood the joke: the jarrah tree produces a well-nigh fireproof wood.

Practical jokers in Western Australia sometimes give newcomers the hopeless task of lighting a fire with this rich red-colored wood. There in the big timber country people use it for chimneys. After ten years of roaring log fires, the jarrah chimney planks are barely charred. In Perth, capital of Western Australia, fire buckled stout steel girders in a factory but merely charred the outside of the factory's heavy jarrah beams.

This astonishing timber is nearly indestructible. It resists decay, termites, and shipworms. Jarrah railway sleepers last 40 years or more. Wharf piles have been discovered sound after 50 years. For half a century, traffic in London's Piccadilly, Pall Mall, and Regent Street, and in Paris's Rue Chateau d'Eau and Rue Lafayette has rolled over paving blocks of jarrah.

Surprisingly, the extraordinary eucalypt timber is easily worked and makes very fine furniture. The jarrah (*Eucalyptus marginata*) is the Robert Ripley showpiece of a protean genus of trees that dominates the Australian landscape and comprise 94 per cent of Australia's forests. The eucalypts cover large areas of a continent that is almost as large as the United States.

They are bewildering in their variety and adaptability. Ghost gums with paper-white trunks and twisted arms grow above the snow line in high ranges, and straight-backed giants soar up from the valley sides. Red gums, blue gums, spotted gums, and a host of others —often with misleading names like box, oak, apple, and mahogany— spread their huge tangled arms over mountain slopes, swamps, savannas, and streams. Dwarf eucalypts, called mallees, with leathery

leaves and wizened limbs, contrive to live in parts of Australia's Sahara-like interior.

The genus was first named in 1788 by l'Héritier. He gave the very apt name of eucalyptus (literally "well-covered") to a specimen of what is now called *Eucalyptus obliqua.* It had been collected from Tasmania by Nelson and Anderson on Captain Cook's third expedition in 1777. The description "well-covered" refers to the lid, or operculum, covering the stamens in the bud stage.

One of the earliest students of Australian eucalypts was Baron von Mueller (1825-1896), who described 100 species. Today over 525 species and 160 varieties have been classified. Large areas of Australia remain to be explored botanically, and it's quite possible that up to 1,000 species will ultimately be described.

Identification of eucalypts is difficult even for expert botanists. The tree's bark and general appearance have not proved sufficient for classification. Young and old leaves as well as buds and fruit have to be considered.

Faced with this problem, the average Australian picks out a few trees and calls them red gum, blue gum, white gum, mountain ash, ironbark, and stringybark. The name "blue gum" is applied to at least eight different species. There are ten red gums and fifteen whites. The rest are simply called gum trees. And perhaps this isn't such a bad idea, as long as the experts can't agree. The dividing line between a species and a variety of eucalypt often remains a matter of individual opinion.

Strictly, the "gums proper," or "smooth barks," number only about 120 species. But these are the most striking and characteristic of the eucalypts. Someone once called them the "evergreens with deciduous bark." The bark peels away in long ribbons or plaques in autumn.

The other 400 eucalypts can be conveniently but arbitrarily divided into five groups: ironbarks, with very strong, thick, hard, and deeply furrowed bark; bloodwoods, with thick scaly bark; stringybarks; boxes, with thin scaly bark; and finally a mixed bag of blackbutts, woolly butts, mahoganies, and peppermints with thickish bark. Many of this last group are "half barks," with smooth upper branches and rough trunks.

What most eucalypts have in common is a sparse foliage of sickle-shaped leaves hanging in sheaves. These gray-green leaves are tough and leathery and have a large vein running round the edge. They exude tiny oil globules, which give Australian forests their characteristic eucalyptus aroma. It is popularly asserted in Australia that the eucalypts never shed their leaves. The eucalypts do shed them, of course, but always retain a good proportion, as do many other "broad-leaved evergreen" trees of mild climates.

Eucalypts are hardy and quick-growing. Certain species grown from seed have been known to reach 60 or 70 feet in 20 years. They are also adaptable; the indigenous Australian eucalypt is today cultivated in 36 countries in the milder temperate regions of the globe. Several species have showy flowers and are fine ornamentals for highway and park use. They are also grown in Brazil for railroad ties, pulp, and fuel and in Spain and Portugal for mine tim-

John Sidney is a fifth-generation Australian whose writing has been published on three continents. In 1951, he was awarded a Commonwealth Literary Fellowship. He wrote "Tree-Leaping Kangaroos" (Natural History, Dec., 1955).

➤ Ironbarks rise high in a temperate Tasmanian forest.

➤ In dry interior, at Alice Springs, eucalypts are low.

bers and viscose cellulose. In Central and South Africa, eucalypts are grown for mine timbers, fence posts, and fuel. Italy, Morocco, and Israel have found them useful in soil stabilization, crop protection, and for fuel and pulp. India and Thailand grow eucalypts for fence posts and round timbers. Californians prize them as ornamentals and windbreaks. Few eucalypts can survive if the temperature drops to 20°F. for more than a few hours, but in favorable localities planting for pulp and cellulose is on the increase.

Brazil is the leading eucalypt cultivator, with 750,000,000 trees (100 species) growing on 900,000 acres. Next is the Union of South Africa with 425,000 acres, followed by Madagascar (337,500 acres), Spain (250,000 acres), and Portugal (150,000 acres).

California has been growing eucalypts for a century, long enough to claim one of the group as its own and call it the California blue gum. Some even deny that it ever was an alien. Eucalypts also grow in Arizona, Florida, and New Mexico.

All eucalypts are hardwood. But this is a technicality that doesn't say what it appears to say, at least to the layman. Experts apply the term to all woods with pores. In the actual degrees of hardness there is considerable variation. The boxes and ironbarks are among the hardest in the world; others are reasonably easy to work. One Western Australian eucalypt, yate (*Eucalyptus cornuta*), is so hard that pioneer settlers used it for the cogwheels in their wind-driven flour mills. Its breaking strength approaches that of wrought iron. The white box of New South Wales and Queensland is four times as hard as English ash, which itself is quite a tough wood.

Eucalypt timbers can be divided into two great classes: the red woods and the pale woods. Many are so heavy that they sink in water. Their toughness, strength, weight, and handsome appearance have won them friends all over the world. Railway sleepers of jarrah wood are widely used in South Africa, Ceylon, Mauritius, Malaya, and the Middle East. Sleepers made of this wood outlast several sets of rails. So do those of wandoo (*Eucalyptus redunca*).

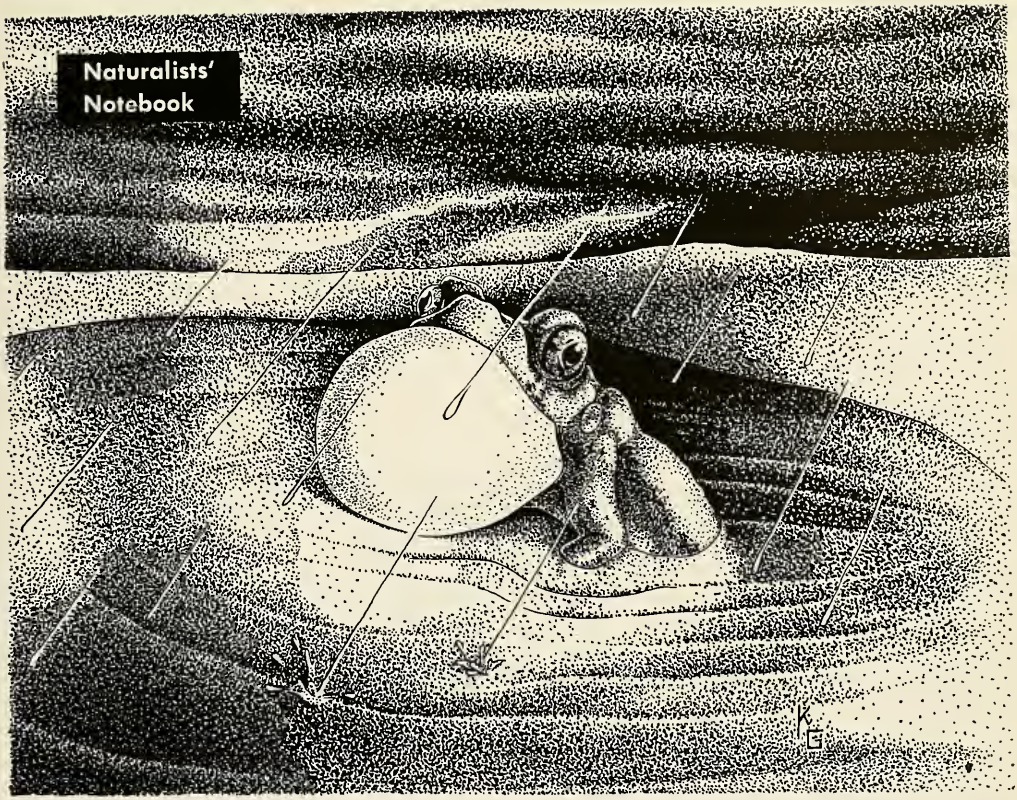
Another fine eucalypt timber is that of the miscalled mountain ash or giant gum (*Eucalyptus regnans*), whose pale-colored tractable timber has grain that runs as straight as a ruled line for tens of feet. I once saw a woodsman split half-inch palings six feet long by one foot wide, each perfectly alike. The king-emperors of the Australian bushland are the mountain ash, whose silver trunks are as straight as gun barrels for 150 feet, even 200 feet, before the first branch. I've stood in a regal acre of 27 of these elegant trees, the highest 300 feet tall. They had been saplings when the *Mayflower* set sail for the New World.

Of all the living trees in the world, only the sequoia soars higher than the mountain ash of eastern Australia. Sixty years ago there were enormous mountain ash in Victoria which may even have topped authentic records for sequoias. The Founders' Tree (*Sequoia sempervirens*) in Founders' Grove, California, is 364 feet high, but it is said that a mammoth *Eucalyptus regnans* which once grew at Thorpdale, Victoria, had a height of 375 feet. Another majestic tree, not far away, was 331 feet high and was named Mark Twain in honor of the famous American humorist, who visited Australia in 1895-6. Unfortunately, this one perished in a bush fire.

Old men in Victoria have told me about colossal trees that were supposed to be 400 or 500 feet high. Such reports may be wide of the mark, but just how tall they were we shall never know. No surveyor measured them. But Alfred Russell Wallace, the famous naturalist and collector, writes of a fallen tree that he says was 450 feet long. And I've been shown the faded photograph of the burnt-out stump of one forest monarch with an inside diameter of 26 feet. It was used for years as a church and later as a stable for five horses. This giant eucalypt had a girth of more than 80 feet. (The girth of Founders' Tree is 47 feet.) I've also seen photographs of two other mammoth trees, one with a girth of 97 feet, seven feet from the ground; the other was 112 feet at ground level. Eighteen men linked hands before they could encircle the latter's trunk.

All these mighty trees are gone. Some fell before the axes of settlers; others were destroyed by bush fires. The tallest known living tree of the species *Eucalyptus regnans* is 320 feet. We did not know of its existence until April, 1956, when forestry officers discovered it in virgin forest in Tasmania. Maybe we will yet find a 400-footer to take world honors in tall timber. Be that as it may, the globe-trotting eucalypt is probably the foremost arboreal migrant in the forests of the world.

▲ SIZE of this felled "smooth bark" eucalypt may be gauged from axe (left).



▲ Wet and content in new-formed pool, this eastern spadefoot inflates pouch, sounds his mating call. Eggs, laid in puddle, will hatch quickly and the tadpoles are ready for a life ashore in ten days.

Scaphiopus—the rain frog

That rain puddle frog didn't fall out of the sky: it dug its way up from under the ground

By Kenneth L. Gosner

SOME people call them "storm frogs" and quote the old yarn that they are "rained down" in summer cloudbursts. "Rained down from where?" you ask. "Well," the farmer replies, "they've never been here before. Where do *you* say they come from?"

We are standing on the edge of a large rainpool. At the bottom of the half-gallon jar the farmer is holding, sits a curious frog. Schools of smoky-brown tadpoles mill about feverishly in the shallows of the rainpool. As they turn in the sunlight, glints of gold flash from their tiny bodies. The frog and the tadpoles are the farmer's evidence of an unusual event that has taken place on his property. Where did the "storm frogs" come from?

One week before, neither the pool nor the frogs and their offspring were there. Then it rained, rained hard, all one night and most of the following day. Late the second night, the farmer was awakened by a considerable noise com-

Kenneth L. Gosner has been on the science staff of the Newark Museum for 11 years. He has made special studies of New Jersey frogs and is particularly interested in color phenomena in nature.

ing from a corner of the pasture behind his barn. This hubbub was so unusual that the farmer pulled on his pants and rubber boots and went out to investigate.

Several hundred yards from the house he found himself near the center of the clamor—a deafening, confusing caterwauling. The run-off from the unusual storm had formed a pool about a quarter of an acre in size, but hardly more than a few inches deep. In the light of his lantern the pool seemed to be dotted with vibrating ping-pong balls. Looking more closely, he found that each "ping-pong ball" had a frog attached to it and was really an inflated vocal sac. Aided by this pneumatic equipment, the males were exercising their loud, booming voices. When the calls of individual songsters were sorted out, the farmer noted that they went "wank-wank-wank," repeated in a steady, insistent way.

The sleepy farmer, disgruntled at being roused out of bed, turned around and went home, picking up one of the creatures, without thinking much about it, to take back with him. By the following afternoon the rest of the frogs had disappeared, but the pool contained much spawn distributed in tangled strings and bunches of irregular shapes.

What is it?

Neither the farmer nor his neighbors had ever seen a beast like this before. The animal's most conspicuous features, now that its big, white vocal sac had collapsed, were its eyes. They were extraordinarily large and bright yellowish-green. They gave it a rather comical, wide-eyed expression of wonder and innocence — not the wise, meditative look of ordinary toads, nor the blank, moronic stare of "pond frogs." The farmer said it was a "frog"; others said it was a "toad." It had short legs and a squat form; it *looked* like a toad. But it had very large, strongly-webbed, froglike feet, and its skin was thin and soft. Someone thought it might be a "storm frog," and so it was called.

The farmer's captive was a spadefoot—its scientific name, *Scaphiopus*. Both the common name and the scientific name have practically the same meaning and refer to a dark, horny ridge on the outer edge of each hind foot. This spade is used for digging, an occupation with which spadefoots are preoccupied. If you hold a spadefoot in your hand, it tries, with a curious backward shuffle, to burrow between your fingers. Place it on sand or loose soil, and it will dig itself out of sight immediately. These fossorial proclivities explain why people seldom see spadefoots.

▲ Horny "spades" on hind feet are digging tools Scaphiopus uses to shuffle its way underground.

In the arid Southwest, the Great Basin, and over much of the high plains of the West, spadefoots are fairly common. East of the Mississippi the hermit spadefoot is equally abundant in many parts of the Gulf coast and on the Atlantic Coastal Plain. Despite the wide distribution of these animals, many people live next door to them without ever making their acquaintance. Except for occasional outbursts of noisy activity, they are inclined to be seclusive.

For a long time naturalists explained their seeming rarity by saying that the spadefoot spends years below the surface of the soil, without ever emerging. We are still not certain that some of them do not live this way, but, in the humid Southeast at least, spadefoots come out regularly on warm, rainy nights.

In the drier parts of the West, rainy nights are infrequent and unpredictable. Long periods of drought provide a perilous existence for amphibians. Salamanders are virtually unknown there, and, except for some of the toads, most tailless amphibians find such terrain equally uninviting. Yet these dry regions appear to be the natural homeland of the spadefoots.

Spadefoots belong to a distinct family of toads—or frogs—and their nearest relatives live in Europe. The New World branch of the family has been here a long time. Fossil spadefoots, apparently little different from present-day forms, have been found in rock beds that were laid down more than twelve million years ago. Four or five species are recognized today but they are all somewhat similar in appearance. Their activities also conform to a single, general pattern that is related to survival in places with a poor water supply. While the eastern species has less to contend with in this regard than its western kin, its habits are essentially the same.

Adult spadefoots escape from drought by digging, and have been found as deep as a yard or more below the surface. As extra insurance against drying out, these animals, like true toads, probably carry with them a reserve supply of water stored in the urinary bladder. In an emergency, the amphibian can draw on this reserve to maintain its body fluids at survival level. In the open air, spadefoots dry out as rapidly as do other frogs, but they can withstand a somewhat greater loss of body moisture than most.

The chief problem of spadefoots is to provide for the continuity of their race. Eggs are laid in water and the young pass through a tadpole stage before emerging as land dwellers. This is the familiar pattern of amphibian life, but it is exposed to special perils in arid regions. Chief among these is the uncertainty of the water supply. Rainfall is irregular in quantity and occurrence. When it does rain, re-

sulting temporary pools become the principal breeding sites. In the East, spadefoots seem to choose such places deliberately for egg-laying even when less precarious situations are available. Puddles of the sort used as spadefoot nurseries last only for a short time unless more rain comes; and the odds are often stacked against the survival of the young until they are able to crawl out on land. Since spadefoots have been meeting these obstacles with some success for countless generations, we may naturally ask how they do it.

The signal: Rain

First, spadefoot breeding activity is geared to rainfall. This is in contrast to the behavior of many amphibians in temperate latitudes which have the egg-laying season governed to a large extent by temperature. Spadefoots seldom emerge for breeding except following heavy rain, the heavier the better. In many parts of the West, the annual quota of rain falls during the warmer part of the year. This is a fortunate coincidence as far as the spadefoot is concerned, since the rate of development of eggs and larvae is greatly influenced by temperature.

If spadefoot eggs are kept at ordinary room temperature, they hatch in about a day and a half, and the polliwogs go through their part of the cycle in two or three weeks. Under the summer sun, the waters of temporary pools heat very rapidly and, at temperatures just below the level at which the animals run the danger of being "cooked," growth is speeded up phenomenally. When pushed nearly to the limits of tolerance, spadefoot eggs hatch in less than 18 hours, and ten days later the first young spadefoots leave the water. This is dangerous living, indeed, because water warm enough to spark such rapid development—close to a constant 90°F.—is hot enough to kill some of the tadpoles. This, nevertheless, is the spadefoot way.

Low temperatures, by contrast, usually spell the doom of spadefoot broods by prolonging development beyond the life of the breeding pool. In cool waters hatching may be delayed a week, the tadpole stage for two months.

Spadefoot embryos and larvae not only have a tolerance for higher temperatures than many amphibians but their rate of development —other things being equal—is also higher. They may be compared in this respect with the common bullfrog whose young have a similar ability to withstand high temperatures but who develop more slowly. Bullfrog tadpoles spend two years becoming frogs and in consequence, this giant species must lay its eggs in deep, permanent ponds. They may be in danger of being eaten by turtles, fish, herons, and other enemies that seldom plague infant spadefoots, but bullfrog tadpoles are not usually in peril of being stranded in drying pools.

Spadefoot tadpoles evince their high rate of metabolism by constant swimming activity. Unlike most tadpoles, they appear to be largely carnivorous. They are not even averse to eating each other. Cannibalistic habits would not appear, at first glance, to give much promise of guaranteeing the future of the spadefoot clan. Under the best of conditions only a small percentage of amphibian tadpoles survive to maturity, and cannibalism among spadefoot young not only nourishes the surviving young but also helps to relieve the problem of crowding in drying pools. The spadefoot way of life is a hard one generally, but despite these dangers "storm frogs" have managed to survive in habitats that few amphibians attempt to colonize.

While much remains to be learned about the ways of spadefoots, enough is known already to give a picture of close adaptation to a rigorous environment. Structurally, the spadefoot family is a primitive one, giving it a place near the bottom of the family tree of frogs and toads. In its fitness to deal with a hazardous existence, the spadefoot is a specialized animal. In its own way, the "storm frog" gets along very well, indeed!

▲ Spadefoot can also be recognized by vertically elliptical pupil of its eye, which expands in darkness (above) but contracts to mere slit in sunlight.

▲ INSCRIPTION HOUSE LIES AT BASE OF A SHALLOW CAVE ABOVE ANCIENT FARMLANDS IN NITSIN CANYON

Navajo NATIONAL MONUMENT

Three of our finest pueblo ruins may be found in settings of dramatic beauty near the corner where four States meet

By William B. *and* Joan L. Sanborn

HIGH in the piñon- and juniper-clad mesa country of northeastern Arizona, amid the spectacular scenery of the Navajo Indian Reservation, is Navajo National Monument, one of the least accessible areas in the National Park System. Set aside in 1909 by Presidential proclamation, Navajo National Monument features the three prehistoric cliff dwellings of Betatakin, Inscription House, and Keet Seel. These ruins, the largest and best-preserved cliff pueblos in Arizona, are located in settings of unparalleled beauty.

It was early June and our route carried us north from Flagstaff toward Navajo country. Eleven miles north of Cameron, we turned eastward, leaving behind the paved luxury of U.S. 89 for the dirt road that would become progressively worse as it penetrated into the Reservation. This western approach to the Monument is through Marsh Pass leading to the trading post of Kayenta in the heart of the barren Navajo Reservation.

Our first stop was at Tuba City to inquire about the road. A mail truck driver said that it was a bit muddy here and there, but O.K. We had no trouble in negotiating the perennial drifting sands of the road near Castle Buttes and Tonalea. A few miles further on, the trader at Begashibito told us that the Monument entrance road was passable. Marsh Pass had been graded recently and the miles slipped away until we came to Calamity Flats and the sign pointing north, reading "Navajo National Monument, Betatakin — 15 miles."

The road into the monument area is a narrow, rough, two-rut affair that crosses sagebrush flats, sand, and the bare rocks of the Zihnez Mesa. The National Park Service

▲ Smallest of the three main ruins. Inscription House has only 75 rooms. Here, Joan Sanborn looks across the site, which was rediscovered in 1909.

William B. Sanborn, Supervisor of Audio Visual Education, San Francisco, has written many articles for Natural History. Joan L. Sanborn, a former zoology major at the University of Iowa, accompanies her husband on field trips.

▲ KEET SEEL is also protected by cliff overhang. With some 160 rooms, it is Arizona's largest and best-preserved ruin. It dates back to 1116 A.D.

▲ INSCRIPTION from which Inscription House takes name is noted by author. The date, 1661, may have been written by some passing Spanish explorer.

keeps this road to Monument headquarters in reasonably good condition and the average passenger car can make it. The last quarter-mile is over bare sandstone, and one or two miles an hour is about the top driving speed.

Finally the headquarters building came into view and we saw our good friends, Ruth and John Aubuchon, waving to us from the parking area. John, or "Auby" as he is called, was Superintendent of the Monument at this time. After an exchange of greetings we prepared to make camp. We had traveled one hundred miles since leaving U.S. 89.

At the Monument

There are no visitor accommodations at the headquarters, other than a limited campground, picnic tables, and a hogan which may be used by campers. Non-campers may find lodging at certain trading posts and guest ranches in this area, such as Goulding's in Monument Valley, Kayenta, Tonalea, Tuba City, and Shonto, a post just twelve miles west of the headquarters.

Although small, the campground is most attractive, with water available, and fireboxes located among the piñons. A magnificent view eastward over Segi Canyon and the Skeleton Mesa country lends enchantment; and the gentle breeze that wafts through the trees almost every evening carries with it the pungent odor of smoke from nearby Navajo campfires.

Theoretically, the Monument is open all the year round; however, travel is limited from November through March, due to inclement weather and poor roads. The winters are snowy, with many clear cold days. The prevailing summer weather is good, with daytime temperatures in the 80's and 90's, but the nights are cool and comfortable because of the 7,200-foot elevation. Intermittent thunderstorms, torrential but of short duration, will often punctuate the summer.

After a pleasant meal with Auby and Ruth, we sat in the living room swapping stories about Park Service and our conversation turned to

archeology. Although we had been to Betatakin before, this time we planned to visit all three ruins, so we asked Auby for some background information on the Monument area in general.

As he pointed out, it is important to clarify a widespread misconception about Navajo National Monument. The great prehistoric ruins of the Monument are in no way connected with the Navajo Indians. The people who built these cliff villages were of an older and different ethnic group than the Navajo and had deserted the area before the influx of the Navajo people into the Southwest. The Navajos today refer to them as the Anasazi (the Ancient Ones) and are very superstitious about the cliff dwellings, believing they are haunted by the ghosts of their former residents.

This general area is frequently referred to as the "Four Corners" and includes the high desert plateaus, mesas, forested peaks and ranges of northeastern Arizona, southeastern Utah, northwestern New Mexico, and the tip of southwestern Colorado. These four states meet at a common point a few miles north of the post at Tes-Nos-Pah.

The Four Corners is a vast territory, much of which falls within the Navajo Reservation. There are few roads. It is rugged country, difficult to traverse, with an almost unbelievable variety of scenic phenomena. The terrain includes windswept expanses of high desert; acres of soft, undulating sand dunes; monoliths and spires; dozens of deep, sheer-walled canyons; great volcanic plug peaks; many natural bridges and arches; and mountainous areas where there are fine stands of pine and fir, aspen-fringed meadows and clear streams. Add to this the magnificent array of color found in the flora and rocks of the region and the impressive and tremendous scale of the country, and you have the land of the ancient Anasazi and the home of the Navajo today.

The plaintive hooting of an owl in the piñons called our attention to the lateness of the hour as we outlined plans for the three days of our

▲ Discovered in 1893, Keet Seel takes its name from the Navajo words for "broken pottery". Tree dates show site was abandoned during the 1300's.

▲ Food stored at Keet Seel includes dessicated squash (left), corn (right). Combination of protective cave and dry climate helped to preserve them.

▲ DISTANT VIEW of cave that contains Betatakin ruin may be had from this lookout, on Sandal Trail across canyon. Cave is 400 feet high, 100 deep.

stay. Tomorrow would be spent in Betatakin, the next day at Inscription House, and our last day at Keet Seel. Auby would go with us to all three ruins and would arrange with the local Navajos for horses. We wandered back to our hogan, but the expectation of the next three days almost prevented sleep.

Ruth and Auby joined us after breakfast for the walk to Betatakin Point. The Sandal Trail winds a mile along the mesa rim to a point affording a superb view of Betatakin ruin, the only one that is readily accessible. Many visitors who have limited time, or who are unable to hike or ride long distances, feel that the view from Betatakin Point is worth the entire trip to Navajo National Monument.

Betatakin Canyon is a short, sheer-walled canyon with brown and pink sandstone cliffs rising over 600 feet to the mesa top. It drains into Segi Canyon from the west. In the north wall is a tremendous natural cavern, the result of water undercutting and general exfoliation erosion. The cave is about 400 feet high, 300 feet wide, and 100 feet deep. Under the protective covering of the great vaulted roof is the ruin of Betatakin — in Navajo, "hillside house." From our vantage point, we scanned the dramatic setting of the village with our binoculars, then walked around to the opposite side of the canyon. In a few minutes we were hiking down the steep mile-and-a-half trail to the bottom. A half hour later, we rounded a thicket of wild rose bushes and the ruin of Betatakin came into view—perched like some well-preserved apartment house on the sloping floor of its cave.

The Climb Up

Auby first showed us the clear, running spring at the front of the cave, one of the features that made this cave an ideal village site. Before entering the ruin, he warned us to stay on marked paths. As a measure to protect the ruins, no one is allowed to enter unless accompanied by a guide or with permission from the Superintendent. We climbed from the canyon bottom to the lowest level of the ruin and followed Auby to a high rock ledge on the east wall of the cave where we sat viewing Betatakin with wonder.

The gigantic cave forming the "roof" is awe-inspiring. In comparison, Betatakin looks like something from a Lilliputian world and seemingly defies gravity by clinging to the sharp slope of the cave floor. Originally, the cave had only limited naturally level floor space, and it was necessary for the Indians to build retaining walls, then fill in behind them with dirt and debris to establish levels. The eastern and western portions of Betatakin are in a good state of preservation, but much of the central section slid into the canyon years ago.

"Who discovered Betatakin?" we asked Auby.

"Certainly some of the Navajo and Ute Indians knew of the ruin long before white men saw it; however, the first white men to 'discover' the ruins were John Wetherill, a well-known trader, and Dr. Byron Cummings, in the summer of 1909," he answered.

Briefly, the archeology of the Anasazi of the Four Corners area essentially involves the slow transition of an ancient people from a nomadic to a well-developed sedentary life, with corn, houses, and a great drought the prime catalysts.

For perhaps thousands of years before Christ, nomadic groups of people inhabited the West. They belonged to a hunting, trapping, and gathering culture, living off the land as they went. These early inhabitants built no permanent homes.

About the dawn of the Christian era, a change took place over a wide section of the Southwest. Farming was either introduced or became more important than before. To tend their crops, the Indians had to settle down. Abundant rock shelters and caves in the canyons served as the first homes. Because of their skill in basketry and their initial lack of pottery, these prehistoric Southwesterners are called Basketmakers. The Basketmakers evolved through a series of developmental periods during which various aspects of their culture improved, notably with the introduction of the bow and arrow and a semi-subterranean dwelling called a pit-house.

In the fourth or fifth century, Basketmaker culture ushered in the Pueblo periods, representing another developmental stage characterized by the use of rock and adobe

masonry. Some of the villages of the early Pueblo period were constructed in the caves, but a far greater number were built in the open on the mesa tops or in the canyon bottoms.

From 1100 A.D. to 1276 A.D. was the flowering or Classic Period of Pueblo culture. Some of the cliff pueblos were of great size and fine construction. Pottery and weaving were well developed. The cliff dwellers continued to farm the thin top soil of the mesa and the bottom land of the canyons. They grew corn, squash, beans, cotton, and kept wild turkeys penned in their villages. The canyon walls of the Four Corners contained dozens of lofty farming villages. One of the heavily populated areas was the Segi Canyon as well as the smaller canyons that drain into it, the locations of Betatakin and Keet Seel.

The rapid rise of this region to prehistoric cultural development was terminated in the late 1200's by a probable combination of several factors. The most influential, beyond a doubt, was the beginning of a 25-year period of drought in 1276. To a primitive farming culture, this could only spell eventual disaster. In addition, poor agricultural methods, which depleted the soil and caused erosion, may have led to the abandonment of the villages. Continued harassment by invaders, disease due to unsanitary living conditions, and possible inter-village strife may also have been contributing factors. By 1300, the great cliff pueblos of the Four Corners were deserted to the winds, the Anasazi moved southward into the Rio Grande and Hopi Mesa country, and Betatakin became a ghost town.

We climbed down from the ledge and Auby took us through the village, pointing out its different features. Betatakin once had close to 150 rooms, about 50 of which were individual family residences. The village probably supported a population of about 150 people. The cave faces south, providing the Indians with maximum sunshine during the winter months and with shade in the summer. When discovered, the dwellings lay under a heavy mantle of wind-blown debris. Small trees had taken root in some sections of the village. In 1917 the ruin was extensively excavated and masonry structures stabilized.

It was midafternoon when we journeyed back to the mesa rim, having thoroughly enjoyed our visit to Betatakin.

By the time the first rays of the morning sun found the smoke hole of our hogan, we had already prepared breakfast and packed a lunch to take to Inscription House.

Inscription House

An early start is essential. Inscription House is located some 20 miles by air, due west of the headquarters. Trips begin at Inscription House Trading Post on the road to Rainbow Bridge, reached by leaving the Marsh Pass Road near Tonalea and traveling north. From Monument headquarters this is a long drive, but Auby knew a short-cut and the jeep whirred across mesa top, ravine bottoms, sand holes, mud, and barren rock, to bring us to the trading post in forty minutes. The friendly traders insisted that we join them for a second breakfast, and while we ate, a Navajo arrived at the post with our horses.

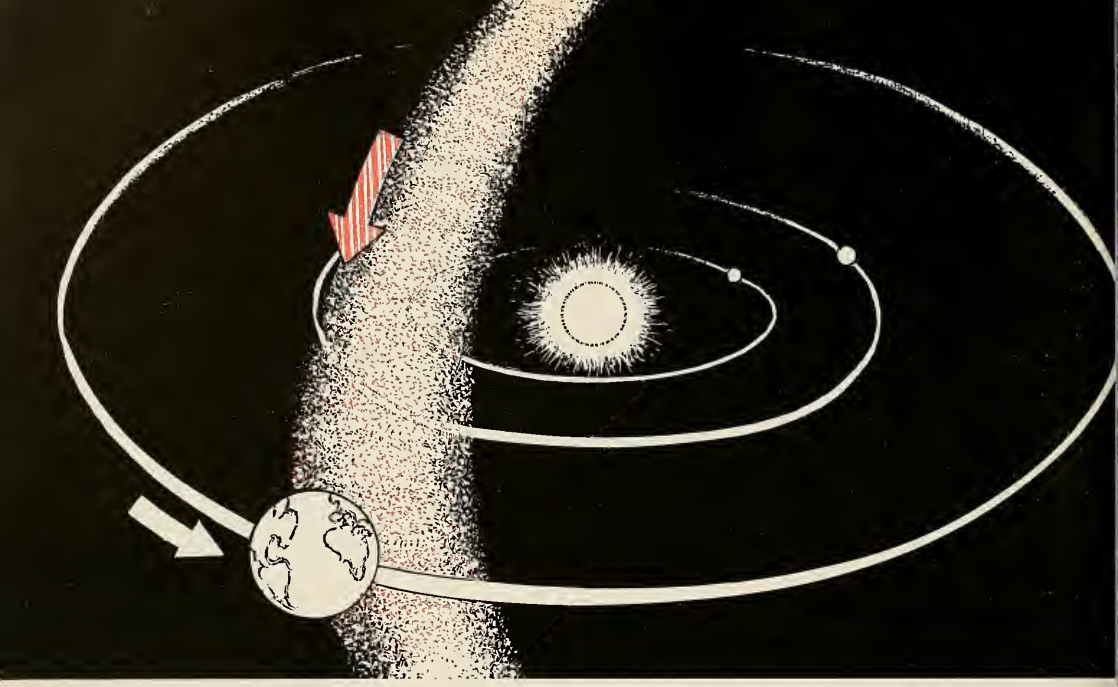
At the mesa edge we looked down into the colorful depths of the canyon. Auby indicated the direction of our goal and we began our descent. Many stretches of the steep trail are at a discouraging angle over barren rock, marked only by rock cairns.

It was midmorning when we reached the bottom. We were now flanked by towering walls of pink and brown sandstone rising vertically to the piñon-capped mesa far above us. The trail leads through broad sandy bottomland, by Navajo hogans, an occasional clump of cottonwoods, and several small ruins tucked high on ledges in the canyon walls. Soon Auby drew rein and pointed a short distance down the canyon. Before us was a huge dome-like bluff of salmon-colored sandstone, with a large shallow cave housing a cluster of buildings halfway up its face. Here was Inscription House, perched some 100 feet above the canyon floor.

"The best approach is by the old hand-and-toe-hold trail," said Auby, indicating a series of niches cut into the rock ascending the lefthand side of the cliff. It took only a few minutes to work our way up into the

continued on page 390

▲ Betatakin's name means "hillside house" in Navajo. Its sheltering cave faces so that dwellings catch winter sunlight, but are shaded in summer.



↑ "GRAVEL-BANK" OF DEBRIS IN ORBIT OF ANCIENT COMET IS SHOWN HERE (COLOR). BECAUSE SPREAD OF DEBRIS IS NOT UNIFORM, METEOR DISPLAY SEEN AS EARTH HITS THE "GRAVEL-BANK" RANGES FROM LARGE TO VERY SMALL.

Lights in the Autumn Night

Astronomical evidence links meteor showers to the debris left behind by passing comets

By FRANKLYN M. BRANLEY

MANY a person, looking skyward on a September or October night, has seen a streak of light flash into view for a moment, then fade into the blackness. "Shooting stars," he says, and perhaps he makes a wish.

What he has seen is one of the millions of meteoroids—most of them as small as grains of sand or smaller—that enter Earth's atmosphere every day at speeds between 10 and 50 miles per second. Most of them never reach Earth. This is fortunate because, even though most are minute, their high velocity makes them dangerous. When these meteoroids hit the air, they become incandescent through friction and produce the streaks we call meteors in the night sky. When these streaks are thin, faint pencils of light, they are called "shooting stars" by many observers. When they are brighter, or when they burst into brilliance, we call them fireballs or bolides.

On any clear night of the year, a patient observer may expect to see a meteor every ten minutes. On occasions, however, when meteors are considerably more numerous, he sees a meteor "shower." Then these streaks seem to emanate from one narrow region of the sky, and we have what is called a "radiant." Because all the meteoroids in a particular stream—or "gravel-bank"—are moving in parallel or nearly parallel paths, their trails are also parallel. The "radiant" is the outward vanishing point of all these trails, similar to the distant point where we seem to see the tracks of a railroad coming together.

In the autumn, the most prominent meteor "showers" are the Perseids, the Orionids, and the Geminids (see table). Historical records of the Perseid shower can be traced back for some 1,200 years. The Perseid shower is the most reliable in terms both of appearance and number of meteors, but even the Perseids are quite varied. In 1912, there was only a thin scattering of meteors, while in 1921, two hundred and fifty meteors per hour were reported.

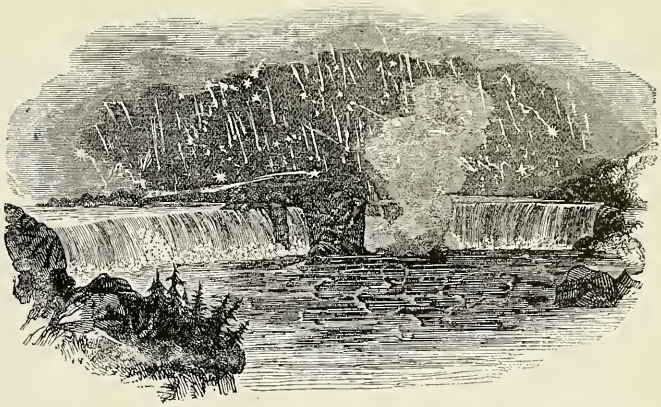
DR. FRANKLYN M. BRANLEY is associate astronomer at the American Museum-Hayden Planetarium, where he is in charge of educational services. He has written two books on astronomy: *Mars* and *Experiments in the Principles of Space Travel.*

The Leonids are another shower of autumn. Although the Leonids are not as numerous as the Perseids, they have a 33-year cycle of historical interest. In fact, the Leonid shower is credited with the most spectacular meteoric performance of historical record—the display of 1833, when 35,000 meteors were observed each hour. Meteors fell as thick as snowflakes and the superstitious folk were alarmed. Many feared that all the stars were falling from the sky. The Leonid shower of 1866 was also brilliant, although not equal to that of 1833. But in 1900 and 1933 the displays were hardly more than sprinklings.

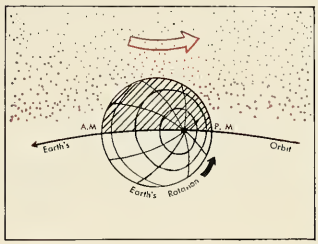
Evidence over the years indicates a relationship between these meteor streams and comets. The story of one such bit of evidence dates back to 1826, when the Austrian astronomer von Biela sighted a faint comet which was shown to be the same comet previously observed in 1772 and 1805. Biela's comet, as it came to be called, was seen also in 1832 and 1846. By 1846, it had divided into two parts. When observed again in 1852, the parts were considerably separated, but since that date they have never been observed. In 1872, however, Earth passed close to the orbit that Biela's comet had traveled, and a magnificent display of meteors was seen. Astronomers consider this to be strong evidence that meteor showers are associated with the debris of comets.

Leaving aside the question of the origin of these meteoric streams, we know that the showers occur only when Earth's orbit carries our planet through or near to such a stream. It does not follow that the shower must occur each year, for the "gravel-bank" of meteoric dust is clustered unevenly in various areas of the stream's orbit and not spread out uniformly. A brilliant shower occurs only when Earth enters these clusters.

If you go looking for meteors this autumn, select a time from this list, choose a location that is free of artificial light, and allow your eyes time to adjust to the darkness. The best time to see meteors is after midnight, for then we are on the front side of Earth as it moves along its orbit (see diagram). You should be rewarded for your vigil by a display of these lights of the autumn night.



↑ Leonid shower of November, 1833, was spectacular. Newspapers of the time published this engraving of display as it was seen over Niagara Falls.



↑ Meteors are best seen at midnight and later, when you are on "front side" of Earth relative to stream.

↑ Superstitious, during 1833 Leonid shower, feared that all the stars were falling from the heavens.

AUTUMN METEOR SHOWERS

Shower	Comet Associated With
Leonids	Tempel's Comet
Orionids	Halley's Comet (possibly)
Geminids	Origin unknown (very likely a comet of the Jupiter family)

Date	Meteor Stream	In Constellation
Sept. 22	Alpha Aurigids	Auriga
Oct. 2	Quadrantids	Boötes
Oct. 9	Giacobinids	Draco
Oct. 18-23	Orionids*	Orion
Nov. 14-18	Leonids	Leo
Dec. 10-13	Geminids*	Gemini

*most reliable both in numbers and appearance

▲ FEMALE LONGBILL GUARDS NEST AMONG PRICKLY PEARS. BIRDS ARE A FOOT LONG, HAVE A TWO-FOOT WINGSPREAD.

Shorebird of the Prairie

Largest of the American shorebirds, the Longbilled Curlew usually makes its nest in "moist meadows." This Longbill, however, hatched its brood on the Colorado prairie

By PATRICIA BAILEY WITHERSPOON

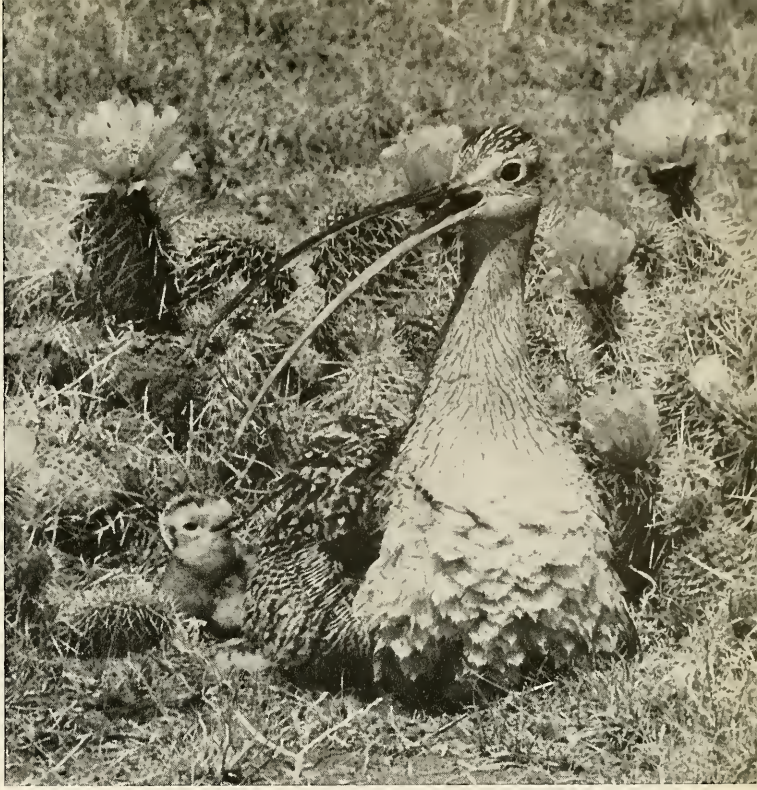
LONG-BILLED curlews usually nest "near low, moist meadows," according to some bird books, but nothing could be farther from describing the nesting site shown in these pictures.

Not far from our home in Denver —a bit east of Lowry Airfield where jet planes streak overhead—stretch miles of undulating prairie. In the early spring it is a soft, silver gray-green, livened by yellow blossoms of the prickly pear cactus. Looking westward 30 miles (on a clear day it seems only five), you see the majestic mountains of the front range, still white-capped by winter snows, with Mt. Evans rising to an elevation of more than 14,000 feet. Perhaps it was this beautiful view that induced a pair of long-billed curlews to make their home on the wide-open spaces among the cactus and buffalo grass, a long way from "moist meadows." Their four large mottled eggs, in a slight depression in the ground, were protectively banked by the attractive prickly pear plants—a thorny place to raise young but a shelter from the winds prevalent on the dry plains from May to September.

Nests of these birds are difficult to find. In fact, it took Bob Niedrach to find this one, a genius at discovering nests and identifying

▲ Two of the four eggs in the nest were pipped on author's return.

▲ Newly-hatched birds were anxious to leave sun for shade of cactus.



▲ Chicks stay close to mother as she scolds author's companion. in open. However, Curlews paid no attention to canvas camera blind set up nearby.

birds by their calls. Although these "shorebirds" occur in small numbers from Denver to Baca County in the southeastern part of the state, this was only the second set of eggs he had located in Colorado in 40 years.

Dad and I were most anxious to take pictures, so we started out early on the morning of June 3 and bounced along in the station wagon over the rough cactus-grown prairie. Bob had shown us the location the day before, but there were no distinguishing landmarks, just miles of slightly rolling hills. I began to wonder if we would ever be able to relocate the eggs. Then Dad caught sight of a curlew standing motionless. Its all-brown coloring camouflaged it well, and I could not make out its slender curved bill and long legs until a moment later, when it flew toward us, calling querulously. It circled close to the car, and its very long beak told us that this was the female. Occasionally, it would land with half-opened wings and then run away as if trying to lead us astray.

We supposed that the male was sitting close by upon the eggs. After carefully searching the vicinity, we finally saw the incubating bird, his neck stretched flat against the prairie and long beak partially hidden by blades of cactus. He remained quiet until we were within a few feet, then fluttered over the ground in an effort to decoy us from the four gray-brown eggs tucked in the center of a clump of sprawling green cactus.

The curlews circled complainingly, dive-bombed at us a few times, and then dropped to the crest of a hill. There, silhouetted against the snow-seamed mountains blue in the distance, they paced back and forth, sending out whistle-like notes. We hastily erected a canvas blind and drove to a low-lying knoll to watch through binoculars. Within fifteen minutes the female cautiously approached, eyed the shelter, and without hesitation settled down to incubate. We wanted the birds to become thoroughly accustomed to our hiding place before disturbing them again and so did not attempt to take pictures until the following day.

