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THE NATIONAL GEOGRAPHIC MAGAZINE

Honolulu, Mid-Ocean Capital

Oriental and Western Ways Blend Harmoniously in Hawaii's Metropolis, Center of Industry, Bastion of Defense, and Tropic Playground

BY FREDERICK SIMPICH, JR.

With Illustrations by National Geographic Photographer B. Anthony Stewart

FACING the world with a bronzed South Seas smile and a welcome of flowers, Honolulu is better known for its hula dancers and surf than for its industries and institutions. But factory smoke as well as guitar music rides the trade winds. For every tourist in a coconut hat there are 20 housewives getting junior off to school.

Like Denver, Colorado, Honolulu is the metropolis of its dominion, and, like Phoenix, Arizona, it is a booming resort town as well as a center of finance and government. It is the only capital now under the United States flag that has been bombed by enemy planes, and the only one where legislators meet in the former throne room of a royal palace (page 594).

From Grass Shacks to Great City

Settled on the site of a Polynesian village known as Kou after trading skippers discovered its excellent harbor in the 1790's, Honolulu is older than most State capitals. Only seven exceed its 248,000 population, which ranks it behind Providence, Rhode Island, as our 44th city in size. Twenty-three states have no city so large.

This capital's mid-ocean domain, Hawaii, includes more than 100 named islands and rocks, only seven of them inhabited, with a total land area of 6,407 square miles (map, page 582).

Picture this place. Some 2,400 miles southwest of San Francisco—10 hours' flight over clouds and water—Honolulu is a shawl draped from the shoulders of Oahu Island's Koolau Range. The city began on the lee and dry southwest side of the sheer 3,000-foot mountains.

Working its way from a cluster of grass shacks that hugged the harbor, Honolulu grew across a narrow coral plain to the cliffs, fingered its way up the valleys and the lesser heights. Then it crawled along the plain and beaches toward famed Waikiki and Diamond Head at one extreme, Pearl Harbor at the other (pages 614 and 615).

In my 20 years here these lee slopes have proved not enough. Now the city spouts through a narrow 1,186-foot mountain pass to the windward, where 11,000 suburbanites live in the communities of Kaneohe, Kailua, and Lanikai.

My first view of Honolulu was at night, from the deck of a freighter. Then, as now when flying in at dusk, I could trace the city's

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The Author

For 40 years the Simpich name has been a familiar one to members of the National Geographic Society. Frederick Simpich, Sr., Assistant Editor from 1927 until his death in 1950, wrote 90 articles for the NATIONAL GEOGRAPHIC MAGAZINE during his 36 years as a contributor and member of the staff.

Frederick Simpich, Jr., his eldest son, has written six previous NATIONAL GEOGRAPHIC articles including two on the Hawaiian Islands, his home for 20 years.

Waikiki's Golden Sands, Silver Surf, and Blue Skies Lure Bathers the Year Round

A 2-mile beach begins at Diamond Head and ends beyond the coconut groves of the Royal Hawaiian Hotel (background). The avenue borders reclaimed marsh land. Ocean temperatures average 75° F.

579 Kodachrome by National Geographic Photographer B. Anthony Stewart

Kalakaua Avenue, Honolulu's Play Street, Was Named for a Former Playboy King

Hotels, restaurants, theaters, and shops line palm-shaded sidewalks (page 601). Navy uniforms, aloha shirts, and bathing suits splash the avenue with color. This part of Waikiki is called Kuhio Park.

caterpillarlike convolutions along the shore and up the valleys by the dancing lights that mark where men have built. But by day the design is lost, as palms and hedges blend the city with the verdure of the mountains.

If some cities have a distinctive color, Honolulu's is green. The coral plain that supported only grass and dust back in 1795 is a vast garden now. Trade winds blow massed Pacific clouds against the mountains, which tap them for their rain. Pumps draw additional water from a rich artesian basin to serve the city's needs. Trade winds keep Honolulu cool, despite its tropic latitude. Temperatures average 75° F. the year round and seldom range beyond the 65° to 85° bracket.

But it was not the benign climate that drew most of Honolulu's citizenry. Of the 275,000 in the metropolitan area, less than a quarter can claim deep roots here. These are the fast-disappearing full-blooded Hawaiians and the *haole* (Caucasian) descendants of early missionaries and traders. The rest came largely in waves of immigration induced by the labor needs of sugar planters.