Early the next morning, the male flew to meet us and then followed us to the blind. Without disturbing the female from the nest, I quickly crawled inside the shelter, set up the camera, and focused the tele-

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Patricia Bailey Witherspoon has been with her father, Director of the Denver Museum of Natural History, on many field trips. They have studied and photographed birds from Newfoundland to the Gulf of Mexico and throughout the Pacific Islands.

photo lens on her beady brown eyes. After all was ready, Dad flushed the incubating bird from her eggs and then drove the car away with both curlews following, their far-reaching voices gradually fading in the distance. However, they were back almost before I was ready for them. They landed upon the ground in front of the blind; and it was evident that, so far as they were concerned, my blind was a natural part of the terrain. The female, scarcely pausing, headed with long, determined steps for the nest. She stood over the eggs, reached down with her enormous beak to roll one into place, and then began to work herself into a comfortable position.

We have found that a satisfactory way to photograph ground-nesting birds is to have one person go into the hide while the other drives the car away from the nest. Usually the impatient parent bird will soon return to her eggs or young and settle upon them. After pictures have been secured, the photographer can summon the driver with a signal from the back of the blind; and when the car slowly returns, the brooding bird invariably rises from the nest but without undue alarm. To frighten the adult from its nest might cause abandonment of the eggs.

On the morning of June 7, we found two of the four eggs pipped, and when we returned in late afternoon there was one downy young. Because the wind was blowing a gale, we took just a few shots and then left the blind.

The following morning, we were dismayed to find only two eggs in the nest and no young. Touring the vicinity, we located the two downy little fellows with necks outstretched, hugging the surface of the buffalo grass. The old birds, unafraid now, darted at us like shrieking arrows, always swerving away when within a few feet of our heads. We placed the precocial youngsters back in the nest, hoping they would remain there until a parent returned, but both scrambled over the rim and hurried into the shadows of the cactus, where they would be protected from the heat of the morning sun. The female induced them to settle under her, but evidently they preferred the cooler shade of the cactus and returned to it.

Several days later, only empty shells cluttered the nest. A few hundred yards away, the old birds scolded us, and we felt sure that they had hidden the four babies among the colorful cactus nearby. Not wanting to disturb the youngsters, we only watched the graceful adults in their dry prairie environment—shorebirds looking strangely out of place on the rolling plains among the golden blossoms of the cactus. We left hoping that we would see them in the same region in future years.

TOWERS in the sky *continued from page 353*

Each year forest fires devastate an area equal in size to the state of Colorado. As a calamity, they rank with floods, pestilence, famine, and earthquakes.

During 1955, a total of 145,180 wild land fires was reported in the United States. Of these, 8,173 were on areas protected by the Forest Service. During 1956, the Forest Service had 12,454 fires. Of these, 7,669 were caused by lightning—mostly in the West—and the remaining 4,785 resulted from man's carelessness. Nationwide statistics, however, indicate that people are responsible for 90 per cent of all wild land fires.

These annual totals include nearly every type of fire from the tiny blaze around a snag to the roaring inferno that leaves acres of forest land in black, smoldering desolation.

Lookouts cannot prevent fires, but their constant vigil and quick action save countless millions of trees each year.

Being a lookout, however, entails much more than just spotting smoke. It also means chopping wood, listening to lightning crackle down a ground wire, relaying radio messages; playing endless games of solitaire, chatting "after hours" by radio with a neighboring lookout, climbing thousands of steps during innumerable trips up and down the tower stairs; pacing the catwalk of a glass cabin, perhaps even fighting the fire he himself has spotted.

But it can also mean watching the dawn break over the high Sierras, seeing huge thunderclouds over the Cascades, hearing the lonely howl of coyotes in the Black Hills, taming grouse in the ranges of the Gunnison, or following the evening flight of herons across the Florida scrub.

"SMOKEY SAYS"

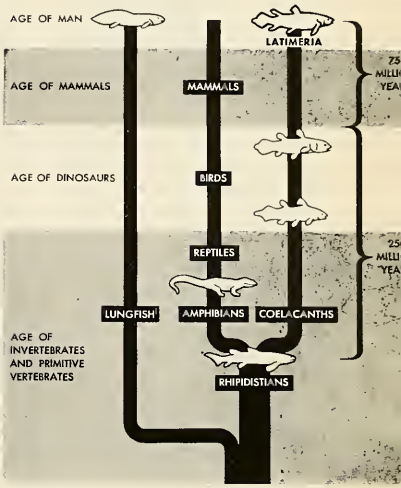
"Follow These Rules"

1. **CRUSH OUT YOUR SMOKES!** When out-of-doors, stop to smoke in safe places only. With the side of your shoe, clear a space in the surface litter down to the mineral soil. Drop your cigar, cigarette butt, or pipe ash on this cleared spot. With the heel of your shoe, grind it into the ground until you're sure it's out. When driving, use your ash tray. NEVER throw burning material from any vehicle.
2. **BREAK YOUR MATCH IN TWO!** This safety test will insure that the flame is extinguished. Always feel the burnt end before throwing your match away. Always make sure your match is DEAD OUT—a good habit, for home or woods.
3. **DROWN YOUR CAMPFIRE!** Before you build a campfire, scrape away all the inflammable material from a spot 6 feet in diameter. Dig a hole in the middle and build your fire there. Keep it small. NEVER build a campfire against trees, logs, or near brush. Before leaving your campfire, stir the coals while soaking them with water. Turn the sticks over and soak both sides, as well as the earth around the fire. Make sure the last spark is DEAD OUT by feeling the embers with your bare hand.
4. **USE CARE IN BURNING!** First of all, find out if your State laws require a permit for burning brush or debris. If so, get one from your local fire warden or ranger. Have plenty of help, tools, and water handy. NEVER burn slash, grass, leaves, or brush in unusually dry, hot, or windy weather.

Remember — Only YOU can prevent forest fires

MUSEUM ARTIST Ferraglio puts final touches on cast of female *Latimeria* in preparation for special exhibit.

FAMILY TREE shows first lobe-finned fishes (bottom) from which stemmed both coelacanths and amphibians.



Coelacanth—

Cast of famous "living fossil" now on exhibit

IN December, 1938, a fishing trawler, at work near the mouth of the Chalumna River off the coast of South Africa, brought to the surface a five-foot-long fish, with heavy scales and curious "lobed" fins, which none aboard the trawler could recognize.

This curious fish was shown to the curator of the museum at the nearby port of East London, a Miss M. Courtenay-Latimer. She, too, was unable to identify the specimen, but forwarded a sketch and description to Professor J.L.B. Smith, a prominent South African ichthyologist. Professor Smith tentatively identified the fish as a coelacanth, a living survivor of a family of fishes believed extinct for some seventy-five million years. This identification was confirmed when he later inspected the specimen itself, and Smith named the dramatic survivor from the Devonian *Latimeria chalumnae,* in honor of Miss Latimer and the place where it was found.

Since 1938, eleven other coelacanths have been caught in waters around the Comoro Islands. Because Madagascar and the Comoros are under French administration, the specimens captured since 1953 are being studied by French scientists. The Paris Natural History Museum has sent a cast of a female specimen of *Latimeria* to the American Museum, which is now on special exhibition here. Before the end of 1957, two other casts from Paris should be on exhibition elsewhere in the United States—one in Washington, one in Springfield, Illinois.*

To put the coelacanths into paleontological perspective, the first primitive lobe-finned fishes appeared more than three-hundred million years ago, early in the Devonian period. Called "rhipidistians," they gave rise not only to the coelacanths, but also to the first land-dwelling vertebrates, the amphibians (Figure, above).

About seventy-five million years ago, the dinosaurs became extinct and the great inland seas disappeared from the continents. Before the 1938 discovery, paleontologists believed that coelacanths, like the dinosaurs, had become extinct.

Latimeria's interest to biologists lies in its slow rate of evolution. The skeleton of the living *Latimeria* bears a close resemblance to the fossil skeletons of coelacanths three-hundred million years old. Although, as noted above, the coelacanths did *not* give rise to the amphibians, the detailed anatomy of *Latimeria*'s lobed fins, with the soft parts available for study, may also give further clues to the transformation of lobe fins into amphibian limbs, a development which heretofore could be studied only in fossils.

*When plans for the exhibition of these two casts are completed, they will be announced in NATURAL HISTORY'S "REVIEWS" Department.

continued from page 359

ties had actually penetrated individual homes.

My first meeting with the women of Swat, face to face, had been at the hospital. I had been struck by their classic beauty and awed by their extreme pallor. Many seemed at death's door, and some undoubtedly were. However, this pallor was apparently caused more by a mode of life than by a specific illness.

I soon became aware that their interpretation of their religion, rather than the religion itself, dominated their lives. The Koran had never prescribed the unhealthful *burqa*, nor had it condoned the neglect of girl babies. Yet here the *burqa* was worn by nearly all women whose occupation permitted them to do so; and girl babies were often unwanted. In one family where the mother had given birth to twins the day before, the woman doctor and I found the babies wrapped in rags in a dark corner.

"The father must be disappointed," whispered the doctor, "they are girls."

I looked at her in surprise.

"How do you know — you haven't examined them yet."

"By the way they have been treated," she murmured.

The children were picked up; and one turned out to be a boy. Never was there such a commotion. Quickly the family produced their best piece of embroidered cloth. This was spread on a *charpoy*, or cot; the old rags were replaced by a piece of fine cloth. After a moment of anger at the neglect his son had received, the father was all smiles. The little girl, meanwhile, drew the attention of only one person, the doctor, who requested a clean rag for the child and was reluctantly given one.

It is generally true, to be sure, that Islam counsels women to lead a more secluded life than men. But here on the frontier, where the men have so great a sense of personal freedom and have already adopted much that is modern and Western, the contrast between the sexes is staggering.

Youth and Progress

Looking deeper into the life of the people, I soon realized that when Gulshahyada had put an end to the tribal wars and had united the people in one state, he had also stirred a new consciousness. The young were becoming aware of their own potentialities as individuals. I visited several of the 125 schools scattered throughout the territory, and everywhere the classrooms were packed. Girls were still in the minority, but no classes were without them. None had so far enrolled in the college, but many were studying outside the state on grants from the government.

▲ THIS MOUNTAINEER, from uplands of Swat, wears a henna-dyed beard.

The contrasts in everyday life may give a hint to the future. At the sport field, which was rarely deserted, bareheaded and barekneed youths were often seen playing violent games of rugby before an audience of old men with henna-dyed beards. They sat watching, wrapped in blankets that allowed only the turned-up toes of their embroidered slippers to show.

The judicial system has also been changed. Feuds between tribes are no longer settled by shooting it out. Misdemeanors and felonies are punished through due process of law. Major crimes deserving capital punishment are also handled by due process, and sentence is passed. However, there is no paid, public executioner. Instead, the guilty man is shot by the nearest relative of the victim. Even this is done under legal supervision.

Native customs regarding marriage dictate that the parents of the prospective bridegroom, or perhaps the young man himself, shall choose the bride. The engaged couple do not see each other during betrothal celebrations or during the marriage ceremony. After that, concealed in an embroidered cloth, the bride is carried away in a *doolie*, a small sedan chair, along with odd pieces of furniture, to the home of the bridegroom.

During my visit in Swat, I attended the engagement party given for a servant girl. It was a gay affair. Countless relatives and friends were there, eating and laughing while music played. To all appearances, everything was strictly conventional. I saw the future bride, a slim girl; her head was bent and she was weeping.

When I asked what was wrong, her mistress replied, "Nothing at all. Since she is leaving her own family, she has to look sad."

I suggested the reason might be that she was marrying a man she had never seen. The woman laughed.

"This is one girl who is different, I can assure you. Not only does she know the boy; she is the one who selected him."

And so it was. Yet, her betrothal and marriage celebrations were held according to old traditions. The bride and bridegroom were kept apart throughout the ceremonies.

The last time I saw her was on her wedding day when she was carried away in the *doolie*. She was wrapped in the same cloth that had concealed many another, but this bride was a woman of new ideas and different beliefs.

"Come back ten years from now," invited one of the men, "and tell me then what you think of Swat."

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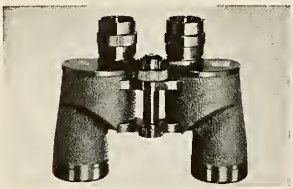

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NAVAJO NATIONAL MONUMENT *continued from page 381*

cave of Inscription House.

Of the three ruins in Navajo National Monument, this is the smallest, having only 75 rooms. Much work had to be done in this cave before actual construction of any houses could begin. The cave is very shallow and might better be described as a high ledge, some 200 feet long. As at Betatakin, in order to get enough floor space for the village, the Anasazi first had to make a heavy retaining wall along the sharply sloped cave front and then fill in behind with tons of dirt and debris. Carrying this material up the sheer cliff face was quite a task, but once the floor level was established, a neat, compact village took shape.

Of particular interest in Inscription House are the unusually large T-shaped doorways with matching miniature windows, strange flying buttresses on either side of some doors, the wattle and daub construction, some curious battens of straw, and mud brick, in addition to regular masonry techniques. Numerous pictographs and petroglyphs can be seen on the walls and, despite the shallowness of the cave, this ruin is in good condition. Discovered the same year as Betatakin by Wetherill and Cummings, Inscription House was later partially excavated and much of the masonry stabilized.

Why the name Inscription House? Auby took us to one of the rooms where, scratched in the mud plaster of the wall, was the name-giving legend "1661" and some undecipherable letters. John Wetherill reported that, when discovered, the inscription read "C H O S 1661 A d n" with more letters that were illegible. It is generally believed that it was placed there by a Spanish explorer.

After examining the inscription, we sat down in the western end of the cave to enjoy the lofty view of the canyon while having lunch. Below us stretched the land once farmed by the Anasazi and now occasionally dry-farmed by the Navajo. Suddenly a wind sprang up, the sky began to darken, tremendous cumulus clouds swept into view, banding together and shutting out the sun. Within minutes rain was pouring down. Thunder crashed, echoed, and reverberated through the canyon. What had been a dry wash below the ruin now began to run water. Rivulets tumbled off the sandstone bluff over the front of Inscription House cave, forming a lacy curtain. The storm continued for about ten minutes, then, as suddenly as it had come, moved on, rumbling along toward Navajo Mountain. The sun reappeared, bright and hot, the wind subsided, and the flow in the wash vanished into the sandy depths of the canyon. The storm had added a most dramatic touch to our visit.

It was eight o'clock the next morning when Auby led the way to the edge of Zilnez Mesa and pointed out our route to Keet Seel. Then we began our descent into Segi Canyon. The steep trail drops over 900 feet to Segi's broad arroyo. We crossed the Segi and turned into Dogozhobiko Canyon, then to a point where it is joined by Keet Seel Canyon from the north. In Keet Seel Canyon, we followed a faint trail along a free-flowing stream.

"Although some people have hiked to Keet Seel," Auby commented, "it is not advisable since the trail is difficult to follow and crosses the stream several times. Not only is it a hot trip, but most of it is through deep sand. Added to this is the 900-foot climb to the mesa rim at the end of the round trip!"

Every foot of the way seemed to take us farther away from civilization. There are no Navajo hogans here. A majestic solitude pervades this beautiful canyon. The horses' hoofs made only a muffled plodding sound in the sand, and great tan-colored cliffs rose a few hundred yards on either side.

Much more vegetation grows in this canyon than in the others we had explored. Ledges, talus slopes, and much of the canyon bottom is forested with juniper, piñon, box

alder, aspen, and some fine stands of fir. We passed through a series of surprisingly flat sections of bottom land, broken only by the incision of the flowing stream. According to Auby, early traders reported that in the late 1880's there was a series of small shallow lakes in this canyon; but recent erosion has destroyed them.

Passing through a dense grove of box alder, we suddenly emerged into a grassy clearing.

"Well," said Auby, "there it is — Keet Seel. Really something, isn't it?" He pointed to the left wall of the canyon.

Our first reaction was complete astonishment. Before us was a huge pueblo in so remarkable a state of preservation that we almost expected to see Indians moving about. It is built on a ledge some 40 feet above the canyon floor, within a broad, deep cave. The village might have been abandoned only yesterday. This is the largest and best-preserved cliff ruin in Arizona, and its buildings completely fill the large cave. Keet Seel is incredible — no words can do it justice.

Richard Wetherill discovered Keet Seel, or "broken pottery," in 1893. The ruin was partially excavated and stabilized in 1934.

We climbed a ladder into the village, and Auby called our attention to the cave's great protective overhang, which shields the dwellings from direct rain and snow. Tree dates indicate that there was construction in this cave as early as 1116 and as late as 1286 (one of the latest construction dates found in the area). However, it was probably abandoned by 1300. The village had approximately 160 rooms and may have supported a population of about 200 people.

The deeply recessed location has helped to preserve the village, while its remoteness and relative inaccessibility have minimized thoughtless "pot-hunting" and vandalism.

Conspicuous throughout Keet Seel are long upright poles. Although they play some part in construction as braces, the projecting ends were probably used as drying racks for meat, clothing, or bedding. Dozens of rooms in this village are in almost perfect condition — roofs are intact, wooden lintels are still present in windows, plastered walls are in good condition, fireplace wind deflectors are in position near doors, and even storage racks made of poles are still standing. Ceilings show yucca plant fibers used as cordage to hold beams in place and all securely tied in square knots.

Elsewhere in the village is a large protruding rock covered with well-worn grooves. Evidently it was used as a sharpening stone for tools. Portions of the cave wall are decorated with dozens of pictographs of handprints, animals, and human figures, done in blue, white, and red paint.

Although the low doorways might lead one to assume that the Anasazi were a very short people, human remains indicate that the ancient pueblo builders were of stocky, moderate stature, comparable to that of the modern Hopi or other pueblo dwellers. Small doorways could be covered more easily with a mat or hide to keep out drafts.

We spent the day at Keet Seel and were reluctant to leave in mid-afternoon. We took a last look at the slumbering ghost village and headed our horses back down the eleven-mile trail to headquarters.

That evening, we once again walked along the Sandal Trail to Betatakin Point. The setting sun bathed Segi Canyon in a pale orange hue. Then dusk crept through the piñons and over the rim; the canyon faded from view, and night settled over this remote and fascinating Monument.

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Letters

continued from page 337

and-a-half inches long, with a wing-spread of about fifteen inches.

I found the bat alive, on its back, near a power station in Louisville. It emits a not particularly high-pitched "clack" and, when aroused, gives a series of hisses and "clacks" that sound somewhat like a dial phone.

BURTON HARTER

Louisville, Kentucky

HOARY BAT. Advice: avoid bites by bats.

The Department of Mammals replies:

Before taking up the question of identification, the Department wishes to emphasize that the unusual circumstances under which this bat was found suggest that the animal may not be healthy. In the last few years, bats ranging the United States have been known to carry rabies (all mammals are potential carriers of rabies). Persons finding bats under unusual circumstances should exercise great caution in handling the animals to avoid being bitten. In case of bat bites under such conditions, and particularly in cases of unprovoked bat bites, the animal should be captured (alive if possible), local health officials should be informed, and advice should be requested from them and from a physician regarding testing of the bat for rabies, and proper treatment for the bitten persons.

And now, two bats in the eastern United States fit Mr. Harter's description. First is the red bat *(Lasiurus borealis)* and second, the hoary bat *(Lasiurus cinereus)*. A third eastern bat, which also has silver-tipped hairs—the silver-haired bat *(Lasionycteris noctivagans)*—may be excluded because it lacks the light-colored patches on the wing bones. Judging from its large size and the color description, Mr. Harter appears to have found a hoary bat, which ranges over most of North America in summer, and migrates southward in the autumn.

The noise reported by Mr. Harter is one of a variety of sounds made by bats, only three of which are audible to humans—the "click," the "buzz," and the "flight-sound." Each of these is usually accompanied by very high-pitched sound, inaudible to humans, which functions in the manner of sonar. With these ultrasonic emissions, bats are able to detect objects by "echo-location."

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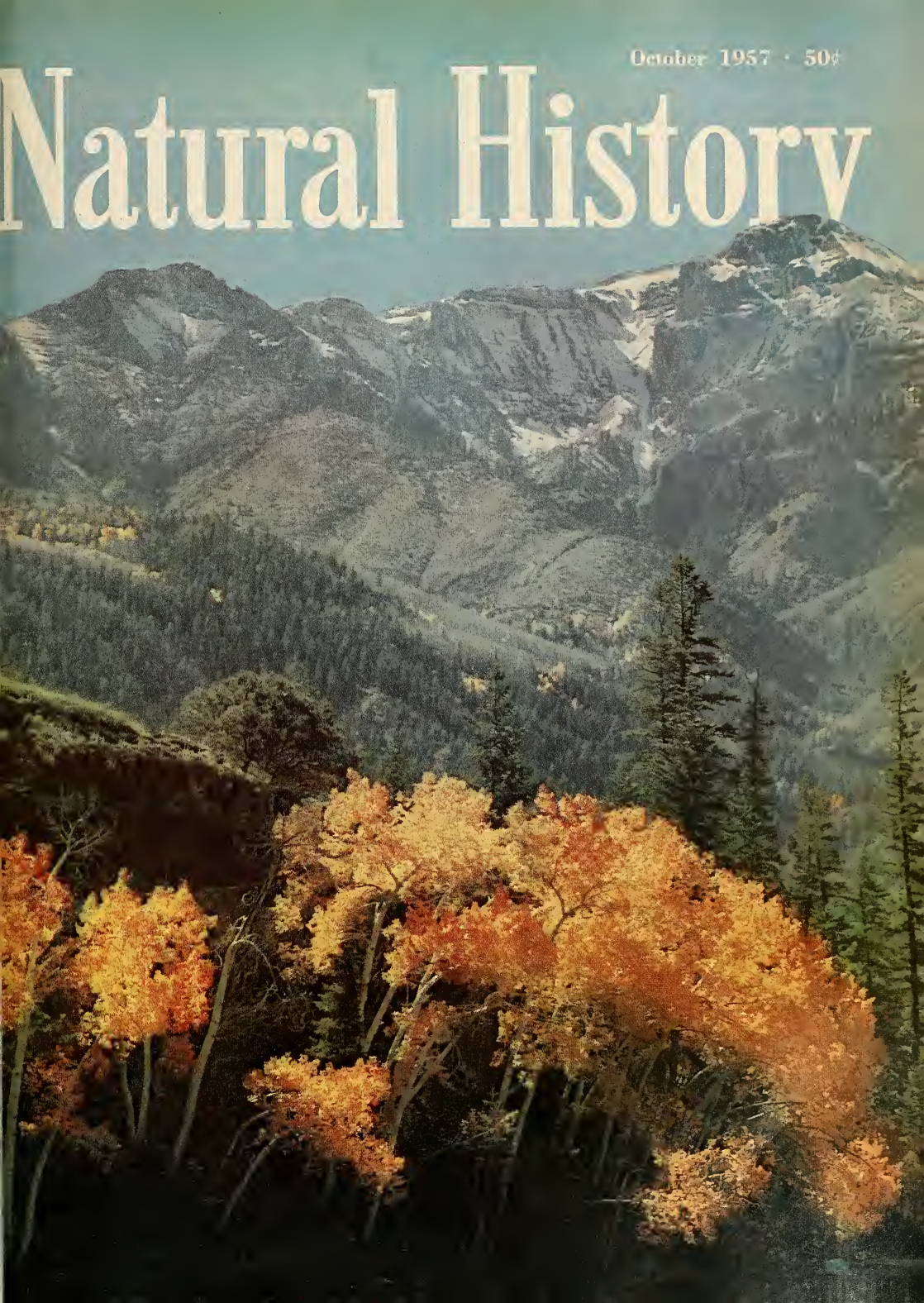

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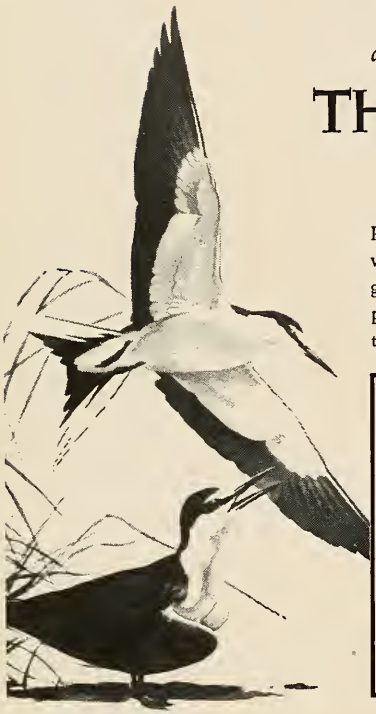

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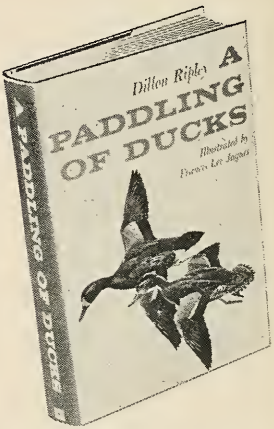

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Letters

More Banana Animals

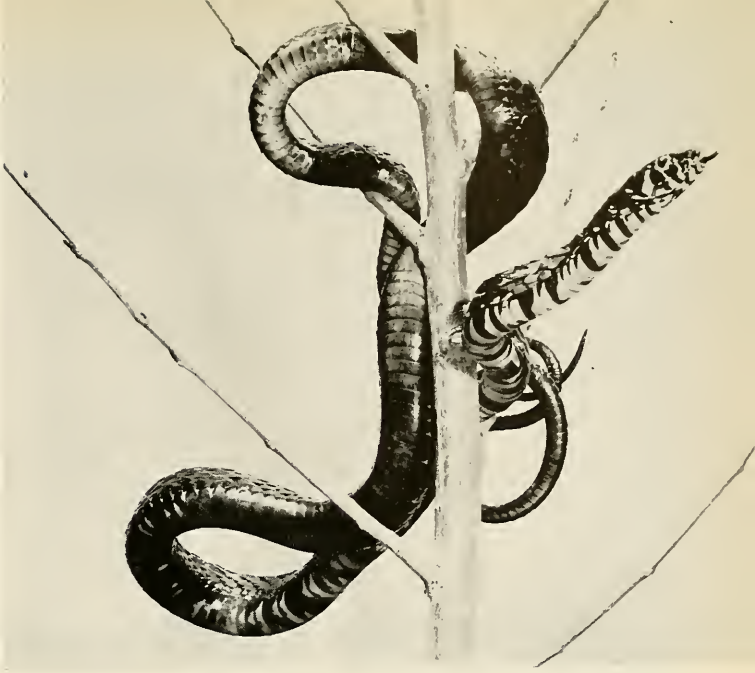
SIRS:

Soon after publication of my article regarding various animals received from banana dealers over a period of ten years or so (NATURAL HISTORY: January, 1957) two interesting new members of this growing family were brought to me. The first, a Tiger Rat Snake, *Spilotes pullatus*, came from Ecuador. A handsome, shiny black, four-foot serpent, with yellow and black tigerlike markings on its sides and below at its head end, it is very tractable and easy to photograph.

The second, also from Ecuador, proved to be one of the owl butterflies, *Opsiphanes tamarindi*. These are fairly common in banana plantations and my specimen probably came as a chrysalis in the bunch of bananas. The larvae live on bananas, probably eating the leaves, and rest along the midrib of the leaf.

WALKER VAN RIPER

Denver, Colorado



LATEST ADDITIONS to family of banana animals: Tiger Rat Snake and Owl Butterfly.

Starlings That Dunk

SIRS:

As a reader of NATURAL HISTORY, I have been particularly interested in the sidelights on natural phenomena that appear in your "Letters" column. I would now like to add a query of my own:

We maintain a bird feeder and bird bath in our backyard, and have logged 38 different species of birds in the last year. Recently we have noticed very interesting behavior on the part of starlings and, occasionally, grackles. We throw bits of stale bread on the ground whenever we have some available, some of them with rather hard crusts.

Although all other species of birds leave these hard crusts alone after a few attempts to peck them, the starlings pick them up and fly to the bird bath. There they place the crusts in the water, even pushing them around with their bills. As the bread softens up, the starlings will either eat the crumbs that float to the surface, or will sometimes pick up the soggy crust and fly away.

We have observed this numerous times, and it appears to us to be reasoned behavior. We would like to know how it appears to the experts at the Museum.

VIRGINIA MILES

Englewood, N. J.

THE DEPARTMENT OF BIRDS replies:

The soaking of food by starlings is not common. However, the association of these starlings with grackles provides an explanation. Food-dunking is a well-known habit of grackles, and probably an inherited one.

continued on page 448

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The Magazine of the American Museum of Natural History

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October, 1957

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What Donald Culross Peattie has called "the purest gold in all the world" may be seen across the lower portion of the October cover. It is a stand of trembling aspen (*Populus tremuloides*), that overhangs the south end of Lake Lenore, near Ouray, Colorado. On the hillsides beyond, a green backdrop of Engelmann spruce (*Picea engelmanni*) displays the more usual color of our western forests, while an early autumn snow-flurry has whitened the skyline of the neighboring landmark, Corbitt Ridge.

Such touches of autumn glory as this are welcome gracenotes in the sameness of our evergreen forests. Many Americans, however, do not know that the vivid range of red and gold that marks our eastern woodlands in autumn is unknown to most of the world. For the story of these colors, see p. 424.

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Reviews

The Beginnings of Chinese Civilization

by Li Chi

University of Washington Press, $6.50
123 pp., illus.

Reviewed by
Walter A. Fairservis, Jr.

Probably, there is no area of archeological research in the world where there has been so much speculation, misinformation, and out-and-out abuse of archeological data as in China. Its poverty-stricken peasants have regarded the looting of antiquities from the tombs and cities of ancient China as a legitimate source of income, worth fighting for if need be; while the antique dealers, who distributed the bronzes, sculptures, and ceramics throughout the world, encouraged them in this wide-scale pilfering.

Although there is little, if any, archeological evidence to support the dating of this mass of unlocalized material from China's past, there are very few museum curators, art historians, and dealers who can resist the urge to place the objects in various periods on no other basis than a mutually acepted order of art "styles." Late Chou, Early Han, Ch'in, Middle Chou, Shang, etc., are period names, based on the dynastic histories of China. Convenient for labeling an antiquity, they have come to mean a particular period of a particular style, as if the antiquity had been excavated from a known level of a known historical site.

The capital of the Shang Dynasty was Anyang, a city in Honan Province in the Yellow River Basin. For years, Anyang was the site of extensive looting, but from 1929 to 1937 Chinese scholars excavated there under the direction of Dr. Li Chi, a graduate of Harvard University. Events after 1937 suspended the work, and the collections of scientifically excavated Anyang material eventually reached Formosa, where they are today. The perseverance of Dr. Li and his colleagues to preserve the treasures of Anyang through so many vicissitudes is almost incredible.

Anyang is, at last, a fixed point on which to gaze if one is to understand something of the beginnings of China and Chinese art. Unfortunately, very little has been published. Dr. Li's present book consists only of the notes for three lectures he gave in the United States. It is cursory and unrewarding, despite many excellent photographs and interesting comment on the origin of the Shang.

The trouble is that this little book is virtually all that the leader of this important and fruitful expedition has been able to produce in the troubled years after 1937. One can only hope that Dr. Li will eventually get the support he so desperately requires, and that full publication of the Anyang material will open the eyes of the world to one of the most fascinating periods of all history.

Mr. Fairservis is an archeologist who traveled extensively in China during the war as a member of the U.S. armed forces. He has since done field work in Pakistan and in Afghanistan's northern provinces.

Double-faced "monster," in marble, from a Hou-chia-chuang tomb; double-face pattern on bronze vessel excavated at Hsiao-t'un.

SCYTHIAN VESSEL carries possible scene of primitive dentistry. Note recurved bows, key light cavalry weapons, in their cases.

THE SCYTHIANS

by Tamara Talbot Rice

Frederick A. Praeger, $5.00, 255 pp., illus.

Reviewed by
LOUIS DUPREE

THE SCYTHIANS, physically extinct but artistically alive, are one of the many non-literate (although in other ways sophisticated) groups which rode swiftly and surely across the political scenery of the Eurasiatic steppes and then disappeared. They left behind incomplete bits of evidence to tantalize archeologists, historians, and art curators. About 700 B.C., these horse-riding, cattle-owning, aristocratic nomads conquered the farmers of the north Black Sea region of South Russia and the Kuban, and controlled this area until the second century B.C.

The Greeks of classical times established several trading colonies in the Black Sea area and the Scythians exchanged meats, salt, grains, slaves, furs, and skins for Greek jewelry, finished metal products, and pottery. Many of these objects have been recovered in the Scythian royal tombs of South Russia. Other tombs of Scythians and related peoples are found scattered from Prussia and Hungary to the Altai region of Siberia. The finds in the Siberian tombs are exceptionally well preserved. After burial, the tombs were covered with earth, and large boulders were placed on top of the round mounds. Autumn rains seeped through the stones and thick ice formed in the winter. The stones insulated the ice layers and kept them from melting. These archeological "deepfreezes" have enabled Russian excavators to recover clothing, arms, tools, horse trappings and covered wagons, mummified horses and embalmed humans in perfect condition. Two such "deepfreeze" Scythians had elaborate tattoos on their arms, legs, and backs.

All these things and more are recorded by Mrs. Talbot Rice in her scholarly, readable, and well-illustrated book. She discusses in exciting detail the scope of Scythian research and the problems still unsolved, various reconstructions of the socio-economic and religious lives of the Scythians, and the impact of these "people-in-a-hurry" on world history and art. Her bibliography includes many recent (through 1955) sources in English, German, French, Russian, and Hungarian.

The Scythians subdued South Russia with a new, superior weapon: light cavalry. The Sarmatians, who developed the metal stirrup and heavy cavalry tactics, destroyed the political power of the Scythians in the first century B.C. The Goths completed the job militarily and, by A.D. 200, the Scythians had ceased to exist as an ethnic entity. But the dynamic, imaginative Scythian animal-art style influenced Chinese, Middle Eastern, and North European art for at least another thousand years.

A fine introduction for scholars and pleasurable reading for the layman, *The Scythians* is a sound piece of work.

DR. DUPREE *has done anthropological field work in Afghanistan and Iran, and is presently an Associate Professor at the Air University, Maxwell Air Force Base, teaching Middle Eastern studies.*

DAWN IN ARCTIC ALASKA

by Diamond Jenness

University of Minnesota Press, $4.75
222 pp., illus.

Reviewed by
EDWARD M. WEYER, JR.

WHEN Stefansson embarked on his largest and longest expedition to the arctic in 1913, he took as his anthropologist a young New Zealander, a former Rhodes scholar who had done field work in New Guinea. That anthropologist has now written this book for his sons, so they could learn how he had passed that first winter, living alone with the Eskimos in northern Alaska.

Some of Dr. Jenness' winter companions were little-known inland folk of the Colville River, "wild" Eskimos, who had scarcely come into contact with civilization. There wasn't any comfortable way to learn about these "wild" people. Dr. Jenness slept sardine-fashion in poorly ventilated and vermin-infested huts, ate food repulsive to many palates, and had to respect the etiquette of a hostess who, instead of washing his cup after a meal, licked it clean.

More vividly here than in technical reports, we glimpse the reactions of the Eskimo to hardship, loneliness, and the threat of starvation; their attitude toward the spirit world, and their views regarding the white man's "better medicine."

When Dr. Jenness had these experiences, almost nothing was known of Eskimo prehistory. He excavated several

continued on page 444

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Overhanging bluff of Modoc site provided natural shelter for archaic hunters of southern Illinois.

The Modoc Shelter

A site in Illinois shows Archaic Man to be nearly 10,000 years old

By Thorne Deuel

SOUTH of St. Louis, in Randolph County, Illinois, the Mississippi River valley is about four miles wide—a low-lying area, bordered by a line of bluffs which marks the start of the gently-rolling prairie. The Missouri Pacific track between East St. Louis and Cairo runs along the flat bottomlands, and a black-topped county highway hugs the foot of the bluffs, connecting the villages of Modoc and Prairie du Rocher.

Over the centuries, wind and rain have deposited soil at the juncture of flat and bluff. A few years ago, a county road-maintenance crew dug away some eight feet of this soil, at a point where the bluff has a wide overhang, to use for fill. During their digging, bones and "arrowheads" were turned up and, in the spring of 1952, Archeologist Irvin Peithman, of Southern Illinois University Museum, brought the site to the attention of Melvin L. Fowler, an archeologist of the Illinois State Museum, who was at work on a dig not far away.

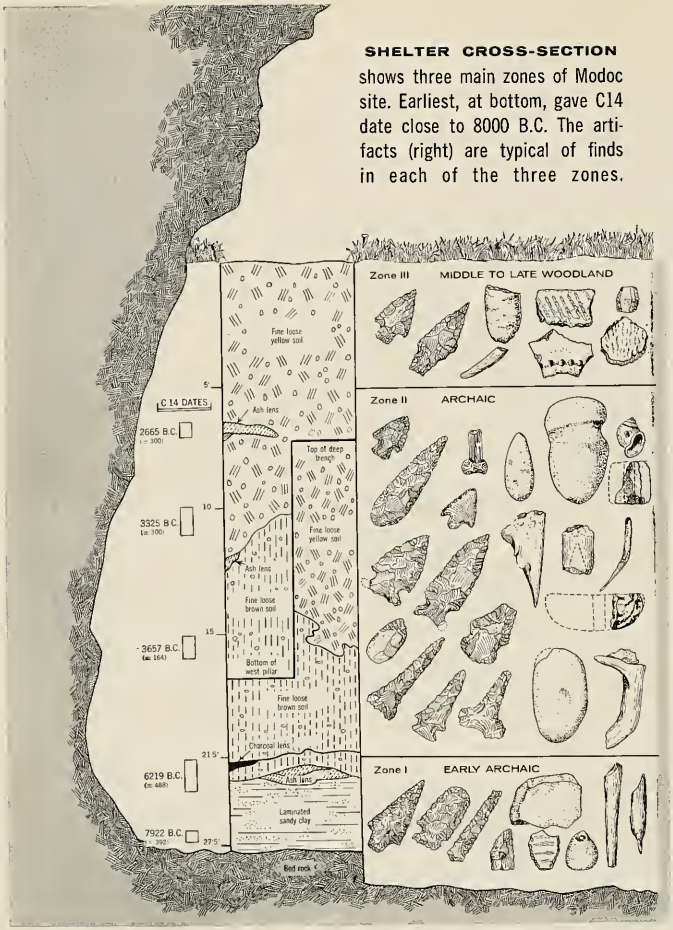
For the remainder of that summer, whenever the weather was rainy, Fowler and his Museum associates left their open site and worked instead under the overhanging bluff which they named "Modoc Rock Shelter." Thus began a systematic study of what has proved to be important new evidence bearing on the prehistory of the eastern United States (see article on p. 406).

DR. DEUEL, the Director of Illinois State Museum since 1938, served his apprenticeship in anthropology under Professor Fay-Cooper Cole at Chicago University.

Sometime before 8000 B.C., the Mississippi, which – during the glacial retreat, about 10,000 B.C. – had washed the very edges of the Modoc bluff, diminished in size, and withdrew from the bluff wall. In places, the ledge that the retreating waters exposed was as wide as fifty to one-hundred feet. Elsewhere, it narrowed to a mere pathway next to the rock. Here and there, a prairie stream cut a gully in the bluff rim, providing narrow entryways to the ledge, protected from rain by the bluff's overhang.

Such a shelter must have had natural appeal for primitive hunters and collectors, and the ashes found in the earth at Modoc

WELL-PRESERVED skeleton is viewed by excavation director Fowler (center).



SHELTER CROSS-SECTION shows three main zones of Modoc site. Earliest, at bottom, gave C14 date close to 8000 B.C. The artifacts (right) are typical of finds in each of the three zones.

lend substance to our imagined picture of such an early people gathered behind a brush windbreak, around a blazing fire.

As the figure (left) shows, all except the upper five feet of the Modoc deposit is ascribed to the so-called "Archaic" period — a stage of life in the New World that preceded the development of farming. The lowest two-and-a-half feet at Modoc, however, have tentatively been assigned to the early Archaic, because the remains there appear to be even simpler than the more typical Archaic above. The topmost five feet, in turn, contain pottery identified as belonging to cultures of a period in which agriculture was known.

If we may judge by the bones found at Modoc, either the great mammals — in whose wake pre-Archaic man had earlier followed — no longer roamed the countryside in numbers, or our Modoc dwellers were too discreet to pursue them. In the Modoc larder, mastodon had been replaced by deer, elk, raccoon, and opossum. Because such animals are likely to remain in one locality rather than migrate, the successive occupants of the Modoc Rock Shelter were also able to stay put for some time without losing their food supply.

TOOL KIT OPEN, student begins slow removal of earth matrix from skeleton.

SLAB OF ROCK covered this skeleton.

In addition, the nearby river provided mussels, snails, turtles, and abundant fish, particularly the smaller sorts that inhabit quiet, slow-moving waters. Almost half the fishbones recovered at Modoc belong to the catfish family. The small number of artifacts found that relate to the use of wild seeds and nuts (milling- and nutting-stones, for example) indicates that such vegetable foods were few.

Hunter's Arsenal

How were these Archaic hunters equipped? We know from bones that – except perhaps in the earliest period – they had the dog as a companion. The bones also tell us that deer was a mainstay. The assemblage of stone implements shows that the hunter's chief weapons in the later levels were the light spear and dart – with broad-shouldered flint heads – that were hurled with a spear thrower, or atlatl. Such projectile points would be difficult for a wounded animal to dislodge. In the earliest layers, on the other hand, the notched weapon-points were narrow-bladed, developed probably from the older Paleo-Indian type which, it has been suggested, were for thrusting and could be more easily withdrawn from the wound.

UNDER HOT SUN, the painstaking work of uncovering skeletons continues.

CLAY-LINED pits found 22 feet down.

EXPOSED BAND of clay, with charcoal (left), is possible remnant of hearth.

Earth taken from excavation is fed into mechanical sifter at edge of pit.

Objects recovered by sifter are washed, labeled as to level where found.

The relatively large number of migrant birds — Canada Goose, Snow Goose, Mallard, and other ducks, which are identified among the many bird bones at Modoc — conjure a picture of the Archaic hunters busy in spring and fall among the reedy, river marshes and upland ponds, taking a rich harvest of passing waterfowl.

If we include the five top feet of Woodland remains, the Modoc Rock Shelter shows a total span of occupancy of almost 10,000 years — from the time of the retreat of the last major ice-sheet down to the present. We base this estimate both on the evidences of climatic change and on Carbon 14 analysis. Material, eight feet from the surface (near the top of Zone 11), when analyzed by the Phoenix Memorial Laboratory of the University of Michigan, gave a date equivalent to 2765 B.C. Charred wood from an ash lens (Zone 1), studied by the University of Chicago Nuclear Laboratory, gave an average of 7922 B.C.

Closing the Gap

This lowest C14 date is of importance to the archeological reconstruction of man's early history in the New World, for it unexpectedly pushes Archaic culture in the eastern United States well back in time — to before the so-called "Thermal Maximum" (3,000 to 4,000 years ago).

Heretofore, many archeologists have been reluctant to believe that even early Archaic culture could predate the Thermal Maximum. Both archeologists and geologists, in turn, have taken the view that Archaic man's precursor in the New World, the hunters whose Folsomoid projectile points are found in association with extinct fauna, must have belonged to an even more remote era than the one to which the earliest Archaic remains have been assigned.

Thus, an apparent gap between Paleo-Indian and Archaic seemed to exist. Finds at the Modoc Rock Shelter go far toward eliminating this supposed gap.

Over-all view of site shows increasing depth of excavation, as archeologists dig for bedrock, 28 feet from surface.

EARLY MAN IN AMERICA

Sites in the eastern United States show that four cultural stages preceded the historical Indian society met by the early colonists

By James A. Ford

THE history of man in America, as we now know it, begins sometime over 10,000 years ago, when the great continental glacier was just starting its last retreat, and horses, ground sloths, mastodons, and mammoths ranged the open portions of the North American continent.

However, the first really convincing discovery to prove that the ancestors of our modern Indians had once been hunters of now-extinct elephants was not made until 1926, near Folsom Village, New Mexico. The skillfully-chipped flint points (with long flakes removed from the blade faces), which are typical of the "Folsomoid" culture, have since been discovered in every state in the Union.

The Carbon 14 method of dating has given us a measurement of the years that have passed since these Folsom flint-chippers and other related, early, hunting peoples flourished in the New World. This time-span has proved to be not so long as many had supposed: most of the Folsomoid C14 dates fall between 6000 and 8000 B.C. (figure, right). Evidently, mastodons continued to live in the Mississippi Valley — and, possibly, other parts of the continent — until as late as 3000 B.C.

The next eastern horizon, following the Folsomoid hunters, is known as the "Archaic." The earliest of the Archaic peoples chipped their spear points in stemmed and leaf shapes. Some of their points have concave bases, with the edges ground smooth — probably a retention of a base-form similar to that of the preceding Folsomoid tradition. Hunters, fisherman, and food collectors, these Archaic people could form into communities only in places with a stable supply of natural food.

DR. FORD, Associate Curator of Archeology at the AMERICAN MUSEUM, has worked at many Mississippi Valley sites, from the Archaic to the Temple Mound horizon.

The transition from the early to the later phases of this Archaic period seems to have occurred about 2000 B.C. It is marked by the appearance of ground and polished tools and weapons, which were lacking earlier. Among these are adzes, three-quarter-grooved axes, and celts. Polished stone spear-thrower weights began to be used and, in the Wisconsin area, making tools from local float copper was an important industry.

THE next chapter of our story brings us to the horizon of agriculture and pottery. The first of the agricultural people in the eastern United States flourished from about 500 B.C. until A.D. 700, and were widespread — from Florida to Michigan, from New York to Kansas. Their great numbers of conical mounds they built as tombs. The bones of their dead, along with a striking assortment of personal effects, were placed in log-roofed vaults, and earth piled above to as much as seventy feet. In some regions, particularly in southern Ohio, miles of earth ridges, up to fifteen feet high, were built near the burial mounds.

Archeological work in the Mississippi Valley and other regions of the East has shown that the Indians whom the European colonists dispossessed in the seventeenth and eighteenth centuries were merely the shattered remnants of still a fourth horizon — a people that had been much more numerous two centuries earlier. Apparently, new diseases, introduced by early European explorers and settlers, had made havoc with this last Indian civilization in the East — a thriving barbaric culture only slightly less advanced than the one existing in northern Europe during the time of Julius Caesar.

The basic elements of this fourth horizon — the so-called "Temple Mound" stage — were introduced from Central America about A.D. 900. The principal means of social organization and control was a religion based on sun worship. Wooden temples, priests' dwellings, houses for the bones of the dead, and other sacred structures were erected on the flat tops of rectangular mounds, laboriously constructed with earth, carried to the site by the basketload on the backs of devotees. These rectangular mounds were arranged around open courts, where ceremonies were held, and each "pyramid" was provided with a log-faced stairway leading from the court up to the door of the sacred building on top.

Forty to fifty feet is not an unusual height for these structures, and the largest — near East St.

THE FOUR STAGES of culture development in the eastern U.S. commenced (bottom) about 10,000 years ago with Folsomoid hunters, known best by the distinctive shape of their projectile points. Next to appear were hunters of the Archaic stage, such as the men of Modoc, who had more and better tools but still grew no crops. They were followed by a farming people, whose burial mounds dot the Middle West to this day. Last came a barbaric civilization of the Temple Mound stage (top), which the white settlers of the New World encountered along the Mississippi.

Louis, Illinois — is 110 feet high. The people who lived about these ceremonial centers were farmers, raising crops of corn, beans, squash and tobacco.

THE mounted Plains Indian, who chased the buffalo and whose face may be found on the nickel, had a culture that largely developed after America was discovered. Horses, which had become extinct along with other Pleistocene fauna, were reintroduced by the Spanish and made possible the nomadic life of these Indians. Earlier ceremonial ideas and patterns of living were markedly changed as the farming Indians on the western side of the Mississippi Valley adopted the horse and moved onto the Plains. However, many vestiges of former rituals could still be seen; for example, in the sun-worshiping ceremonies of several Plains tribes.

Because geologists have estimated an elapsed time of from 15,000 to 20,000 years for the last ice advance, while archeologists could not believe that their oldest Archaic finds were more than about 3,000-years old, a wide gap has seemed to exist between Folsomoid and Archaic. Recent radiocarbon measurements demonstrate that both sets of estimates were wrong: the geological estimates too great and the archeological guesses too modest. There is no gap. The analysis of such deposits as the Modoc Rock Shelter site described on the preceding pages clearly shows the heretofore unrealized antiquity of the eastern Archaic.

WHA

The rigid bittern is likely to remain a r

S IT?

a moment. The others should take longer

IMITATION THORN is actually a tree-hopper, with its upswept prothorax.

"DEAD LEAF" is really the Kallima butterfly, its wings folded in repose.

DISCLOSI

The best camouflage mak

THESE pages show a few of nature's many examples of protective coloration and mimicry, so skillfully fashioned that color, structure, and behavior all assist and protect a wide variety of living creatures. Color and structure both play important roles in enabling an individual organism to blend into its background. In many instances the camouflage is so carefully fashioned that it often misleads even the trained eye. One such example is the famous Kallima, the "dead-leaf" butterfly of the Far East (lower left). Here a masterpiece of deception has been created. The wings of this butterfly, when folded, so closely resemble a dead leaf that even an experienced entomologist may be deceived.

Another classic example of natural camouflage can be cited in the case of some *Membracidae,* or tree-hoppers (upper left). In some of these species, the prothorax is shaped into a curved upsweep which resembles a thornlike structure. When resting on a twig, these little tree-hoppers bear a remarkably close likeness to thorns. Still another deceiving insect is the walking-stick. These closely resemble a slender, many-branched twig and, when at rest on a shrub or tree, blend so closely with their immediate surroundings that they are rarely observed.

The passion-vine butterfly, *Dione vanillae,* is another insect that enjoys at least one phase of its life under the protection of near-perfect camouflage. Although the larva and adult do not practice deception through protective coloring and design, the chrysalis (upper right) makes up for the deficiency. The

IE HIDDEN

or, shape, and behavior

By Roy J. Pence

Mr. Pence, a notable photographer of insects, is Principal Laboratory Technician for the Department of Entomology at the College of Agriculture of U.C.L.A.

chrysalis, when hanging by its tip, or after having fallen to the ground, bears a striking resemblance to the dried leaves of the passion vine, on which it also feeds.

Interesting combinations in color and design have been evolved in members of the spider family. Certain species of spiders have used these combinations advantageously to protect themselves from enemies, or to assure an easy meal. The little crab spider, for example, employs its color and crablike form to blend into flowers that are visited by insects. It can so perfectly blend into the petals, and its outstretched legs can so carefully match the pistils and stamens, that any error on the part of the visiting insect is usually discovered too late.

Other spiders that enjoy a degree of immunity, because of their ability to masquerade, are those designed to resemble an ant. Because ants in general are recognized as unpalatable creatures, equipped with suitable means of defense in their own right, the spider-mimics benefit from this disguise.

Over and above considerations of color and structure, behavior can assist in producing effective camouflage. Any student of wildlife has seen animals and birds render themselves nearly invisible by "freezing," with the result that their protective coloration is assisted by immobility. The bittern shown on the previous page, which "froze" when surprised by the photographer, provides a striking example.

"Withered leaf" is chrysalis of passion-vine butterfly, *Dione vanillae.*

"Drowned leaf" is the Amazonian leaf fish, *Monocirrhos polyacanthus.*

T. macrocephala, as is known from years of observation, carries its eggs in its mouth until hatched. But "Why?"

MOUTHBREEDERS' PUZZLE

By Lester R. Aronson and Evelyn Shaw

Many generations of West African mouthbreeders have been raised in the American Museum's aquarium tanks in the past twenty years, and their specialized breeding behavior has been extensively studied by the Department of Animal Behavior (Natural History, March, 1956).

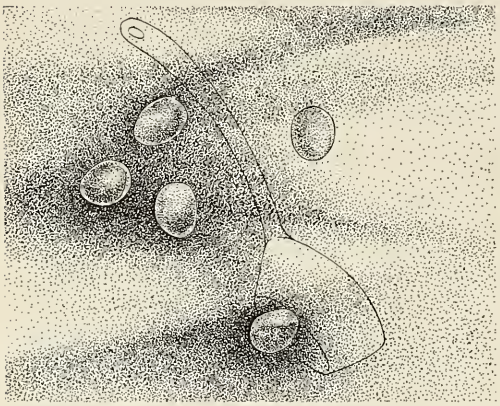
Recently, the Department's curator and one of his associates began to speculate about the reasons underlying this fish's name-giving habit of carrying its eggs about in its mouth during the two-week incubation period.

What follows is the story of how these two scientists examined, tested, and rejected a number of considerations and finally found an answer. As scientists, they were not surprised when that answer, in turn, led to a further question demanding still a further answer. The readers of Natural History will enjoy this case history in the application of the scientific method.

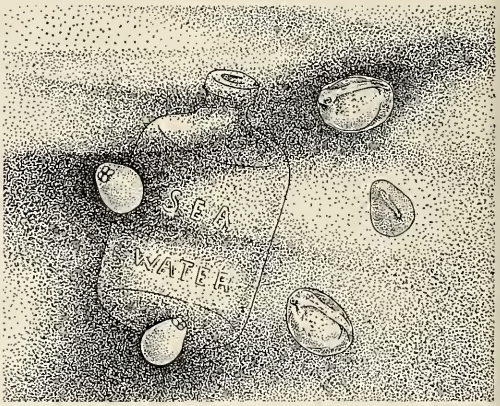
Part I

FISH endowed with the mouthbreeding habit possess some obvious advantages in their struggle for existence. Their eggs do not remain exposed in the water during the period of early development, when they might be food for hungry snails, crustaceans, and fish, who delight in gobbling fresh roe. Later, the newly-hatched young, while still helpless, remain sheltered by their parent's mouth. To be sure, some losses occur when the mouthbreeder, itself, occasionally swallows an egg. And, too, after the incubation period, the young must be quick to take refuge from their parents,

Dr. Aronson's research in behavior has included laboratory work with fishes, frogs, and cats, and field work in Africa and the Bahamas. Dr. Shaw's analysis of the antiseptic factors in the mouthbreeders' behavior was part of her doctoral dissertation.

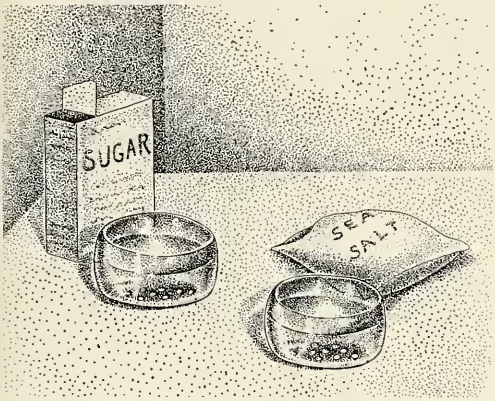


Prime question arose when eggs, removed from parent's mouth and put in aquarium water by themselves, died.



First test, adding sea water to the aquarium water, was a complete success. All eggs thrived, developed into fry.

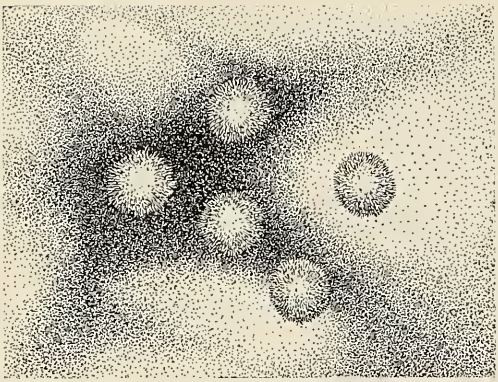
TILAPIA *macrocephala*, the black-chinned West African mouthbreeder, gathers up new eggs from nest on bottom.



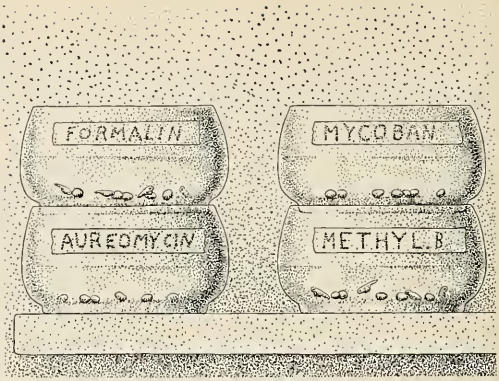
BUT "WHY?" REMAINED. Neither special salt-mixes, nor an equivalent osmotic solution of sugar would help eggs.

who show no hesitation in dining on the fingerlings they have previously guarded. On balance, however, it has usually been accepted that this behavior-pattern, by itself, possessed sufficient custodial advantage to assure its perpetuation by means of the machinery of natural selection.

The thought had not previously occurred to us that mouthbreeding might make other contributions to the survival of the embryonic fish. We were, therefore, astonished one day when, in the course of another study, we gently removed some eggs from a father Tilapia's mouth and placed them in a separate bowl of aquarium water. Within twenty-four hours, the eggs were all dead! Perhaps, we thought, this was just an accident, and all these eggs would have died even if they had remained in the parental mouth. To repeat the test, we persuaded a number of other brooding fathers to spit out some of their eggs. These eggs, too, were placed in separate bowls. The answer, we soon found, was that if the eggs were removed from the mouth within a day or two after they had been laid, they invariably died.



First breakthrough came from discovery that dead eggs, after week-end's neglect, were covered with a white mold. New clue: antiseptic effect of sea water.



Test of antiseptics was unsuccessful at first. In some, all eggs died. In others (Formalin and methylene blue), a few eggs lived to hatch, but the fish were deformed.

Our curiosity was aroused. What was killing the eggs? How could it be prevented? Now the universal panacea for sick tropical fish is a salt water solution — not table salt, but coarse sea salt or rock salt. We had no coarse salt in our laboratory at the time, but we did have a dusty bottle of old sea water. We diluted this sea water with fresh aquarium water and placed some young embryos in the mix. The eggs thrived and developed into frisky fry. After many tests, we determined that a mixture of 40% sea water and 60% aquarium water resulted in excellent survival.

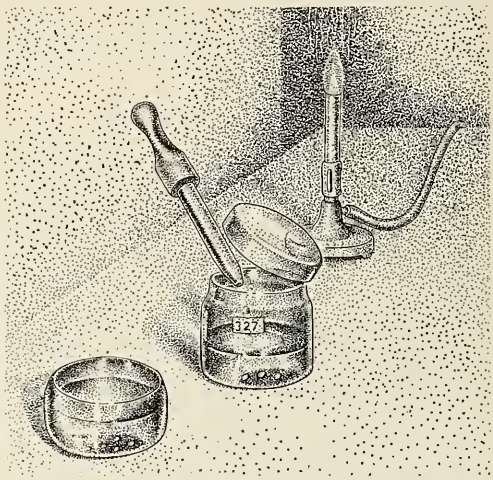
We could now keep almost all our experimental eggs alive outside a parent's mouth. From a technological viewpoint, the problem was solved: we had the "how." But science is rarely satisfied with "how." We still wanted to know "why," and in the search for this answer difficult problems confronted us.

The Problem of Common Properties

What properties, if any, we asked ourselves, are common both to Tilapia's mouth and to sea water in keeping the eggs alive? It was inconceivable that the fish, in fresh aquarium water, was capable of building up a concentration of salts in its mouth equivalent to diluted sea water. We organized our attack on this question by setting up over 100 pair of Tilapia in our laboratory, in order to guarantee a steady supply of freshly-laid spawn.

Now, the most important characteristic of sea water is its mixture of salts, in which sodium chloride (common table salt) appears in greatest abundance. Perhaps, we thought, the eggs needed one or more of these salts. So we set about making various salt solutions. We first tried a solution of sodium chloride. In repeated trials, all the eggs died. Next, we experimented with the other major salts, calcium and potassium chloride, still without success. Next, we tried a combination of eight salts. Even this careful combination — a close laboratory reproduction of sea water — could not keep the eggs alive. We realized that we were following a wrong trail.

We next considered another factor — osmosis. As we knew, the skin or outer covering of fish will permit water to pass through slowly, inward or outward, depending on relative salt concentrations. We reasoned that perhaps the diluted sea water was maintaining life in the eggs through osmotic adjustment of the amount of water they contained. If this were so, we could test the hypothesis by placing the eggs in an equivalent concentration of sugar water, which would provide the identical osmotic regulation. Once again, eggs were taken from parental fish and placed, this



Second breakthrough came with realization that tested antiseptics were poisoning eggs. In new test, eggs were dipped briefly, placed in sterilized aquarium water.

time, in a syrupy solution. Again we suffered the disappointment of a wrong hypothesis: all the eggs died! Thus, we had ruled out both salts and osmosis as parallel factors in the two viable environments, the parental mouth and the sea water mix.

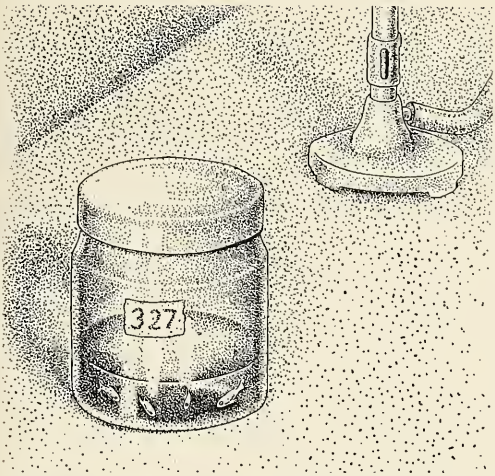
Usually, after each experiment, we would carefully wash and stack our bowls, to be ready for the next series of tests. But this Friday afternoon, we wearily left the dead eggs untouched over the weekend. On Monday morning, as we were about to throw the decayed eggs away, we noticed each one was covered with a delicate carpet of white mold. This accidental observation forcefully reminded us of a third, and well-known, property of sea water that we had completely neglected to examine – its effective lethal action on many kinds of bacteria and molds.

The Concept of Antisepsis

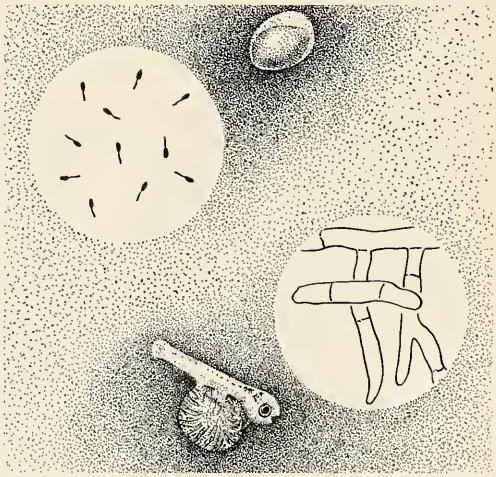
Ideas jelled: from time immemorial, sea salt has been used for preserving fish and meat because of its bactericidal action. Was it this property of sea water that was protecting the eggs? We promptly began to test our eggs in a variety of antiseptics – among them, aureomycin, Formalin, methylene blue, lysozyme (a substance found in tears, which is thought to protect the eyes from infection), and Mycoban (a mold inhibitor, sometimes used in bread and cake). Again, the outcome was most disappointing. All the embryos died, except a small percentage that had been placed in highly diluted solutions of methylene blue and Formalin. The few survivors, in turn, were all badly deformed.

An important qualification for the scientist is the ability, like Bruce's spider, to keep trying in the face of failures. We began to ponder. Why did some of the embryos survive in dilute methylene blue and Formalin? And why were the survivors abnormal? Then a simple idea occurred. Certainly, these substances were protecting the eggs from infection but, at the same time, they were poisonous and were, therefore, also killing the eggs or deforming the embryos. We decided to rerun the antiseptic tests, this time limiting the time of exposure. We found by trial and error that dipping the eggs just ten minutes a day in a very dilute solution of Formalin was sufficient to keep a high percentage of them alive. Excited because we now seemed on the right trail, we sterilized some aquarium water. Then we dipped our test eggs in the antiseptic, transferred the eggs to the sterilized water and closed the jar, thus keeping out airborne germs. To our gratification, most of the embryos survived. We repeated this experiment twenty times, with success each time.

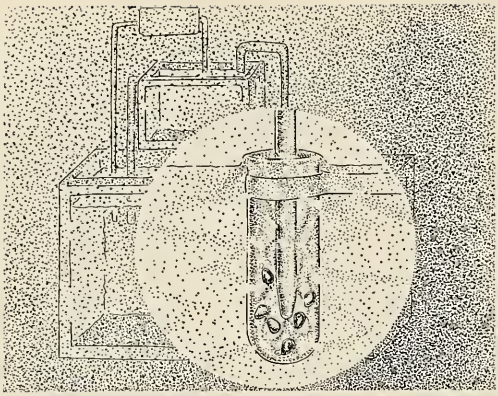
Now, because sterilization will destroy both bacteria and fungi, we still needed to know which of these two types of organisms had been killing our unsterilized embryos. Thus, our next step was to get bacterial and fungal smears from eggs that had died in normal aquarium water, and then produce pure cultures. When this was done, we placed new batches of treated eggs in jars of sterilized water, and added drops of pure bacterial culture to some and pure fungal culture to others. The results were striking. All the eggs exposed to the bacteria died, while those exposed only to fungi survived. After many repetitions, we were able to conclude that the bacteria softened the surface membranes of the eggs and eventually killed them. The weakened membranes, in turn, permitted the development of fungal growths and this is what we had seen that fateful Monday in the unwashed dishes. Finally, we realized that the diluted sea water of our earlier



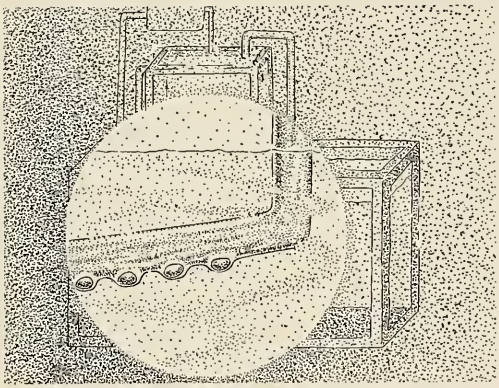
Success at last: in twenty separate tests, most of the eggs that had undergone a brief dip in dilute Formalin and then been put into sterile jars hatched normally.



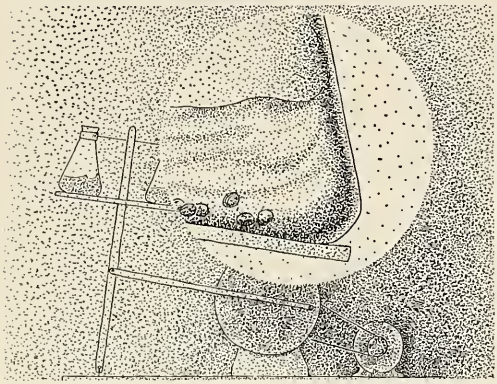
Next question: What was killing the unsterilized eggs—bacteria (left) or fungi (right)? Test with pure cultures showed bacteria caused the fatal softening of membrane.



ANALYSIS of oral environment required further testing. Eggs, in parental mouth, are both churned and flushed. This churning apparatus gave moderate survival rate.



FLUSHING TEST, however, proved a bleak failure: all the eggs died. Conclusion: movement of water around the eggs was unimportant, but movement of eggs was vital.



FINAL PROOF of this conclusion was provided by a third apparatus, which rocked the eggs back and forth. The result proved movement as important as antisepsis.

tests was the only antiseptic substance which had no associated toxic effect on the eggs.

Thus, we now had a number of answers: we knew why our eggs would *not* survive in aquarium water if they were removed from the parent's mouth; we also knew why salt water *would* keep them alive. But we were even more curious to know how mouthbreeding achieved its sterilizing effect in our aquarium tanks.

The Mouth: a Sterilizing Machine

Watching a mouthbreeder carrying eggs, two features of the behavioral environment stand out. First, the eggs are continuously churned around in the parental mouth. Secondly, the eggs are constantly being flushed by the stream of water taken into the parental mouth through respiration. We wondered if either or both of these actions was inhibiting bacterial growth. So, first, we built a churning apparatus to test this hypothesis. A stream of water, flowing through a test tube which contained several eggs, gave them a steady mild churning. Survival in this apparatus was no more than moderate. What about flushing? We blew a series of small depressions in a piece of glass tubing, one egg was placed in each depression and a stream of water was channeled through the tube. These eggs were now flushed, but *not* churned. They all died.

We then set up still a third experiment. In this, the eggs, in a jar of aquarium water, were set on a machine that provided a constant rocking motion. Although these eggs rolled much more slowly than do the eggs agitated in the parental mouth, survival was good. We concluded that the agitation of the eggs in the mouth, by causing them to rub continuously against each other as well as against the fishes' mouth-walls, prevents bacteria from gaining their deadly hold. Indeed, the parental mouth, by its continuous mechanical action, is almost as effective a bactericide as is the chemical action of sea water.

The Answer Poses Another Question

Thus, at length, our first question — the cause of the death of the eggs — was answered. But, as so often happens in science, the long-sought answer to this one question has now raised another to bedevil us. We had demonstrated that Tilapia's mouthbreeding behavior, besides providing a refuge, is also an efficient mechanism for preventing the infection of eggs in fresh water. But, so far as we knew, these fish normally live *only* in the brackish waters of coastal lagoons and the tidal zones of rivers. This is to say that apparently the antiseptic qualities of dilute sea water are always present in Tilapia's usual environment.

What, then, we asked ourselves, is the value of this behavioral mechanism to a fish whose eggs are normally bathed in such a brackish, antiseptic wash? This new and broader question left us with yet another answer to seek.

FRUIT TREES AND VINES, carefully fertilized with pigeon guano, dot the harsh slopes by this cluster of tufa cones.

The Land of the Cones

These remote valleys of classical Cappadocia, in central Anatolia, hold a surprise for the traveller: dwellings cut from living rock

By Kenan Erim

ANATOLIA, that great peninsular bridge between Europe and Asia which is the very core of modern Turkey, embraces not only a fantastic variety of landscapes but carries traces of half a hundred ancient civilizations. From the towering Caucasus mountains of the northeast, through the steppe of the central plateau, down to the lacelike profile of the Aegean shores, the peninsula is a land of contrast and beauty. Fertile and verdant river valleys border arid highlands and lofty peaks, while modern roads follow the lines of antique, caravan trails. Archeological sites range from Paleolithic and Neolithic, through the still only half-known, imperial remains of the Iron Age

Hittites and the foundation stones of fabled Troy itself, down to some of the finest and best-preserved ruins of the Roman Empire's former eastern frontiers.

SOME of these areas of ancient culture are well known and easily visited: others remain remote and seldom seen to this day. Perhaps none is more unusual than the small area of central Cappadocia which is shown on these pages. Here stands an extinct volcano — Erciyas Dagi, the Mount Argaeus of classic times — whose snow-capped summit, reaching above 13,000 feet, is the highest point in Asia Minor. West of the mountain lies an area covered aeons ago by volcanic ash. In this plateau, approximately triangular and some sixteen miles in its greatest length, wind and water have carved almost a lunar landscape. Scattered about, sometimes in isolation and sometimes clustered together like the tents of a formidable camp, stand thousands of chalk-white and tinted cones, pinnacles, and peaks.

MOST ELABORATE of the rock-cut dwel

TURKISH FARMER of Göreme valley leads his donkey on the road to Ürgüp.

The effect upon the traveler is that of an unreal vision, a phantasmagoria of legend or myth — ruined cities, towers, minarets, domes, and pyramids in multiple hue under the brilliant Anatolian sunlight. Geologically, the explanation is realistic: the tons of ash and powder vomited by Erciyas Dagi, untold thousands of years ago, along with harder lava-flows, consolidated in due course into a mass of friable tufa. This soft material, subject to erosion by streams tributary to the nearby Kizil Irmak, as well as by the winds of the plateau, was sculpted by the hand of nature into its present depressions and fantastic shapes. Frequently, as weathering continued, harder rock, initially buried in the soft mass, became exposed.

built by Byzantine religious communities. This is the chapel of a monastery.

These tougher substances acted as cap-stones or "umbrellas" for the softer material directly beneath them, so that, as the centuries passed, the surrounding soft rock eroded away while the protected columns seemingly "grew" up out of the plain. Eventually, these caps were undermined by wind and water, to fall away themselves and allow the naked columns of softer stone to weather into needle points.

SUCH patterns of erosion are not uncommon in the western United States and, if their distinction lay in landscape alone, the Cappadocian valleys of Ürgüp and Göreme might do no more than attract an occasional party of hardy tourists who wished to peer at these Turkish "badlands." However, there is a unique distinction: this bit of unreal landscape in central Anatolia has been inhabited for a thousand years or more and its inhabitants have built their dwellings within the very pinnacles that catch the eye!

Taking advantage of the softness of the stone, which makes quarrying and carving easy work, men long ago cut innumerable dwellings and storage areas within the cliffs and cones. In addition to the ease with which the stone is worked, two other factors may have contributed to this choice of a cave-dweller's way of life. First, the region lacks an ample supply of timber for the construction of more usual house-forms. Second, the even-temperatured and dry cave-interiors provide welcome relief from the rigors of the Anatolian summer and snug shelter in the depths of winter.

No work has yet been done to

IN OPEN COURT outside rock house, these farm women winnow grain.

LIGHT FOR LOOM come from window chiseled out of cone's solid rock.

FARM WOMAN passes rock houses.

Mr. Erim is a classical archeologist of Turkish descent, born in Istanbul and at present a Ph.D. candidate at Princeton. As a member of Princeton's archeological expedition to central Sicily during 1955 and 1956, he specialized in numismatics.

establish the earliest date at which these rock-cut homes were first made. Some negative evidence at least implies that, archeologically speaking, it is a comparatively recent development: Cappadocia was a province of considerable importance in the classical period, but we find no direct reference to these unique cave-dwellers in the works of the classical authors.

After the partition of the Roman Empire, however, when Cappadocia formed one of the easternmost provinces of Christian Byzantium, this exotic region attracted the attention of a number of Christian ascetics. Side by side with the peasant farmers of these valleys, early monks established their cells and monasteries — excavating tombs, chapels, and even sizable churches out of the tufa.

ONE of the infrequent Western visitors to the area—the English writer, Patrick Fermor — says of the religious influx:

"Who were these monks? When did they come, and how did they live? . . . Did they arrive as hermits in flight from the corruption of Byzantium and Antioch? The troglodytic refectories, with the long stone tables, the wine-vats and runnels scooped out of the rock, the great hearths still black with the smoke of . . . meals, the shelves for kitchenware and the slots for hanging saucepans, all point to a communal life. . . . It was plainly monasticism of a simple kind. The Levant, at that time, was sprinkled with ascetic extremists. Anchorites immured themselves in caves. Stylites, seated on the capitals of ruined temples, wore their lives away in prayer and meditation, and the stranger Dendrites chained themselves for decades to the topmost branches of lofty trees.

Near the summit of an easily-scaled pinnacle, the camera looks out across

: of the Göreme valley in a photograph that successfully captures the spirit of this grotesque volcanic landscape.

SUCH GOATS as this, together with pigeons, are main domestic animals.

"The date of the valleys' evacuation," Fermor continues, "is as problematical as that of the cutting of the first grotto, and as unknown as its cause. . . . One plays with the thought of lost edicts from Byzantium evoked by some unknown heresy, of a sudden berserk outbreak of the advancing Mongols, of decay through a falling-off of vocations; and then, reluctantly, for lack of evidence, every theory must be abandoned. The caves, the crepuscular churches and the numberless painted saints remain enigmatical as ever."

We must concur with Fermor that mystery shrouds the date at which these curious religious communities were abandoned. However, the decoration of the various churches and chapels does provide a number of specific clues to the date of their construction.

Even today, in the better preserved of these churches, it is hard to find an unpainted interior surface — walls, domes, and arches are covered with scenes from the New Testament, and the likenesses of saints and evangelists. In the earliest examples, where paint was applied directly to the rock in decorative, geometric designs, interspersed with crosses, the work may date back to the eighth century. The later and more elaborate decorations — figured frescoes, painted on plaster surfaces — date between the ninth and the thirteenth centuries. Thus, even if we assume — as is improbable — that the Christian ascetics were the first to dwell in these valleys, we have a minimum span of occupation stretching at least a thousand years.

Few visitors to Turkey are aware of this hidden marvel of Cappadocia, and the cones and the cliffs today are the haunts of goat and pigeon. The peasants of such villages as Maçan, Soganli, and Sinasos continue to lead a simple life, the roots of which antedate the local efflorescence of Byzantine Christian art. In the green valleys and along the slopes, goats graze, and cereals and orchards of fruit trees are cultivated. Grapes and watermelon thrive on terraces leveled among the peaks and domes. Many families still live in the rock chambers, while others continue to use them as cellars, stables, and for storage space. Basically, today's peasant life is not far different from the one led by the Cappadocians over the centuries. The fantastic *decor* of cones and cliffs, however, transports the imagination to remote geologic times, when the earth was young, or even to a completely strange world — another planet, conceived only in dreams. Yet, Göreme and Ürgüp are real, a blend of earthly beauty and exoticism, and only two among the many jewels of Turkey, where the past and the present look together toward a promising future.

ROUGH-HEWN GAP in cone-house wall permits view across dry wasteland to fruit trees and a skyline of pinnacles.

CLEAR LIGHT of an Anatolian sunset brightens the twin pillars of a former chapel and its present inhabitants.

The Colors of Autumn

The vivid woodlands of October owe their splendors to a simple sequence of three families of pigments

By Jack McCormick
Illustrations by Matthew Kalmenoff

EACH autumn—in what has become commonplace for Americans but actually is an event limited to the forests in a few widely scattered regions of the world—the lush green monotone of summer is discarded and trees deck themselves in brilliant yellow and gold and vivacious shades of red. This period comes as a staccato note between the end of summer's sameness and the beginning of winter's naked silence.

Like many other wonders of nature, autumn's color display is largely taken for granted. In truth, however, autumn coloration is a feature unique to temperate, deciduous (winter-bare) forests, and only three large regions in the world are occupied by such forests, all of them in the Northern Hemisphere. One of these regions comprises the British Isles, and west-central Europe, where the color display is particularly well developed along the slopes of the Alps and in the Rhine and Danube valleys. The second includes eastern China and portions of Japan, and the third lies in the eastern part of North America.

In the world's southern half, autumn coloration is a rare phenomenon. In all of Africa and South America, with the exception of a small region in southern Chile, there is no autumnal extravaganza. Elsewhere, south of the equator, only limited areas in Tasmania and New Zealand present displays of autumn color (maps, right).

Both Dr. McCormick, staff ecologist of the American Museum, and Mr. Kalmenoff, a Museum artist, are currently at work on a new exhibit, the Hall of Forests.

To our good fortune, most of the eastern half of the United States and a portion of southeastern Canada are situated in what is not only one of the largest, but probably the most spectacularly colored of all deciduous forest regions. Memories of dozens of brilliant panoramas may be conjured up by the mention of late September in the Missouri Ozarks, the Adirondacks, or the White Mountains, or October in the hills of southern Indiana or the Smokies of Tennessee. Wisconsin so prides itself on its autumnal display that the state recognizes October as "Colorama Time." Several other states mark their highways in autumn with signs indicating the best color trails. New Hampshire even issues weekly maps, to show the progress of coloration.

Even in the evergreen forests, which extend unbroken across portions of our continent, and reach their arms southward along the mountain chains of the western United States, autumn color is to be found in dramatic settings. There, patches of aspen, whose color Donald Culross Peattie has termed "the purest gold in all the world," appear in a crazy-quilt fashion against the dark green backdrop of spruce and fir or pine.

Many consider that the red maple, in the zenith of its coloration is—more than all other trees combined—the crowning glory of autumn. Thoreau wrote of this species: "Some single trees, wholly bright scarlet, seen against others of their kind still freshly green, or against evergreens, are more memorable than whole groves will be by-and-by. How beautiful, when a whole tree is like one great scarlet fruit full of ripe juices, every leaf, from lowest limb to topmost spire, all aglow, especially if you look toward the sun! What more remarkable object can there be in the landscape? Visible for miles, too fair to be believed."

Yet many other trees are famous for their autumnal foliage. Two biologists in particular, Justus Watson Folsom (who extolled the autumns in New England) and Charles A. Shull (to whom the colors of mountainous North Carolina were unsurpassed), have written vivid accounts of these others:

"By the first of September," wrote Folsom, describing the Boston area, "a wholesale coloring has begun among blueberry, blackberry, sumac and other plants, although maples, oaks and poplars are not

generally changed. Before the end of the month red maples are intensely colored, while sugar maples are not at their brightest until the middle of October, in company with the poplars. Last of all come dogwood and scarlet oak, alone in their glory among the withered leaves of late October."

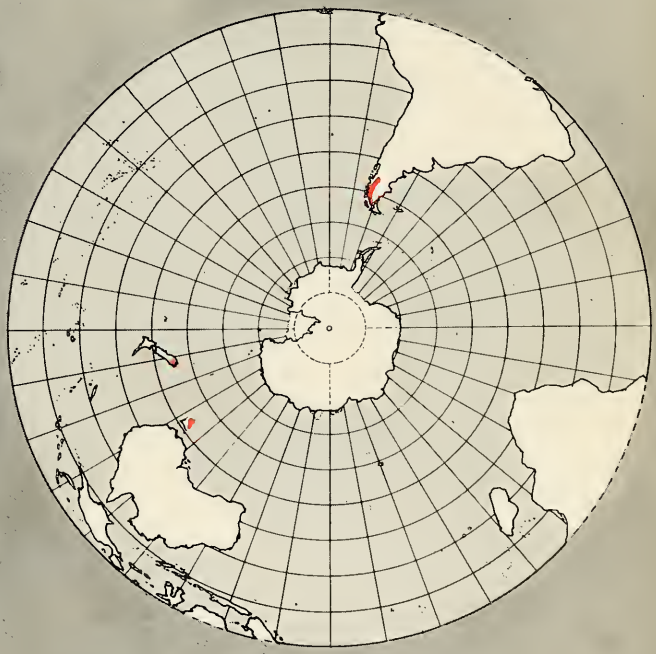
"In North Carolina in late September," wrote Shull, ". . . the oaks remain green at first, while the sourwoods, dogwoods and sumacs turn scarlet and crimson. The yellow poplars turn brilliant yellow, the hickories are yellow to orange, and look like great golden statues among the other trees. The ash trees, and occasional persimmons, are often a deep purplish color. . . . Each tree can be seen as an individual, rank upon rank, up the mountain sides. . . . As the season progresses, the green oaks change to flaming crimson bouquets...until the whole landscape is a magnificent riot of color."

If our annual display, itself, is taken for granted by many who view it, how much more so are the biochemical factors which underlie it. This seldom-heard story is one of pigmentation and the seasonal-changes' effect on pigments.

Without pigmentation, a tree's leaf would appear white. During the summer, several pigments occur in the leaf. Although they comprise only about 3% of the fresh weight of the leaf, they color it thoroughly. Of these pigments, the first in importance is chlorophyll. This substance, which enables plants to utilize the energy of the sun to synthesize food from inorganic raw materials, constitutes over 80% of all the pigments to be found in a leaf, and imparts its characteristic green color to summer foliage.

Chlorophyll does not mix with the other contents of leaf cells. Instead, it is contained in millions of tiny, transparent capsules, about 2/10,000's of an inch in diameter, called chloroplasts. These capsules, nature's food-manufacturing centers, float in the sap of the cells.

The display of autumn foliage, a commonplace to most Americans, is a relatively rare phenomenon in the world. Confined to three main areas in the Northern Hemisphere (above), it is almost unknown in south (below).



BLACK LOCUST

Robinia pseudo-acacia is a native of the Southeast and the Middle West. Its inch-long leaflets can turn translucent yellow as early as mid-July; its seed-pod ripens in fall.

CATALPA

Catalpa speciosa, now a widespread favorite for lawns. had an original range from Tennessee to Texas. Its large (six- to twelve-inch) leaves are yellow-gold in autumn.

Our next pigments are present in all the green, as well as in many of the non-green portions of plants (and, in such animal products as egg yolks and butterfat). These two, collectively known as the carotenoids, are the xanthophylls (yellowish in color) and the carotenes (yellowish-orange to red). They are responsible for the yellow and orange colors of zinnias, sunflowers, and goldenrods, the luscious ripe colors of oranges, lemons, red peppers, and tomatoes, the bright red of rose hips, the yellowish orange of carrots, the mellow tone of a ripe ear of corn.

Combined, the two carotenoids comprise about 16% of the leaf pigments, with the yellow xanthophylls usually more abundant than the orange-red carotenes. Like chlorophyll, both these pigments are also contained in tiny capsules, or "plastids." In green leaves, they are universally associated with chlorophyll, and located physically within the chloroplasts, where they probably also perform a role in the manufacture of food. Neither of the two carotenoids nor chlorophyll is soluble in water, but all dissolve readily in warm alcohol.

During summer, the vibrant colors of the carotenoids are eclipsed by the more intense greens of chlorophyll, which, although very unstable and readily decomposed, is continually being renewed. Toward the end of summer, however, the rate of chlorophyll renewal begins to decline, and ultimately terminates, while decomposition proceeds at an accelerated rate. As one author aptly states, "The once-active food-making machines go to the scrap heap in autumn and have no further value except as junk."

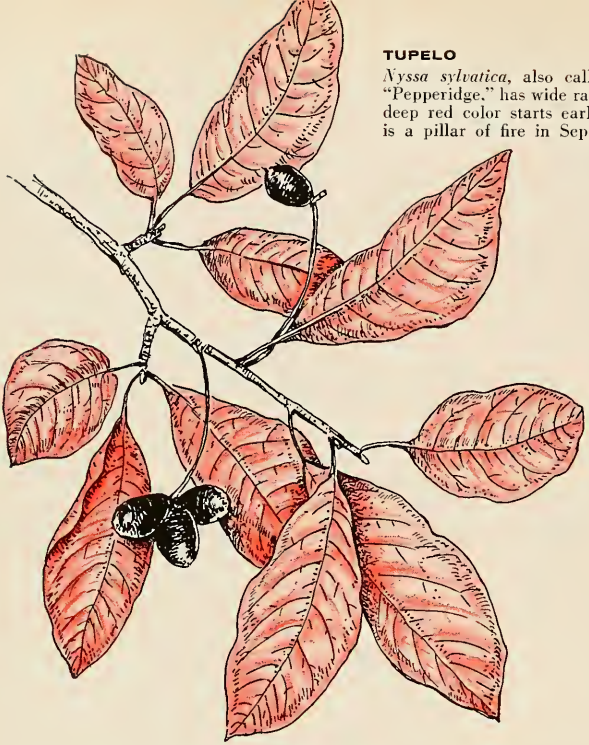
However, the decomposing chlorophyll does not, as was once believed, break up to form various colors. Rather, it fades completely from the leaf tissues. When this

AMERICAN ELM
Ulmus americana's two- to six-inch leaves are a rich butter-yellow, flecked with brown, in autumn. It grows throughout the eastern U.S.

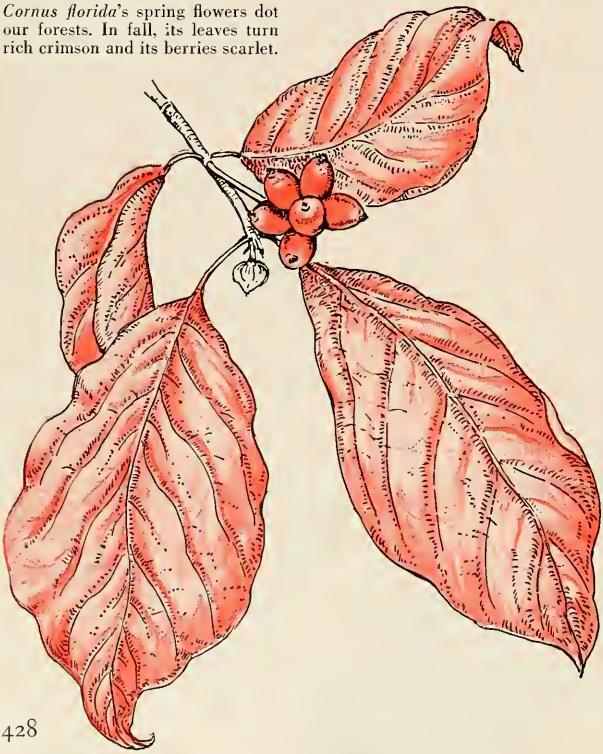
SHAGBARK HICKORY
Carya ovata has large compound leaf, with five leaflets that turn dull gold in autumn. Its fruit drops after the first frost, is favored by squirrels.

happens, the more stable carotenoids are evident. This is when poplars, birches, elms, and many other species brighten the autumnal landscape with their living gold.

The superior stability of the yellow pigments over the green is easily demonstrated in the laboratory by exposing the green alcoholic extract from a leaf to bright sunlight. After a short time, perhaps an hour, the green will have faded, leaving the fluid with a yellowish tint which persists for a considerable time. Because the carotenoids are always present in green leaves and are nearly always exposed before the leaf falls, the



TUPELO
Nyssa sylvatica, also called the "Pepperidge," has wide range. Its deep red color starts early: tree is a pillar of fire in September.



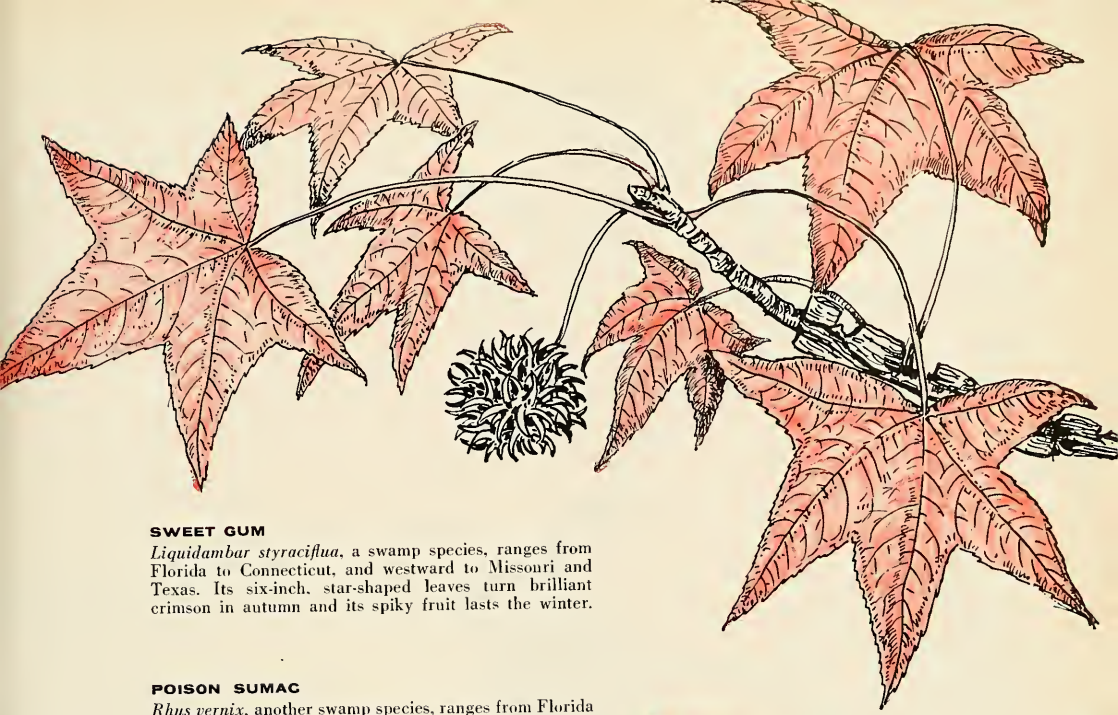
FLOWERING DOGWOOD
Cornus florida's spring flowers dot our forests. In fall, its leaves turn rich crimson and its berries scarlet.

various yellows are autumn's most common color.