The Chinese were first, beginning in the 1850's. Their blood now runs in about 10 percent of Honolulu's people. Between 1877 and 1890 came the Portuguese; then, in 1885, the Japanese. These latter with their descendants now number a third of the population. Next were the Filipinos, beginning in the early 1900's.

Chinese Leave Fields for City

Whereas the Chinese have left the plantations to become merchants and professional people in town, and the Japanese are in midpassage, the Filipinos have yet to invade the city in numbers.

The rest who live here, some 60,000, are largely haoles who came for various reasons and, wooed by climate and opportunity, remained as teachers of Western ways to the newcomers from the Orient.

Honolulu has a simple parlor game called "How did you get here?" Guests tell their story in turn. Thus I learned that G. W. Sumner, president of one of Honolulu's big businesses, came first as a young naval ensign, and resigned from the service because he loved the place. President Eisenhower's new High Commissioner for the Trust Territory of the Pacific Islands, Frank E. Midkiff, arrived here 40 years ago to teach school.

Katsumi Kometani, chairman of the Commissioners of Public Instruction, asks, "Where else in one generation can you move from immigrant field hand to head of the school system?"

Biggest Business: Serving Uncle Sam

The city's biggest business is serving Uncle Sam. The military has its focus in the office of the Commander in Chief, Pacific—CINCPAC to the Navy. His oblong concrete headquarters, overlooking Pearl Harbor, resembles a landlocked ship, with its tiers of open porches like decks and its radio towers resembling masts. From here Admiral Chester W. Nimitz guided our Pacific forces in World War II, and from here today the administration and supply of the Pacific Fleet are directed as far forward as Korea and Japan.*

Under unification of the services, CINCPAC also coordinates the activities of Army, Navy, and Air Force in and about Honolulu.

"What do the services do that makes them so important to the economy of Honolulu?" I asked Admiral Felix Stump, CINCPAC as this is written.

"Basically, provide jobs, more than 20,000 of them last year," he said, "and buy goods and services. Ship repair, airfield construction, operation of the Honolulu terminals of the Military Air and Sea Transport Services—all these things mean work and money for the city."

"The sugar industry," I said, "earned about $140,000,000 last year. That's the biggest private business here. How much did the military spend?"

"More than a quarter of a billion dollars," the admiral answered. "That much went for wages and lumber for barracks, asphalt for runways, and provisions for ship and shore messes. It doesn't reflect casual spending by the thousands of transient military personnel moving to and from the Far East."

Tourists are big business, too. By boat and plane 78,000 came to Honolulu last year. The Hawaii Visitors Bureau, jointly financed by business and government, spends more than half a million dollars a year publicizing island charms. In 1953 tourists spent $41,600,000 in Honolulu. This means countless

(Continued on page 586)

* See "Our Navy in the Far East," by Admiral Arthur W. Radford, NATIONAL GEOGRAPHIC MAGAZINE, October, 1953.

Kodachrome by National Geographic Photographer B. Anthony Stewart

Honolulu's Melting Pot Bubbles. Happy Faces Flash a Map of the Pacific

University of Hawaii students show the islands' dominant racial groups: Caucasian and Hawaiian (standing); Filipino, Chinese, Japanese, and Korean. Hawaii's flag incorporates the British Union Jack.

Hawaii's Busy Capital Is Hub of the Mid-Pacific

Honolulu is larger than all but seven State capitals, and the city covers more ground than any seat of State government. Seventy percent of the 499,700 islanders live on Oahu. In land area the islands would make five Rhode Islands, but only 1/40th of Texas. Residents pay more Federal taxes than the people of half a dozen States. Distant Midway (not shown) belongs to the archipelago geographically but not politically.