The next source of autumn color is still a third group of pigments, known as anthocyanins, which are not usually present in leaves during the summer. The anthocyanins produce a variety of hues, from the most brilliant scarlet through a gamut of reds, subdued lavenders and purples, to deep blue. They are most familiar to us in other forms: the red of ripe apples, the rosy tints of mellow peaches and pears, the deeper reds of roses, the flaming scarlet of cardinal flowers, the soft blue of violets, the purple of grapes and blueberries.

Anthocyanins are responsible for the color of beets and the purple varieties of cabbages, potatoes, popcorn, hazel, and barberry. In a few species of trees, they are present in the leaves during summer. These trees, especially the copper beech, purple-leafed plum, and the Japanese maple, are noted for their unusual and decorative bronze-, wine-, and purple-tinted summer foliage. Several species of trees in the northeastern United States, notably the oaks and the maples, also exhibit a brief flush of anthocyanin coloration as the young leaves expand in the spring. In most trees, however, anthocyanins are formed only in autumn.

These anthocyanins are chameleon-like chemicals. Certain of them behave as do the litmus indicator-papers of chemists (often also utilized by gardeners to test soil acidity), appearing red when dissolved in acid solutions, violet in neutral solutions, and blue in alkaline solutions. The pigment in the flowers of the common chicory, for example, produces a light blue color at the peak of floral development. But as the petals wither and acid residues accumulate in them, the color of the pigment changes to a pale pink. Slight variations in the chemical composition and structure of these anthocyanin pigments and in the acidity of the leaf fluids make a tremendous range of colors possible.

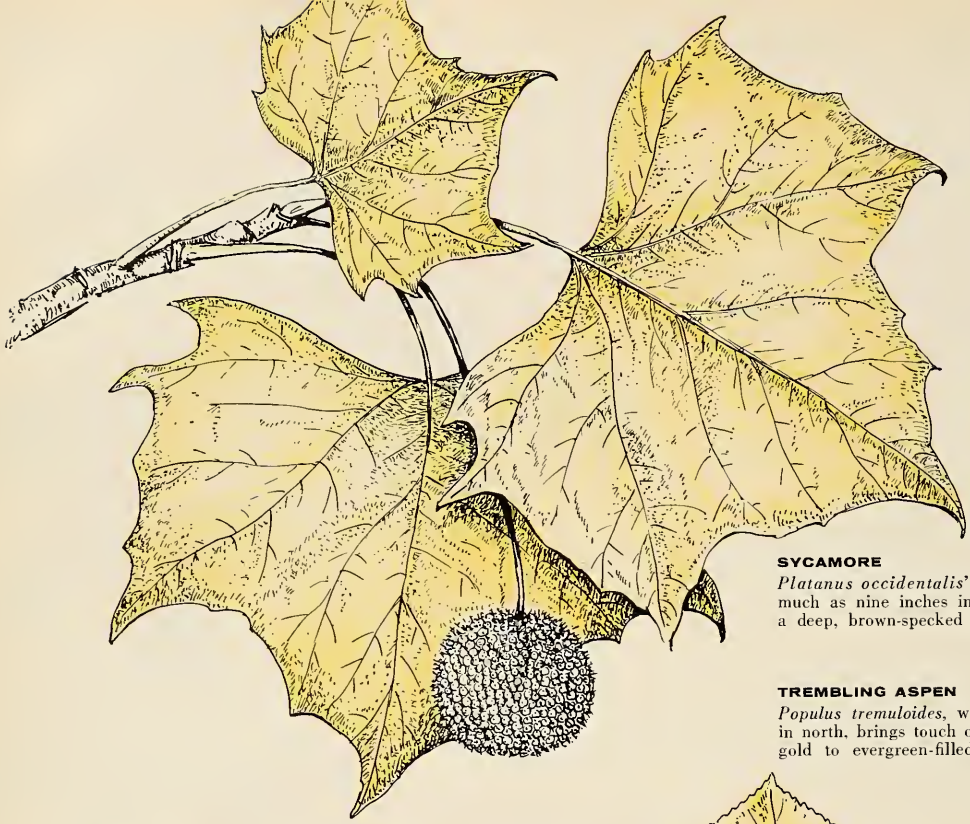


SWEET GUM

Liquidambar styraciflua, a swamp species, ranges from Florida to Connecticut, and westward to Missouri and Texas. Its six-inch, star-shaped leaves turn brilliant crimson in autumn and its spiky fruit lasts the winter.

POISON SUMAC

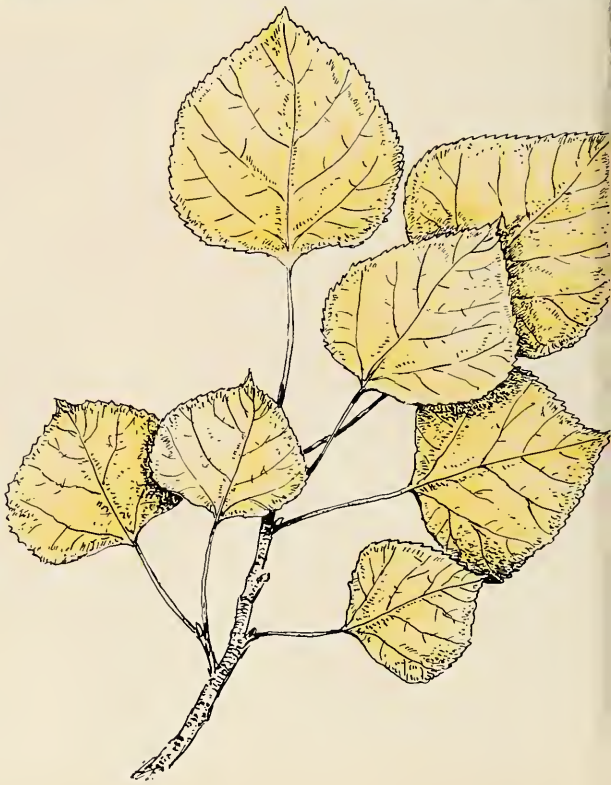
Rhus vernix, another swamp species, ranges from Florida to southern Canada. Its flaming scarlet leaflets (from two to five inches long) and its attractive white fruits lure the unwary into exposure to its blistering poison.



SYCAMORE
Platanus occidentalis' leaves are as much as nine inches in breadth, turn a deep, brown-specked yellow in fall.

TREMBLING ASPEN
Populus tremuloides, with wide range in north, brings touch of pure autumn gold to evergreen-filled forest lands.

TULIP
Liriodendron tulipifera has a tall, stately trunk, ranges from southern Canada to Louisiana. In fall, its four- to six-inch leaves turn a radiant yellow.



This third pigment group differs from chlorophyll and the carotenoids in several ways. The anthocyanins are *not* confined in plastids, but rather are dissolved in the fluids of the leaf cell. Thus, they color the fluid content of each cell as a drop of ink or iodine colors a glass of water. Further, while the green and yellow pigments are primarily confined to the loose tissue in the leaf's interior, the anthocyanins occur almost exclusively in the single layer of cells which forms the leaf's protective covering—the upper epidermis (see figure, p. 432). And, as against the greens and yellows, anthocyanins are water-soluble.

Combinations of autumnal pigments produce many unique shades. When the deeper-seated carotenoids are overlaid by the reddish anthocyanins in the leaf's epidermis, a yellowish-red or scarlet color is seen. If the outer layer of anthocyanins should be bluish instead, a striking crimson results. The purple tints of the ash's leaf are caused by the overlapping of chlorophyll by bluish anthocyanins.

The striking golden-bronze of the beech and some oaks, in turn, is produced by a combination of xanthophylls with still a fourth group of pigments, the brown tannins. This fourth group gives the puckery taste to unripe persimmons, plums, and other fruits. Tannins are also present in relatively large quantities in the bark of various trees, in the hulls of walnuts, in certain insect galls, and in the green leaves of many species, particularly the oaks and the sumacs. Although the astringent qualities and bitter taste of this group of pigments give them some value as insect repellents and fungicides, they appear primarily to be waste products. As such, they are commonly found in the liquid portions of plant cells. The tannins also occur in the cell walls of wood, bark, and dead tissues.

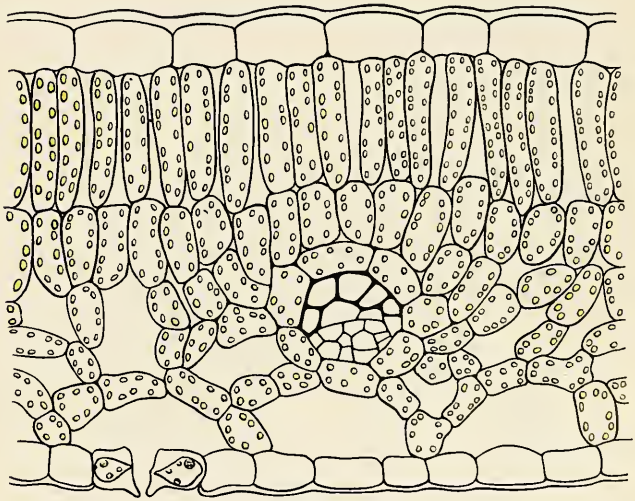
Contrary to popular opinion, some basic colors of autumn—the yellows and browns—are little affected by external conditions. Extended dry periods may cause premature leaf-fall and lessen the quantities of pigments present, rainy autumn days may reduce the hours of sunshine when the colors show to best advantage, and strong winds may sweep the leaves from the trees before massive tracts of trees have had adequate time to develop their coloring. In spite of all this, every autumn shall have its leaves of yellow-gold and brown.

However, the more exotic shades of autumn—the red and purple colors produced by the anthocyanins—are particularly subject to external influences. Even the same tree may vary considerably in these colors from one year to the next, while trees of the same species, growing in different situations, are often quite differently colored in the same year. Even different portions of the same tree may exhibit anthocyanin-produced colors of very different hues.

Laboratory investigations, begun in the latter half of the nineteenth century, have shown that high concentrations of simple sugars in the leaf cells favor the formation of anthocyanin pigments. Branches injured by insects or disease, or by mechanical damage, often change color prematurely. Presumably this early change is the result of accumulation of sugars manufactured in the leaves but unable to move through the injured tissues into the trunk and roots.

Environmental factors which may affect the anthocyanins include light intensity, air and soil temperatures, nitrogen supply, and soil moisture. Although anthocyanins are formed in total darkness by radish and beet roots, bright light influences pigment production in most plants by increasing the rate at which sugar is manufactured in the chloroplasts. So localized is this effect of light that, where one leaf shades another, a "sun print" of the overhanging leaf may be formed on the lower one—colors developing in the exposed portion of the lower leaf, while the shaded portion remains green or yellow.

However, the intensity of light required for pigment formation varies from species to species. Thus, we find great variation in



CROSS SECTION OF LEAF shows structure of inner cells between the heavy layers of upper and lower epidermis. Here, chlorophyll, in its plastids, has decomposed at summer's end, exposing the carotenoid pigments.

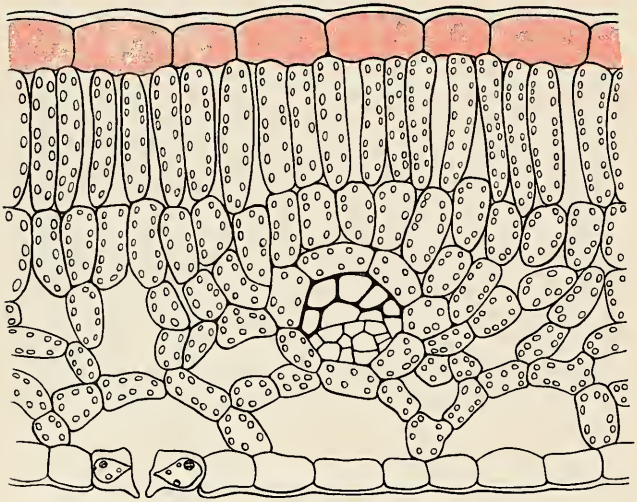
PRESERVING LEAVES

Several methods, none of them wholly satisfactory, are used to preserve the colors of autumn leaves. Each gives an interesting result.

The easiest way to preserve whole branches, with their leaves, is to place the freshly-cut branch in a dark, cool location, such as the cellar. This works well with beech leaves and with the foliage of the sumac and maple. It is unsuccessful with oaks. A second method consists of splitting the cut branch a few inches and then leaving the split end in a solution of four parts glycerin and one part water for about two weeks.

A third method involves drying the branches in warm sand. Clean, dry sand (screened, builder's sand is best) is heated in a metal can until it is very warm, but not painful to touch. While this sand is heating, another portion of sand, which need not be hot, is poured into a large box and smoothed out. The branches are then laid on this sand-bed in a natural position, and their outer ends carefully nailed to the sides of the box and supported by a few wires or sticks. The warm sand should then be sifted into the box, rather quickly and very evenly. The warm sand not only promotes evaporation of water from the leaf cells, but also presses the leaves evenly in a natural position. The excellence of the colors preserved by this method is surprising. Even the deep reds, among the most difficult to keep, lose very little of their natural beauty.

Single leaves can be preserved by coating them individually with paraffin. This may be done either by dipping the leaf into a pan of melted paraffin or by pressing it on each side with a warm flatiron upon which a little paraffin has been melted (a steam iron should not be used). The coating of paraffin should be thin, for a thick layer will dull the color of the leaf. This method preserves the color indefinitely. Leaves dip-coated by the author, while he was in a high-school biology class nearly fifteen years ago, still possess remarkably lifelike colors.



CHAMELEON-LIKE ANTHOCYANINS, unlike carotenoid pigments are not in plastids, but dissolved in leaf-cell fluids. As cross section shows, these pigments, red to blue in color, concentrate in leaf's upper epidermis.

autumn coloration from one year to the next, although both autumns have seemed the same. One autumn may afford conditions favorable to anthocyanin formation in just a few species, while another autumn, outwardly similar, affords conditions favorable to pigment formation in many more.

Temperature is another factor. Low, but not freezing, night-air temperatures encourage the conversion of starches to sugars, inhibit the movement of sugars from the leaves to the stem and roots, and result in a reduction of the respiration rate, which effects a further saving of sugar. Freezing air-temperatures, in contrast, result in the immediate death of leaf tissues and, consequently, in the loss of their brilliant colors.

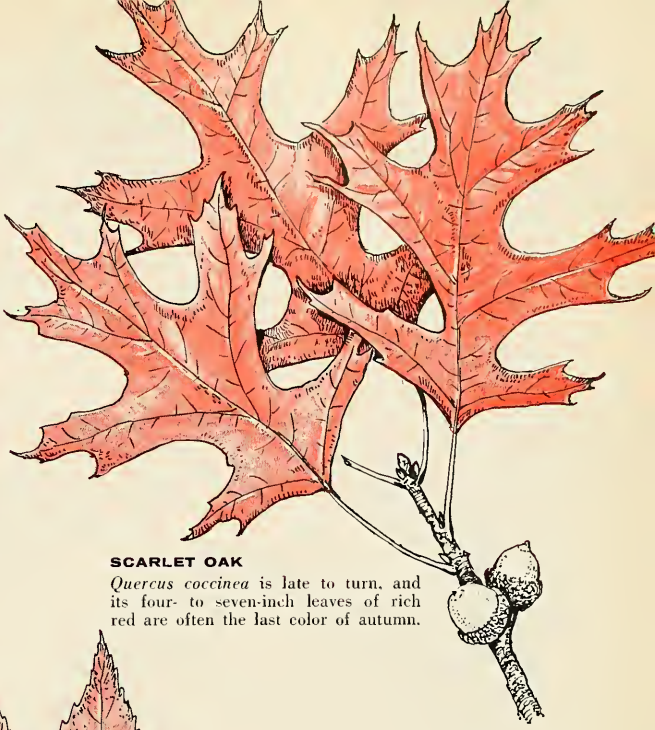
Low soil-temperatures retard the absorption of water by tree roots, producing the same effect as low soil-moisture. The lack of water favors anthocyanin synthesis indirectly, by promoting the conversion of starches into sugars and also by tending to reduce the rate of absorption of nitrogen from the soil (a low level of nitrogen in the leaf cells reduces the rate of withdrawal of sugars). In 1902, a botanist, collecting plants in Spitzbergen, north of the Arctic Circle, observed that in areas frequented by birds, plants were green, while in adjacent soils the plants were brightly colored. He attributed this condition to the fact that the bird excrement, which is rich in nitrogen, fertilized the soil in the nesting area. Similar observations have been made in other regions.

Thus, autumn color will be most intense and brilliant in areas where these requirements for maximum anthocyanin production are most competely fulfilled. Of course, the genetic composition of the plant, itself, is ultimately decisive: many species of trees—notably the poplars—which lack the proper genes, are incapable of producing noticeable quantities of anthocyanin, regardless of soil or weather.

Three closely-allied species il-

SASSAFRAS

Sassafras albidum has four- to six-inch leaves, sometimes a clear yellow in fall, but often a soft pink or even blood-red.

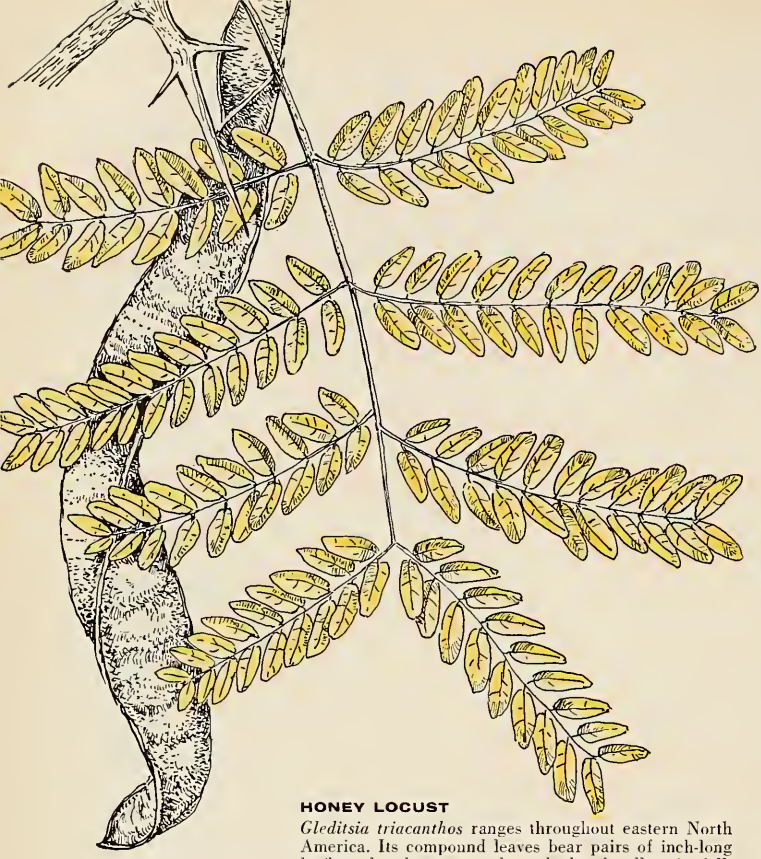


SCARLET OAK

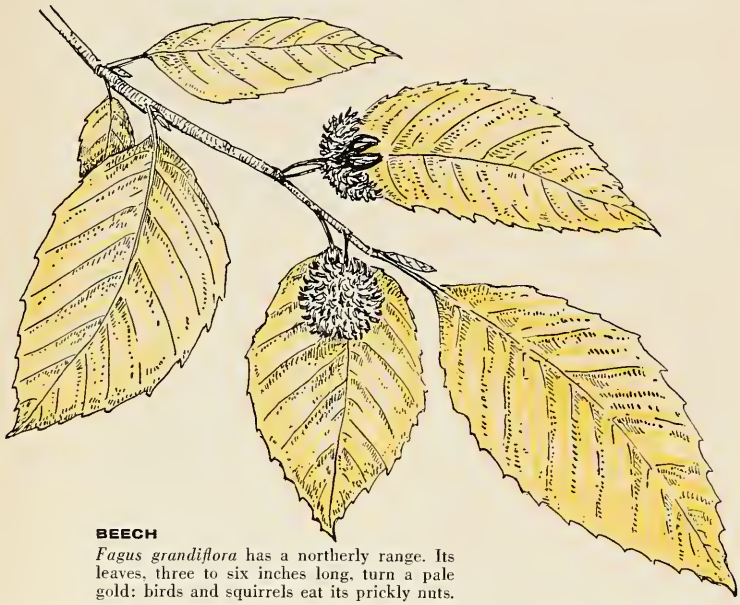
Quercus coccinea is late to turn, and its four- to seven-inch leaves of rich red are often the last color of autumn.

RED MAPLE

Acer rubrum, Thoreau's favorite, has two- to three-inch leaves. It can be a beacon of scarlet flame while neighbors still show green.



HONEY LOCUST
Gleditsia triacanthos ranges throughout eastern North America. Its compound leaves bear pairs of inch-long leaflets that become a clear shade of yellow in fall.



BEECH
Fagus grandiflora has a northerly range. Its leaves, three to six inches long, turn a pale gold: birds and squirrels eat its prickly nuts.

lustrate the importance of this inheritance factor. In the red maple, the autumn leaves, as well as the young stems, leaves, flowers, and fruits, are brilliantly colored by anthocyanin pigments. The sugar maple, although a brilliant tree in autumn, produces anthocyanins in much less abundance. Finally, the black maple, hardly distinguishable from the sugar maple in appearance, rarely produces observable quantities of anthocyanins: its autumn leaves are, at most, a translucent yellow.

Autumn coloration is most intense during years in which a relatively dry, sunshiny summer is followed first by a rainy period in early September (to freshen the leaves and retard early leaf-fall), and then by an autumn with moderately low night-temperatures and bright, crisp days. In eastern North America, such a spell of weather —with clear, crisp nights, hinting of frost, and warm, bright, blue days — is called "Indian Summer," and our forests have an inner glow of intense yellow and flaming red.

Warm, cloudy autumns, in contrast, are marked by the development of dull colors, with shades of yellow predominant. In England, noted for its moist atmosphere and slow seasonal changes, autumn coloration is not only more subdued but may extend over three months, from early September to late November or early December. The forests of England and the Continent are composed of few species in comparison with the varied forests of eastern North America. In England, beeches turn to a burnished gold, the birches and poplars become pale yellow, and the oaks are cloaked in warm tones of wine and brown.

Thomas Pownall, Governor of Massachusetts a few years before the Revolutionary War, wrote of New England's vibrant contrast to Old England: "If I should persuade the Painter to attempt the giving a real and strict Portrait of these Woods in Autumn, he must mix in upon his Canvass all

the Colours of the Rainbow, in order to copy the various and varied Dyes which the Leaves at the Fall assume; The Red, the Scarlet, the bright and the deep Yellow, the warm Brown, the White, which he must use, would give a prismatic motley Patch-work that Judgment would not bear; and yet the Woods in this embroidered Garb have in real Nature an Appearance beyond Conception."

The botanical significance of autumnal pigment production is obscure. Some have suggested that the pigments act as a screen to protect leaf tissues against the sunlight while various substances are being transferred from leaf to stem for winter storage. Most scientists, however, agree that autumn color is a chemical accident, which carries with it no particular benefit to the plant. The beautiful tints, they believe, do no more than mark an early stage of decomposition, signaling the seasonal triumph of the environment over the living plant. For soon, as autumn progresses, both the carotenoid and the anthocyanin pigments follow the lost chlorophyll and disintegrate, and the brown tannins increase until, ultimately, the forest is carpeted by a drab monotone of fallen leaves. Winter has arrived.

GRAY BIRCH

Betula populifolia is equally at home in the barren soils of abandoned farmlands or thickets of swamp and marsh from Canada to Virginia, westward to Indiana. Its three-inch leaves assume autumnal shade of soft golden yellow.

TWENTY-TWO ELEPHANTS, RANGING FROM WEEK-OLD CALVES TO MATURE FIVE-TON BULLS, MILL ABOUT THE ARTIFICIAL SA

Animal Lookout

ABERDARE NATIONAL PARK PROVIDES A FINE VIEW

IN the mountain forest of Aberdare National Park, a short journey from Nairobi, Kenya's capital, now stands the successor to the unique and famous animal lookout, "Treetops." The old "Treetops" was destroyed in 1954, when the giant fig tree in which it stood was fired by Mau Mau terrorists. The new lookout, also called "Treetops," is actually a two-story house, standing on heavy stilts, forty feet above the ground. Opened in late 1956, with guest accommodations for fourteen, the lookout today plays host to scores of visitors who watch with delight as the great animals of the African forest slip through the twilight to drink at an adjacent water hole. Some of the sights they see are on these pages.

E OF "TREETOPS" WATER HOLE. FOR VISITOR'S VIEW, TURN PAGE

PEERING DOWN from 40-foot roof, visitors get bird's-eye view of herd.

LOOKOUT director Walker and baboon.

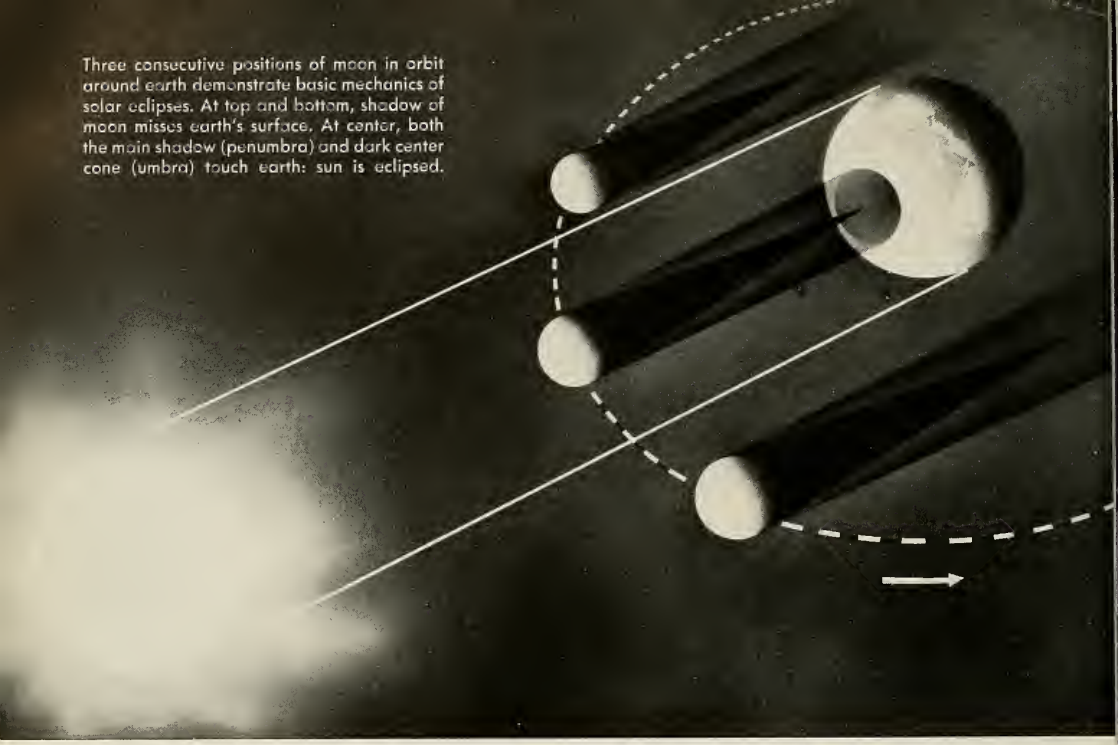
STUMP of former "Treetops" fig tree.

MAJOR WALKER, aide spread rock salt near water hole.

YOUNG BULL is first to arrive and sample salt lick.

In waning light, pair of Cape buffalo drink at the "Treetops" water hole.

Surprised rhino, approaching in night, is caught by photographer's flash.



Three consecutive positions of moon in orbit around earth demonstrate basic mechanics of solar eclipses. At top and bottom, shadow of moon misses earth's surface. At center, both the main shadow (penumbra) and dark center cone (umbra) touch earth: sun is eclipsed.

SOLAR ECLIPSES

On October 23, the second solar eclipse of 1957 is to take place: the celestial mechanics of these fleeting events is explained here

By Franklyn M. Branley
Illustrations by Helmut Wimmer

THE celestial mechanics of solar eclipses show little respect for human convenience. Astronomers who wish to observe these fleeting extinctions of the sun have been forced to visit the tundras of Canada, the deserts of Africa, and the jungles of South America. Expeditions in pursuit of total eclipses have visited the far corners of the world — Sumatra and Siberia, Niuafoo and Hokkaido, Labrador and Mombasa.

Often, after a distant journey, vagaries of local weather make observations at the critical moment impossible, so that both time and painstaking preparations come to no avail. In 1955, for example, teams of astronomers from round the world gathered near Batticaloa, in Ceylon, to photograph an eclipse on June 20. Although this eclipse was an especially long one — seven-and-two-tenths minutes — a sudden bank of clouds obscured it, and no effective photographs could be made from the ground.

Dr. Branley and Mr. Wimmer, of the Hayden Planetarium, are author and illustrator of *Exploring by Satellite*.

One or two eclipses of the sun usually occur each year. This year, there was such an eclipse on April 29, and there is to be another one on October 23. The eclipse of April 29 was of the annular type (see figure, p. 442) and was visible only over a limited region near the North Pole. October's eclipse, in turn, will be visible only in Antarctica. It will be a total eclipse, but the area of totality is extremely lim-

ited, and totality will last only a few seconds. A year or so ago, it might have gone altogether unobserved: this year, thanks to the presence of scores of IGY scientists in Antarctica, it will be seen.

The area of totality for October's eclipse is a small segment of the Weddell Sea, just off Coats Land, where British and American scientists — already in the area making IGY investigations — will be in a position to observe it. Any information will be disseminated through the three World Data agencies of the IGY Committee: one in the United States, one in the Soviet Union, and one operated jointly by Western Europe and Japan.

Just what is a solar eclipse? Such an event occurs when the earth moves into the shadow which is perpetually cast by our satellite, the moon. Now, the length of the moon's cone-shaped shadow is 232,128 miles. Because the distance between the moon and the earth varies from 217,800 miles to 248,-500 miles, there are some times when the moon's shadow can reach the earth's surface and other times when it cannot. When the moon's shadow does reach the earth, the resulting eclipse of the sun is total. When the shadow falls short of the earth's surface, what we see is an annular eclipse, in which a ring of the sun remains visible around the edge of the moon.

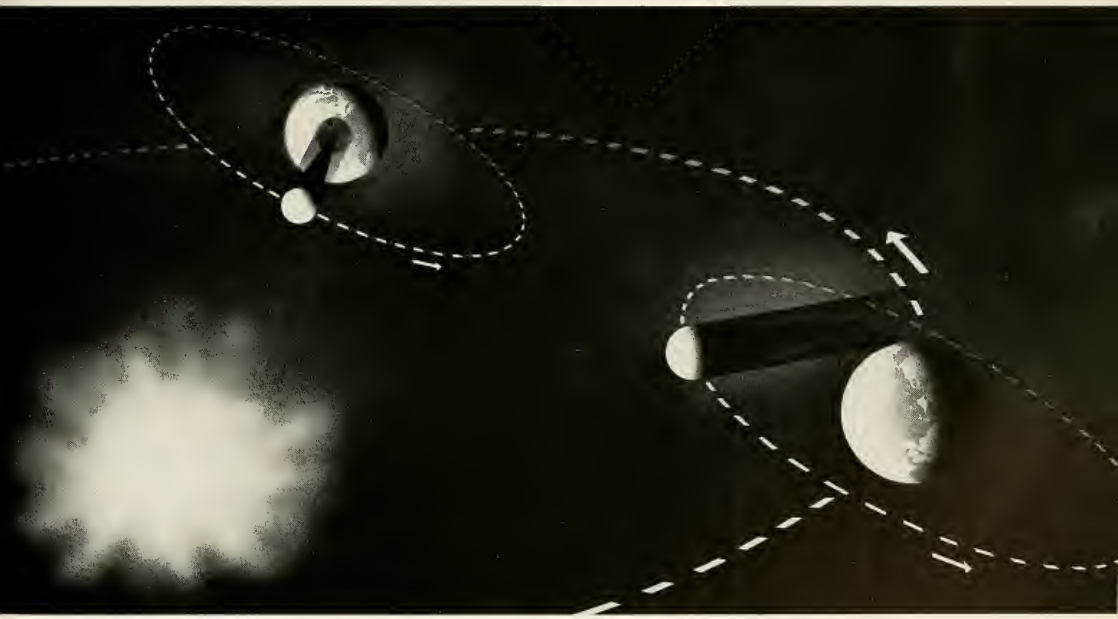
Annular eclipses are of little value to astronomers. Total eclipses, however, allow many investigations. Among them:

The polarization of light of the sun's corona. The deflection of starlight caused by the sun (observable evidence on this phenomenon gives verification of the theory of general relativity). Study of the corona, chromosphere, and reversing layer of the sun. Measurement of heat radiation by the corona.

How do solar eclipses occur? If the plane of the orbit of the moon coincided with the plane of the earth's orbit (figure, below), we would see solar eclipses once a month. However, the plane of the moon's orbit is actually tilted 5°8′, relative to the earth's orbit. Under these circumstances, in order for an eclipse to occur, the moon must be in a position in its orbit at or near what we call the "line of nodes." The nodes are those two points where the moon crosses the ecliptic, the imaginary line round the bowl of the sky which marks the outer edge of the plane of the earth's orbit. A further imaginary line, joining these two points of orbit intersection, is the line of nodes. When the moon is at or near this position, and between the earth and the sun, the moon's shadow falls toward or onto the earth. At all other times, the moon's shadow escapes us.

Because the orbit of the moon changes somewhat during each revolution, the nodal points appear to move slowly round the sky, completing a full circuit in slightly over eighteen years (precisely — 18 years, 11 days, and 8 hours).

If a solar eclipse were to occur today, with the sun precisely at one of the nodes of the moon, then, 18 years and 11 days later, the new moon again would be just



TILT OF MOON'S ORBIT makes its shadow fall above or below earth on most occasions (right: shadow falls above). Only when orbit's nodes are in line between earth and sun (left) does moon's shadow actually pass across the earth's surface.

TOTAL ECLIPSE (right) comes when the moon is near enough for its 232,128-mile-long cone of dark shadow actually to reach the earth.

ANNULAR ECLIPSE is seen, instead, when the moon is too far away from earth to allow the cone-shaped shadow to touch the ground.

PARTIAL ECLIPSE may be observed when only a portion of the moon's entire shadow is in a position to reach the earth's surface.

NO ECLIPSE at all is observable when moon's shadow falls free of the earth's surface. This is what happens most of the time.

about the same distance from the earth, and the sun would be close to the node. At that time, a "repeat" eclipse, very similar to the previous one, would occur, except that it would be observed in an area about 120° west of the site of the earlier one, because the earth would have rotated that far in the eight-hour period that completes the cycle.

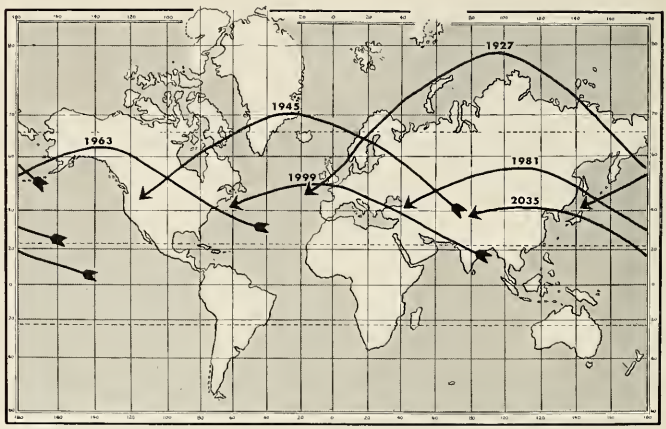
This cycle, called the "saros," was known to the Chaldeans some 2,000 years ago, and, in consequence, they were able to predict eclipses. Some historians believe that it was Thales of Miletus' knowledge of this cycle that enabled him to predict the eclipse of May 28, 585 B.C. which ended a war between the Medes and Lydians.

Eclipses that occur in this saros interval fall into series. Each series contains about seventy solar eclipses and has a duration of 1,200 years. Such a series begins with a small partial eclipse near one of the earth's poles. After twelve partial eclipses, which increase steadily in area and decrease in latitude, the series becomes total or annular for the next forty-five eclipses. Then the series reverts to a dozen partial eclipses, and ends at the opposite pole.

Right now, a dozen such series of total eclipses are in progress. One of the series—which included the eclipses of 1919, 1937, and 1955, and will bring the eclipse of 1973—is outstanding because the duration of totality is very close to the greatest length possible—7 minutes and 40 seconds, when observed from a point near the equator and under the most favorable conditions.

Eclipse-hunting in the field possesses a strong fascination. Disappointment and frustration are the lot of the astronomer when the skies cloud over, when equipment fails to function, or apparatus loses adjustment because of rapid temperature changes, for the next opportunity to make observations may be decades away.

In spite of the obstacles (or maybe because of them), and in spite of the briefness of the time for observation, each eclipse is enthusiastically anticipated. S. A. Mitchell, an outstanding observer, expressed the challenge, the paucity of available time, and the elusive nature of these events, when he wrote in his *Eclipses of the Sun*: "I have traveled ninety-thousand miles to witness nine total eclipses of the sun. The total accumulation of time afforded for scientific observations during these nine eclipses has been approximately eighteen minutes."



WESTWARD TREND OF SAROS CYCLE is shown here. First eclipse illustrated (1927) began off Aleutians, ended off Spain. Next of this "family" (1945) began some 120° farther west, in Asia. Eclipse of 1963 will begin still farther west.

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Reviews

continued from page 397

TRAINED EYE of Eskimo is shown in this extemporaneous pencil sketch of reindeer.

dozen, ancient house-sites in the rocklike frozen soil, digging at the rate of only an inch or so every two or three days. His subsequent efforts, and those of other archeologists, revealed many basic facts about the cultural evolution and migrations of these people.

Dr. Jenness saw interesting portions of arctic America at a time when some groups of Eskimos had been seriously damaged by diseases and economic changes brought in by civilized people, while others were still following their ancient mode of life. Such varied scenes formed the basis of his lifelong interest in the Eskimo and their problems.

Much that he saw was destined soon to vanish. It is therefore fortunate that so articulate a scientist kept such a meticulous diary. Dr. Jenness describes the events of that winter, previously unpublished, both vividly and with the perspective of mature reflection.

Journalistic accounts have given the public some false notions about the arctic. The reader is able to believe everything he finds in this book.

DR. WEYER *was the editor of* NATURAL HISTORY *from 1935 to 1957. He received his anthropological training at Yale, and has twice done field work in the arctic. His volume, "The Eskimo," is well-known.*

OUR ASTONISHING ATMOSPHERE

by J. Gordon Cook

Dial Press, $3.00, 197 pp., illus.

Reviewed by
JEROME SPAR

IN this well-written popularization, one of the Science for Everyman Series, Dr. Cook, a British chemist, demonstrates that a book about the atmosphere need not be concerned exclusively with weather. Indeed, the expected discussion of weather and weather forecasting is confined to a single chapter, and the remainder of the book is devoted largely to simple, lucid, and up-to-date descriptions of the chemical and physical properties of air.

Much of the material is unique. For

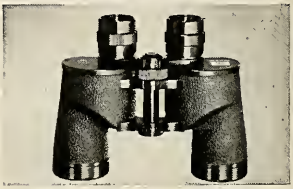
EXHIBITS OF INTEREST

AMERICAN MUSEUM

New York City (October): Corner Gallery. Photographs by Lee Boltin: sculpture and ceramics of Mexico (1000 B.C. to A.D. 1000), together with a selection of the original artifacts.

NEW YORK STATE MUSEUM

Albany (October). Photographs by Warren Steenberg. The animals and landscape of Alaska, photographed by a Cornell graduate who is now a park ranger at Mount McKinley National Park.



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example, following the opening chapter on the structure and composition of the atmosphere—including an extensive and perhaps too enthusiastic discussion of the jet stream—an entire chapter is given to the utilization of wind for power. This is followed by a review of the biological, chemical, and structural problems of high altitude and high speed flight. The next chapter is on sound, and discusses the psychological effects of noise, and the industrial uses of ultrasonics.

The fifth chapter, on weather, is probably the least satisfactory, containing several erroneous statements and being limited largely to a discussion of British weather. But having gotten through this section, Dr. Cook, the chemist, is once again on firm ground as he plunges into three excellent chapters on the oxygen, nitrogen, and carbon dioxide in our air.

There is a modern (though slightly naive) treatment of cloud seeding and rainmaking, an excellent chapter on the pollution of the atmosphere by man, and a highly satisfactory account of auroras, cosmic rays, and other aspects of the upper atmosphere.

Dr. Cook succeeds in making science not only understandable but also dramatic and interesting. Yet, throughout, the style has a minimum of attention-getting tricks.

While the book may disappoint some who expect a treatise on weather phenomena only (especially American weather), it does give an excellent popular account of the upper atmosphere and the chemistry of the air in which we live.

Dr. Spar is Research Associate Professor, Department of Meteorology and Oceanography, New York University.

THE FIGHT FOR FOOD

by J. Gordon Cook

Dial Press, $3.00, 208 pp., illus.

Reviewed by
JACK MCCORMICK

COLORFUL magazine or newspaper advertisements, bountifully stocked supermarkets, shockingly expensive surplus food purchases, and a constant audio-visual bombardment featuring weight-reducing plans and diet aids make the plight of half the world population—poorly fed and famine ridden—seem remote and unreal. Impending dangers of world overpopulation and widespread food shortages appear mythical.

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Romantic speculation, describing possible cosmic events and their effects on mankind—moon, asteroid, and star collisions, the explosion and death of the sun, peacetime and wartime uses of atomic energy. The book, by a former lecturer at New York's famous Hayden Planetarium, bears this blessing of Albert Einstein: "Rich in ideas and offers much solid knowledge in an easily digestible and very attractive form." It is a completely remade and revised edition of *The End of the World,* embodying the latest scientific theories. $3.00

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In this concise, vividly written, and authoritative volume, Dr. J. Gordon Cook clearly outlines the uneasy situation facing the inhabitants of our planet. But this is not a work given to presenting the black future in store for humanity nor is it a great work of philosophic significance shining like a beacon in the gloom. Instead it is a lucid evaluation of modern methods of pest and disease control, plant breeding, soil improvement, and food preservation and protection; of the biological principles underlying the production and use of food; of artificial improvement of oceanic habitat to increase fishery resources; and of possible utilization of mass algal cultures and synthetic foods.

Throughout the book, the modern is emphasized, but the traditional is not forgotten. And woven throughout is a fascinating correlation of the problems of food production and supply with the course of civilization and social progress. But the account, while factual and broadly inclusive, is never dull or unreadable. By building each chapter around fascinating case histories, intriguing investigations, and unusual applications, Dr. Cook has created a volume which is not only an education, but also a pleasure to read.

Dr. McCormick is staff ecologist of The American Museum of Natural History and author of Atoms, Energy and Machines.

THE WORLD OF WATER

by J. Gordon Cook

Dial Press, $3.00, 192 pp., illus.

Reviewed by
JOHN H. DAUGHERTY

WITH this volume, Dr. Cook adds a third title to the Science for Everyman Series. Here are 192 pages packed with information presented in concise, understandable language.

In the preface, he reminds us that life began in water—the sea—and even land animals enclose the water they need within their bodies. Dr. Cook brings us up to date about the lands beneath the sea. Following is an interesting narrative of water on the move and the power of water. Water in the atmosphere receives rather slight treatment only because it is covered in another volume (reviewed above).

Man's utilization of raw materials from the sea is traced from the early use of seaweed to the present-day extraction of such products as magnesium, iodine, and algin.

A vivid account is given of plants in the sea and the animals that float near its surface. The unrelenting struggle for existence in the jungle beneath the waves is sure to fascinate most readers.

The use of water and man's constant struggle to find water fit to drink are well covered. The story is told of the research being done to obtain fresh water from the sea at low cost. Especially interesting is a discussion of problems introduced by the use of modern detergents.

Other topics include: water—the eccentric chemical; the adaptations of animal life to the scarcity of water; and the way in which water is bringing ever-changing land features to the face of the earth.

Prof. Daugherty is Chairman of the Department of Science at The National College of Education, Evanston, Ill. He is the author of "The Wonders of Water" (NATURAL HISTORY, *December, 1956).*

IN SHORT

The inexpensive, science guides published by many of the larger natural history museums provide interesting background information about the exhibits which cannot be obtained from the labels. The Smithsonian Institution has just issued a new booklet called "The World of Dinosaurs," by David H. Dunkle, Associate Curator in the Division of Vertebrate Paleontology at the United States National Museum.

Well written and attractively illustrated, this booklet briefly describes the major kinds of dinosaurs, as well as how dinosaur remains are discovered, collected, and preserved. Copies may be purchased from the Smithsonian Institution, Washington 25, D.C., for 50¢ postpaid.

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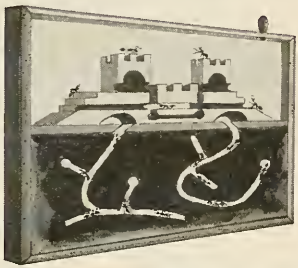

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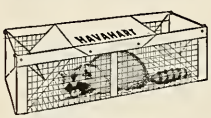

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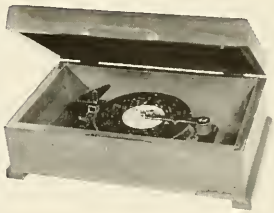

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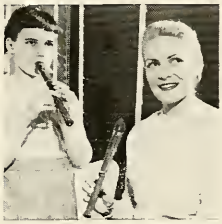

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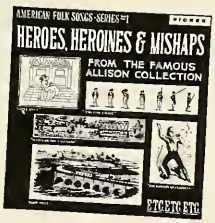

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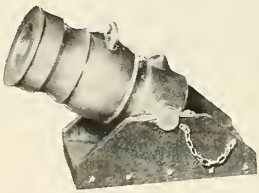

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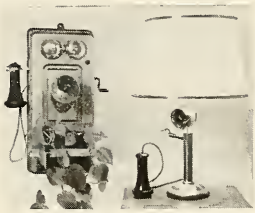

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Vol. LXVI **NATURAL HISTORY** No. 9

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November, 1957

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In the remote highlands of Peru live a people whose mode of existence is closer to the time of the Incas than to the twentieth century. At altitudes of fourteen thousand feet, and above, they tend the herds of llamas and alpacas about which their lives revolve. Their culture has become adapted to the bleak environment in which these animals thrive best. The resulting aspects of communal living, and indeed the physique of these Quechua Indians, appear alien to us. Yet these patterns make a complete life, and one that formed the base on which a sequence of elaborate civilizations flourished in the Andes until the Spanish Conquest.

For a portfolio of remarkable photographs of these people, together with the story of a cultural survival from the days of the Incas, turn to page 482.

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Reviews

WRITINGS FROM NATURE

A NATURALIST IN PALESTINE by Victor Howells *(Philosophical Lib., $6)*. JOHN & WILLIAM BARTRAM'S AMERICA edited by Helen Cruickshank *(Devin-Adair, $5)*. THE EXPLORATION OF THE COLORADO RIVER by John Wesley Powell *(edited & introduction by Wallace Stegner; University of Chicago Press, $3.75)*. WINGS OF THE FOREST by William J. Long *(Doubleday, $2)*.

THE term "nature writing" has gained an acceptance that would seem to indicate a field of literature as clearly defined as the Gothic novel. Actually, of course, there are nearly as many kinds of nature writing as there are people writing about nature, although—fortunately for reviewers—there are some fairly well-defined main currents in the stream.

Four books recently published—even though not recently written—serve well to indicate some of the directions that nature writing can take.

The great popularity of nature writing has made literature something of a hazard for the professional naturalist. With lively memories of William Beebe and optimistic dreams of royalty checks, many a scientist finds his meticulous field diary beginning to change shape and assume new colors. *A*, after all, made quite a good thing out of his summer on the Niger, and *B*'s volume on the electric eel was selected by the Book-of-the-Month Club. Perhaps something might be done about that collecting trip in Brazil.

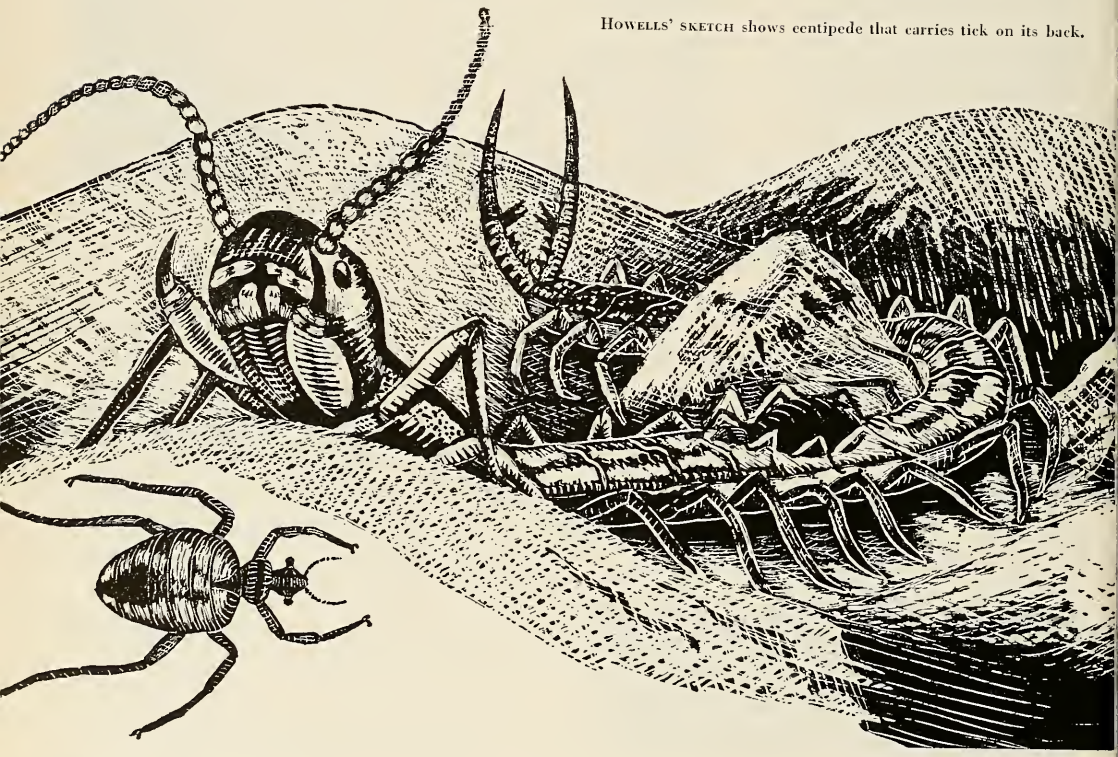
And indeed something might—perhaps. It is probably no more difficult to become a good writer than it is to become a good ornithologist. Unfortunately, it is no easier, as is proved abundantly by Victor Howells' *A Naturalist in Palestine*.

This account of a leisurely nine-month trip through what are now (but were not then) the countries of Israel and Jordan, fails not because of its subject, nor because of a lack of most careful observation and study, but very simply because its author is unable to communicate the interest and wonder of what he saw. He has conscientiously set it all down—flora, fauna, Bedouins, landscapes, sandstorms and sunsets—till the reader has a sense of being engulfed by an index or buried in a whole library of field guides. The collecting and categorizing reflexes of the field scientist are a heavy handicap to anyone trying to practice the highly selective discipline of writing.

This criticism, of course, is directed at Mr. Howells' book in terms of a work to be read for pleasure. As an unsystematic but compendious nature guide to a little-documented part of the world, it may well have other values.

Two other professional naturalists succeed much better in communicating the eternal excitement of discovery in *John and William Bartram's America*. The story of John Bartram, the self-taught Quaker botanist of colonial Phila-

HOWELLS' SKETCH shows centipede that carries tick on its back.



delphia, who created the continent's first botanical garden and ranged the whole Atlantic seaboard to find unknown specimens for his own collection and for his eager correspondents in Europe, is quite familiar. His son William, who collected for his father and took over the garden after his father's death, was equally noted as an ornithologist and produced one of the earliest lists of American birds.

The Bartrams' writings are less well known than the facts of their lives, and this selection is the first to make them generally available. This self-taught father and son had little pretention to authorship, though William suffered from spasmodic attacks of "fine writing." The various *Journals, Accounts,* and *Travels* that they wrote were by-products of their work as naturalists. But, perhaps largely because their main interest lay in communicating what they had found and seen, they are able to evoke sharp pictures of the almost mythical wilderness that was once our eastern states. As John Bartram wrote to a friend in England:

"Good grammar and good spelling may please those that are more taken with a fine superficial flourish than real truth; but my chief aim was to inform my readers of the true, real distinguishing characters of each genus, and where, and how, each species differed from another, of the same genus. . . ."

Without fine, superficial flourishes, there is good writing in the same letter, describing the snapping turtle:

"They are very large—of a dark muddy color—large round tail, and feet with claws—the old ones mossy on the back, and often several horse leeches sucking the superfluous blood; a large head, sharp nose, and mouth large enough to cram one's fist in—very sharp gums, or lips, which you will, with which they will catch hold of a stick offered to them—or, if you had rather, your finger—which they will hold so fast that you may lift the turtle by it as high as your head, if you have strength or courage enough to lift them up so high by it. But as for their barking, I believe thy relator *barked,* instead of the turtle. They creep all over, in the mud, where they lie *perdu;* and when a duck, or fish, swims near them, they dart out their head as quick as light, and snap him up. Their eggs are round as a bullet, and choice eating."

Any book of exploration is inevitably nature writing in the broadest sense, and, indeed, some of the best writing in the field has come from explorers. A classic of American exploration, long out of print, is John Wesley Powell's account of his pioneering descent of the Colorado River (which included the first passage of the Grand Canyon). This account has now been republished.

William Bartram illustrated his own reports. This shows an east Florida bream.

Powell himself was an extraordinary man, a one-armed veteran of the Civil War, a daring leader of expeditions, a geologist, first head of the U. S. Geological Survey and, as founder of the Bureau of Ethnology of the Smithsonian Institution, one of the first scientists to make a study of the American Indian. His voyages down the Colorado, which took place from 1869 to 1872 (but telescoped into one continuous narrative in his account), are epic raw material. Powell and his nine companions—in four boats, and meagerly supplied—pushed into the unknown hazards of one of the roughest rivers in the world, through totally unexplored territory. Inventing the skills of white-water seamanship as they went along, they made backbreaking portages, and lined their boats down the worst falls and rapids from unsteady perches on the cliffs and rocks far above.

Powell's account slights none of the details of the journey, describes the awesome surroundings with care, and still manages to avoid the slightest sense of actuality. Powell himself must have been aware of his own shortcomings as a writer, for he attempted both to give his account more immediacy by relating it entirely in the present tense, and to dress up his descriptions of landscape with rhetorical figures that seem to have escaped in quantity from mid-Victorian schoolbooks. The result is a work that, unhappily, can be read only as a document. The publishers of this edition have done their best to make it even heavier going by including a handful of unremarkable contemporary plates and omitting any kind of a map. Regretfully, Powell must go back on the reference shelf, until someone comes along to tell his story as it deserves to be told.

William Long's *Wings of the Forest* is the work of an amateur in the best and truest sense. Dr. Long obviously spent many of his days watching birds and other forest life out of pure pleasure and affection. His writings, which he never attempted to publish during his lifetime, were equally obviously labors of love. This book, like his earlier *Spirit of the Wild,* is a collection of fond reminiscences.

Anyone who has ever watched birds for the simple joy of watching will find himself immediately at home in Dr. Long's circle of acquaintances. As a member of the family, he probably will not be annoyed by the doctor's borrowing of Ernest Thompson Seton's arch device of calling animals by Indian names that inevitably sound like baby talk.

This same sympathetic reader will also probably share with Dr. Long (and many other writers) a tendency to overpersonalize the animal kingdom—to regard chipmunks and bluejays as humanoid individuals, somehow disguised in fur and feathers. Scientists, of course, reject such attitudes and talk of anthropomorphism, and perhaps of the pathetic fallacy. Fallacy or no, the personalizing of animals is a universal human reaction to the sense of wonder at the variety of life, that extends from the dignity of the primitive totem to the vulgarity of the comic strip.

There is, however, another way of looking at the natural world, which rejoices in the uniqueness of created things, rather than in their similarities and questionable analogies. In the canon of nature writing, this is a most uncommon viewpoint: indeed, it is rare in any writing. Yet it is an attitude that can produce the finest of all writing about nature.

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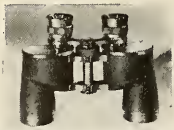

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It can be seen at its best in the work of Colette, one of the few modern writers of any kind who had a good title to the name of genius. To read *The Ripening Seed* (Signet, 25¢) is to move into a world that has not only suddenly become three-dimensional in print, but has also become alive with the very sounds, tastes, textures, and smells of the natural world.

Colette is writing fiction, but her characters—an adolescent boy and girl—move through the pattern of her story not before a painted backdrop (labeled: the Brittany coast in summer), but as breathing parts of a landscape where every detail, from the barnacles on the rocks to the wisps of cirrus in the sky, has been observed and fixed forever in luminous clarity:

"These late August mornings smelt of autumn from daybreak till the hour when the sun-baked earth allowed the cool sea breezes to drive back the then less heavy aroma of threshed wheat, open furrows and reeking manure. A persistent dew clung sparkling to the skirts of the hedgerows, and if, about noon, Vinca came upon a fallen aspen leaf, the white underside of its still green surface would be damp and glistening. Moist mushrooms poked up through the earth and, now that the nights were chillier, garden spiders retired in the evening to the shed where the playthings were kept, and there wisely took up their abode on the ceiling.

"But the midday hours were free of the wisps of autumn mists and of the gossamer threads stretched over bramble bushes laden with blackberries, and the season showed every sign of going back to July. High in the sky the sun sucked up the dew, rotting the morning's mushrooms and smothering with wasps the antiquated vines and their puny clusters of grapes. . . ."

Not "nature writing," but August itself.

CHRISTOPHER GEROULD

MR. GEROULD, an active reporter of the sciences for over twenty years, was Science Editor for Funk & Wagnall's *New Standard Encyclopedia*, and other works.

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continued on p. 500

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A book buying guide for Christmas

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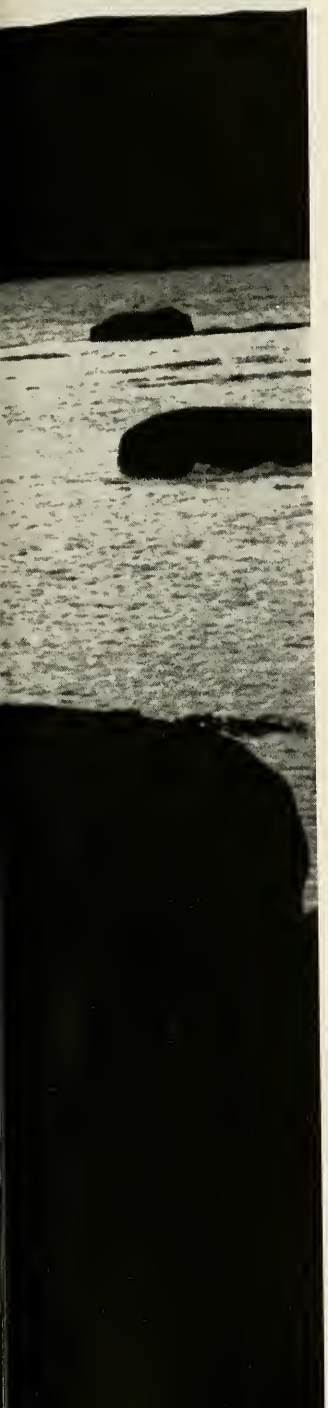
Sitting in a beached dory, biologist Malcolm Gordon watches the twilight at Hebron Fjord



COLD FISH PROBLEM

To see how fish survive in below-zero water, these scientists took their lab to Labrador

By Susan Scholander with photographs by David Linton

SOME five years ago, two physiologists of the Woods Hole Oceanographic Institution, Scholander and Van Dam, started to consider the question of what permitted fish to survive in water which was colder than the freezing point of fish blood. Investigation of this question had originated even earlier, when a biologist, one R. H. Backus, found evidence of a considerable fish population which could live at the bottoms of deep fjords in northern Labrador, in water of minus 1.7° Centigrade, almost a whole degree below the freezing point of ordinary fish blood. This seemingly impossible situation had led to a trip to

ICE FOR EXPERIMENTS was readily obtained by chopping pieces from the small bergs that drifted down the fjord all summer. Here, Peter Hay holds his launch alongside, while Dr. Scholander attacks iceberg with a hatchet.

PHYSIOLOGIST Scholander peers at ice crystals formed in the eye of this experimentally-frozen tomcod.

AT SUNSET, gill net (between two buoys) is hauled in. Fish either were studied or served for dinner.

Baffinland, in the spring of 1953, where Messrs. Scholander and H. T. Hammel, after weeks of work with Eskimos and a dog team, caught a single fish that yielded a few drops of blood for analysis.

Because this single fish made a rather slim basis for publication, a second trip north was planned. It then developed that Commander David C. Nutt, of the Arctic Institute of North America, was fitting-out for a summer expedition with the schooner "Blue Dolphin," to make hydrographic studies off Labrador. Commander Nutt welcomed the opportunity to combine these studies with a program in biology.

Thus, when the schooner "Blue Dolphin," sailed from Boothbay Harbor for Labrador on June 21, 1954, three of the nineteen scientists aboard were from the Woods Hole Oceanographic Institution. They carried with them a specially-built, knocked-down laboratory, which was stacked on the deck as piles of plywood, equipped even to a pencil sharpener for the wall and cheesecloth curtains to cut down the glare of the arctic sun.

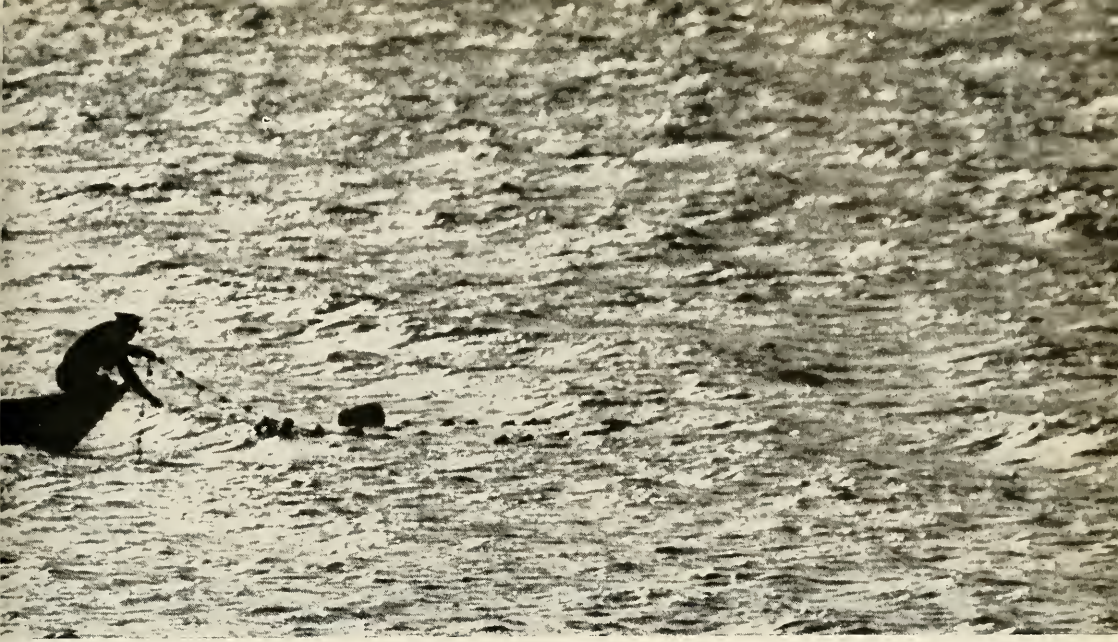
Scholander and Van Dam, of course, were two of the Woods Hole contingent: the third member of the Oceanographic Institution to accompany the expedition was John W. Kanwisher, research associate in biophysics. Kanwisher had been interested for some time in the survival of algae and marine animals which freeze regularly during the winter along New England's shores, and he had developed some ingenious methods for determination of the ice they contained. Labrador offered ideal conditions for similar studies on organisms which continue to survive more rigorous winters than at Woods Hole.

Portable Laboratory

Because precise physiological analyses are often impossible onboard ship, the Institution's boat carpenter, K. Morrison, had set to work early in the spring to design the portable, "polar" laboratory. The biological program of investigation, in turn, was developed around the facilities which would be made possible by means of such a steady and protected land-based establishment. The laboratory had an area of eight by twelve feet, with three small windows on each side; a door at one end, and a wide, working counter attached to the walls. A partial floor rested independently on the ground, so that its vibration would not affect the balances, microscopes, or other instruments on the counter. The working space, equipped with stools, was adequate for as many as seven people, so long as they were organized, congenial, and not too active.

Since it was essential that there be some means of expeditiously pulling up specimen fishes from the deep waters of the fjord, it was planned to copy the system which had been used by Scholander and Van Dam at the Lerner Marine Laboratory, at Bimini, where time had also been a critical factor when hauling fishes up from the deep

MRS. SCHOLANDER met her husband when he came to Swarthmore (where her father was professor of biology) with a Rockefeller Fellowship. She has worked with him since their marriage. This account first appeared in the Woods Hole Oceanographic Institution's periodical, OCEANUS, and is reprinted by permission.



waters of the Gulf Stream. There, they had used a target-towing winch, installed in a small boat, and adapted to reel in a steel trawl line.

Site Selected

The vicinity of Hebron Fjord, in northern Labrador, was chosen as a suitable destination for the portable laboratory. Water temperatures of minus 1.7° to minus 1.8° C., at the bottom of the fjord, had been recorded in previous summers, and there was a good likelihood that snow and ice would remain in patches along the shore, for as long as they would be needed to produce freezing temperatures for laboratory determinations. In March, Commander Nutt made a reconnaissance trip to this area, and engaged the summer services of Peter Hay, of Nain, and his sturdy motorboat, which could easily take the winch and its engine, as well as all the other fishing gear for the party.

With laboratory and collecting facilities so organized, it was possible to consider opportunities for bacteriological studies, and the expedition was fortunate to be able to add W. J. Nickerson, Professor of

CATCH FROM SEVENTY FATHOMS is about to come aboard the launch, as Hay and Gordon haul on line and Scholander (rear) observes. Aircraft target-towing winch, loaned by Navy, was adapted for use in this deep trawling.

PORTABLE LABORATORY, built of prefabricated plywood panels, was twelve feet long, eight wide. Designed for seven people, it frequently held eight.

Microbiology at Rutgers University, to its membership. Other welcome recruits were Malcolm S. Gordon, from Cornell University, who had sailed on the "Blue Dolphin" before and had had valuable experience with the biological conditions along the Labrador Coast, and R. T. Wilce, algologist from the University of Michigan, who decided to precede the "Blue Dolphin" to Labrador. After collecting in the vicinity of Red Bay, Wilce joined the expedition there. Meanwhile, the writer, together with another expedition wife, Joan Kanwisher, traveled to Nain on the supply steamer that plies up and down the Labrador Coast in the summertime. The entire expedition met there on July 5; Peter Hay also came on board the

SOLIDNESS of lab permitted work at precision apparatus that could not have been used aboard a ship.

GROUP AT WORK includes (l. to r.) four scientists: Kanwisher (rear), Nickerson, Van Dam, Scholander.

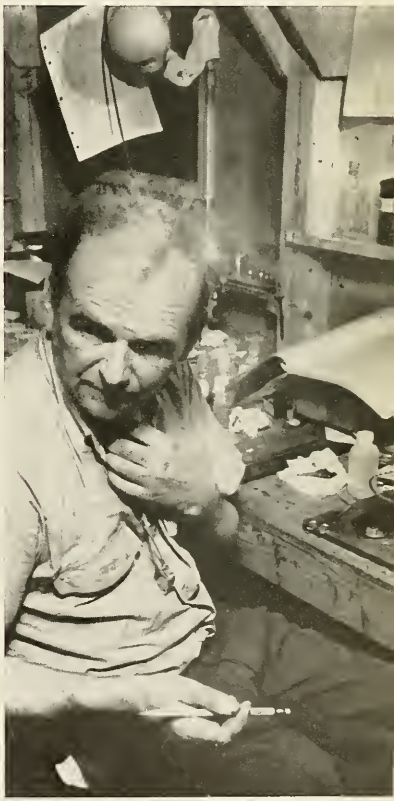
"Blue Dolphin," and his motor-boat was taken in tow.

The "Blue Dolphin" began to proceed slowly up Hebron Fjord on July 7. After several exploratory trips ashore, the white tents of an Eskimo fishing camp were sighted about seventeen miles from the coast —on a grassy slope near the shore, in close proximity to streams of melt water which ran down from the mountains along the fjord. A laboratory site was chosen about one mile from this Eskimo settlement, a location with streams on both sides, and a large snow field in a nearby hollow. The crew of the "Blue Dolphin" unloaded the laboratory and tents, and had them set up within a few hours' time. The remainder of the equipment was unloaded the next morning, and the "Dolphin" sailed away, leaving ashore a party of nine —the Scholanders, the Kanwishers, Nickerson, Van Dam, Wilce, Gordon, and Peter Hay.

Setting up Camp

The laboratory formed the focal point of operations to an even greater extent than was anticipated. As many as eight, not seven, at a time managed to work there. The space along one side, beside the door, was occupied by a large water-bath containing a series of small respirometer vials, where Mrs. Kanwisher and the writer determined the respiratory rates of some of the arctic plants and insects. The rest of that wall-side was taken up by Scholander and Gordon, with apparatus for the determination of the freezing point of fish blood. At the far end of the laboratory, Van Dam did the chemical analyses, and Kanwisher, beside him, worked on ice determinations. Nickerson and Wilce covered the remaining side with bacterial cultures and algae collections, and there was still space at the end beside the door for a stove and a drying oven.

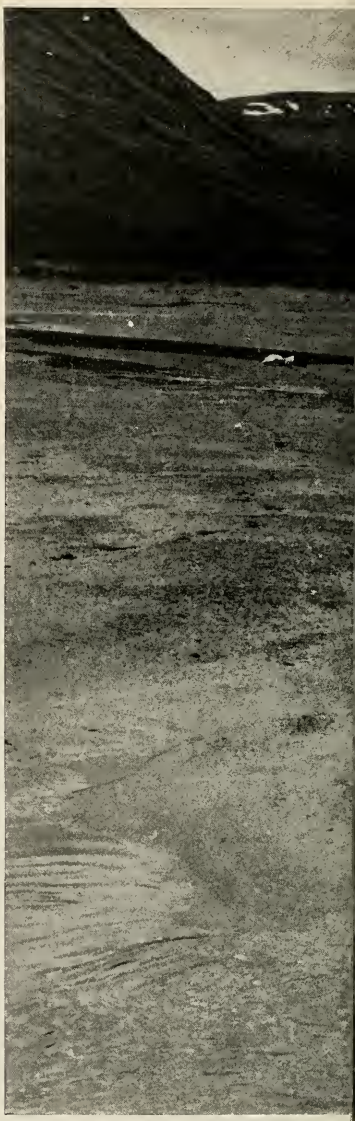
Large, regulation Army tents were used for living quarters, for the storage of equipment and food supplies, and for cooking. The cooking was done on a pair of two-burner stoves. In a small portable oven, placed on top of either stove, bread could be baked or, sometimes, burned. Fresh fish were available throughout the summer in great



Expedition's leader, Dr. Per F. Scholander, turns from his work to pursue discussion with colleague.

GROUP ALSO collected specimens of fresh-water life (above) from lakes and ponds in nearby tundra.

TUNDRA yields a mouse, which biologist Gordon (below) shows to his companions, digging pond bottom.



FALLING TIDE left party's dory beached

quantities. Enough cod for dinner could be caught within a few minutes, by hook-and-line, without bait. Char were obtained regularly from nets just offshore.

Local Rations

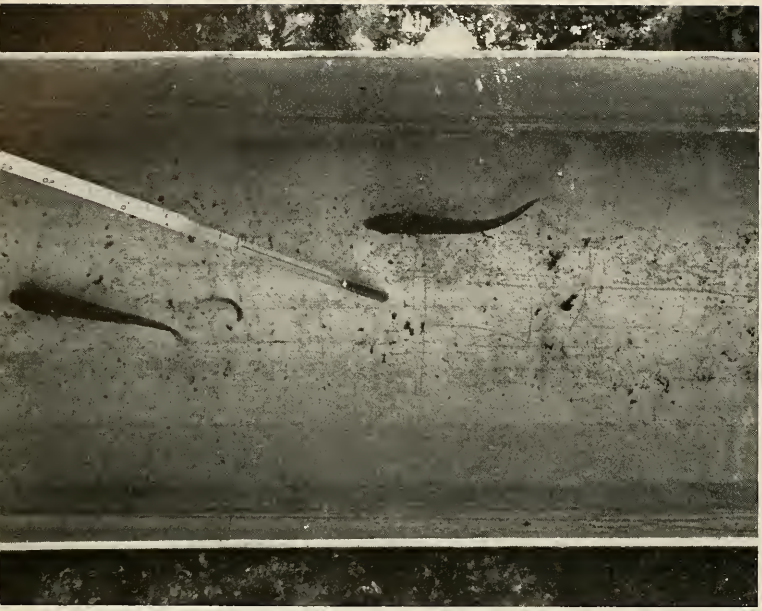
On a knoll near the camp, a fish smoke-oven was built from an old gasoline drum. After the fish had been split through the backbone,

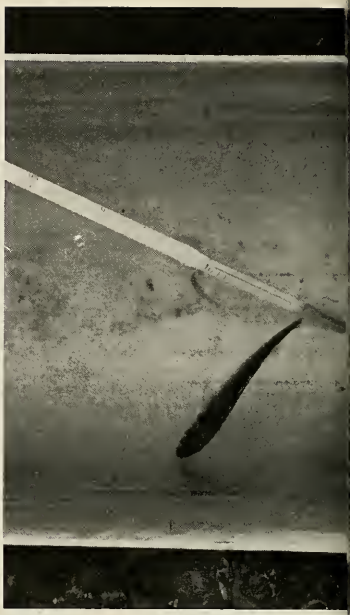
ta at head of Hebron Fjord. Here, Scholander (rear) and Gordon drag boat back to deeper water for the trip home.

covered with rock salt, and dried in the sun for a day, they were hung by the tail in the smoker for a day or so longer, with the two sides of the fish held apart by twigs. The supply of smoked char was generally excellent and ample, in spite of the several occasions when the fire became too hot and the fish fell down into the smokepipe.

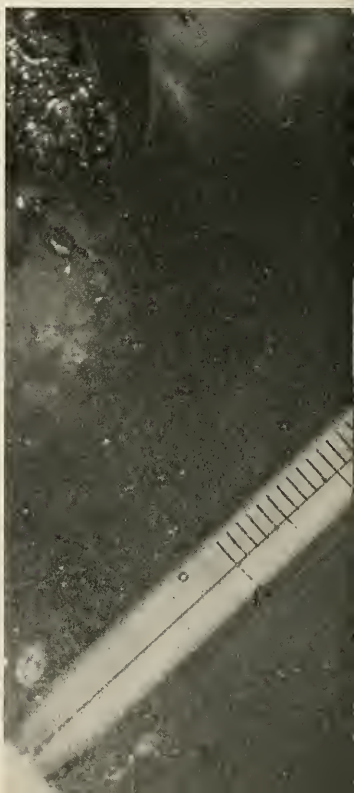
Once the expedition's winch was installed on Hay's motorboat, deep hauls were made in the fjord almost every day of good weather. The crustaceans brought up in the net provided many shrimp cocktails and, to those who were more venturesome, even hermit-crab canapes were a delicacy. Mushrooms could sometimes be obtained in sufficient quantity to add variety to the menu.

We kept the cook tent fairly free of mosquitoes and flies with liberal insect spray, and a screen door on the laboratory eliminated the problem there. On cold days, the laboratory could always be kept warm with no more than a Primus stove. On warm days, it was more of a problem to cool the laboratory, but a canvas tarpaulin could be arranged as a shield from the sun. The weather was prevailingly sunny



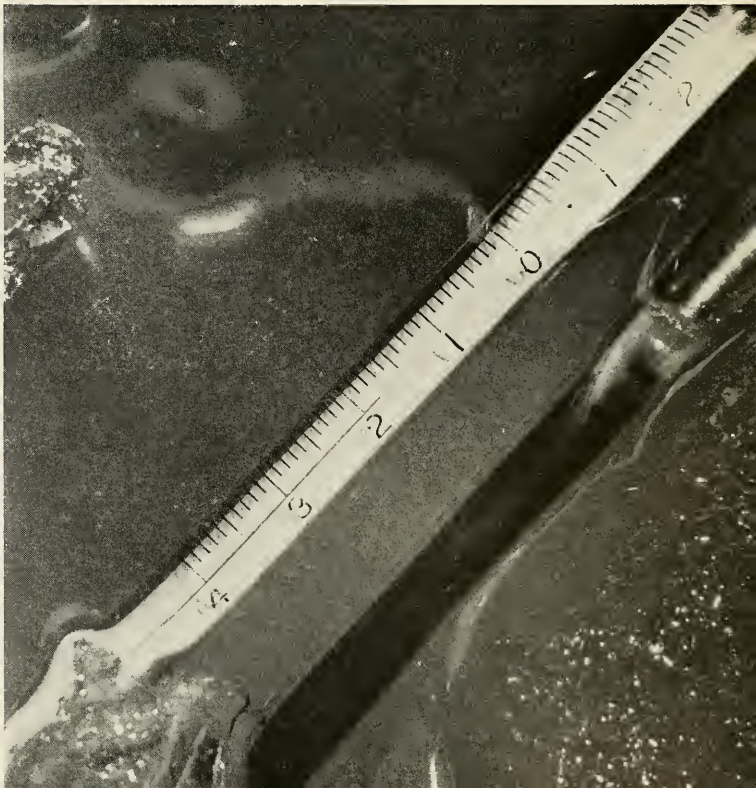


BASIC QUESTION WAS how fish, whose blood freezes at minus 0.9°C., were able to live at fjord's bottom, where temperature was nearly one degree colder. To see how cold a fish could get before freezing, trough (above) w set in an ice bath. At left, a pair of tomcod (the fis that proved toughest) still swim in water at minus 1.9°



BLOOD FOR TESTS was taken from fresh-caught fish (above, sculpin). In experiment which reproduced the minus 1.7°C. temperature of fjord bottom (right), supercooled blood in test tube submerged in freezing bath remains liquid, as does blood of living bottom fish. But adding an ice crystal (second picture) is enough to start freezing process. The normal freezing temperature of blood proved to be minus 0.9°C.

center, with water approaching minus 2.5°C., tomcod
he right has frozen and rolled on its side. In final
ure, both fish have frozen. Other bottom fish, used to living in water at a temperature of minus 1.7°C., froze at that temperature in the trough on the surface. Freezing had been triggered by presence of ice crystals in water.



and clear and, in July, the sun barely dropped below the horizon at night. By August, darkness fell earlier, and the aurora borealis was bright.

Outside the Lab

The actual period for working turned out to be very short, and time for exploratory trips proved unexpectedly limited. Walking and collecting was relatively easy over the tundra, so long as the dense thickets of low willow and birch could be avoided. In early July, the ground was white with the blossoms of Labrador tea and bakeapple. Later in the summer, these were replaced with the deeper colors of the arctic fireweed, bluebells, and goldenrod. In August, the blueberries and cranberries were beginning to ripen round Hebron, and a little to the south, at Nain, the bakeapple berries were in their prime. Lichens were conspicuous and varied everywhere, and several members of the party made collections to identify and take home. Some plants growing right round the camp provided material for respiratory studies, and gave data for a later comparison with the same or closely-related species from warmer climates.

Fresh-water aquatic material, however, involved a wider search. The long valley at the end of the fjord, fifteen miles farther inland, proved to be a fertile place, carpeted with fireweed, cotton grass, and bluebells. Some of the water plants common to Labrador and more southern localities were found in pools in this valley. Others were found in lakes on the opposite side of the mountain from the camp, a stiff half-hour's climb away.

At the Lake

Toward the end of the summer, a study was undertaken of the physiological adaptations in fish which migrate regularly from salt to fresh water. Salt-water char were easily obtained, but the search for their fresh-water counterparts led to the exploration of a large lake surrounded by spectacularly rugged mountains near one branch of the fjord. This involved poling and scraping the dory up the long shallow stream which connected the lake with the fjord. When the party returned with an outboard motor and nets to seine the fish in the lake, these proved unusually elusive.

The Eskimos had several fishing camps around the fjord, where they salted char for export to Newfoundland. They were frequent visitors, friendly and very helpful, although communication was halting, since few spoke any English. Most of the Eskimo group near our camp had moved on to new territory by the end of July, but all were on hand when the "Blue Dolphin" arrived on August 15 to dismantle the laboratory and take us aboard. Although the Eskimos seemed embarrassed by gifts, they eagerly salvaged whatever we left behind – food, clothing, or scraps of wood.

The Problem Remains

The problem of the survival of arctic fish in cold water seemed no nearer solution when the biologists left Hebron Fjord than when they arrived. During the previous winter, analyses of the blood from the one fish caught in Baffinland indicated that this fish avoided freezing by increasing the concentration of its blood until it had a freezing point almost equal to that of the sea water in which it was swimming. At Hebron Fjord, in the summer, the blood of the fishes caught at the surface had a concentration only about half as great as that of the fishes in the winter, and when they were placed in a bath of freezing sea water they froze immediately, as was expected. The surprising thing was that most fishes from the deep water of Hebron Fjord showed almost the same blood characteristics as the surface fishes, and they also froze instantly in a bath of cold sea water at minus 1.7°, although this was exactly the same temperature at which they normally lived on the bottom of the fjord.

The biologists argued that the fish could not be wrong and, as a last resort, undertook to check the oceanographers' reversing thermometers. This possible loophole was plugged when they found that their own laboratory thermometers were off by a few hundredths of a degree.

There was nothing to do but accept the fact that, in the deep waters of Hebron Fjord, the temperature of the water is minus 1.7° and, at this temperature at the *bottom* of the fjord, a whole fish fauna is living which will freeze at the same temperature on the surface.

The Problem Solved

The seeming mystery was solved in Woods Hole the following winter, by a chance observation on *Fundulus*. These fish had been supercooled in the laboratory for several hours without harm, when they accidentally came into contact with an ice crystal and froze. At Hebron Fjord, the surface water, used to test the fish, contained enough ice crystals to trigger the freezing process.

On the bottom of Hebron Fjord, however, fish can live supercooled indefinitely. Since ice can never occur at these depths, the potential instability of the fishes' supercooled state is no detriment.

Much of our summer's biological data would have been impossible to obtain except through a land-based operation. The time was short, and some of the work was felt to be only preliminary. Its significance in indicating a means of approach to problems in arctic biology, however, was obvious early in the summer. With suitable means of transportation, it is an easy matter to pick the most promising location for any investigation and there set up a temporary laboratory. With such a steady and established base, and with due organization and preparation beforehand, there is almost no limit to the operations that may be performed.

EXPEDITION LEADER Scholander (foreground) works on notes, as M Kanwisher takes readings at respirometer by the laboratory door. T conclusion: supercooled fish survive because they never encounter i

King snake's prey (a corn snake, swallowed head first) undergoes digestion. Nearly half of meal (right) is still in esophagus

A SNAKE'S DINNER

The slow vital processes of the Ophidia mean that they need not eat often, and a good meal will last them a long time

By Georg Zappler

MR. ZAPPLER was born in Austria and recently took his Master's degree in Zoology at Columbia University. A member of the New York Zoological Society, he is now engaged in research in both herpetology and paleontology.

SNAKES have achieved an economy of nutrition that is unique among vertebrates. Even among reptiles, which, as a group, have a much lower rate of metabolism than do warm-blooded animals, they stand out. Since all the vital processes of these cold-blooded creatures proceed at a slower rate than do those of birds and mammals, it is only logical that the food requirements of reptiles should be less. However, do not receive the mistaken impression that reptiles, and snakes in particular, function fully at low temperatures—optimum living is achieved only when conditions favor a body heat just a few degrees lower than the level of warm-blooded vertebrates.

The price at which birds and mammals have achieved their state of relatively constant alertness and activity is one snakes chose not to pay. In consequence, they also do without the related benefits. Still, the snakes have attained other advantages. For example, there is no need to search daily for food—the snake's urge to eat is satisfied by occasional spurts of the activity, often widely spaced, needed to capture a meal.

The ophidian predilection for prey that seems much too large to be swallowed, and comfortably contained within its body, is another factor involved in the snake's infrequent, and yet physiologically satisfying, food consumption. These gargantuan feasts can exceed the animal's daily needs by several hundred times. Yet the energy the snake expends in securing this amount of

nourishment for itself is relatively small. The attack is usually immediate and, for perhaps half an hour or less, the snake's activity is vigorous. By then, the prey has been killed and swallowed whole.

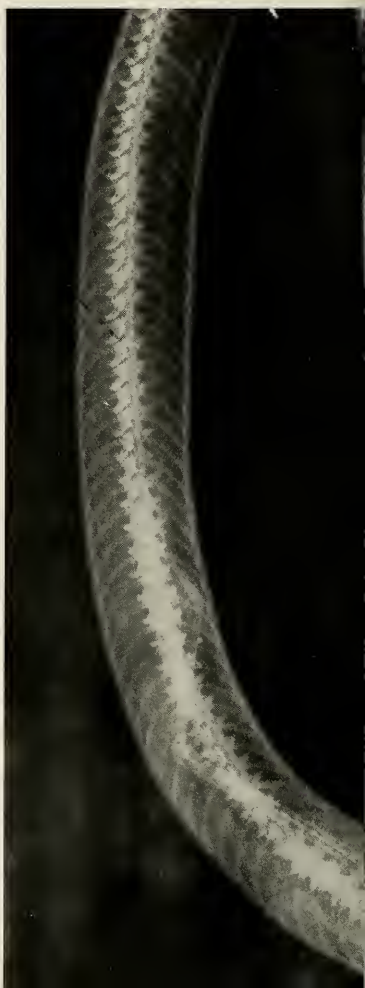
Because the snake neither tears nor chews its food, it is of interest to examine the process by which snakes engulf and digest entire animals. The two halves of the snake's lower jaw, instead of being solidly joined toward the front as in other vertebrates, are connected by an elastic strip of tissue—permitting independent movement to each segment, as well as an over-all, sideways expansion. The articulation of the lower jaw with the top part of the skull is also arranged in such a fashion that widening can occur toward the rear of the mouth cavity. The food object, then, although larger initially than the snake's head, can, by appropriate stretching of the snake's jaw, be slowly worked down into the upper portion of the snake's digestive tract, the esophagus.

By X-raying snakes that have been fed a radio-opaque salt, it is possible to delineate and trace the living anatomy and movements of the snake's digestive system. The esophagus is revealed as a long, tubular structure, extending almost half the snake's length. Equally-spaced waves of constriction and dilation, observed passing down this tube under X ray, must play an important role in moving the ingested food object along. There is no sharp demarcation between the snake's esophagus and its stomach. However, the stomach (which is very long and tubular, and also longitudinally folded—a structure capable, then, of great expansion) is sharply set off from the bowel by a very narrow passageway, the pylorus. This must be of importance in keeping food restricted to the stomach region during digestion.

Such an anatomical provision, assuring maximum breakdown before passage to the next portion of the digestive tract (the small bowel), is essential. Only the

SEQUENCE starts with marsh bird in snake's stomach (below: second day).

BY FOURTH DAY, bird's forward parts



stomach secretes the chemical agents capable of producing efficient digestion. Thus, much food value would be lost were the swallowed animal allowed to slide through the stomach without first being broken down by the stomach's gastric substances.

Further Absorption Past the Pylorus

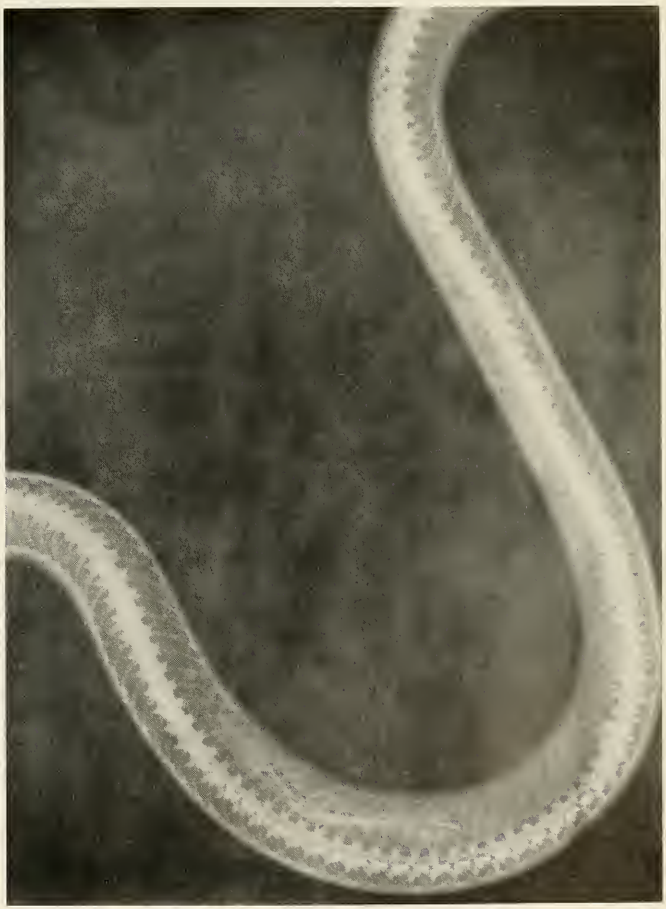
Once in the small bowel, the only highly-coiled portion of the snake's otherwise essentially straight tubular digestive system, the broken-down food is absorbed into the blood stream. Barium salts were found to remain for almost fifty hours in this region of absorption — its tight twistedness no doubt facilitating such a long stay. Thus, again, we find a provision to assure maximum efficiency—this time for assimilation. Finally, the dehydrated, remaining waste materials pass along into the comparatively wide, segmented large bowel — from which they are eventually eliminated.

The digestive enzymes of snakes must be very effective since the bones of the prey are completely absorbed—only mammal hair, bird feathers and bills, and sometimes rodent claws are relatively untouched and finally eliminated. The exact chemical nature of the breakdown chain is not known. Experimental evidence, which indicates a surprisingly small amount of hydrochloric acid secretion, makes the rapid disintegration of bulky food masses difficult to explain. So far, no particular enzyme for the digestion of proteins has been demonstrated. However, it seems probable that a special chemical must exist to effect the startling demineralization of bone that occurs. Possibly, this same enzyme also plays a role in the rapid breakdown of the food masses.

Perhaps the snake's way of obtaining and dealing with food strikes us as primitive. Still, there are evident advantages to having one meal and then making it last for a month or so—or, in a pinch, even for a year.

orbed, but leg bones are still visible.

On tenth day, only a few fragments of leg bone remain to be dissolved.



PARÍCUTIN, formed in February, 1943, stayed active until August, 1951.