O A H U

Kahana Bay
Kahana
Kaaawa
Kahana Stream
Kamehameha Hwy
Mokolii Island
Moli'i Pond
Kualoa Point
Kaaumakua Peak
Waikane
North Fork Kaukonahua Stream
Wahiawa
South Fork Kaukonahua Stream
Schofield Barracks
Wheeler Air Force Base (Closed)
Waiahole
Waiahole Stream
Kamana Peak
Kahaluu
Waiawa Stream
Waiaholo Stream
Waiaholo Stream
Kawipoo Peak
Waiawa Stream
Kunia Road
Waiawa Stream
Kamehameha Highway
Waimalu Stream
Keahiakahoe Peak
North Halawa Stream
Waipahu
Pearl City
Lake Eo
Middle Loch
East Loch
Aiea
Red Hill
Moanalua Stream
West Loch
Pearl Harbor
Lake Hamalom
Ford Island
Naval Air Station (Closed)
U.S.S. Arizona
Moanalua Golf Course
Tripler Army Hospital
Waipio Peninsula
Salt Lake
Naval Base
Halawa Stream
Ewa Plantation
Hickam Air Force Base
Honolulu International Airport
Kamehameha Schools
Bishop Museum
Oahu Country Club
Papukolea Stream
Nuuanu
Ewa
Marine Corps Air Station (Closed)
Honolulu
Pineapple Canneries
Foster Gardens
Nat. Mem. Cemetery of the Pacific
Hongwanji Temple
Punchbowl
Ewa Beach
Keahi Point
Honolulu Harbor
Iolani Palace
Punahou School
Keehi Lagoon Seaplane Base
Kawaiahao Church
Academy of Arts
Hawaiian Sugar Planters' Assn. Exp. Station
Honolulu Stadium
Kewalo Basin
Ala Moana Park
Ala Wai Canal
Ala Wai Yacht Basin
Royal Hawaiian Hotel
Waikiki
Kuhio Park
Zoo
Aquarium
Natatorium
Kapiolani Park

Mamala Bay

Pacific

0 1 2 3 4 5 6
STATUTE MILES

Drawn by Robert C. Ellis, Jr. and Irvin E. Alleman

Main Hawaiian Islands

Westward, the archipelago embraces more than twenty small islands and rocks, uninhabited except for Midway. The westernmost island is Kure, 1,200 miles from Niihau.

Kauai
Niihau
Kauai Channel
Oahu
Lihue
4046
Honolulu
Kaiwi Channel
Molokai
Lanai
Maui
Wailuku
Haleakala Crater
10023
Kahoolawe
Alenuihaha Channel
Pacific Ocean
Mauna Kea
13784
Hilo
Hawaii
Mauna Loa
13680
Kilauea Crater
4090
0 25 50 100
STATUTE MILES
160°
154°
20°
22°