MOUNTAINS OF ASH

The volcanic eruptions of today are puny, compared to the cataclysms of earth's past

By Thomas M. Griffiths

ON FEBRUARY 20, 1943, in the middle of a cornfield near Uruapan, in west central Mexico, an earth fissure opened, and fumes, and ashes began to pour forth. By eight o'clock the following morning, a mound of ash thirty feet in height had been spewed out. Five days later, this growing cone was 500 feet in height. By August, 1951, when this new volcano became quiescent eight years after birth, the now world-famous Parícutin had built a cone over 2,000 feet in height.

Parícutin's fireworks made newspaper headlines. Volcanologists, those earth scientists who specialize in the study of volcanoes, came from round the world to study this Mexican youngster. Maps and cross sections, depicting its birth and development, appeared in the world press. Yet, even as the geologists studied it, they knew that the outbreak of Parícutin was a puny disturbance compared to some of the

IN ITS EIGHT active years, the Mexican volcano built a cone over 2,000 feet in height, and covered

acres of once-fertile cornland with its lava-flows, cinders and ashes. Vulcanologists came from round the world to watch Parícutin's growth, while such dispossessed farmers as this one (left) stayed on as guides. Yet this was a small disturbance in geological terms: for a comparison, see pictures and map on next pages.

LIZARD HEAD PEAK, which dominates the skyline on the pass between Rico and Ophir, Colorado, shows almost no hint of the horizontal breccia beds of which it is composed. Yet it is a remnant of a vast volcanic outburst.

LOOKING NORTH from Potosi Peak, mor than 13,000 feet above sea level, th horizontal strata of Teakettle Mountai

upheavals of past geologic time which have left their silent record in the earth's crust.

Let us climb a mountain called Potosi Peak in the San Juan Range of southwestern Colorado, some eight miles west of the picturesque little mining town of Ouray. When we stand on its broad summit, we are 13,790 feet above sea level, and all around us stretch, like a tossing ocean, spectacular peaks and deeply-carved canyons. To the east and southeast, we can look down the narrow gash of Canyon Creek as far as the point at which it meets Uncompahgre Canyon at the town of Ouray. Beyond this junction, to the east, a vast semicircular amphitheater rises above the town's elevation (7,800 feet) to a 12,500-foot crest. From this distance, the rock appears a basic gray, shot through with smears and stringers of vermillion and ocher; it has been eroded into a forest of pinnacles.

As we examine this vast semicircle, it will become apparent that, from top to bottom, it is composed of the same type of rock. If we look

right) are immediately apparent. The pper three terraces were formed by the otosi series, the last major outburst.

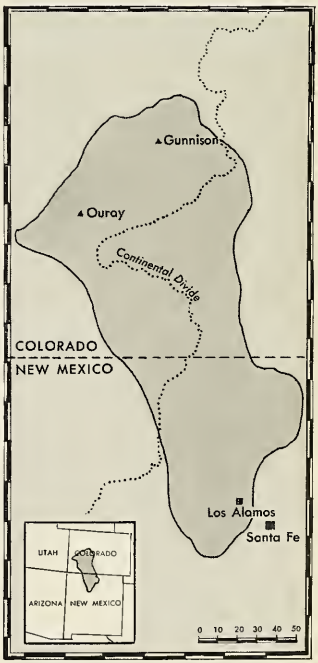
Looking southeast from Kismet Peak, Teakettle is at left. Potosi by the climber's head. Breccia beds can be traced from mountain to mountain: the lower horizontal masses here were formed by the earlier Silverton series.

back, now, to our own vantage point, we will see that we are standing on the same sort of rock. Then, looking eastward again, beyond the distant semicircle, we see the huge bulk of Uncompahgre Peak (14,301 feet), the highest and most massive mountain in the whole San Juan Range, some eighteen miles from our present site. This massive mountain, too, is composed of the same gray, color-streaked rock. We cannot see so far from the summit of Potosi, but—for another fifty miles due east—each mountain and hill has been carved out of the same stuff. To the west, a similar landscape stretches to the San Miguel Range, fifteen miles away, while, south by southeast, the same is true for 180 miles, clear into New Mexico.

What is this rock that we are standing on? Basically, it is light gray or reddish gray in color, made up of fragments cemented by a very fine, ashy material. In numerous places, it is cut across by bands and sheets of a solid texture. To the geologists the fragmental material is called "tuff" or "breccia". It had its origin as ash and fragments of molten material, blown into the air from the vent of a volcano. After settling back to earth, layer upon layer, it has slowly been cemented into solid rock by compression and the circulation of bonding solutions.

The non-fragmental bands and sheets, in turn, were once molten volcanic rock, which poured out onto the surface or melted its way through the layers of ash already in place. The high coloring has two sources: some of it results from the injection of hot mineralized solutions into these rocks during more recent times; some is the result of the natural weathering and oxidation of the volcanic material.

This distinctive rock blankets a vast region of southwestern Colorado and northwestern New Mexico. It can be found over some 14,000 square miles, extending as far south as Santa Fe and Los Alamos. In thickness, the accumulation of ash and interbedded lavas is rivaled



Extent of the San Juan volcanic area: 14,000 square miles of lava and ash, two miles deep in places.

Professor Griffiths, a geographer at the University of Denver, received his Ph.D. at Northwestern. His pictures prove him a photographer of professional rank.

in few places in the world. From our Potosi vantage point, we have already seen an accumulation of volcanic rock from 7,800 feet above sea level, at Ouray, to 14,301 feet at the summit of Uncompahgre — a total thickness of about a mile and a quarter. The geologic evidence points to a much greater original thickness, before erosion began the slow work of stripping much of the material away. A conservative guess would place the maximum thickness at close to two miles in some parts of the San Juan region.

Thus, it is easy to see why the geologist considers Parícutin a small-time performer compared to the great fire mountains in the San Juan, which belched forth 14,000 square miles of ash and lava to a thickness of 10,000 feet.

No humans were round to watch the fiery cataclysm of the San Juan. The disturbance, which began about forty million years ago, in the Oligocene epoch for the Teritiary period, lasted for some thirty million years. Geologically speaking, this was only yesterday. Before this great upheaval, the San Juan region had been the site of at least three ancestral mountain ranges, each of which had suffered the erosive fate that awaits all mountains.

Then, in Oligocene times, an outburst of at least six discrete, major, volcanic upheavals began. These piled up ejected material, layer upon layer, to the tremendous depth and over the wide area just noted. Three volcanic stages were responsible for the major amounts of debris in the area. The San Juan volcanic stage deposited tuff and breccia up to 2,000 feet in thickness; the Silverton volcanic stage created interbedded tuff and lava flows up to 4,000-feet thick; and the Potosi volcanic stage poured out intermittent lavas and fragmental material to another 5,000 feet of thickness. None of the numerous volcanic cones and

TODAY, THE SAN JUAN RANGE FRONTS ON SUCH SERENE UPLAND MEADOWS AS THIS ONE, NEAR RIDGEWAY, COLORADO.

conduits from which all this great mass of material issued has ever been identified. Evidently each was masked by subsequent disturbances.

Following the last major upheaval, hot solutions and molten rock, bearing metallic ores, were injected into the weak places and fissures in the overlying mass of volcanic debris. When both the volcanic activity and the subsequent injection of metalliferous veins finally ended, some two to five million years ago, the normal processes of erosion began—carving a jumbled mountain mass out of the high volcanic plateau. The ice sculpture during glacial advance and retreat, the processes of stream erosion, and the constant wastage, as gravity pulled material down the slope, have produced here some of the most spectacular mountains in North America. The ore bodies and lodes, when brought near the surface by this erosion, drew gold and silver-seekers to this western region in the 1870's, and were responsible for the rich mines of precious metals in the area. The former fiery chaos now became known as the "Silvery San Juan."

Season by season the great peaks, valleys, and cirques of the San Juan provide a changing vista. Under the heavy snows of winter, they present an alpine aspect. In summer, the snow is gone except for cirque-cradled glacial remnants on the north sides of the higher peaks; but the brilliant colors of the stained volcanic rock, the deep green of forested slopes, the sparkling blue of high lakes and the softer glow of the flower-sprinkled alpine meadows create a landscape of incomparable beauty. The beholder comes to realize that here is one of the most magnificent mountain vistas to be found anywhere in the world. It is almost impossible to realize that such gentle beauty has followed from such violent origins.

RESTS CLOAK THE PIEDMONT AND, IN THEIR QUIET GLADES, FLOCKS OF SHEEP AND HERDS OF CATTLE GRAZE PEACEFULLY

"Duck Sickness"

Outbreaks of botulism continue to take a heavy annual toll in the West

By Jess T. Reid

THE HEADLINE ran: "DUCKS DYING BY THOUSANDS . . . Elephant Butte Mud Flats Scene of Stinking Death." Reading hurriedly through the story, I telephoned the home of Larry Merovka, Regional Supervisor of Game Management for the U.S. Fish and Wildlife Service, in Albuquerque.

Mrs. Merovka answered. Larry was already at the Butte. I could get him at the hotel there, if I called right away. In a few minutes, I heard Larry's booming voice: "The biggest mess I've seen in a long time. Come down and I will show you."

PROFESSOR REID, recently retired from the field of adult education at the University of New Mexico, is now pursuing his other major interest — conservation.

I met Larry that evening, with a group of his co-workers in the wildlife field. As I listened to their conversation around the dinner table, I learned that the "duck sickness" that had hit the Butte was nothing new in other sections of the West.

A hundred years ago, both Bridger and Fremont recorded in their memoirs the spectacle of dead ducks in great numbers on the mud flats of the West, particularly in northern Utah and at Tule Lake, on the border between California and Oregon.

Until the thirties, it was believed that duck sickness in some way derived from the alkali contents of these flats. But the disease kept spreading, often to areas where alkali was not present, until it became common in western Canada and nearly all of the states west of the Mississippi.

Larry turned to me. "You prob-

THREE DEAD DUCKS, killed by drought-induced botulism, lie rotting where they have washed up on the mud flats of Elephant Butte Lake, a New Mexican water reservoir.

WITH NET READY, Wildlife Service officer Merovka is off in pursuit of a sick duck that has jammed its head into the shallow bottom in attempt to escape by diving.

CAPTURED DUCK joins fellow-victims of botulism in cockpit of airboat for ride to shore. At Elephant Butte Lake, the total number of dead ducks was between six and eight thousand, mostly green-wing and blue-wing teal.

ably think we're stretching the story a little," he said, "but we're not. We'll go out in the morning and you can see for yourself."

Out on the Lake

After a hurried breakfast, we drove to where the boats were moored, at Hot Springs Landing. Elephant Butte Lake was built in 1916, as a storage reservoir for irrigation. It has a capacity of some 2,500,000 acre-feet of water, garnered via the Rio Grande from the snow peaks of northern New Mexico and southern Colorado. During the past forty years, its capacity has been drastically reduced by silting. Its drought-worsened shallowness now required us to use flatboats, driven by airplane propellors.

We started up the lake. I could tell that the water-level was unusually low, but I wasn't prepared for the sight we saw when we reached Three Sisters Basin, above Kettle Butte. Here, the water played out into a thin film over a mud flat, some four miles long and perhaps two miles wide, and the breeze bore a gagging stench. The carcasses of ducks lay all about, fallen wherever the ravages of duck sickness had overcome them.

Within a mile, I had seen some two thousand dead ducks—and we had covered only a narrow strip of the quaggy area. For every fifty or so dead ducks, we found one still alive, hunkered up as if asleep, on this sea of mud. With a long-handled dip net, Larry scooped these dying birds into the boat. They lay in the bottom of the boat, too weak to attempt escape.

Most of them looked like teal, about three green-wings to two blue-wings, and here and there a pintail, a shoveler, a few baldpates. Larry confirmed my guess; most of the sick ducks were teal. The Fish & Wildlife team estimated that the whole muddy expanse held between 6,000 and 8,000 dead ducks: in my view, a conservative estimate.

We were back at Hot Springs Landing about one o'clock. Jack Allen, a Wildlife Service biologist, was waiting with his pickup "ambulance" to receive his patients and rush them to an improvised hospital at a nearby federal fish hatchery, for examination and treatment.

I went along with Allen, to learn more about duck sickness. He told me that pioneer work by the Biological Survey in the early thirties had established that the disease was botulism, of the same sort that is known as "limberneck" when it strikes domestic poultry and "forage poisoning" in livestock. Its cause is the toxin produced by the bacterium, *Clostridium botulinum.*

There are four principal strains of *Clostridium:* types "A" and "B," which produce botulism in humans; and types "C" and "D," which affect a number of animals. Type C is the one which causes duck sickness, limberneck and forage poisoning.

In the case of ducks, the toxin appears only when a number of conditions exist. The first requirement is a mud flat that contains decaying organic matter, such as rotting plants, or dead animals or fish. Second, *Clostridium* must be present in the mud. Third and fourth, the water must be shallow and stagnant enough, and the temperature high enough to provide that lack of oxygen and warmth of environment that fosters production of the bacteria's deadly toxin.

"We used to think," Allen explained, "that these were all the required conditions, assuming that the ducks then took something — food or water — in which the toxin was concentrated. But, more recently, we have found a new source of infection. We have examined the digestive systems of many poisoned ducks. Now, these ducks do not normally feed on insects. But we discovered that these victims had consumed quantities of midge-flies, the *Chironomid,* and their larvae. We cultured these midges and injected the cultures with fatal results."

"Thus," Allen continued, "a fifth condition for this outbreak of duck botulism has been a hatch of insects that, by their own feeding habits, harbor the bacteria-produced toxin."

"What Can Be Done?"

That day, the boats brought in about 150 sick ducks. While injections with antitoxin saved as many as ninety per cent of the ducks retrieved, this was obviously no help to the thousands already dead or beyond reach of rescue.

What could be done to prevent this wholesale extinction? I asked if the mud flats could not be sprayed to keep down the hatches of the midge-fly. I was told that such sprays, besides being less than fully

effective, could also be fatal to ducks and other wildlife on and around the mud flats. Another preventive, a form of harmless detergent, could be sprayed on the fly-infested areas, but the percentage of concentration required was prohibitive in cost.

"If you'll think back to our five conditions," Larry Merovka pointed out, "most of them are linked to this extended drought we are having, particularly in the Southwest. As it gets dryer and dryer, more of our lakes and streams and reservoirs expose the mud on their bottoms. The water is shallow and stagnant and hot. Things are then just right for outbreaks of duck sickness in new areas. It could get a lot worse before it gets better."

A pessimistic thought? Perhaps. Adequate rain would solve much of the problem, but men have not learned how to break droughts. Conservation of impounded water, the prevention of excessive siltation in streams and lakes, a return to the wet end of the present weather cycle —these and other long-term factors may provide the answer.

But we still have dead ducks on Elephant Butte Lake today. And at Bear River Refuge, and around Great Salt Lake in Utah, and at Tule Lake. And we could have recurrence of the past losses recorded for the panhandle of Texas, and Alberta and Saskatchewan; for North and South Dakota, Minnesota, Nebraska and Kansas; Arizona and Nevada; Montana and Wyoming. The death toll from western duck sickness, in some years, has run as high as a half million birds. This is a serious problem that should be faced by all of us.

ANTITOXIN is injected by Wildlife Service biologist Allen. High percentage of ducks recover after treatment.

Q'EROS: A STUDY IN SURVIVAL

In this barren part of Peru, people still use the Inca system of keeping records, the quipu

By John Cohen

OVER four hundred years ago, during the time of the Inca Empire, the people of Peru had developed a system for keeping various accounts without the use of writing. They tied knots in cords in special ways, thereby establishing a numerical record. These knotted cords, known as "quipus," have been discovered in a number of ancient Peruvian graves.

Both the cords and their interpreters were inadequately described by Spanish chroniclers at the time of the conquest, and the exact kind of record which the Peruvians kept by means of their quipus has never been clearly established. Some quipus may have indicated dates, but the terms used—lunar months, solar years or other cycles—remain unknown. Almost certainly, others were routine inventories—so many baskets of potatoes, so many llamas,

ANDEAN DAWN shows frost on the stony ground, the roofs, and even the backs of wakeful Q'eros llamas.

BY NOON, the clouds have rolled up from the jungle, to obscure sun and veil the peaks of Kolpa Pampa.

WEAVING is women's other major endeavor. Girl at left has begun a poncho, one of two basic garments made. Child, above, wears knitted cap, made by his father, showing condor, plow, llama and the Cross.

so many ponchos or pots or gold ornaments – but, again, the commodities concerned cannot now be determined.

One needs only to examine these ancient quipus, with their complex use of a variety of colored yarns, to come to the conclusion that the quipu-keepers occupied a special position in past Peruvian society. But, soon after the Conquest, the practice of quipu-keeping—and perhaps the men who understood the art – were no longer to be found.

It was thus with some sense of rediscovering the past that, in March, 1957, I arrived at a remote Quechua community in Peru where use of the quipu still survived.

The region of Q'eros lies between six and sixteen thousand feet above sea level, on the eastern slope of the Andes in southern Peru, some 100 miles from the ancient Inca capital, Cuzco. Eastward from Q'eros, the jungle of the montaña begins: westward, the Andes rise to their snow-capped pinnacles, 17,000 feet and higher. The area is isolated, both geographically and culturally. Only recently have roads been built from west to east through this section of the mountains, and none of the new roads comes within miles of the Q'eros area.

Although the communities of the region have churches, the traveling priests, who visit other isolated Indian communities, rarely come here. There are no schools for the children. Spanish is not spoken: the language is exclusively Quechua. The land is held by absentee *haciendistas*, but even their *mayor domos* seldom visit the isolated Q'eros communities.

Indeed, the only contacts with the outside world come from a few itinerant peddlers who cross the mountains from the west to barter buttons, pottery or dyestuffs for local alpaca wool, and, from the east, from trade with the primitive peoples of the montaña, from whom the Q'eros communities obtain the bright feathers of jungle birds and some of the large snail shells they use in their festivals.

Traveling in Peru to study contemporary weaving-techniques, I first heard of Q'eros in connection with two rumors – that these isolated people reputedly "wove from the left" and that they "kept quipus." Evidence of the survival of quipus in another remote community had already been reported by the Peruvian ethnologist, Nuñez del Prado, although I was not aware of this at the time. Since textiles were my prime interest, the first of these two rumors appeared worthy of pursuit (later, it proved baseless). So I set out for Q'eros.

To reach the area meant nearly a day's ride in a truck along the one-way mountain roads eastward

IN THE DARK of a stone hut, this Q'eros mother plays with her child before day's work with the flocks.

MR. COHEN, who holds a Master's degree in Fine Arts from Yale, made these fine photographs during a seven-month stay in Peru, studying Indian textile techniques.

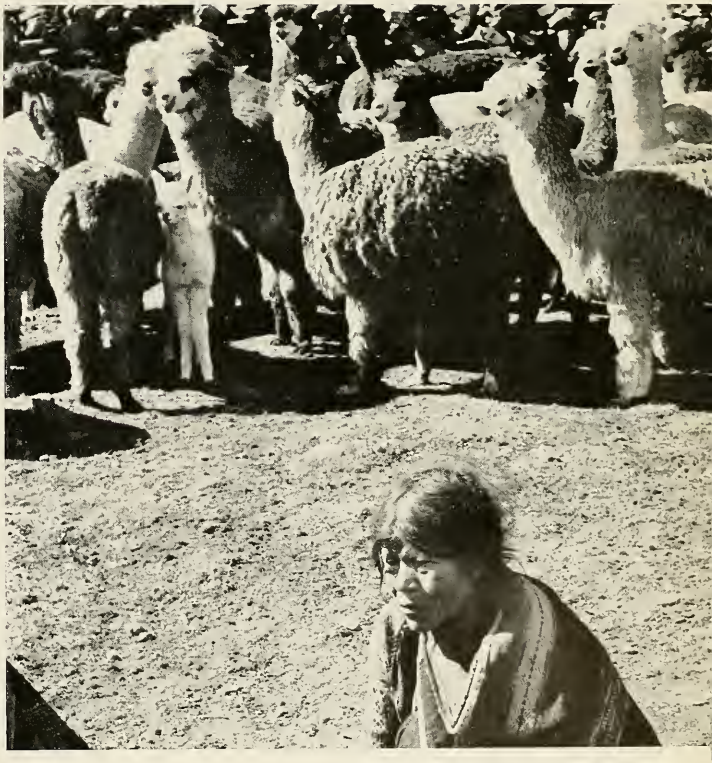
FESTIVAL for Q'eros flocks comes after Carnival. A village official here blows imported conch trumpet.

RETHATCHING A ROOF IS A COMMUNITY ENTERPRISE. WOOD FRAME (ABOVE) IS F

THIS MAN wears his hair long, as was the ancient custom. Others of Q'eros have learned about scissors.

LE; GRASS (BELOW) FROM MOUNTAINSIDE.

BUCK LLAMA, who had been disturbing his flock, led these Q'eros boys a merry chase before he was roped. Here, they take buck to an isolated pasture. Decorative tassels on llama's ear are to ward off evil spirits.



ALPACA FLOCK, here seen in corral with attendant Q'eros woman, grows a finer wool than do llamas, and this is preferred for weaving. Greater abundance of fleece on alpaca legs, chests and necks is apparent above.

THE QUIPU OF Q'EROS here pulls out fibers from a handful of raw wool and spins a length of yarn. Such yarn-making is the steady occupation of all Peruvian Indians. The yarn shown here was destined to become a quipu.

from Cuzco. Then, when the road could bring me no closer, I went on by horse through the 16,000-foot divide beyond which the Q'eros region lies. On my arrival, I found a society so isolated that it was not difficult to imagine I had returned through the centuries to the time of the Incas.

Although the people of Q'eros choose to live at high altitudes, they utilize the full range of their mountain slope. In the warmer, low regions, they cultivate corn. Higher up, where flat land cannot be found, they plant potatoes. Finally, in the barren pastures just below snowline, at altitudes ranging from 14,000 to 16,000 feet, they keep their flocks of llamas and alpacas – their beasts of burden and their source of wool for weaving, their dung for fuel at these treeless heights, and an occasional feast of meat.

Because the Q'eros people do not own the land on which they dwell, each adult male member of the community must work half the year for his absentee *haciendista*. This debt is paid by cultivating half the cornfields for the *haciendista*'s benefit, and by tending the *haciendista*'s half of the communities' herds.

Why do the people of Q'eros choose to live just below the snow line, in harsh and desolate terrain, when richer land and warmer climate are at hand below them on the mountain slope? To this question, the people offered me a number of answers. The llamas and alpacas, they said, prefer the mountain tops and, indeed, these animals seem to do better at higher altitudes. In the lower regions, they added, their flocks are in greater danger of attack by pumas. The last word I had on this subject was from a young girl of Q'eros: it was well known, she said, that people who lived down by the jungle soon had their teeth go bad! Whatever the underlying cause, the Q'eros people—as do most Andean Indians—fit their high environment. Their chests are larger and their red blood cell count is higher than normal: both adaptations help them handle the oxygen-poor air efficiently. Like other Andean Indians, they also chew coca leaves. At an altitude where any exertion brought my own pulse-rate from a normal 70-per-minute to as high as 160, they led normal lives.

Soon after my arrival in Q'eros, with the rumor about "weaving from the left" amply deflated, I decided to run down the second rumor, by seeking the keeper of the quipus. Using the equivalent word in Spanish, "contador," I was met with blank stares until I had first described a quipu in detail and then delivered a brief lecture on its presumed function. I was then told that "the Quipu" (as the keeper was himself called in Q'eros) was away with the flocks and would not return until nightfall.

In fact, it was three more days before I was able to talk to the Quipu of Q'eros. In this isolated community, it was his responsibility to keep count of the livestock, and the *mayor domo* had sent word that he wished an immediate report.

At the very time that I asked after him, the Quipu was at work in the corrals, knotting cords of various textures and colors in a census of the Q'eros flocks. Early next morning, with his carefully prepared record tucked in a bundle, with some dry corn and potatoes for nourishment and a little coca for comfort, the Quipu of Q'eros set off on foot across the mountains to render his accounts. On his arrival at the roadside village selected as a meeting place, the Quipu found the *mayor domo* too intoxicated to receive his report. Not until morning, was the weary Quipu able to discharge his responsibility. On his return journey, he was caught in a snowstorm and reached Q'eros only at nightfall, sick and weary. Plainly, I realized, this modern Quipu no longer enjoyed the special position of his ancient predecessors.

The next day, I talked with the Quipu – a man whose ancient art was so little known that even his wife was unable to point out for me which were the quipus and which merely miscellaneous aggre-

gations of string in her husband's bundle. No, he replied to my question, none of his quipus was for sale. But, yes, he would be glad to make me one, as an example.

With the various strands of colored wool in his bundle, he began to work – naming the numbers of the knots as he did so. Seven little knots for seven units of one; four medium knots for units of ten; two large knots for hundreds: before my eyes, the Quipu had produced an understandable, decimal "247."

As he explained, a series of such knots on a strand of a different color could represent another category – female, as opposed to male llamas, for example. Thus, a bundle of differently knotted and colored cords could represent the count, by categories, of all the community's flocks. Such had been the quipu he carried across the mountains to the graceless *mayor domo*.

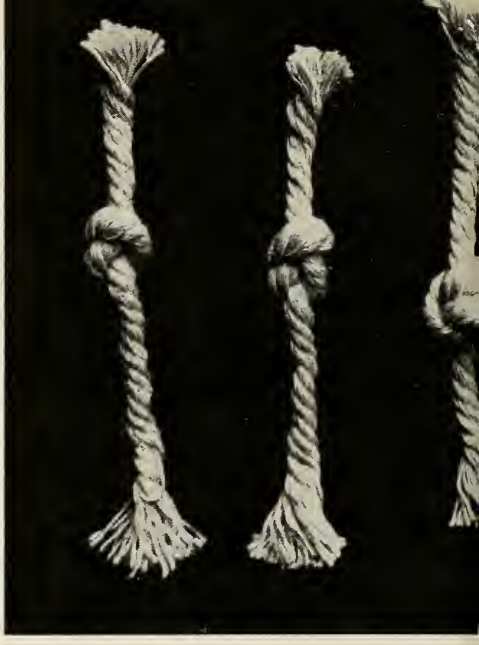
Was there any tradition as to the choice of colors for different categories? The Quipu of Q'eros said "no." Anything that came to hand would do for a quipu, a scrap of wool, a bit of twine, even plant fibre, roughly twisted into string. Perhaps there had been a master-code once, but – if so – I saw that no clue to it remained with the Quipu of Q'eros. So far as he was concerned, colors were selected at random and designated only for the specific occasion.

Thus, the quipu, as it survives at Q'eros today, is an extremely simple device. The knots no longer follow the complex ancient variations from one to nine; size, rather than position, is the clue to higher numeral values. Perhaps its simplicity and its continued usefulness

continued on page 492

Bundle in hand, the Quipu of Q'eros trudges wearily toward home, after delivering his account of the flocks.

ILLUSTRATION from sixteenth century manuscript, by the bilingual Peruvian Indian, Guaman Poma, shows Inca (left) receiving a report from a lesser official, carrying a quipu.

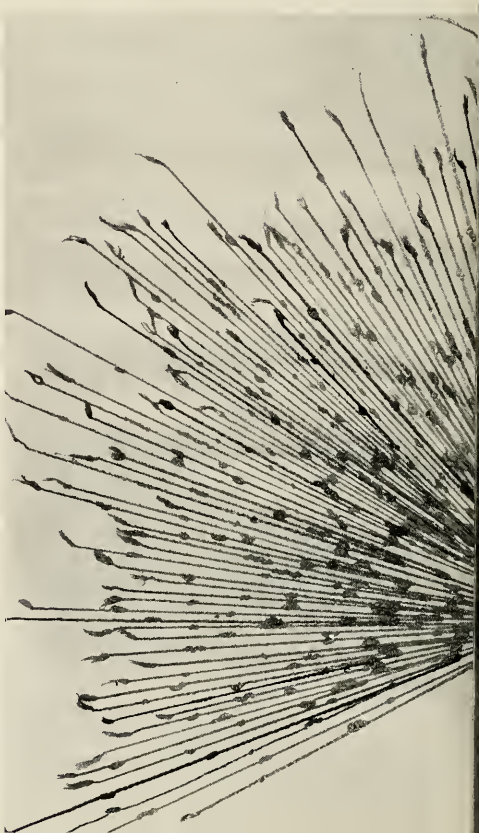


SEQUENCE OF KNOTS for the numbers from one to nin shown above. The overhand knot (first at the left) ma either the number one, or ten, or one hundred, or one t

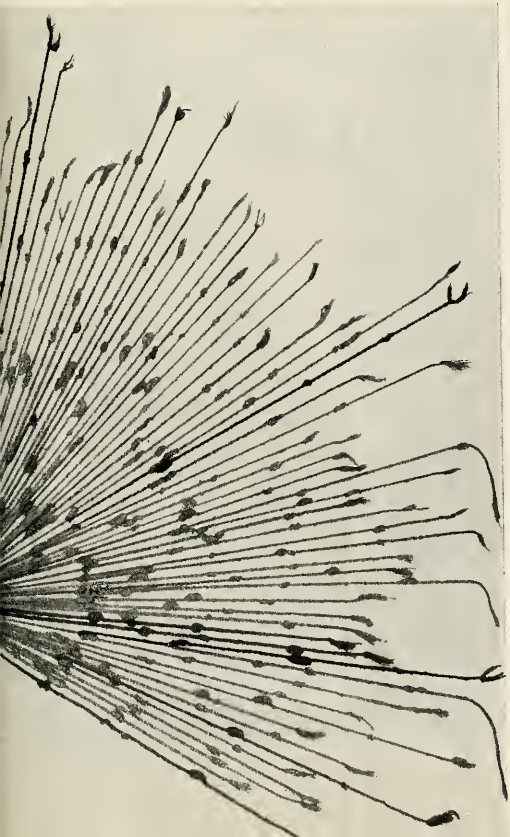
THE FINE ART OF THE QUIPU

The first definitive study of quipus was made early in the twentieth century by Leland Locke, who studied forty-nine available specimens (forty-two of them in the collection at The American Museum of Natural History) and managed to deflate a variety of myths that had grown up round these curious knotted cords of the Inca Empire. Searching the early chroniclers for observations, Locke gave first honors for an account of the quipu to the Sevillian, Cieza de Leone, who wrote, in the mid-sixteenth century:

"The system of the Peruvians [for keeping these accounts] was by quipus. These were long ropes made of knotted cords, and those who were accountants and understood the arrangements of these knots, could, by their means, give an account of the expenditure, and of other things during a long course of years. On these knots they counted from one to ten, and from ten to a hundred, and from a hundred to a thousand. On one of the ropes are the units, on another the tens, and so on. Each ruler of a province was provided with accountants who were called *quipucamayos*, and by these knots they keep account of what tribute was to be paid in the district, with respect to silver, gold, cloth, flocks, down to firewood and other minute details."



depending on its position along the cord. Next to the is the knot that usually represents the number one. after, the loops around the line multiply in succession, to form the numbers two, three, four, and so forth. System is complete with the number nine (at right), after which any larger sums are accumulated by means of decimal sequences.



CONTRAST between elaborate, ancient quipu (left) and modern survival from Q'eros (above) is vast. Specimen at left, from the American Museum's collection, came from an Inca grave in the coastal valley of Chancay. The degenerate example of this record-keeping system was made for the author by the Quipu of Q'eros in 1957.

is the secret of this quipu's survival.

Compare a contemporary Q'eros quipu with one found in a burial of Inca times (p. 490). In basic form, one resembles the other: but the ancient quipu is sophisticated; the modern one, crude. This distinction was perhaps as true of Q'eros and its people at the peak of the Andes' pre-Columbian civilization as it is today. At Q'eros, what we may see is a remnant of Sierra Indians who were as much bypassed by the highly organized society of the Inca Empire as they are bypassed by the Hispanic Peru of today. In such a harsh environment, where energies must be mainly devoted to staying alive, there is little impulse to keep up with the world.

PILE OF STONES is a Q'eros way of scaring off the Andean condors that attack the community flocks.

ALONG BLEAK slopes below snowline, the animals, on which life at Q'eros centers, rest and graze.

ORGANISMS AND THEIR ASSOCIATIONS

Nature's community relations range from simple association to the extreme of parasitism

By Horace W. Stunkard

This account of associations between organisms has been prepared as a general introduction to accompany Dr. Hutchins' account (p. 496) of the symbiotic relationship between the *Pseudomyrma* ant and the so-called "bull-horn" acacia plant: an example of the happier phase of "living together." NATURAL HISTORY will publish additional studies of symbiosis in future issues.

FOR MILLIONS of years, organisms have lived together in communal associations, with one group utilizing the products of others. For example, green plants use light energy with the reduction of carbon dioxide, liberation of oxygen, and formation of carbohydrates; whereas, animals oxidize these plant-made organic compounds and, in the process, liberate and utilize the energy while forming carbon dioxide and other substances that, in their turn, are used by plants. Similarly, plants use nitrates and sulphates in the formation of amino-acids which are condensed into the proteins of plants and animals, while bacteria oxidize the proteid residues from plants and animals back to nitrates and sulphates. The well-known rotation of the elements in nature is maintained by the metabolic activities of living organisms.

Closer relations often develop between members of certain species, and the term "symbiosis" was coined by Anton de Bary (1879) to designate the intimate and permanent association of two distinct specific organisms with mutual and reciprocal benefits. He applied the term explicitly to the lichens—to an association in which an alga and a fungus live in such intimate and constant relations that each lichen manifests characteristic morphological, physiological, and developmental features. The dual nature of lichens had been discovered by Schwendener (1867). Etymologically, the word "symbiosis" signifies merely living together, and authors after De Bary have broadened the original concept until the word has acquired various connotations. Oskar Hertwig (1883) extended the meaning to include associations of animals and plants. Symbiosis, as a concept, has become so general in meaning that other and different terms have been employed to identify the stages in a varying but continuous series of more or less firmly established associations. As a rule, the sequence proceeds from commensalism to mutualism to parasitism. There is a gradual transformation from commensalism (literally—eating at the same table) to mutualism (the sort of symbiosis that is mutually beneficial to both symbionts or in which they are mutually dependent). In most instances, however, one of the symbionts eventually acquires more and more advantage, until the mutual condition no longer obtains and one species (the parasite) becomes increasingly dependent and lives at the expense of the other (the host). The most complete and comprehensive account of these relations is given by M. Caullery (1952) in *Parasitism and Symbiosis.*

In addition to the association of algae and fungi, mentioned in the case of the lichens, there are innumerable associations between other organisms: of higher

SEA ANEMONE and hermit crab are shown in symbiosis above. At right is a communal association in aquatic environment. Rockweeds (top) are photosynthesizers, while periwinkles take proteins and carbohydrates from weeds. All animals shown also release carbon dioxide, which is absorbed by weeds in growth process. Carnivorous starfish (left) feeds on mussels, that have ingested both plant and animal matter. On the bottom, slow bacterial decay is oxidizing residues of both dead plants and animals into their simple, original compounds (nitrates, sulphates, carbons and others) and cycle starts again.

plants with one another and with bacteria; of lower invertebrates with algae, bacteria, and fungi; of insects with both fungi and higher plants; of flowers and pollinators; of invertebrates with one another and with vertebrate animals. These categories may be illustrated by a few examples. The roots of leguminous plants frequently bear nodules containing nitrogen-fixing bacteria, and mistletoe is a familiar semiparasitic plant which grows fixed on the branches of various trees, especially oaks, and which in early days was recognized as the mysterious "Golden Bough." Many protozoans, sponges, hydroids, and a few worms harbor algae, usually *Zoochlorella* or *Zooxanthella,* with mutual benefit.

Some ants cultivate "fungus gardens" and other ants maintain aphids which were called "dairy cattle" by Linnaeus. In their search for nectar and pollen, insects assist in pollination of flowers and, by their flight from flower to flower, often insure cross-pollination. Indeed, the evolution of flowering plants parallels the evolution of insects with sucking mouth-parts. The primitive plants were coarse, without flowers, and primitive insects had chewing mouth-parts adapted to feed on them.

One of the most intriguing examples is provided by the hermit crab which places a large sea anemone on the snail shell in which it lives. If the anemone is removed, but left in the same aquarium, it will be back in place the next morning. The anemone provides protection to the crab by concealing the voracious predator, and, in turn, benefits from bits of food that escape into the water from the mouth-parts of the crab.

Mutualism may engender a dependence which is the initial step toward parasitism. The host–parasite relation is very extensive; no group of plants or animals is entirely free from parasitic infection and frequently the incidence is very high. Most species of animals harbor several parasitic species and, in the case of protozoan parasites, the number may be astounding. In addition to the bacterial and fungal invaders, man harbors more than one hundred different protozoan, helminthic, and arthropodal species. Stoll's survey of 1947 showed over two billion cases of human infection by parasitic worms.

Thus, the range of associations between organisms runs the gamut from mutually beneficent relations to a situation in which one of the associates becomes the helpless and dependent victim of its parasitic existence and the unfortunate host is doomed to support the original *Man Who Came to Dinner.*

Dr. Stunkard, who headed the Biology Department at New York University for 30 years, continues research both at the Marine Biological Laboratory, Woods Hole, and at the American Museum.

BRANCHES OF BULL-HORN ACACIA are marked by these distinctive pairs of exaggerated, hornlike thorns, from which the plant has taken its name. In actuality, these bull-horns are modifications of the acacia's bracts.

ACACI

In Middle America, a bush called the bull-horn lives in symbiosis with tenants

By Ross E. Hutchins

DR. HUTCHINS, professor of entomology at Mississippi State College and author of *Insects: Hunters and Trappers,* is noted as a photographer of insects and plants.

S AN ANT PALACE

FRANCISCO HERNANDEZ, sent by Spain's Philip II, in 1570, to study the natural resources of the New World, may have been the first Western observer to record the strange association of the bull-horn acacia bush and the ants of the genus *Pseudomyrma*. Speaking of a thorn tree seen in northern Mexico near the Pànuco River, Hernandez wrote:

"The Hoitzmamaxalli is a tree with leaves resembling those of a mezquite or tamarind, yellow flowers, edible pods, and horns very like those of a bull, growing upon the tree's trunk and branches. . . . Moreover, within the horn there are generated certain slender ants, tawny-colored and blackish, whose sting is hurtful."

Since Hernandez' day, we have determined that there are actually many different kinds of bull-horn acacias, ranging from northeastern Mexico southward to Colombia. They vary in size from small shrubs to spreading twenty-foot trees, with trunks often as much as five inches in diameter.

The bull-horn's leaves resemble the leaves of the mimosa, to which the acacias are, in fact, related. However, a feature that sets the bull-horn apart is the presence of many strong spines growing in pairs along its branches and trunk, often closely resembling the gracefully curved horns of a bull. Actually, these thorns or "horns" are modified bracts (the small leaflike structures found at the bases of leaves of many plants).

These robust thorns are almost always inhabited by the *Pseudo-*

DRAWING from an early Spanish manuscript (above) gives an even more exaggerated picture of the bull-horn acacia's distinctive thorns. Spaniards also noted presence of ants.

CLOSEUP of modified bract (left) shows *Pseudomyrma* ant next to entrance hole that has been gnawed into the pulpy interior of horn to provide space for shelter and storage.

CUTAWAY VIEW of horns shows ants' shelter (above). At left is an adult worker; elsewhere are ant larvae of various sizes, as well as some *Pseudomyrmae* in pupal stage. Closeup (below) shows strong jaws of a worker ant.

myrma ants. Ants of this genus may be found in many habitats, although most of them live in small colonies inside the stems and twigs of various plants. A few types occur in the southern portions of the United States, but most are dwellers in the warm lands south of the Mexican border.

Probably the first person really to understand the true nature of the relationship between the acacias and the ants was Thomas Belt, who discussed them in his classic work, *The Naturalist in Nicaragua.* To Belt should go the credit for determining the details of this remarkable example of symbiosis.

Under ordinary conditions, nearly every thorn on the bull-horn acacia is a happy, ant palace. The thorns, when young, are green and filled with a sweetish pulpy substance. When they reach a certain degree of maturity, the ants gnaw a small entrance hole near the tip of one of a pair of thorns. In due course, the ants hollow out the centers of both thorns, leaving only the tough outer shell, in which they never pierce more than the single original entrance.

Thus, each pair of spines makes a snug shelter for a group of adult ants and their young. The ants also use these nesting sites to some extent for food storage.

But the bull-horn acacia does more than provide living quarters for its insect associates. At the base of each leaflet-bearing stem, near the point of attachment to the central part of the thorn, the plant possesses a crater gland that secretes a honey-like liquid. The ants find this good to eat. Nor is this the acacia's only contribution to the *Pseudomyrma* ants' larder. When the plant's small leaflets unfold, a tiny yellow fruitlike body appears at the tip of each. Each "fruit" is about one-twelfth of an inch in length. The fruits have no relation to the plant's reproduction cycle. Rich in oils, proteins, and carbohydrates, they provide the ants with a highly efficient food. When these fruits are ripe enough, the ants carefully gnaw them off and carry them away to the hollow nests within the bull-horns.

Thus far, we have examined the remarkable bounty provided by the bull-horn acacia for the benefit of its associated ants. The question remains: what benefit is derived by the plants from this association? Belt found the answer to this question both by observation and by experimentation.

First, he observed that any animal (including man) that comes in contact with the bull-horn acacia soon finds himself under attack by an efficient "standing army" of *Pseudomyrma* ants. The shaking of a branch is sufficient to rally a swarm of ants to the attack, and their sting is severe (in the case of man, it raises a painful welt that lasts for hours). This sort of protection, it may be guessed, provides the acacia some insurance against browsing animals, although in pre-Columbian times (before the introduction of cattle, sheep, and goats), the danger from browsing must have been slight.

Belt's Experiment

Belt tried an experiment. He planted a number of bull-horn acacias in a section of Nicaragua where there were no *Pseudomyrma* ants and the plants were therefore deprived of their usual associates. He found that the local population of *Atta,* or leaf-cutting ants, often stripped his experimental acacias of their foliage in a single night. Bull-horns with attendant *Pseudomyrma* ants normally never suffered such attacks.

Now, the physical shock of a goat's browsing is a major sort of

alarm-signal, but the sly attack of a leaf-cutting ant is a comparatively quiet event. Belt searched for the "signal system" that warned the *Pseudomyrma* ants of such insect attacks. He discovered that the acacia's tiny fruits did not mature all at once, but in staggered fashion over an extended period. He also found that the ants maintained, in effect, a "standing patrol" of their plant, searching out the newly-ripened fruits.

With such foraging parties continually on the move over the whole acacia, it was almost impossible for any predator – beetle, caterpillar, leaf-cutting ant, or the like—to establish itself on the plant without discovery and attack by the roaming *Pseudomyrma* ants. Belt found that the guarded acacias were normally free of nearly all plant pests. Only one insect—a beetle which visits the plant to lay its eggs in the flowers of the bull-horn – goes unmolested by these continual *Pseudomyrma* patrols.

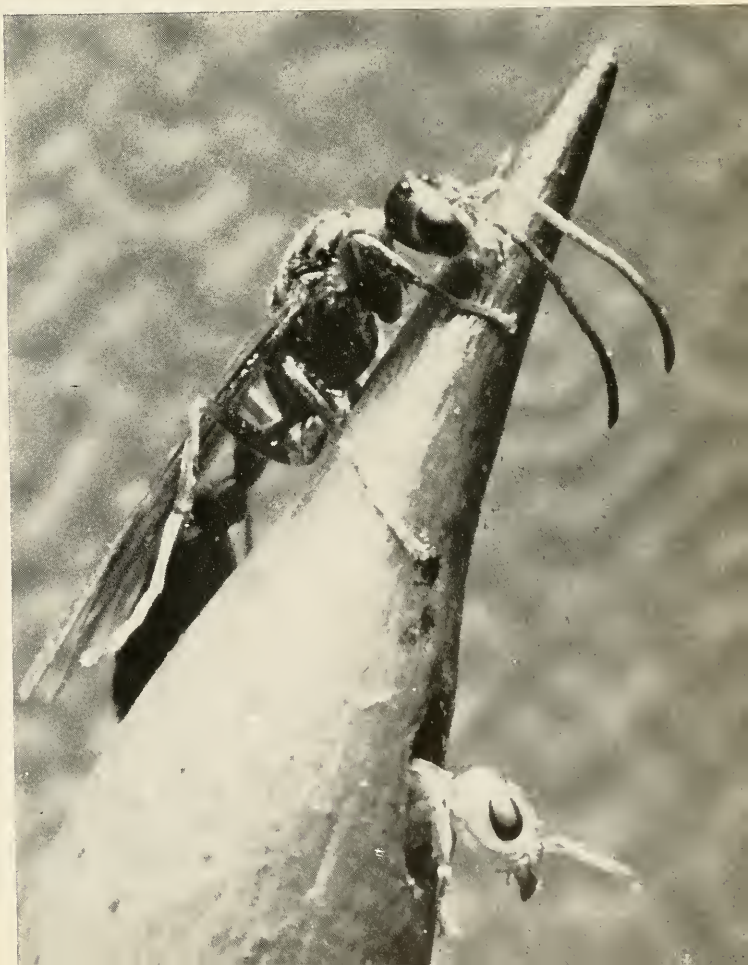
Thus, the *quid pro quo* of this association became clear: the bull-horn offers food and shelter to its associated ants, while the ants guard the plant from possible animal and insect ravages.

It is interesting to speculate on the origin of this association. There are other plant-and-ant partnerships, especially in the tropics, where nature reaches her greatest degree of specialization and competition. One such association is that of the *Cecropia* tree and the *Azteca* ant, whose story is similar to that of the bull-horn and the *Pseudomyrma* ant.

It is possible that the bull-horn always had thorns and that the ants gradually developed the habit of dwelling within them. It is reasonable to think that trees whose thorns were tenanted by ants had a better survival rate because of the ants' protection. In time, the trees, by natural selection, may have developed both honey-secreting glands and fruits, the better to nourish the symbiotic ants. But exactly how this symbiosis began must remain a matter of conjecture.