P a c i f i c

O c e a n

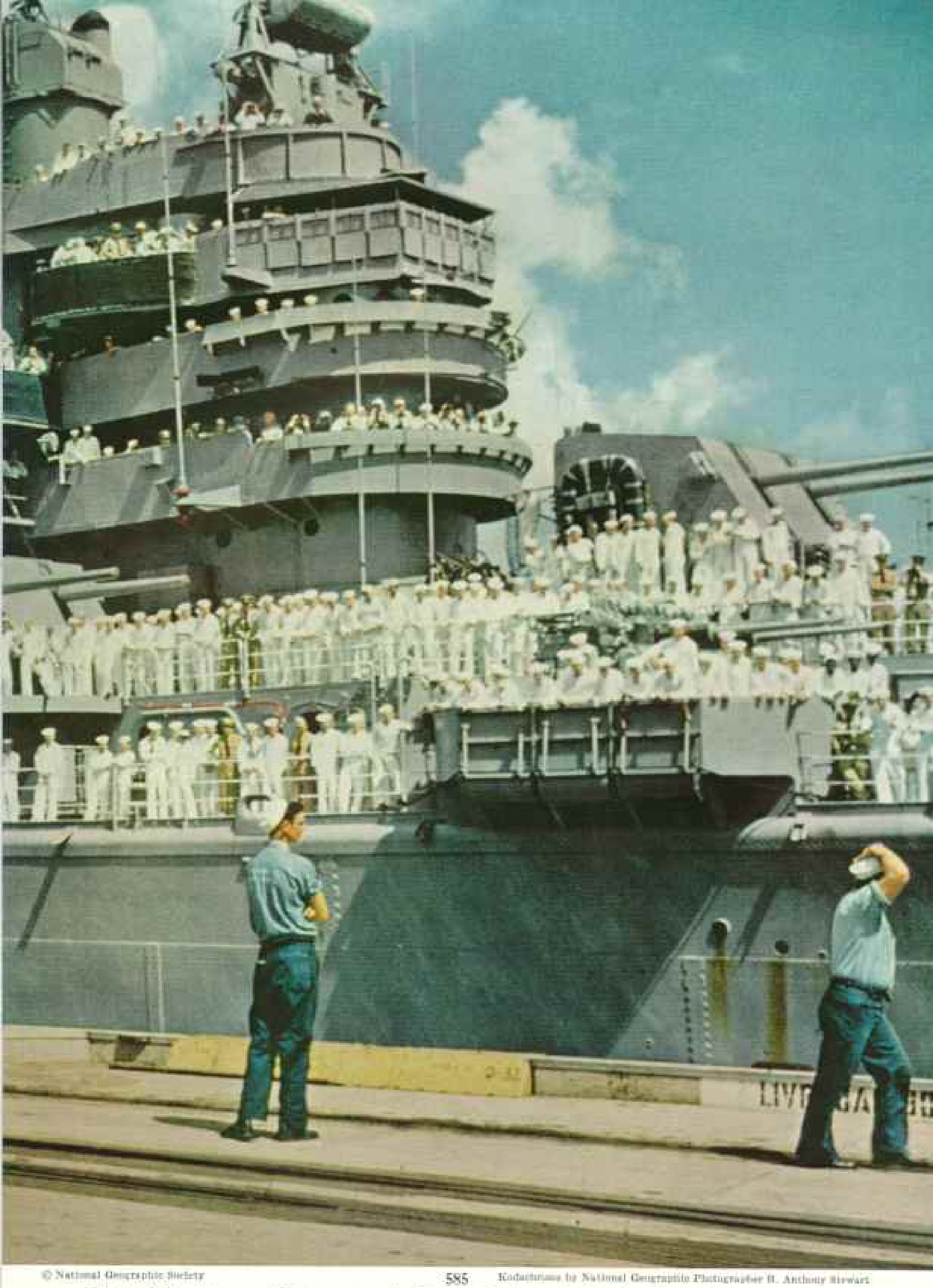
n e o h e

B a y

Moku Manu
Pyramid Rock
Mokapu Point
Marine Corps Air Station
Mokapu Peninsula
Mokuo Loe (Coconut Island)
Heeia
Mokapu Point
Mokolea Rock
Kaneohe
Coral Gardens
Kailua Bay
Kalama
Kawainui Swamp
Kailua-Lanikai
Mokulua Islands
Kaelepulu Pond
Nuuanu Pali
1186
Reservoir No. 4
Konahuanui Peak
Olomana Peak
1643
Bellows Air Force Base
Waimanalo Bay
Waimanalo
Waimanalo Beach
Manana Island (Rabbit Island)
Kaohikaipu Island
Makapuu Point
Manoa Valley
Palolo Valley
Univ. of Hawaii
Kulioouou
Koko Crater
Kuapa Pond
Nuu
Kalanianaole Hwy.
Kaimuki
Ala Wai Golf Course
Wailupe
Maunalua Bay
Koko Head
644
Hanauma Bay
Kahala
Kupikipikio Point
Diamond Head
Kaiwi Channel

P a c i f i c

O c e a n



Kodachrome by National Geographic Photographer B. Anthony Stewart

Hula Girls Dance a Welcome to the Heavy Cruiser *St. Paul*. Shore Leave Begins

Dancers meet ships at Honolulu and Pearl Harbor. Hibiscus adorn these girls' hair; leis wreathe their necks. Feathered gourds shake out a rhythm to ukulele music.

jobs for laundrymen and cab drivers, flower vendors and musicians.

Tourist money finds its way throughout the city. No one takes more pictures than tourists, unless it is men in uniform. Honolulu sidewalks are jammed with both, camera-laden. The large beach hotels employ more than 2,000 people. Some 300,000 leis, the flower garlands of the islands, are sold each year, bringing in half a million dollars (page 588).

With airlines offering coach fares as low as $250 plus tax round trip from San Francisco and Los Angeles, and commercial jet flights from Vancouver promising a 6-hour flight from the mainland, no one knows the limits of this tourist trade. It will remain small in comparison to California's and Florida's, however, until more hotels are built. So crowded is this city that local courts once declared two mistrials—because no hotel had room for juries overnight!

Sugar and pineapple are the less dramatic but dependable backbone of Honolulu's economy. Honolulu's little Wall Street, called Merchant, is short and narrow (page 618). From its solid, squat buildings is directed Hawaii's annual production of 1,000,000 tons of sugar—one-eighth of United States needs—and some 29,500,000 cases of pineapple products—nearly three-fourths of the world's processed pineapple.*

The Island of Oahu itself produces about one-fifth of this sugar, which is shipped from Honolulu docks. Most of the pineapple is brought by barge and truck to three big canneries in the city's industrial district. The Dole cannery, world's largest fruit-packing plant, alone employs 5,500 during the season (page 608).

Imported Oil Provides Power

Power to run Honolulu factories and trolley buses and light its neon barbecue and *saimin* (meat and noodles) stands comes from oil, 5,250,000 barrels of it each year, tanker-borne from west coast ports. Leslie Hicks, University of Hawaii-educated president of the Hawaiian Electric Company, Ltd., looks to a promising future. "Honolulu," he says, "will have a million people some day. And to save all that oil for other useful purposes we will probably turn to atom power."

Banks set up branches to serve needs peculiar to each district. The Bishop National Bank's branch at Waikiki offers drive-in service and girl tellers in Hawaiian-style beach clothes who cash checks drawn on Des

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Moines, Nashville, or Yonkers, beneath Jean Charlot's colorful mural of Hawaiian history (page 603).

W. O. Cogswell, head of the Visitors Bureau, studies travel trends and finds time, too, for staging such stunts as an annual snowball fight at Waikiki, flying in snow from the Island of Hawaii for the occasion. I asked him the size of the transportation business.

"Boats bring us nearly 500 people a week," he said, "and our airport is always busy. There are 800 seats on scheduled flights to and from the west coast each day, and often extra sections. There is a Stratocruiser a day to the Orient, and frequent service to Sydney, Australia."

This talk of the airport recalled the grim contrasts presented there during the Korean War. Regular commuters to the west coast and expectant tourists muted their laughter as khaki-clad replacements filed through, board-

* See "Because It Rains on Hawaii," by Frederick Simpich, Jr., National Geographic Magazine, November, 1949.

Fires Set by Torch Speed the Sugar-cane Harvest by Consuming Leaves and Trash

Workers used to lay bare the stalks by hand. An accident proved that flames could remove useless foliage; juicy stems are not harmed if cut immediately. Singeing of the cane sends flames leaping 50 feet; smoke mushrooms like atomic clouds. Bulldozers clear firebreaks (foreground) to avert disaster.

ing for Seoul. The open-air waiting room was deathly still when red-robed wounded, Stateside bound, trudged down landing ramps.

Honolulu's productive enterprises include a tuna cannery, a growing garment industry specializing in Hawaiian-style sports clothes, and a packer of macadamia nuts—an Australian delicacy that grows well here.

Harbor Handles Heavy Sea Traffic

The rest of the town works at satisfying the wants generated by all these activities. Shipping is the most important. Honolulu Harbor is more distant from a continent than any other major port in the world. Yet through it yearly move more than two million tons of dry cargo on ocean-going vessels.

Virtually everything the city wears and uses, and much that it eats, must come by sea. Crowded docks remind one how complex life has become. Acres of TV sets shoulder water heaters and automobile tires. Scotch whisky and lubricants are ranged beside linoleum rugs and cleaning tissue. I never knew there were so many kinds of baby food!

All these goods reflect the general prosperity. Boom signs are everywhere. Beachfront land, if you can buy it, brings more than $2 a square foot. Though 23,000 new houses have been built since World War II, more subdivisions are being opened.

Somehow the city supports seven radio stations and 20-odd movie houses where, despite two TV stations, you must stand in line for a chance to see the latest Hollywood releases. The island has 125,000 automobiles, one for every 2.8 persons, compared with the national average of three. Still, freighters bring some 250 more each week.

All these automobiles, the city's narrow streets, and its large Japanese-American population make for tight traffic jams on occasions

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Kodachromes by National Geographic Photographer B. Anthony Stewart

↑ Lei Maker Weaves a Scented Rainbow of Carnations, Orchids, and Tuberoses

Garland making survives as one of the last native crafts among Hawaii's Polynesians. Agnes Makaiwi, head of the Lei Makers Association, here sews 125 carnations into a string to be sold for about $3.