PLANT'S PAY to the ants includes nectar from crater glands (above), and "fruits" from leaf tips (right).

ANTS' PAY to plant consists of a continual "standing patrol." Here, immature queen sees worker emerge.



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REVIEWS *continued from p. 454*

with these. *The Story of Perri* is called a "True Life Fantasy."

We are told that, in this form of entertainment (shall we call it "genuine pretense"?), the fantasy never impairs reality. We are not, therefore, to look upon "The Story of Perri" as merely an entertaining bedtime story, but also as a seventy-four-minute documentary report on the reality of animal life in the Uinta National Forest in Utah. Naturalists, it is to be feared, will find reality considerably impaired.

One such impairment begins with an alleged, hungry predator—a racoon—peering uncertainly into a den of young martens in a hollow stump. The mother marten returns—just in the nick of time, the narrator tells us—to save her cubs. We see the mother *carry them away one at a time,* leaving the raccoon free to help itself to those still there.

Were this marten concerned at all about the raccoon, one blazing snarl would have sent the supposed enemy tumbling all over itself to be out of the way. One wonders if, instead, the marten's real objective was not to get its babies away from that annoying cameraman? And, possibly also, to get them out of a den, perhaps belonging to the puzzled raccoon, where a designing human hand had placed them?

The reviewer has studied flying squirrels intensively, both afield and in captivity. Another one among many impairments of reality, for him, was the implication that the casual pecking of a woodpecker, a foot or so below a squirrel's den entrance, could "frighten" this nocturnal animal into a fantastically long glide in full daylight across an open, unobstructed space. Perhaps the cause of flight was less the woodpecker's proximity than the script's dramatic requirement that the squirrel, in such a glide, be snatched from the open sky by a goshawk.

With springtime—the time for courtship—*The Story of Perri* becomes too viscidly lyrical. The unseen choir dins into one—with the knifing insistence of a commercial—the song, "Together Time." With this, pair after pair of different animals, presumed mates, are displayed—even, *ad nauseum,* to a pair of crayfish.

That this will prove to be a popular film, the reviewer has no doubt. It is no pleasure, as a naturalist, to be forced to declare it decidedly downgrade from the fine things that Walt Disney has given us in such "True Life Adventure" films as *Prowlers of the Everglade, African Lion,* and *The Vanishing Prairie.*

JOSEPH CURTIS MOORE

DR. MOORE, a Research Fellow of the AMERICAN MUSEUM, was a biologist at Everglades National Park, where he often worked with Disney Studio camera-crews.

EXHIBITIONS OF INTEREST

NATIONAL MUSEUM OF CANADA, Ottawa (November—December): Canada's forests and their products. Commercial trees; their industrial uses; conservation. **NEW YORK STATE MUSEUM,** Albany (November—December): animal paintings by Celia Schwebel; also. Fourth Salon of Nature Photography (North American subjects). **AMERICAN MUSEUM,** New York City (November—December): Corner Gallery. Photographs by William Vandivert—"Pup, Cub and Kitten": wild animals and their young.

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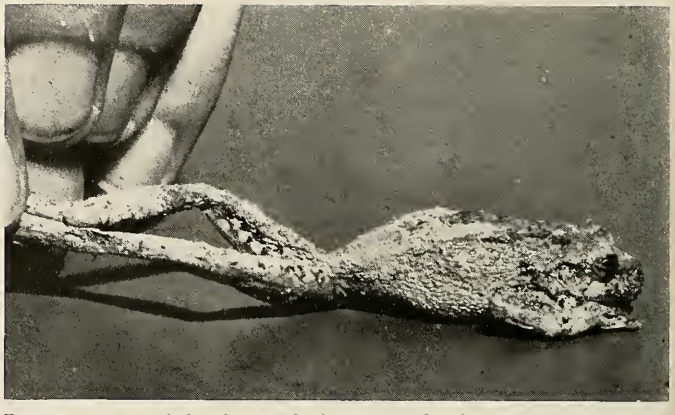
Letters



THIS FROG came to light when a school floor was demolished in Asheville, N. C.

Entombed Amphibian

SIRS:

Three weeks after school was let out this summer, workmen digging up a concrete floor at the Lee H. Edwards High School, in Asheville, N. C., discovered this frog (photo), when their air hammer broke through the concrete.

The floor was poured 28 years ago. How the frog got into the floor is a mystery. Some believe that the frog must have jumped into the concrete when it was still soft, and then hibernated for those 28 long years. I would like to know the Museum's opinion.

MARGUERITE ALEXANDER
Asheville, N. C.

THE DEPARTMENT OF AMPHIBIANS AND REPTILES replies:

The myth of prolonged survival of toads and frogs, supposedly entombed in rock or concrete, continues to be revived year after year. Good newspaper copy evidently never dies, and only the protests of the scientists fade away. While amphibians and reptiles are capable of enduring periods of starvation much beyond the capability of mammals (see *A Snake's Dinner, p. 468*), they must nevertheless slowly use up their reserves of stored energy, and the decades of living entombment often attributed to toads and frogs are far beyond reasonable expectations.

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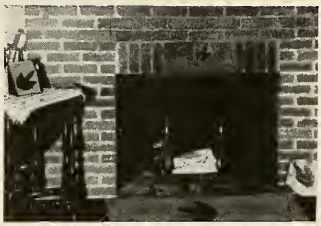

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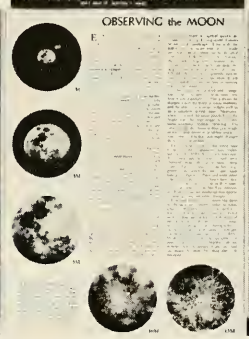

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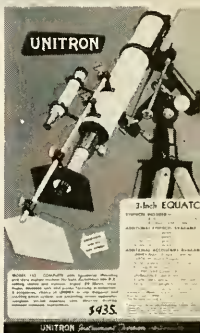

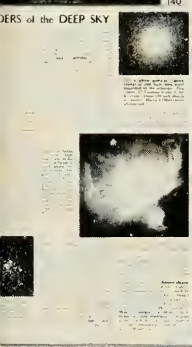

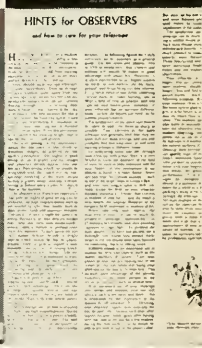

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siderations, one sturdy English investigator, in 1825, decided to settle the matter by burying toads in sandstone and limestone boxes. Some of the boxed toads survived for more than a year, but all were dead before two years had passed.

The animal that appeared to be buried in the concrete floor of the High School in Asheville was a Gray Treefrog, *Hyla versicolor*. Perhaps the fact that this species normally has a gray, somewhat concrete-like color made the discoverer think it had been entombed. One may suppose that the frog had found its way into a burrow beneath the floor and appeared when the concrete over its head was broken away. There is no reason to believe that it could have performed the supernatural feat of living trapped in concrete for 28 years.

Sounds of Nature

SIRS:

The many friends of Dr. Loye Holmes Miller in our Society read with pleasure his article in your September issue. Those of your readers to whom Dr. Miller is less well known may be glad to be informed that he has recorded four examples of "Music in Nature," including many fascinating bird calls. These recordings (12-inch, 78 R.P.M.) are obtainable from our Society, c/o the Department of Zoology, University of California, Los Angeles, 24.

C. V. DUFF, Secretary
Cooper Ornithological Society
Los Angeles, Cal.

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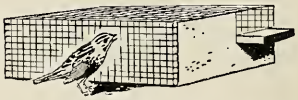

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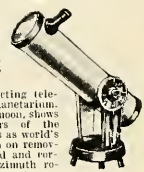

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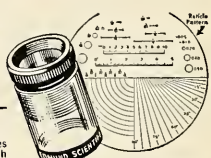

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December, 1957

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In an eastern woodland setting, this mother raccoon, *Procyon lotor*, placidly nurses her young. Such a photograph is not easily obtained, by either the weekend naturalist or the professional zoologist. The man who made it is neither, although he has recently become a walking repository of woodsy lore. A professional photographer, William Vandivert has spent much of the past two years in pursuit of America's common wild animals, with strobe lights and cameras. This December, the fruits of his labor — with accompanying notes by his wife, Rita, detailing the lives and habits of the sixteen animals portrayed — will appear as a Dell book. For a portfolio of Mr. Vandivert's pictures, and an account of how they were produced, turn to page 520.

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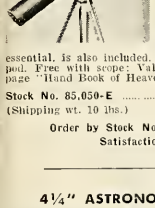

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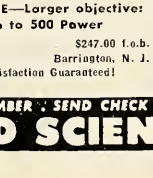

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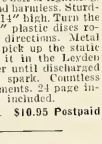

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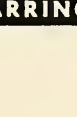

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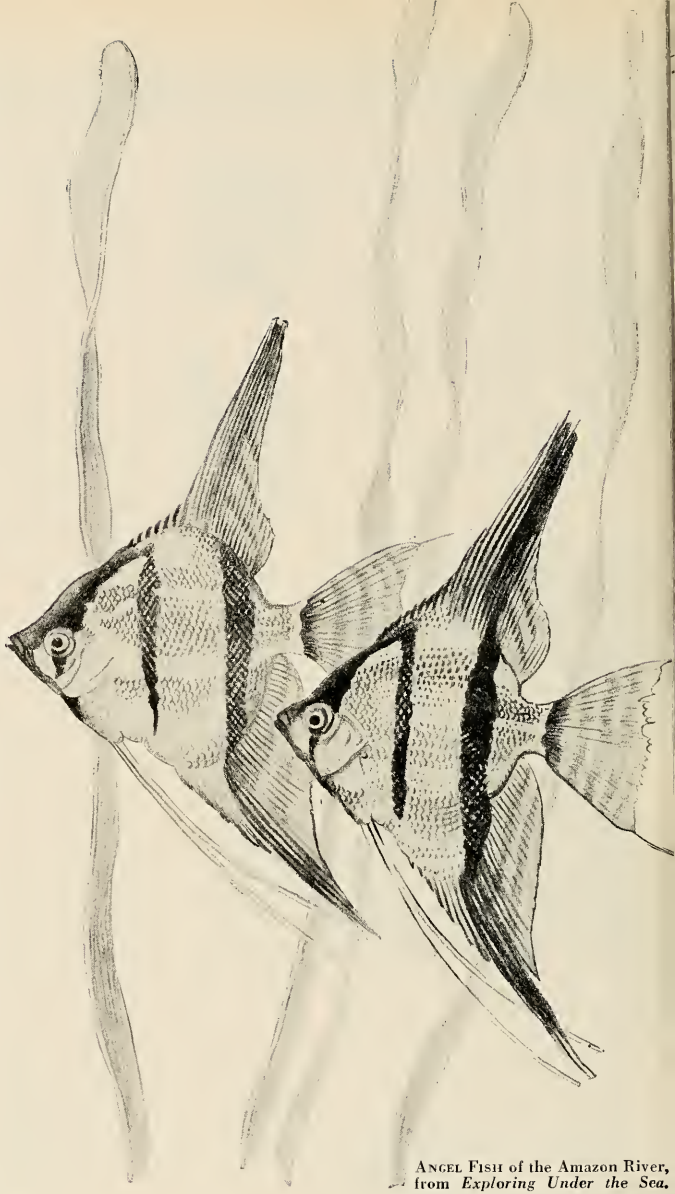

ANGEL FISH of the Amazon River, from *Exploring Under the Sea.*

Reviews

NATURAL HISTORY, Senior—feeling its seniority more heavily than is usual, with the new year looming ahead—has turned to its sister, JUNIOR NATURAL HISTORY, for advice on those children's books in the field of science which seem both deserving of chronicle and likely to persuade the young folk of this television age to read more. Herewith, JUNIOR's list:

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ASTRONOMY

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GIANT QUEEN of this ant species takes workers for new colony on mating flight.

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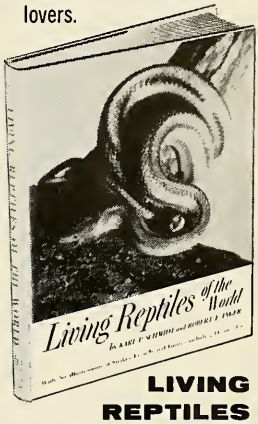

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Hinton (Doubleday), is a large, full-color book of anecdotes about the denizens of the deep and shallows: it also sketches a brief picture of what remains in this vast realm for science to explore and commerce to exploit. $2.50, 63 pp.; *age* 10 *and up.*

Undersea Explorer, by James Dugan (Harper), is a biography of the French oceanographer, Captain Jacques-Yves Cousteau, containing color illustrations, photographs and diagrams. $2.95, 234 pp.; *age* 10 *and up.*

To return to shore, we find the subject of the jungles discussed in two good books: *Tropical Rain Forests*, by Delia Goetz (William Morrow), a beautifully illustrated volume, 64 pp.; $2.50 (*age* 8–12); and *See Through the Jungle*, by Millicent Selsam (Harper), $2.50; 48 pp.; *age* 7–11. Each page of the latter is illustrated in color, and the text presents an imaginary trip through the rain forests of South America.

Swamp Life, by Glen Rounds (Prentice Hall), lays great emphasis on conservation. The book is illustrated by the author with more than fifty drawings. $3.00, 128 pp.; *age* 10 *and up.*

BOTANY

To begin at the beginning, *Play With Seeds*, by Millicent Selsam (William Morrow), presents information both about seeds and about seed products. The experiments outlined by the author can be done by children of *age* 10–14. $2.50, 96 pp.; with numerous illustrations.

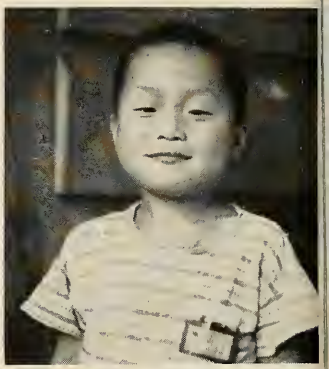
Common Shrew's minute size is shown in drawing from Ripper's *Moles & Shrews.*

For older boys and girls who want accurate, clearly presented facts about trees, general and particular, we have *Trees and Their World*, by Carroll Lane Fenton and Dorothy Constance Fallas (John Day), $2.95, 96 pp.; with fifty illustrations.

ZOOLOGY

Of the mammals, the smaller ones get the nicest books. An especially laudable

continued on page 554



"I AM GOING TO BE A TEACHER"

Six-year-old Yoo Song Kim entered the first grade last April. He gets good marks and his wish to become a teacher is natural, for in Korea, a scholar is greatly revered and respected. Yoo Song, who was born after his father was killed in a bombing raid, is today supported by a widowed mother. Despite a crippled left hand, Mrs. Kim is a bread peddler and works late into the night to support two boys.

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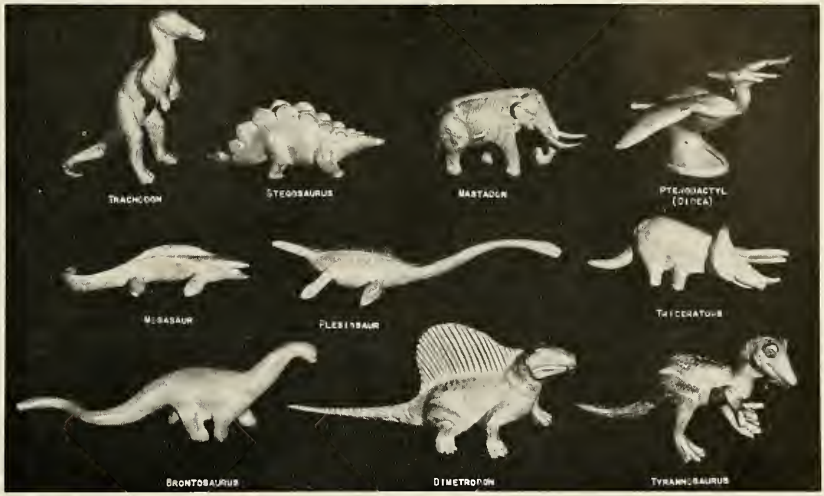

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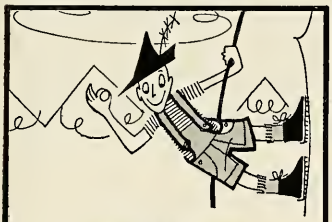

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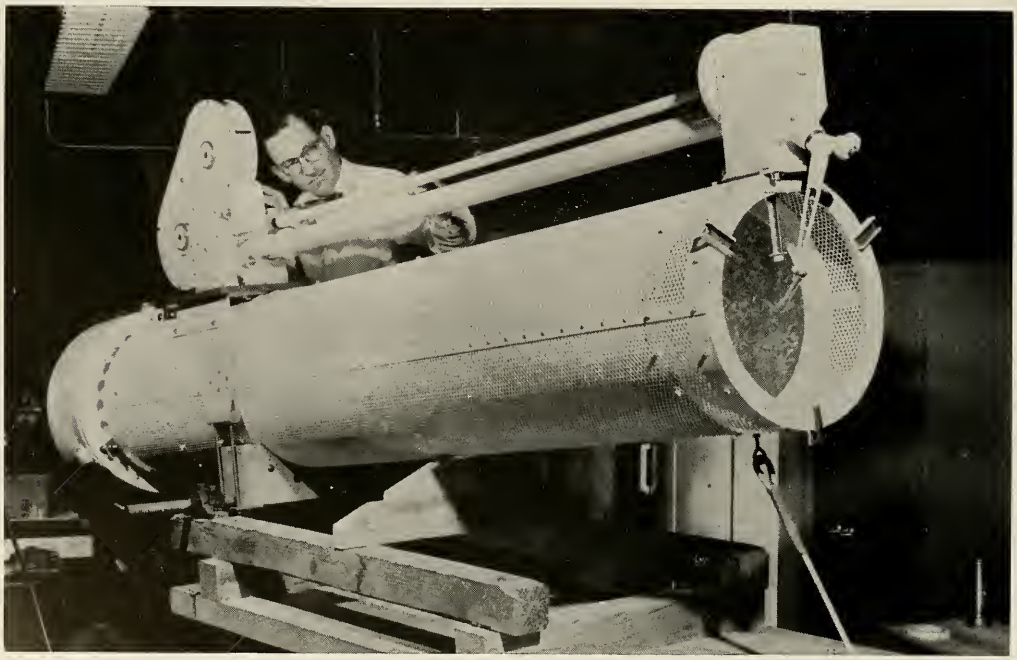
NEW LOOK AT THE SUN

By Franklyn M. Branley

IT MAY still be impossible to correlate the activity of sun spots with changes in the time of swallows' migrations, variable yields of wheat or the periodicity of social revolutions, but one bold attempt to learn more about these and similar phenomena must certainly be correlated with the world-wide scientific activities in progress during the International Geophysical Year.

On September 25, an elaborate U.S. scientific effort

PRINCETON ASTRONOMER, Dr. Martin Schwarzschild, *above*, is originator of Project Stratoscope. In working clothes, just before launching, *right*, he studies the balloon's probable course with representative of the Office of Naval Research (which sponsors the five-year-old program). Perforation of telescope tube, *below*, is for ventilation. Mounted on tube is camera. Tiny secondary mirror is at the end of rotating arm. The instrument was constructed by Perkin-Elmer.



Dr. Branley is an Associate Astronomer of The American Museum—Hayden Planetarium. His book, *Exploring by Satellite*, was launched almost simultaneously with Sputnik.

was crowned with success in making the first photographs of the sun's surface from stratospheric heights. That day, a Skyhook balloon, carrying a specially-constructed telescope—camera, rose above the cornlands of Minnesota to an altitude of fifteen miles. In the space of about four hours, 8,000 feet of film were exposed, photographing the sun's surface at one-second intervals. While the data contained in these photographs has not yet been fully evaluated by Professor Martin Schwarzschild, of Princeton University (the project's scientific director), there is no doubt that the Stratoscope pictures will provide answers to many persistent questions.

Previously, photographs of the sun's surface could be made from no higher points than mountain-top astronomical observatories, and the results were almost invariably unclear at high magnification, because of the intervening blanket of dense air. The telescope used here, however, was suspended *above* ninety per cent of the earth's atmosphere, thereby allowing unusual clarity of detail.

This instrument was an ingenious piece of engineering — a twelve-inch reflector, scaled down to weigh only three hundred pounds. Two chief devices were employed to counteract the distortions of focus that could be expected from exposure of the instrument to the sun's heat. First of all, the secondary mirror, made of quartz, mounted on a rotating arm, remained in the sun's image only long enough to obtain each exposure—ninety-eight per cent of the time it was "cooling." Secondly, a relay lens was installed between the secondary mirror and the film. Every twenty seconds, this lens went through a cycle of twenty different positions of focus, each of them recorded by the camera. Thus, of every twenty exposures, at least one was sure to be at optimum focus.

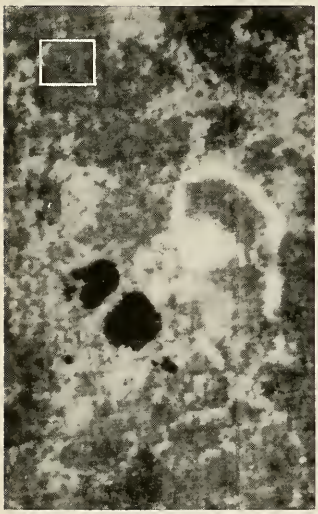
Still a third bid of ingenuity was involved in pointing the telescope, as it hung beneath the balloon, directly at the sun. This was done photoelectrically, in a combination of coarse and fine controls that gave an accuracy within one minute of arc.

Stratoscope take-off shows instrument suspended beneath Skyhook balloon. Tubular cage around telescope houses elaborate mechanism, designed at University of Colorado, that pointed telescope directly toward the sun.

WHAT DO astronomers and physicists hope to gain from these high altitude films? Above all, a much greater knowledge of the violent, turbulent eddies in the sun's atmosphere—the great bubbles of hot gas that have worked their way to the surface like gigantic thunderheads. The photo on the right shows some of these eddies, revealing the variations in brightness caused by temperature differences of many hundreds of degrees, the hotter eddies being brighter than the cooler ones.

In addition, the Stratoscope photos are expected to reveal much more precisely both the size of these giant eddies and the details of the smaller local storms of hot gas on the sun's surface. This data should also provide the basis for a better understanding of such solar phenomena as the "spots" and "flares" which appear related to the magnetic disturbances in our ionosphere that can make long distance radio communication impossible.

And since, coincidentally, the period 1957–58 is one of maximum solar activity, these flares are also being studied as part of the IGY program and correlated with changes in cosmic rays and solar influence on the auroras and magnetism of the earth (*p.* 518).



EARTH-BOUND photograph of sun's surface, *above*, contrasts with one of the Project Stratoscope pictures, *right*. Inset on smaller photograph covers approximately the same area of sun's surface as balloon closeup.

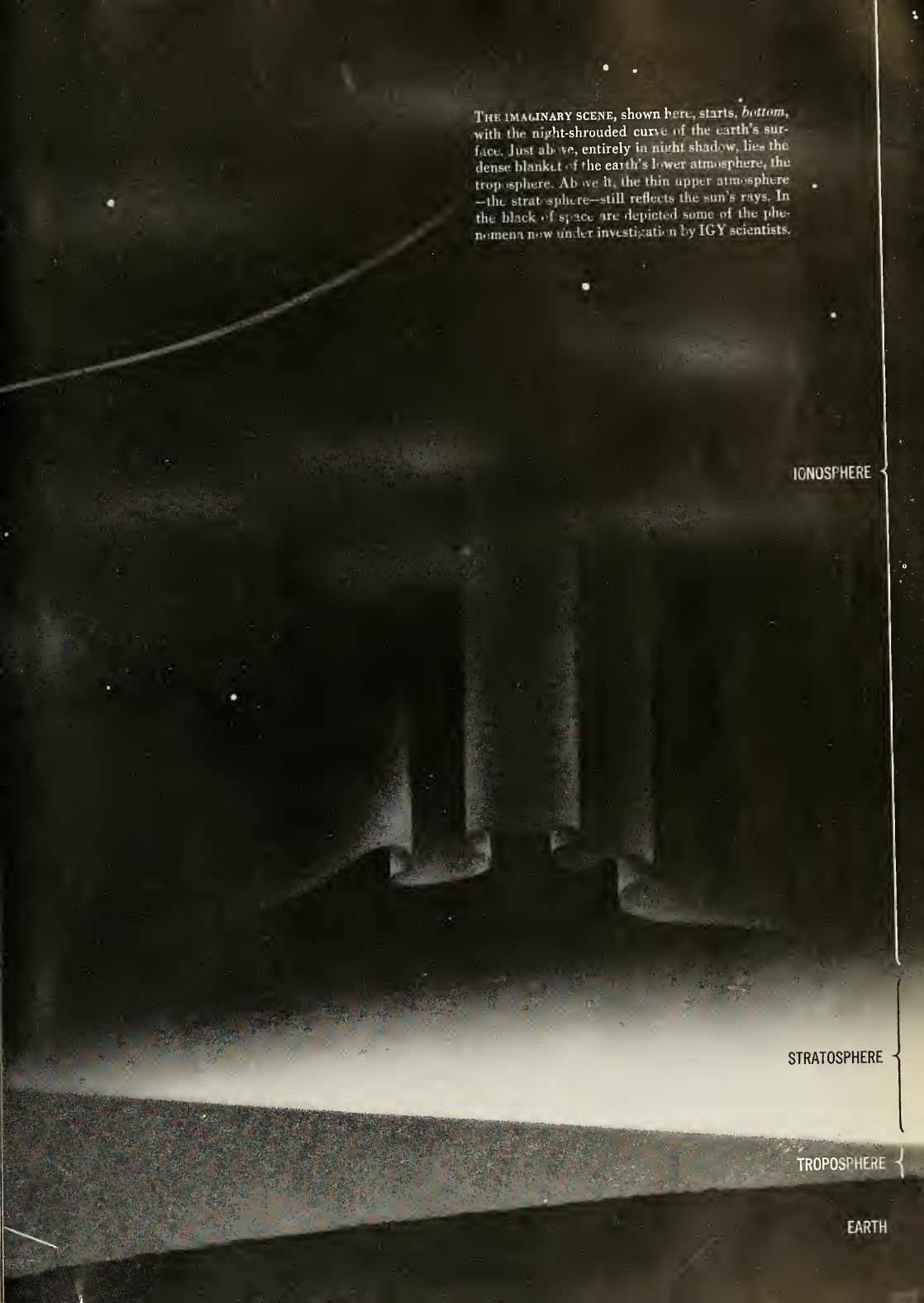
СПУТНИК ЗЕМЛИ

This phrase—SPUTNIK ZEMLI in English orthography—is the Soviet name for its vehicle. Translation: "Satellite of Earth."

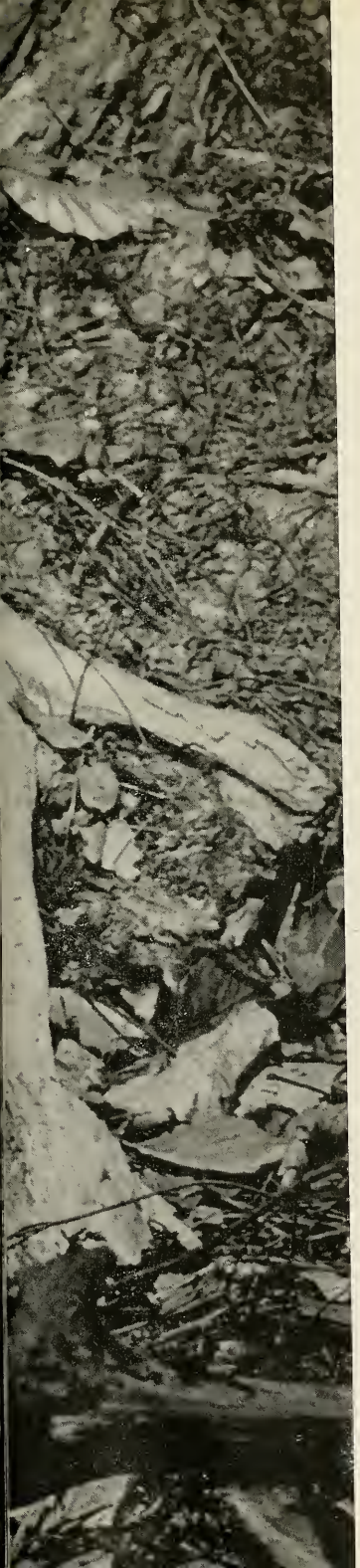
NINE DAYS after the sun's new portrait was made, the U.S.S.R. astonished the world by being first to put an artificial satellite into space. Although solemnly declared to be only a "test" vehicle, preliminary to a number of "official" Soviet IGY earth satellites, Sputnik—as it is now internationally known—has captured the attention of scientists and the public round the world.

This month, the U.S. is scheduled to launch several small, test satellites of its own. By March, 1958, the first of six fully-instrumented U.S. satellites should be in orbit. The number of new Soviet companions that Sputnik will have by then is, now, a matter of conjecture. In any case, these devices—and other IGY projects—are serving to bring new knowledge of the phenomena depicted here.

We should soon know more about the swarms of meteoroids through which the earth passes (seen, in incandescence, *below*); about the cosmic particles, *center, below*, which continually bombard the earth; and about the magnetic and electrical fields of the vast ionosphere, with its auroral displays, *right*. In the perspective of future history, the IGY's answers to the many questions that plague the earth sciences today may well prove to be of greater substance than the narrow issue of which nation won in the satellite race.



THE IMAGINARY SCENE, shown here, starts, *bottom*, with the night-shrouded curve of the earth's surface. Just above, entirely in night shadow, lies the dense blanket of the earth's lower atmosphere, the troposphere. Above it, the thin upper atmosphere —the stratosphere—still reflects the sun's rays. In the black of space are depicted some of the phenomena now under investigation by IGY scientists.



The photograph, *left*, and those on the following eight pages, have been selected from *Common Wild Animals and Their Young*, by William and Rita Vandivert (DELL, publishers), and are reprinted by permission.

AMERICAN BESTIARY

This collection of remarkable photographs documents family life among many of the common wild animals of the United States

By WILLIAM & RITA VANDIVERT

FIVE DIFFERENT animals are shown on these pages, out of a total of sixteen that we have documented in our book. The total effort took us something over two years to complete. It was never easy, but it was lots of fun, nonetheless. Successful animal photography requires limitless patience and—most important of all—an idea for the picture or series. Add to these a flexibility based on sympathetic understanding of animals, and you have a working formula.

Since wild animals and their young live secret lives, each of the animals was a problem both in logistics and in photographic techniques. Some, like the deer, the porcupine and the beaver, were photographed in the open, often with telephoto lenses. Others, like the raccoon, were "confined" in large enclosures, within which whole woodland settings were laid. Still another group, the mice, came and lived with us indoors for the period during which they were observed and photographed. Each method had its own problems. Assistance with the animals was an absolute necessity. Working with us much of the time was one of the greatest woodsmen we have ever known, Niles Fairbairn—now retired after many years with the New York State Conservation Department — a gentle genius with animals of all kinds.

To the list of ingredients for animal photography should be added sweat and tension. The lightning swiftness of small animals, as they dashed in and out of focus or in and out of scene, created a tension that could be stood only for relatively short periods, friends though we became. But the great frustrations in wild animal photography make the occasional triumphs even sweeter. Certain moments of excitement remain as wonderful memories—the more so when they are on film, too. For us, perhaps the high point of this whole effort came with the scene caught on the cover, and again opposite: when a mother raccoon, in her enclosure, moved her family into sight and then sat down to nurse them.

MOTHER RACCOON, *Procyon lotor*, has finished nursing her litter. Here, she holds one of her young in an almost human pose as she cleans it with her tongue.

Young Mice & Mother

NEWBORN white-footed mouse, *Peromyscus leucopus,* is being moved to new nesting place. Several litters may be born during nine-month breeding time.

DISTURBED mother makes for safety, with young still clinging to her teats. These three-week-old babies will be ready to breed in five more weeks.

HUNGRY mother investigates acorn, as young mouse looks on. Omnivorous feeders, white-footed mice have preference for seeds, berries, nuts and fruits, but will also eat buds and bark. In summer, insects and snails add to diet.

Fawn into Hiding

BABY DEER, left by feeding mother, bounds for shelter. Eight-week-old fawn is one of the white-tailed deer, *Odocoileus virginianus.*

SHELTER in sight, the fawn slows down, creeps towards thicket. At this age, fawn is scentless, and safe from predators when motionless.

STEALTHY approach to cover is nearly over. White spots of fawn's coat, which will disappear later, afford it protective coloration now.

AT REST among bushes and flowers, the fawn now possesses the safet of immobility, the dapple of sun and shadow mingling with its spot With dusk, mother will return from day's browsing, nurse her young

Porcupine

MONTH-OLD porcupine, *Erethyzon dorsatum*, follows mother up into tree branches and has a lesson in climbing as a result.

CLINGING apprehensively to tree trun young porcupine starts lesson. Althoug physically able to climb soon after birt porcupines are clumsy and slow to lear

ow to Learn

Almost falling, the student squeaks in alarm. The porcupine continues its climb, however, encouraged by occasional grunts from the parent, feeding in trees above.

Safe in fork, student still appears ill at ease. When porcupines find a suitable tree, they often stay aloft for several days of browsing, and do severe damage.

The Beaver Family

BEAVER, *Castor canadensis*, litter crowds together for warmth on bed of twigs and grasses. These kits, born in spring, are six weeks old.

PAIR OF KITS get into swim with mother. Coat of young beaver does not have long guard hairs of the adult, and is readily waterlogged.

EAR OF CORN technique is beaver's typical feedi posture. Balancing on its hind legs and flat ta kit nibbles on poplar twig grasped between forepa

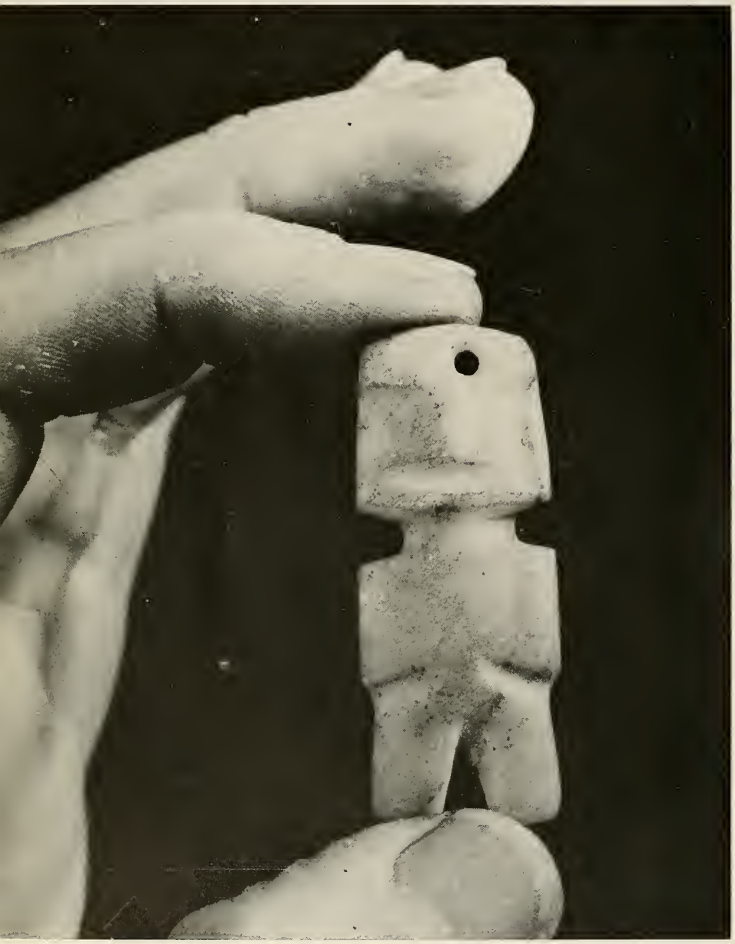
THE FIGURES OF MEZCALA

The early artists of western Mexico carved tiny stone ornaments in a monumental style

By Gordon Eckholm Photographs by Lee Boltin

FEW countries of the world have richer and more varied archeological remains than Mexico. Each region of the country has its specialty in some characteristic style or kind of object or ruin. In architecture, the lowlands of Yucatan contain the ornate limestone buildings of the Maya, that contrast markedly with the massive and severe pyramids of Teotihuacán in the Valley of Mexico. The Gulf coastal region is notable for the superbly refined, stone carving of the Tajin or Totonac style and, in another section, the formidable monumental sculptures of the Olmec, such as the great stone heads that weigh as much as fifteen tons. The outstanding specialty of western Mexico — of the States of Colima, Nayarit and Jalisco — is in the ceramic sculpture that is so much admired at the present time.

Until recently, other local style areas in Guerrero (the Pacific Coast state usually identified with its historic port city, Acapulco), were little recognized. Guerrero has been much neglected by archeologists and very little is known of its ancient cultures. It was, however, a favorite area of the late artist—archeologist, Miguel Covarrubias, who avidly collected and studied the objects that, through the years, were turned up by the plows of farmers and shovels of road builders — or by treasure hunters. Through his unexcelled perception and appreciation of these ancient arts, our attention has been drawn to Guerrero.



Smallness of a typical Mezcala figure, less than two inches high, is emphasized here by size of hand.

Three-inch-high model of temple, made of green stone, is a further example of Mezcala miniature work.

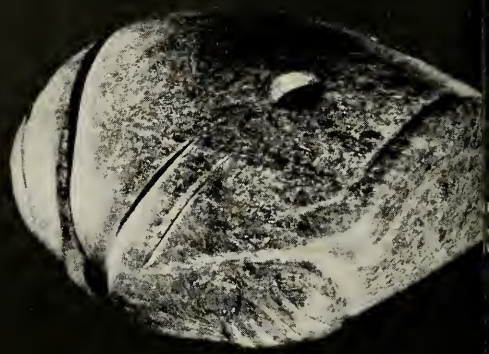
CURVE of this Mezcala figure, reproduced full size, is a departure from traditional form of stone axe.

Dr. Eckholm is Associate Curator of Archeology at the American Museum and a specialist in Central American material. Mr. Boltin, formerly of the American Museum, is a notable photographer of fine arts, specializing in archeological objects.

Covarrubias attempted to chart the complex mixture of cultures and influences that appear in the remains of this area but had to admit that only many excavations and much study would eventually provide a clear picture of its history. "But," we quote Covarrubias, "one important, clear-cut cultural unit, occupying a well-defined area, stands out in this archeological dusk. I have called it the 'Mezcala style' because it is found mainly along the Mezcala River basin, and is marked by stone objects that possess a distinctive and purely local personality."

THE Mezcala style is characterized by small stone objects — figurines that may be only one or two inches in height and seldom over fifteen inches — by masks and small effigies of animals or other objects, and by various ornaments such as beads, pendants and earplugs. They are cut from many kinds of hard stone, often from green diorite, but also from gray, black or mottled stone. The figurines have a basic form that is similar and sometimes merges into that of an elliptically-shaped celt — or stone axe — with the features and limbs merely outlined by simple grooves and planes. In describing their sculptural qualities, Covarrubias says: "These pieces are highly stylized and schematic, and their coarse, vigorous character makes them readily identifiable. . . . The Mezcala sculptures have all the vigorous simplification and the tendency toward abstract, pure form so dear to the most ancient and the most modern art — from the Cycladic marble figures of the Greek islands of 4,000 years ago, to the abstractions of Brancusi and Henry Moore."

Shown on these pages are a number of typical Mezcala figures. Although small, their fundamental monumentality is reflected by the camera. The artists who carved them were working in miniature, but to us their conceptions appear as massive and powerful as the heads of Easter Island or the rock-cut deities of Egypt.

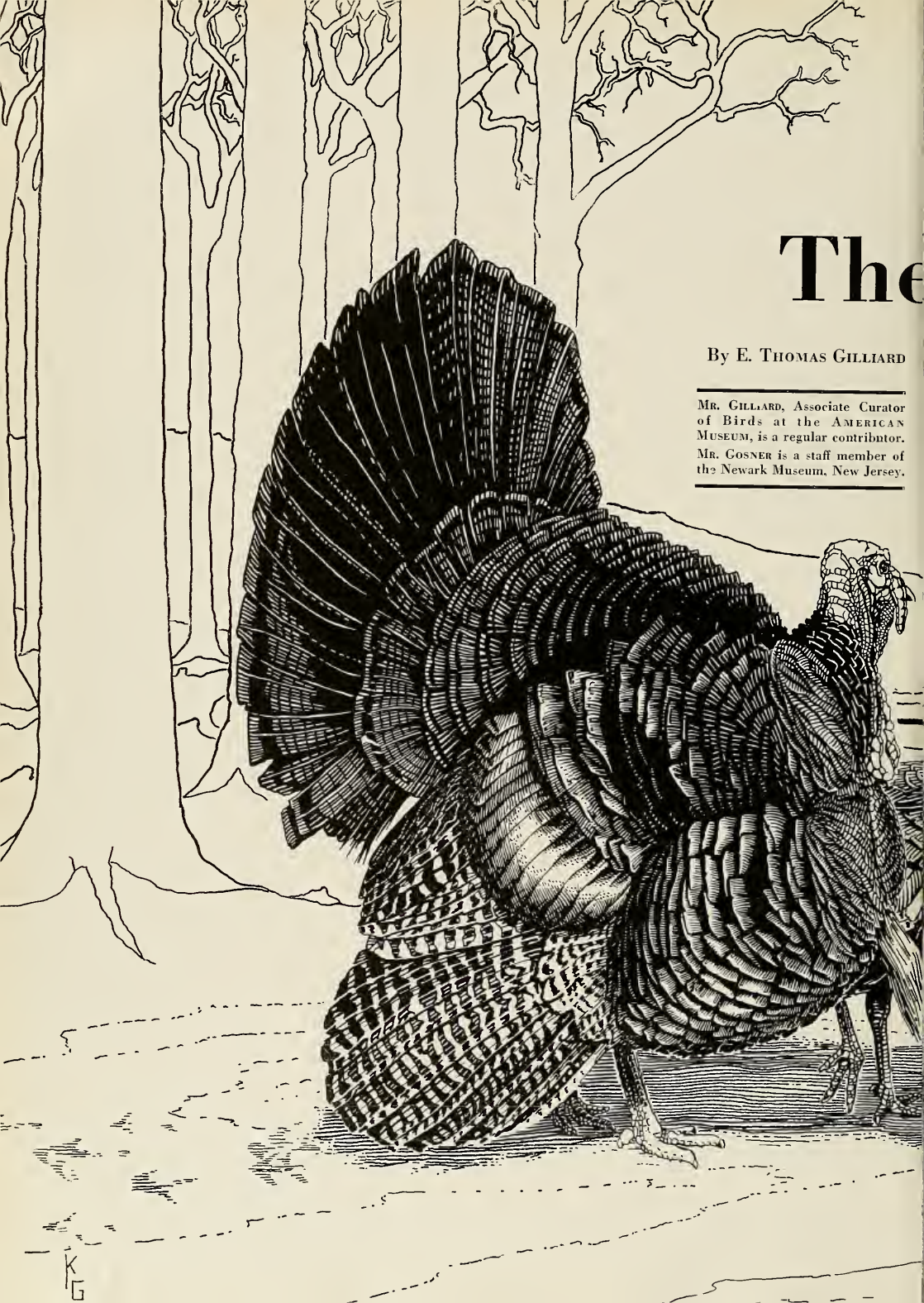


Standing figure, with lines, is more Mexic appearance than the c

ZED FROG is shown full
as are the other objects
n on these two pages.

SEATED FIGURE of man, done in black stone, is only two and a half inches in height.

ABSTRACT FACE decorates top of this variation on traditional stone axe shape.



The

By E. Thomas Gilliard

Mr. Gilliard, Associate Curator of Birds at the American Museum, is a regular contribntor.

Mr. Gosner is a staff member of the Newark Museum, New Jersey.