↓ University of Hawaii Coeds Work for May Day's Gala Lei Festival

Honolulu's lei fiesta dramatizes the history of the garland. Children in the pageant play the bamboo pipes by striking them on the ground. Reed baskets serve as purses; flowers substitute for earrings.

important to the Japanese. Worst congestion came on April 8, 1953, when Wesak Day, Buddha's birthday, was followed by the arrival of Crown Prince Akihito the next morning.

In a crowded hotel lobby, awaiting Prince Akihito's entrance, a twittering woman tourist asked a photographer of Japanese descent, "How do you say 'aloha' in Japanese?"

He answered, "Aw, lady, I wouldn't know."

So Honolulu's personality is nevertheless American—a baby Boston with a bit of Los Angeles thrown in.

Most people have jobs you would find anywhere—insurance salesmen, car washers, bus drivers, and bus boys. But certain occupations brought here from the far corners of the Pacific survive.

Some Oriental Ways Persist

On crowded Bethel Street aged Chinese dart between parked cars, their backs stooped under laden carrying poles in the centuries-old posture of coolies. In open-front shops off River Street deft Japanese hands roll moist rice around a core of carrots and water cress and wrap it in a skin of seaweed to make the bland *sushi*.

Here, too, newly arrived Filipinos can find better educated countrymen who serve as professional letter writers. Thus they report back home to Luzon or Mindanao on life in paradise.

Each day Diesel-powered sampans put out for fish from Kewalo Basin (page 617). Nisei crews are American in dress and manner. They make their meals from choice sirloin, washed down with soda pop. But when they sight circling birds that tell of tuna, they wrap themselves in the padded kimonos and broad straw hats of Kagoshima and Sendai for protection from flying hooks and hot sun. Cruising with them one day, I could see no difference between them and fishermen I'd seen at work in Japan.

Some Polynesian jobs survive as well. No one has been able to mechanize the tedious stringing together of blossoms that go to make a lei. And the throw net is still best for fishing flat offshore reefs (page 622).

One night my wife and I watched a fisherman stalk with such a net. In one toss he enmeshed nine wriggling mullet, all of them two pounds or better.

People of this polyglot city follow most Western patterns in their homes. Search River Street's crowded tenements or the coast around Diamond Head—the house without a mechanical refrigerator or inner-spring mattress is rare. The only grass shacks you find are in museums or night clubs, where they make cozy quarters for dining tourists. Until someone builds a bridge to California there will be no trailer camps or motels. But scores of families keep house on boats in the Honolulu equivalent, the Ala Wai yacht basin.

Still there is congestion. With Oriental fortitude and candor many families sleep six to a room, with sexes mixed, but make space for a console-type radio or a TV set.

Fortuitously, Honolulu's Chinatown, once known throughout the seven seas for its opium dens and rampant vice, burned to the ground in 1900. This squalor of clapboard shacks near the harbor was replaced by long rows of two-story frame structures, each with a shop on the ground floor, living quarters above. These once orderly blocks are now the city's lowest grade housing. They give way, if reluctantly, to new projects like the Mayor Wright Homes, where 364 lower income families live under Public Housing Administration standards of sanitation, floor area, and park space.

Elsewhere, Honolulu is a city of detached houses, each with its garden. Apartments are few, mostly concentrated at Waikiki, where they are tenanted largely by transient service families, tourists, and newcomers not yet committed to making Hawaii their home.

No Furnaces Needed in Honolulu

The typical Honolulu house is a bungalow of single-wall construction with no basement or attic, and, of course, no need for central heating. Its modest lot is hedged by one of the myriad varieties of hibiscus or the ubiquitous shrub panax.

Curiously, here much residential land is leased. When the European system of land ownership was adopted in the 1840's, vast wedge-shaped segments of the island, running from the mountains to the sea, were awarded members of the royal family, among them daughters later married to canny Yankees who would not let them sell. Honolulu has since stretched across two such segments, now held in trust. But the city is so adjusted to this system that houses on rented land are traded freely.

While residential districts are not socially

Samoans Spice a *Luau* with Fiery Dances and Wild Shouts

The luau, Hawaii's native feast, was once a main fete of village life. Nowadays restaurateurs stage such frolics for paying guests. Diners at Don the Beachcomber arrive for a 5-hour stay, wearing South Pacific garb at the command of their host.