A search into the ancestry of our traditional holiday turkey reveals a complicated history

Great American Bird

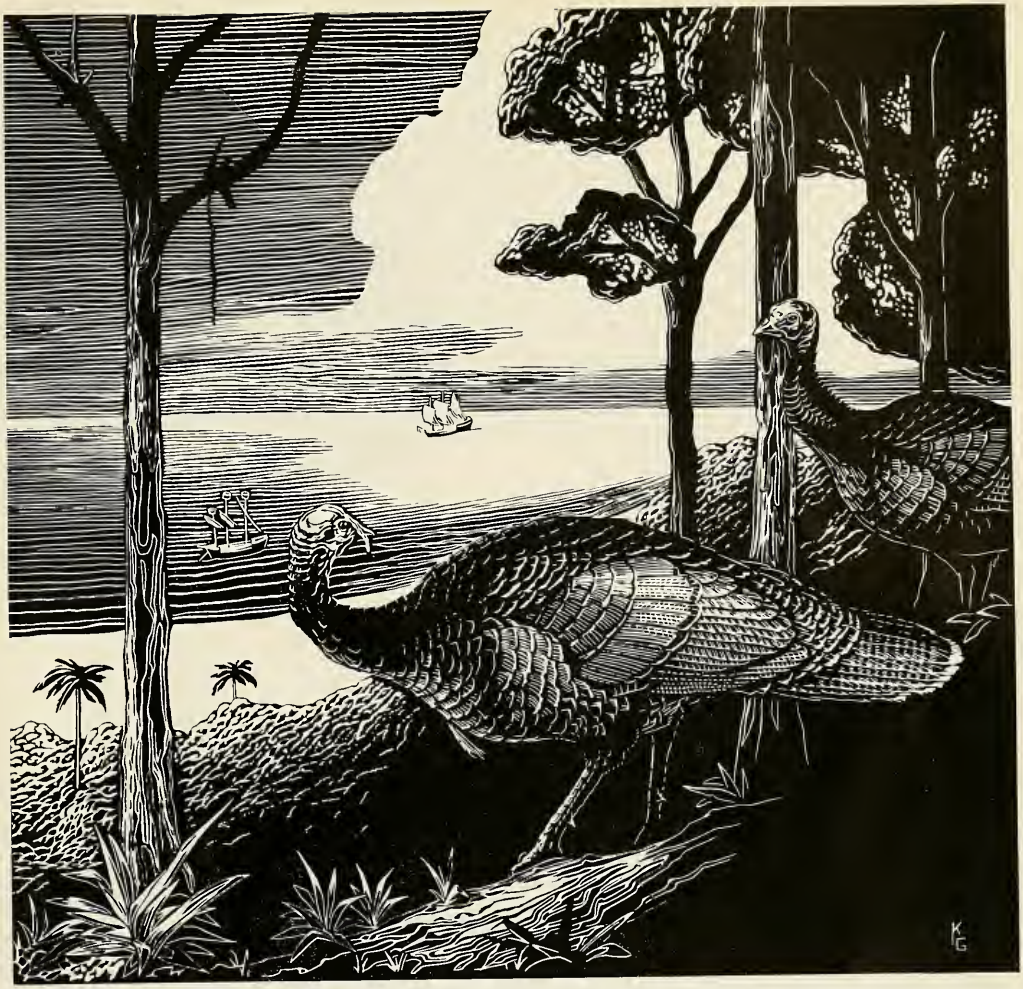
THIS ROBUST TOM and shy hen have been seen in a thousand works of art since they graced the first Thanksgiving table in colonial New England. Among the best-known of all fowl—and probably the latest in history to have come under domestication—the Great American Bird is also the subject of many misconceptions. The subspecies shown here, for example, is the wild bird that formerly ranged from Canada to northern Florida, and westward across the Alleghenies—*Meleagris gallopavo silvestris*. Although often considered the prototype of all turkeys, *silvestris*' actual role in the ancestry of today's domestic breeds is one that is almost impossible to judge—other than to say that it was probably quite small. For, at the same time that *silvestris* had become a favorite game fowl on the tables of the early colonists, as many as half a dozen breeds of domestic turkey were already known in Europe—and destined to be reimported to the New World by later settlers. *Silvestris*, the Pilgrims' turkey, was probably never domesticated—although cross-breeding with turkeys from Europe, by accident or design, may well have occurred. The complex history of the turkey's true origin is outlined on the following pages.

Illustrations by Kenneth Gosner

COLOR of feather-tips indicates subspecies: The Mexican variety shows white at tip; *intermedia* is darker; *silvestris* is chocolate-brown.

TO UNTANGLE the history of the Great American Bird, it is helpful, first, to establish the turkey's position in the overall world of birds. First of all, then, the turkeys—in common with such varied fowl as the peacock, grouse and chickens—belong to the order of Galliformes (or chicken-like birds). Within this order, the turkeys form the family Meleagrididae, which, in turn, is composed of two genera. To make things more complex, each such genus contains but a single species, and thus is what zoologists call a "monotypic" genus. One of these species is the Ocellated Turkey, *Agriocharis ocellata*—a magnificently lustrous, wild bird, that still ranges the lowlands of Costa Rica and nearby areas of Central America. No subspecies are known.

The other species (of the other monotypic genus) is *Meleagris gallopavo*—with which we are already partly familiar. But, as the map, *below*, shows, the subspecies of this putatively familiar bird are numerous. Until recently, indeed, there was little common agreement on their exact number. We have already become acquainted with *silvestris*, the Pilgrims' turkey, that once ranged from New England to northern Florida. A second variety—called *osceola*, after the famous Seminole chief—is still to be found in the southern wilderness of Florida. Beyond the Great Plains, in turn, in the foothills of the Rockies, exists still a third variety, known as *merriami*—after the famous physician-naturalist, Clinton Hart Merriam. Nor is this all: astride the Texas—Mexico border, there is still a fourth variety, *intermedia*—the so-called "Rio Grande turkey." And, finally, in the highlands of Mexico Proper,



TURKEY'S ANCESTOR, *Meleagris gallopavo gallopavo*, from which all present domestic turkeys descend, had already been domesticated by the Indians of Mexico when the Spanish arrived. It still survives in its original wild form.

we find yet a fifth variety—known zoologically as *Meleagris gallopavo gallopavo*—the true ancestor of all the domestic turkeys of today.

IT was this subspecies that the early Spanish adventurers discovered, being kept in domestication by the Indian nations of Mexico. The Aztec emperor, Montezuma, had such turkeys in his zoo—kept, it is said, as food for the other animals. By 1526, the chronicler Oviedo reported that these "peacock, abounding in New Spain," were already popular domestic fowl among the Spanish colonists of the West Indies. "The meat of these peafowl," wrote Oviedo, "is very good, and incomparably better and more tender than that of any peafowl of Spain."

Hereafter, the history of the turkey accelerates. Taken to Europe by the Spanish, the Great American Bird was commonplace enough in England, by 1585, to have joined the lyrical list of dishes for the Christmas season:

"Beefe, Mutton and Pork, shredpiece of the best,
Pig, Veale, Goose and Capon, and Turkie
well drest . . . ."

By this time, or soon after, the varieties of turkey in England, alone, included the dull-black Norfolk, the Suffolk, the White and the copper-colored Cambridgeshire. The Netherlands esteemed a buff-yellow breed, with a white topknot—perhaps ancestral to what we call the White Holland today. The stage was set for reimportation to the New World, whence their progenitor had come, of numerous new domestic varieties of America's unique bird. The details of this countermovement are not known with precision, yet turkeys may be found today in barnyards round the world. To see six common varieties, turn the page.

FAVORITES OF TODAY

STANDARDBRED BRONZE

One of the six recognized standard varieties in the United States today, this iridescent beauty—together with its nonstandard cousin, the Broad Breasted Bronze, and crosses between the two—is the biggest and most commonly raised of all our domestic turkeys.

WHITE HOLLAND

Another of the six standard varieties, this medium-sized fowl is a "sport," possibly of the original wild stock, or, the Bronze. Its plumage, to be standard, should be a pure white, its "beard" black and its beak light pinkish-gray. Shanks and toes are pale pink.

BOURBON RED

This medium-sized turkey is another of the standard varieties recognized by the American Poultry Association. First bred in Kentucky, it exhibits a handsome color contrast between its white tail- and wing-feathers, the rich brownish-red of its other plumage.

NARRAGANSETT

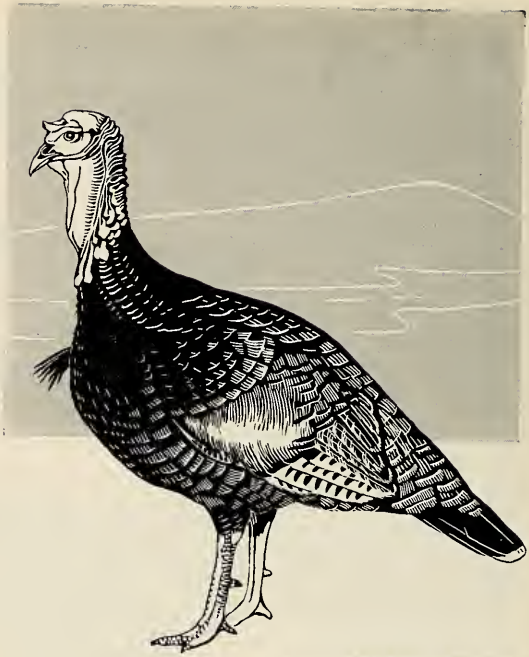
Another medium-sized standard variety, it is said to be a cross between the English Norfolk and *silvestris*. In color pattern, it resembles the Bronze, and young poults of both varieties look alike. When full grown, however, it lacks the Bronze's iridescence.

BLACK

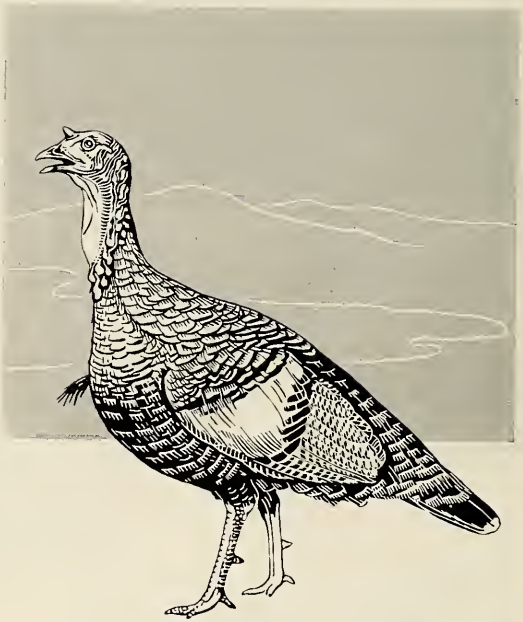
This is the American name for the medium-sized standard known in England as the Norfolk turkey, notable for its lustrous green-black plumage. This is one of the lineal descendents of *gallopavo*, reimported to the New World after being developed in Europe.

BELTSVILLE SMALL WHITE

This present-day favorite is the result of U. S. Department of Agriculture selective breeding of six separate domestic varieties, plus wild turkey stock. Scaled to a size in wide demand, it is ready for market as much as a month ahead of other turkey varieties.

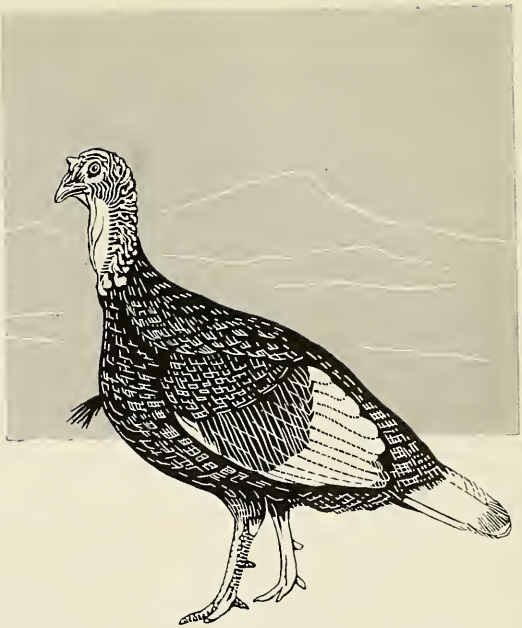


STANDARDBRED BRONZE



NARRAGANSETT

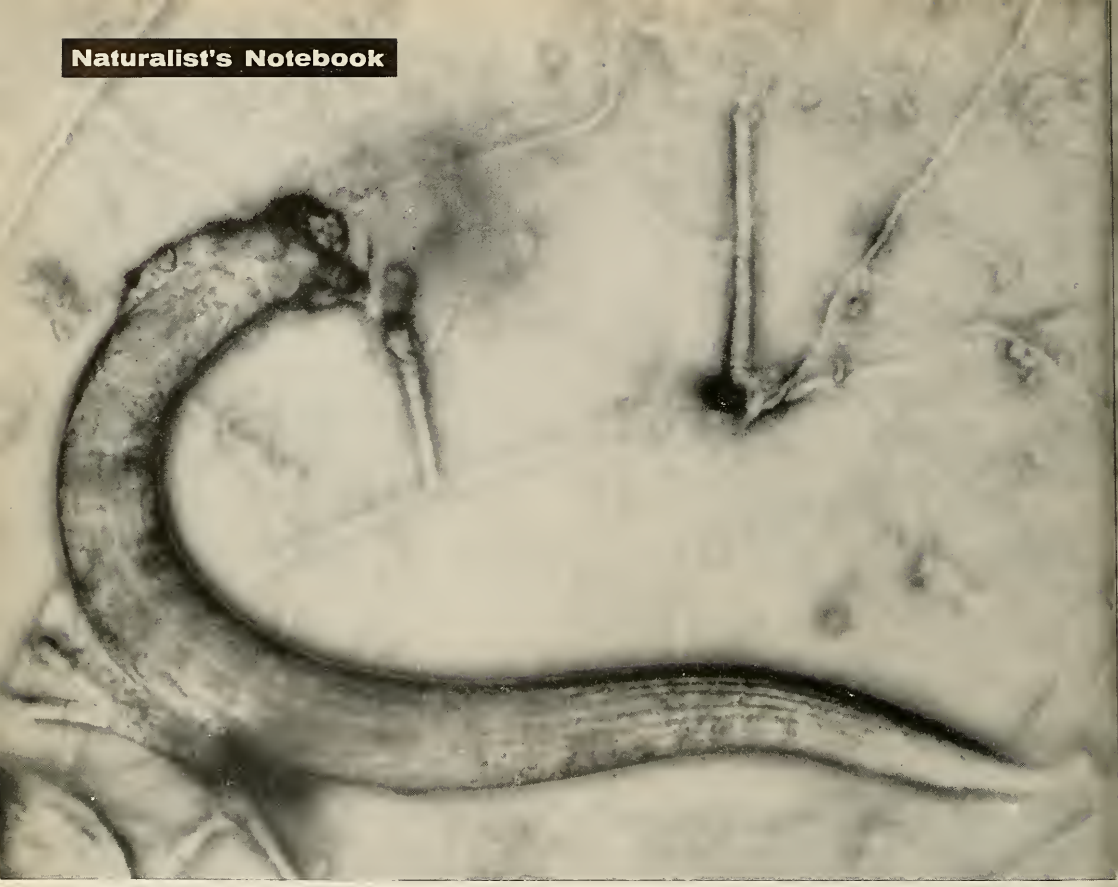
WHITE HOLLAND



BOURBON RED

BLACK

BELTSVILLE SMALL WHITE



QUICK NEMATODE, an earth-dwelling crop damager, has just entered a fungus trap, *top*, is now struggling to escape.

MICROSCOPIC TRAPS

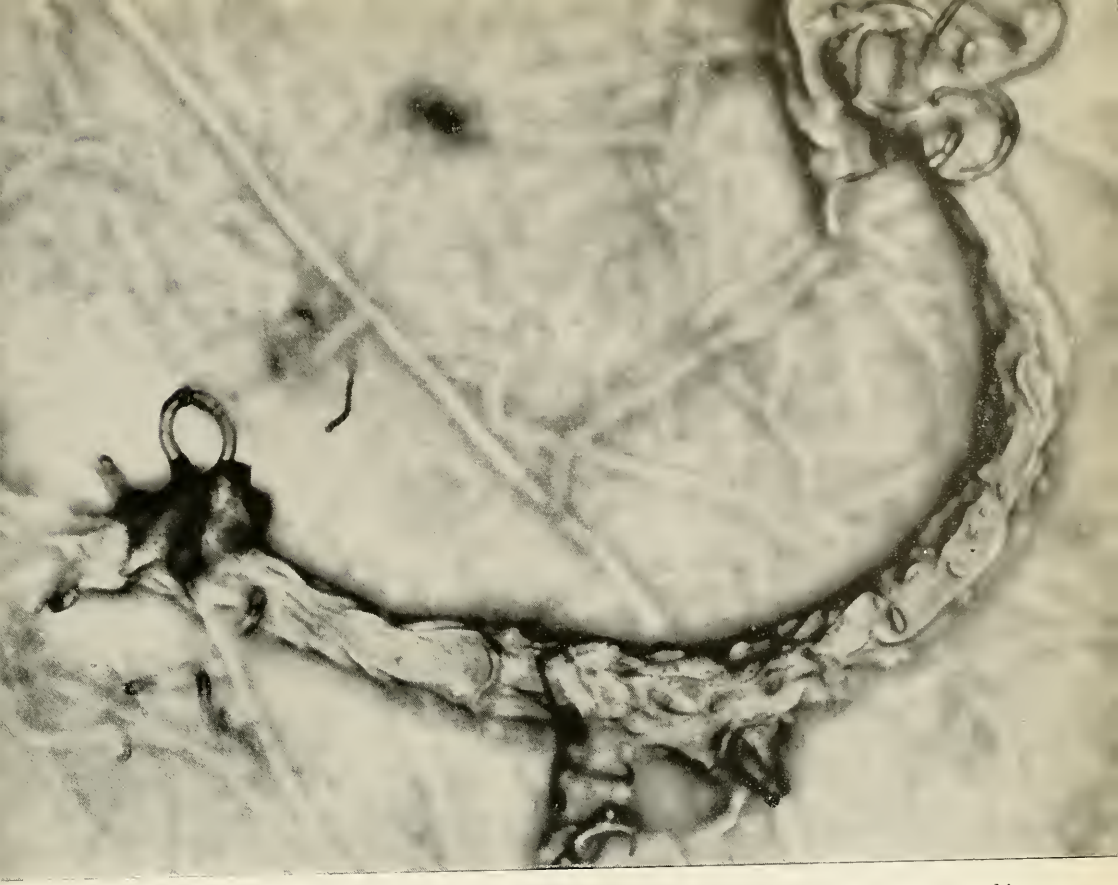
As an example of biological balance, consider the numerous nematodes. Abounding in the soil, they are trapped and destroyed by special fungi

By DAVID PRAMER and NORMAN DONDERO

THE nematodes, better known as roundworms, or threadworms, are among the most abundant and widespread of all organisms. Some species — such as *Trichinae*, which produce trichinosis, and *Necator*, the common hookworm — are parasitic in animals, including man. Other parasitic species attack plants of all kinds. Free-living nematodes are numerous in the bottom muds of rivers, lakes and oceans, and they abound in soil, reaching densities greater than twenty million per cubic yard. Over ten thousand species of nematodes have already been described and many more still remain to be discovered.

Most nematodes are too small to be seen easily without the aid of a microscope. A full-grown nematode may be less than one sixty-fourth of an inch in length, and the species that are plant parasites are rarely greater than an eighth of an inch long.

Although nematodes have been known and studied for over a hundred years, it is only recently that we have become aware that they attack a wide range of plants and probably cause as much damage to crops as do better-known agricultural pests. The damage done by nematodes to our crops each year is estimated to be more than one



DEAD NEMATODE, soon after being trapped, has been fed on by the fungus until little remains but an empty skin.

hundred million dollars. Because of the extent of this loss, nematodes are receiving much attention from investigators of methods for the control of such agricultural pests.

Some success has been achieved. It is possible to reduce losses and prevent the spread of a nematode infestation by various means — including crop rotation, selection and breeding of resistant varieties of crops and chemical treatment of infected plant stock and soil.

Although the control measures devised by man are of great importance and value, they are far from being as ingenious as nature's own methods for limiting the activities of nematodes in the soil. We have long known that there is a biological balance in nature, controlled by a system of checks and counter-checks, that tends to maintain an equilibrium among organisms in any natural enviroment. If conditions are such that one species develops to a greater extent than is normal, a second species, capable of destroying the first, usually will also proliferate.

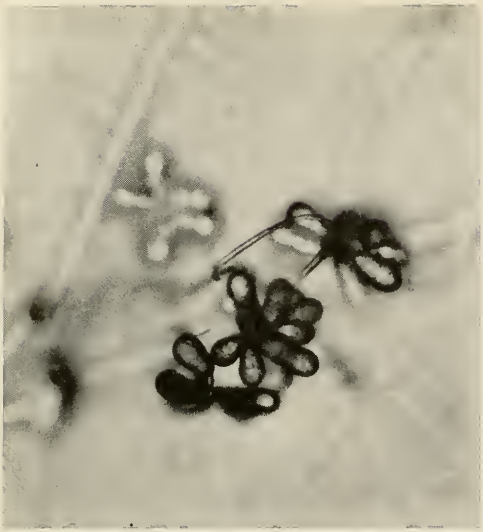
If we plant a field with a crop susceptible to nematode attack, the soil environment is thereby modified to favor the development of nematodes, and their numbers will then increase greatly. If we check with a microscope, we see that, as the number of nematodes increases, certain fungi also develop.

These are the nematode-trapping fungi, a group of fascinating, microscopic molds that prey upon nematodes. While the existence of these nematode-trapping fungi has been known since 1874, they have received little attention. Even today, they are generally considered little more than scientific curiosities.

Three distinct groups of fungi are known to prey upon nematodes. Two of these are obligate parasites and will not be discussed here. The members of the third group are of particular interest, however, for they have developed a number of highly-specialized organs which enable them to capture nematodes alive.

Some of these trapping organs are sticky and act on a flypaper principle; others are best compared with rabbit

Both DR. PRAMER and DR. DONDERO are microbiologists at the Agricultural Experiment Station, Rutgers University. Each has published a number of papers in various technical journals, but this report—illustrated with their own photomicrographs—is their first joint effort and first venture into natural history.



REPRODUCTIVE spores of a nematode-trapping fungus (pear-shaped bodies), *above*, stand in clusters at the tips of filaments rising vertically above the surface.

CLUSTER OF TRAPS, the fungus' specialized weapons in its war with the roundworms, are seen here. Each "rabbit-snare" is composed of a trio of curved cells.

snares. Both are very efficient. Once a nematode is trapped, the fungus filaments grow through its body walls and the fungus feeds on its victim, until, eventually, only the empty skin of the nematode is left.

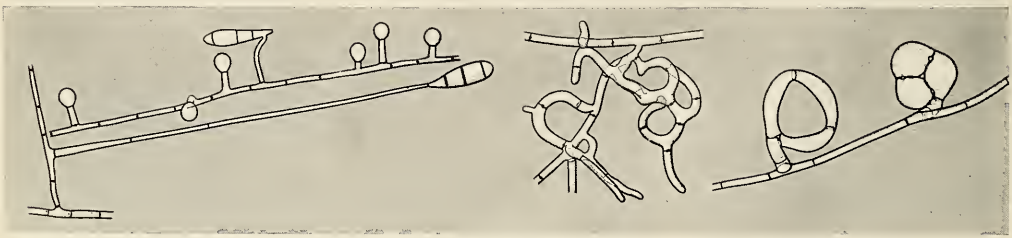
One fungus, that traps nematodes by the flypaper principle, produces small spherical knobs on the end of short stalks — called "lethal lollipops." The surface of the knobs is coated with an adhesive substance secreted by the fungus. A nematode that comes into contact with one of these sticky knobs seldom escapes.

TWO KINDS of fungus trap operate on the snare principle: they are the non-constricting and the constricting ring. Each ring is composed of three curved cells, attached to the fungus by a stalk. The non-constricting rings have such a diameter that, if a nematode attempts to pass through the opening, it becomes wedged and usually cannot escape. Should a captured nematode succeed in snapping the rather fragile stalk and escape, wearing a detached ring, it will not live for long, for its body will soon be invaded by fungus filaments that develop from the ring itself.

The constricting ring is an even more remarkable nematode trap. Very similar to the non-constricting ring in appearance, it is active rather than passive. When a nematode passes into the opening of a constricting ring, the ring cells swell quickly, exerting pressure on the nematode — making escape impossible and death rapid.

The photomicrographs on these pages show the action of the non-constricting ring in detail. Thus far, we have been unable to obtain satisfactory pictures of the "lollipops" or the constricting rings.

Nematode-trapping fungi, in a recent survey, are shown to be extremely widespread and common in soil. However, we have insufficient knowledge at present to evaluate their importance in nature. The use of nematode-trapping fungi for the control of nematodes which are plant parasites has been attempted with rather promising results. But this is not a simple matter; much more research is needed before this interesting possibility can be assessed as a practicality.



THREE KINDS of traps are shown here. First, *left*, is the "lethal lollypop"—an adhesive knob at the end of a short stalk—produced by *Dactylla asthenopaga*. Second, is the non-constricting ring of *Arthrobotrys oligospora*, the type seen in the photographs. Last is the constricting-ring trap of *Dactylaria brochopaga*.

MIDWAY through a field of spores and traps, a wandering nematode has worked half its length through the ring trap of the fungus *Arthrobotrys oligospora*, and is now firmly caught. Escape is hopeless, because the fungus' lethal action has already begun, and filaments from the trapping cells are entering nematode's body.

Pathan's Way

THESE "WILD" BORDER-TRIBES LIVE BY A RIGID CODE

By James W. Spain

ABOUT eleven million Pathans—or "Pukhtuns," as they call themselves—live along the Afghanistan—Pakistan border, in the area centering on the Khyber Pass. Divided into dozens of clans and subclans, some Pathan groups dwell wholly within Afghanistan, some wholly within Pakistan and some astride the border. This last group, most of whom live in Pakistan's Tribal Territory, exempt from the national laws of Pakistan, have preserved their tribal society virtually intact to the present. The others, who dwell in the eastern and southern provinces of Afghanistan and the "settled districts" of Pakistan, have been affected to some extent by "civilized" culture, represented by the Pathan cities of Peshawar, in Pakistan, and Kandahar and Jalalabad, in Afghanistan.

The Pathans and the Northwest Frontier area in which they live first became popularly known in the West through the writings of Rudyard Kipling. Kipling had little regard for many of the peoples of India, but he loved the Frontier and glorified the Pathans for their love of battle and high sense of honor. It was for them he made the exception to his rule that ". . . never the twain shall meet":

"But there is neither East nor West,
Border, nor Breed, nor Birth,
"When two strong men stand face
to face, tho' they come from the
ends of the earth."

Long before Kipling "discovered" the Pathans, they were known throughout Asia for their fierce courage and fanatical devotion to *Pukhtunwali*, the "Way of the Pathan." This devotion remains as strong as ever today, and, whatever differences in taste or outlook may continue to exist among the various clans, they are decidedly one in their strict observance of their home-grown code of honor.

Mr. Spain first met the Pathan as a Foreign Service officer; later, he studied the Afghanistan—Pakistan border as a Ford Foundation fellow. He is writing a book about the frontier.

The code has three commandments: *badal* — revenge, regardless of cost; *melmastia* — unlimited hospitality for all comers, Pathans or strangers; and *nanawati* — sanctuary for all who claim it, friends or foes.

The greatest of these is *badal*. The obligation to take revenge for every insult to the honor of the individual or family rests heavily on Pathan graybeard and child alike. It has left its mark on the countryside in family feuds, carried over generations, and so desperate in intensity as to make the Hatfields and the Coys look like half-hearted schoolboys. *Badal* is the stuff from which the tales of high chivalry are made — and they are told whenever Pathans gather together.

Just after the freedom and partition of British India in 1947, the Pathans invaded Kashmir and touched off a bloody struggle which lasted more than a year before the United Nations could succeed in arranging a "cease-fire." They still clamor to return. Why? "We must go back because we lost men there and they have not been avenged," explains an Afridi chief-

On the long trek from its summer ranges in Afghanistan, this *powendah* caravan, *above* and *left*, rests by the roadside in the Kurram Valley. The rough timbers, beside the camels, will be sold to provide funds for winter.

STRATEGIC POINT, WHERE THE NARROW HIGHWAY ENTERS MALAKAND PASS, IS GUARDED BY WATCHTOWER, [CENTER].

tain. "We came home when the Pakistan Government said all would be well, but it has not been so and we must reclaim our honor."

IN WAZIRISTAN, the fortified houses are connected with the government-guarded road by deep ditches through which the occupants make their entry and exit. The local representative of the Pakistan Government explains that the district is really very peaceful and that most of the old family feuds, which once decimated the neighborhood, have died out.

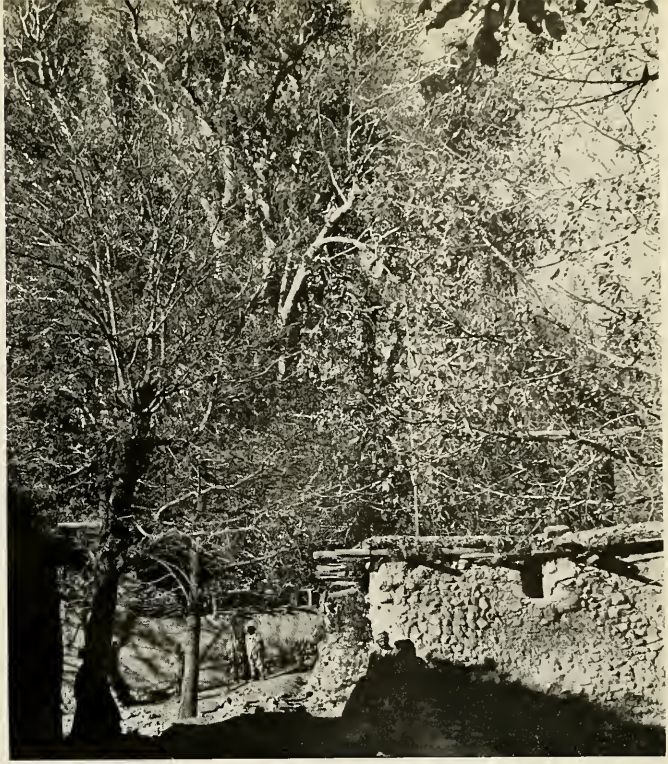
Why then do the tribesmen still use the ditches instead of just coming across the open ground? "Ah, yes," says the official, "they don't shoot at each other from the houses anymore, so it's really not necessary. But if a man were to take to ignoring his ditch and walk boldly in front of his house, his neighbor might feel he held his fellows in low esteem. In that case, honor would require that he be shot at — if only to remind him of his manners."

The high casualty rate that comes from following the "Way of the Pathan" is evident in a government hospital in Waziristan. "About average this week," explains the doctor in charge of the surgical ward. He gestures at the six bearded tribesmen and a young boy, who occupy the beds.

TANT PLAIN MARK PATHAN DWELLINGS.

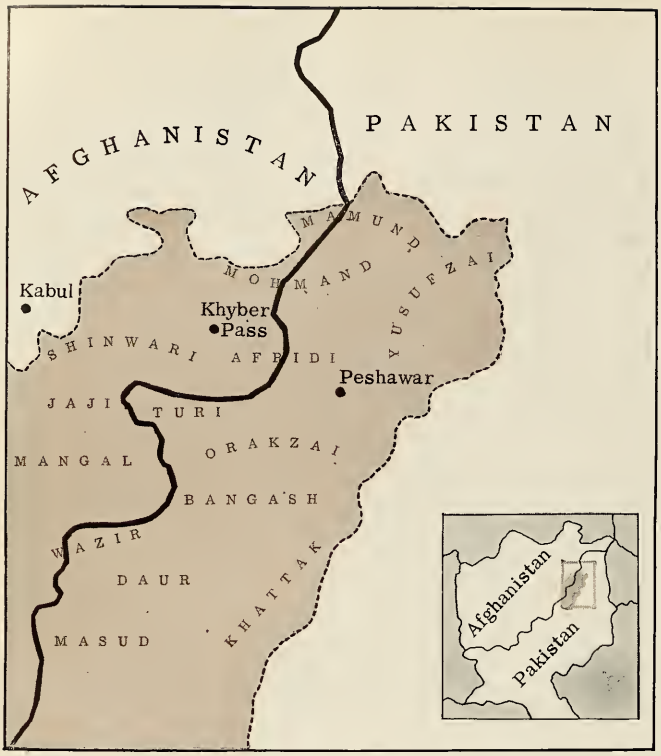
"Six gunshot wounds. All 'accidental'." The patients grin their agreement from their beds. The doctor adds, as an afterthought, "The lad has a broken leg from a fall — also 'accidental'."

Melmastia is a gentler side of the Pathan character. When a visitor arrives, he is greeted with the words "May you never be in need." He then replies "May you never be tired." Hospitality invariably follows.



THE HOUSES of this Kurram Valley village are overtopped by a grove of giant chinar trees, providing a welcome pool of shade in the arid plain.

ARMED ESCORT is a routine for this Pathan landlord, *center*, pointing out his domain to visitor. To omit guards would be thought overly proud.



PUSHTU SPEAKERS' geographic range and major clans are outlined above.

FIRST LOVE of the Pathans is a rifle. Village gun factories, such as this one near Kohat Pass, manufacture respectable imitations of standard Western arms. This ancient smith is turning a barrel on a primitive lathe.

Among the poorer tribesmen, *melmastia* means more than equal sharing of the host's meager possessions. It involves turning over all there is to the guest. What was to have been the week's supply of wheaten flour and meat is expended on a repast of round, flat loaves and spicy *kabobs*. The thin blanket that wraps the host's shoulders is laid over the bed of the guest no matter how thick and heavy is the bedding he has brought with him, and the life of anyone who harms or insults a guest would be forfeit.

The hospitality of a chieftain is more elaborate, but no less intense. A fat-tailed sheep is killed for a feast. Kinsmen and retainers are called in to sit with the guest and do him honor. If the visitor is a foreigner, he may be given a locally-made gun or dagger to wear on his person as a sign that he is the chief's guest and, hence, as inviolable as the honor of his host throughout the land of the Pathans.

This extreme hospitality is sometimes embarrassing to the foreigner. The Pathan, however, when away from his own home, accepts it as a right. He is aware that any attempt to restrain it comes perilously close to derogating his host's honor. Anyway, he is not a humble man and sees nothing unusual in being fussed over. He will return the compliment when circumstance permits and, if he should hate or distrust his guest, the greater his effort will be.

Practically every village has a *hujra* —a guest house—and every visitor, great or humble, stops there. The *hujra* also serves as a kind of social club. The men of the village gather there in the evening to talk politics and exchange gossip. Since many *hurjas* now have radios, which bring the "Voice of America," the B.B.C. and Radio Moscow (as well as Radio Pakistan and Radio Kabul) into the Pathan hills, the conversation can range all over the world for topics. The guest shares in this and in the *chelum*, the crude water pipe which passes from man to man. When finally he goes on his way, he is followed by a chorus of voices bidding him, "*Pa muka deh ka*"—"May goodness go before you!"

Nanawati, the right of sanctuary, is inviolable even in the poorest Pathan hut. Sanctuary can be claimed by anyone, and the protector has to defend his bitterest enemy as vigorously as his dearest friend. Once the refugee has voluntarily left the premises, how-

GUN FACTORY'S outdoor salesroom is seldom without customers, who will make several days' journey to bargain for—or merely look at—a rifle. Weapons hanging on wall are homemade versions of former British infantry arm, the Enfield .303. Their price—$90—represents two years' cash income for average Pathan.

ever, his erstwhile host may set out in a deadly pursuit quite as enthusiastic as his previous protection.

The "Way of the Pathan" is interpreted by *jirgas* or assemblies, which also act for the community on broader civil problems. In some clans, all adult males take part; in others, only the elders and chieftains. In either case, the *jirga* is accepted as the voice of the community, speaking to its own members and the outside world.

A *jirga* is always picturesque. It may be a solemn convocation of chieftains of all clans, assembled on Government House lawn in Peshawar to discuss a new international policy with the prime minister of Pakistan; or it may consist of a few tribesmen, squatting by the side of a dusty road in Waziristan, telling the local government official that they cannot be expected to stop the hot-headed young men of their clan from cutting down the telephone cables to make bullets, unless the government supplies them with the real article.

THE PATHAN'S great love is guns. He has been smuggling them in from the Persian Gulf, stealing them from the British Army, and making them himself for more than a hundred years. As a result, there are today, at a conservative estimate, at least half a million modern rifles (the Enfield .303 or its equivalent) in the Pakistan tribal area. This number is increasing daily, as a dozen little factories, scattered through the hills, turn out new weapons with astonishingly primitive equipment.

This imposing armament is used primarily within the border tribal area to implement the dictates of *Pukhtunwali* and to settle the Pathans' private

WATER IS LIFE'S BLOOD among the barren hills and dry plains of the tri region. *Top*, the Kabul River flows down from Afghanistan, to tumble out of hills into the Peshawar Valley. A major dam is being built here, under Colon

quarrels over *zar, zan* and *zamin* (gold, women and land). However, in 1929, the tribes used their guns to put a new king on the throne of Afghanistan. In 1937–38, in Waziristan, they mounted a full-scale war against almost 50,000 regular troops of the British Indian Army. In 1947, more than 100,000 tribesmen swarmed into Kashmir and, for a brief time, held their own against picked troops of the Indian Army and the Indian Air Force. At the moment, the Frontier is quiet, but it will be years before administrators in Afghanistan, Pakistan and India can rule out the chance of another such exploit.

IN OTHER ways, however, the Pathans are selecting what they want of the twentieth century. Schools and hospitals are beginning to appear in the hills, and at Warsak, a few miles from the Khyber, a crew of Canadian engineers, aided by thousands of tribesmen, are placing a huge dam across the Kabul River.

The old city of Peshawar grows more cosmopolitan as the years go by, without losing any of its Central Asian charm. In the great central square, a crowd gathers around a *hakim* who is demonstrating his medicines "guaranteed to cure all the ills of man." "The wise need not fear King Cobra," he says. "I offer you safety for life." He smears a brown paste on his wrist and permits the cobra to strike him.

The crowd holds its breath. One of its ragged members turns to pass a friendly remark. With a glance of only mild surprise at seeing a Western foreigner next to him, he says something pleasantly casual in Pushtu. A college student nearby translates.

n auspices. *Center*, the Swat Canal brings a thread of vital water out onto flat farmlands. *Bottom*, a modern hydroelectric plant has been built among stony hills that lie below the Malakand Pass, forty miles above Peshawar.

BAZAARS OF PESHAWAR are filled with sights to delight Pathan visitors. In the central square, *above*, a bearded doctor hawks his nostrums. *Below*, dealer in snake-bite remedies sets the stage for an active demonstration.

"He says that he does not think the Hakim Sahib will die, but that sometimes these doctors make mistakes, and that would be well worth seeing."

The fame of Peshawar's bazaars is at least a thousand years old, and they are still piled high with exotic merchandise: red and gold slippers, brass and copper vessels, enameled daggers, golden turbans and all the multicolored spices of the East. The dazzling white of the minarets of the great mosque of Mahabat Khan is reflected on earrings and bangles in the dusky street of the silversmiths. Save for the maze of electric wires overhead, and an occasional tin can in the gutter, Tamerlane might ride by once again and not notice the passage of five centuries.

Along the crumbling walls of the city nestle the ancient *serais*, where once the great caravans from Bokhara, Samarkand and Kashgar unloaded. Now many of them are garages. In one, the only hint of former glory is a tattered, snow-leopard skin, hanging on the wall above a grimy schedule of the Afridi Bus Line. A twinkling-eyed old man, patching a tire, explains: "A caravan brought it long ago from the mountains of China. All that is gone now," he adds, "but it is no matter. Buses are much faster."

Each fall, hundreds of thousands of nomads — most of them Ghilzai Pathans from Afghanistan, known locally as *powendahs* — come down into the valleys and plains of Pakistan, seeking food and shelter from the bitter winters of their own country. Whole villages move together. Marriages are made, children are born and old people die on the road. The migrants are poor and bring only a few hides or rough timbers with them to trade in the Pakistani markets.

The *powendahs* constitute a heavy, additional drain on Pakistan's scanty food supply. Why are they allowed to cross the international boundary? A young Pathan official of the Pakistan Government, a Cambridge graduate, fellow of London's Inner Temple, provides an answer. "Why should we stop them? They are our own people, aren't they?"

This, too, is *Pukhtunwali* — the "Way of the Pathan."

MILLENIUM-OLD Peshawar was once caravan crossroad. The old man, sitt this chance shaft of sunlight, would looked much the same in Tamerlane

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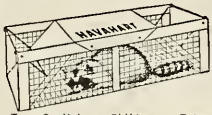

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REVIEWS *continued from page 510*

work is *Cottontail Rabbit*, by Elizabeth and Charles Schwartz (HOLLIDAY HOUSE). The book is more than the biography of a single animal, for it discusses the cottontail's habitat in all its range and interrelatedness; $2.50, 46 pp.; *age* 6–9.

Animals of the field and furrow are treated in two pleasant books: *Moles and Shrews*, by Charles L. Ripper (WILLIAM MORROW); $2.50, 64 pp.: *age* 10–14; and *Mice at Home and Afield*, by Olive E. Earle (WILLIAM MORROW); $2.50, 64 pp.; *age* 8–12).

Moving on to the insects, we should note one general book—*Insects–Hunters and Trappers*, by Ross E. Hutchins (RAND MCNALLY; $2.95, 96 pp.; *age* 10 *and up*) as well as two detailed studies of these fascinating creatures: *Insect Engineers, the Story of Ants*, by Ruth Bartlett (WILLIAM MORROW); $2.75, 128 pp., *age* 8–14); and *Praying Mantis*, by Harriet E. Huntington (DOUBLEDAY); $2.00, 45 pp.; *age* 8–12.

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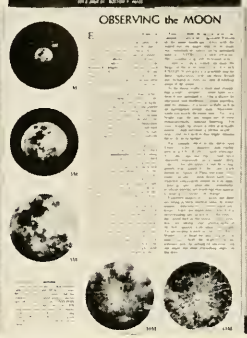

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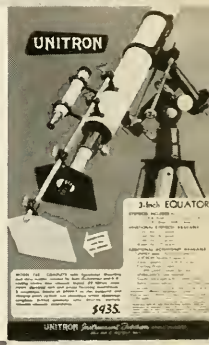

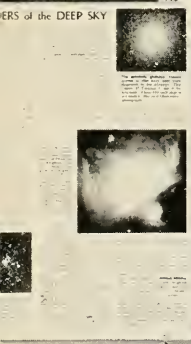

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CARR, ARCHIE, and GIOVANNOLI, LEONARD. The ecology and migrations of sea turtles, No. 2. NOVITATES, No. 1835, 32 pp., 13 figs., 6 tables (June).

DEICHMANN, ELISABETH. The littoral holothurians of the Bahama Islands. NOVITATES, No. 1821, 20 pp., 71 figs. (March).

ELIAS, HANS, and SHAPIRO, JACK. Histology of the skin of some toads and frogs. NOVITATES, No. 1819, 27 pp., 39 figs. (March).

—and BORTNER, SEYMOUR. On the phylogeny of hair. NOVITATES, No. 1820, 15 pp., 31 figs. (March).

EMERSON, WILLIAM K., and PUFFER, ELTON L. Recent mollusks of the 1940 "E. W. Scripps" cruise to the Gulf of California. NOVITATES, No. 1825, 57 pp., 2 figs., 1 table (April).

FORD, JAMES A., and WEBB, CLARENCE H. Poverty Point, a late archaic site in Louisiana. ANTHROPOLOGICAL PAPERS, vol. 46, P. I, pp. 1-136, 45 figs., pl. 1-6, 9 tables, $2.00.

GOODWIN, GEORGE G. A new kinkajou from Mexico and a new hooded skunk from Central America. NOVITATES, No. 1830, 4 pp. (May).

HOWDEN, HENRY, and VAURIE, PATRICIA. Two new species of *Trox* from Florida (Coleoptera, Scarabaeidae). NOVITATES, No. 1818, 6 pp., 3 figs. (February).

HYMAN, LIBBIE H. North American Rhabdocoela and Alloeocoela, No. 6. A further study of *Mesostoma*. NOVITATES, No. 1829, 15 pp., 17 figs. (May).

LABERGE, WALLACE E. The genera of bees of the tribe Eucerini in North and Central America (Hymenoptera, Apoidea). NOVITATES, No. 1837, 44 pp., 42 figs. (June).

LEVI, HERBERT W. The spider genera *Enoplognatha*, *Theridion* and *Paidisca* in America north of Mexico (Araneae, Theridiidae). BULLETIN, vol. 112, art. 1, pp. 1—124, 421 figs., 41 maps, $1.75.

LINSLEY, E. GORTON. Descriptive and synonymical notes on some North American Cerambycidae (Coleoptera). NOVITATES, No. 1828, 21 pp. (April).

MARTIN, CHARLES H. A revision of the Leptogastrinae in the United States (Diptera, Asilidae). BULLETIN, vol. 111, art. 5, pp. 343-386, 55 figs., $.75.

MAYR, ERNST. Notes on the birds of northern Melanesia, No. 4. NOVITATES, No. 1823, 14 pp., 6 figs., 2 tables (March).

MCDONALD, W. A., and HOGUE, C. L. A new *Trithyreus* from southern California (Pedipalpida, Schizomidae). NOVITATES, No. 1834, 7 pp., 10 figs. (June).

MCDUNNOUGH, JAMES H. Synonymic and biological notes on Coleophoridae (Lepidoptera). NOVITATES, No. 1827, 4 pp., 2 figs. (April).

MOORE, JOSEPH CURTIS, and WOOD, F. C., JR. Differences between the beaked whales *Mesoplodon mirus* and *Mesoplodon gervaisi*. NOVITATES, No. 1831, 25 pp., 5 figs., 2 tables (June).

RABB, GEORGE B., and HAYDEN, ELLIS B., JR. The Van Voast-American Museum of Natural History Bahama Islands expedition. Record of the expedition and general features of the islands. NOVITATES, No. 1836, 53 pp., 15 figs., 3 tables (June).

RUCKES, HERBERT. The taxonomic status and distribution of *Thyanta custator* (Fabricius) and *Thyanta pallidovirens* (Stal) (Heteroptera, Pentatomidae). NOVITATES, No. 1824, 23 pp., 1 fig. (April).

SIMPSON, GEORGE GAYLORD, and DE PAULA COUTO, CARLOS. The mastodonts of Brazil. BULLETIN, vol. 112, art. 2, pp. 125—190, 11 figs., pl. 1—23, 13 tables, $2.25.

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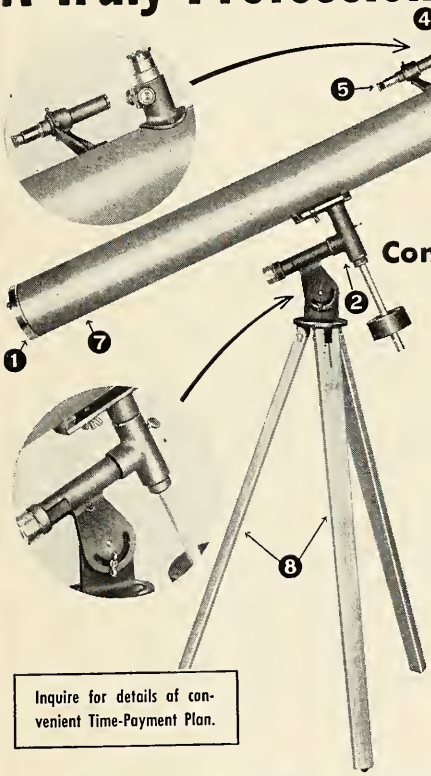

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