Invited into Tahitian thatched huts, guests sip cool drinks from green bamboo sections and listen to Hawaiian music. At nightfall they gather in the garden to hear a ceremonial chant of thanksgiving over whole pigs cooked on beds of hot rocks (opposite).

For a feast of Hawaii's old-fashioned dishes, the guests sit crosslegged on mats and eat with their fingers. Besides roast pig, the luau's supreme delicacy, they dine on *lomilomi* salmon, raw fish mixed with tomatoes and onions; stewed chicken mixed with taro tops and coconut cream; poi, taro root pounded to a paste; pineapple; baked yams, bananas, and breadfruit.

Later, Samoans, Tahitians, and Hawaiians entertain with dance and song. This pair from the Mormon colony at Laie wear seed-pod skirts for a traditional dance.

Luau Pigs Roast 5 Hours in a Fireless Oven

➔ Hungry guests watch as pigs come from a steaming pit of volcanic rocks.

➔ Cooks stuff hot stones into shoulder pockets of 100-pound porkers. The carcasses are wrapped in ti and banana leaves and buried beneath canvas and sand.

stratified, pioneer families make their homes on the ridges and in the valleys near the center of town. Newcomers, haole or not, seek the beaches and the more distant modern developments. When the city spilled over the mountains during World War II, it was the latest arrivals—defense workers and service families—who led the way.

In 1917 H. K. L. Castle, known in Honolulu equally as a financier and a breeder of working dogs, bought some 13,000 acres at the foot of these mountains as a ranch. It is now becoming an important part of the city.

"But we are not going to build beyond demand," cautious Castle tells me. "We would prefer to see slower, planned growth rather than a boom and a bust that would destroy the savings people have put in these houses."

Older homes, particularly in Manoa Valley, are mainland types—multistoried, with dormer windows suggesting nostalgia for New England. In newer sections houses have picture windows, patios, and open living rooms fashioned after the native lanais (page 602). So many homes have plants growing inside that you are rarely aware of moving outdoors.

Many of the showplaces are owned by mainlanders with names familiar to the social and financial pages. Doris Duke's marble home at the foot of Diamond Head has man-made waterfalls, a private yacht harbor, and a diving board that adjusts to different heights electrically.

Ship Channel Is City's "Main Street"

Small wonder that those who are new here seek the beach. Though swimming may be hampered a bit by coral outcroppings, it offers two of Honolulu's great lures—sun and sand (page 578). Added attraction is the steamer channel that circles off the city. Always active, it is Honolulu's Main Street. Every 12 to 14 days the Matson Lines' white *Lurline* steams by, carrying someone you know. Here aircraft carriers with famous names like *Bataan* and *Princeton* practice launching and landing their jet planes. Busy little tugs ply back and forth, towing barges loaded high with pineapple.

It is a rare day when the sea is not dotted with sport-fishing boats, their outriggers flung high like the antennae of as many crickets. From my beachside lanai I have watched ducks straggling in at the end of their annual 2,300-mile flight from Alaska, waterspouts racing across the horizon, and playful spouting whales cavorting like trout.

Sadly, there is not enough beach front to go round. But every Honolulu home has its garden. With water, everything will grow here. Tuberous begonia with spectacular blossoms, gardenia hedges, driveways lined with orchids are flowering proof.

Surprisingly few flowers that make the city a floral heaven are native. Even the green-leafed *ti* was brought from islands farther south by early Polynesians.

City of Sports Champions

Honolulu plays hard, and produces champions in many sports. Long hours over the fairways of the Moanalua course helped part-Hawaiian Jackie Liwai Pung win 1952's National Women's Amateur Golf Championship. In Nuuanu Valley the Oahu Country Club's 18 hilly holes challenge any golfer's wind.

Just as down-Easters learn to ice skate, anyone born in Honolulu learns to swim. The 100-meter sea-water pool of Honolulu's Natatorium, a memorial to World War I dead, turns out a champion a year. Currently, young Honolulu men hold more than a dozen national and world records. Hawaiian-born Japanese-American Ford Konno, a leading local swimmer, was high individual point scorer among U. S. competitors in all sports at the last Olympic games.

The city's full enjoyment of the sea can't be measured from the record books. Surfboarding, sport of Hawaiian kings, is usually pictured on the gentle rollers off Waikiki (pages 596 and 598). Actually, devotees find better surf at other beaches. Some citified version of the jungle telegraph tells when conditions are right at Makaha or Sunset Beach, where 30-foot waves can thunder in when the wind blows from the northwest. Then cars with surfboards strapped on top speed bronzed surfers to the scene.

Body surfing is a variant of the sport, developed by island boys generations ago. Requiring no equipment, skilled practitioners can belly-ride a hundred yards on the crest of a comber. A favorite spot is off the flank of Koko Head, at the city's eastern end.*

My son, back from college for the summer, enjoys taking visiting friends out for their

(Continued on page 609)

* See "Waves and Thrills at Waikiki," 8 illustrations in duotone, by Thomas Edward Blake, National Geographic Magazine, May, 1935.

593 Kodachrome by National Geographic Photographer B. Anthony Stewart

Chinese-American Girls Gather at a Moon Doorway, Its Form a Symbol of Completeness

Chinese went to Hawaii in 1852 to work in sugar fields; their sons soon entered merchant ranks. Oriental dress to the contrary, these young ladies are thoroughly Americanized.

Hawaii's Representatives Meet in the Throne Room of Iolani, Once the Palace of the Islands' Rulers

Lawmakers like to celebrate opening sessions with music and hula dancing. Kalakaua, Hawaii's last king, sat enthroned beneath the velvet canopy.

← **Torchlike Kahilis, Once Symbols of Royalty, Blaze with Hibiscus Blossoms**

When Hawaii was a kingdom, bird feathers covered the kahili's barrel-shaped top. Flowers decked these standards for last year's inauguration of Territorial Governor Samuel W. King. Croton leaves form the lei.

↓ Students from Kamehameha Schools brandish a Hawaiian spear and dagger before Kukailimoku, war god of Kamehameha the Great, first king of the united islands. Now a showpiece in Bishop Museum, this image once rode into battle, his countenance flushed with feathers of the *ōʻū* and *oo* birds, his eyes flashing with pearl shells, and his mouth grim with dogs' fangs. Feather capes on the youths copy those worn by old-time chiefs. The boy on the right calls himself Kekoalauliionapalihauliulilokekoolau Kaapuawaokamehameha. His first name translates, "The small-leafed koa on the verdant cliffs of the Koolau Mountains." His family name means "The awa cup bearer of Kamehameha the Great."

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Waikiki Breakers Lift Canoes and Surfboards. Riders Start a Thrilling Rush to Shore

Reef formation and curving shore raise long smooth swells unexcelled for surf riding. Hawaii's kings and queens were masters of the sport, using it for gambling as well as recreation.

597 Kodachrome by National Geographic Photographer B. Anthony Stewart

Beach Boys Paddle Outriggers with Such Skill that Even Babies Enjoy the Sport

Many Hawaiians, holding bodies stiff, surf with no board at all. Here the distant rider stands erect. Another (foreground) rides out to catch the next swell. Fourth passenger in the big canoe is an infant.

← **Its Wild Ride Ended, an Outrigger Beaches**

Outriggers, ranging in length from 15 to 40 feet, are hollowed out of single koa logs. Arching timbers connect the hulls to buoyant floats of *wiliwili* wood.

Steering a 1,500-pound canoe requires an athlete's strength. A mature man's muscles qualify the Waikiki beach boy. A master surfboard rider, he commands up to $10 an hour to pose for photographs atop his board.

This Is It! Canoe and Boards Catch the Crest →

Want to ride a Waikiki wave? Then take your surfboard a distance out to sea. When you spot a swell coming, lie stomach-flat on the board and paddle shoreward at top speed. As the wave overtakes you, rise to your knees, then to your feet. Racing with the sea, you feel like a bird—so they say at Waikiki.

Seen from Nuuanu Pali, Storm Clouds Scud Across Koolau Range. The Sun Spotlights Kaneohe

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↑ **Pineapple Halves Are Served as Edible Fruit Bowls at the Royal Hawaiian**

Salad fruits—avocado, banana, tangerine, and papaya—grow in the islands. Twilight darkens distant Diamond Head. Vanda orchids garland the diners, and cattleyas grace the table.

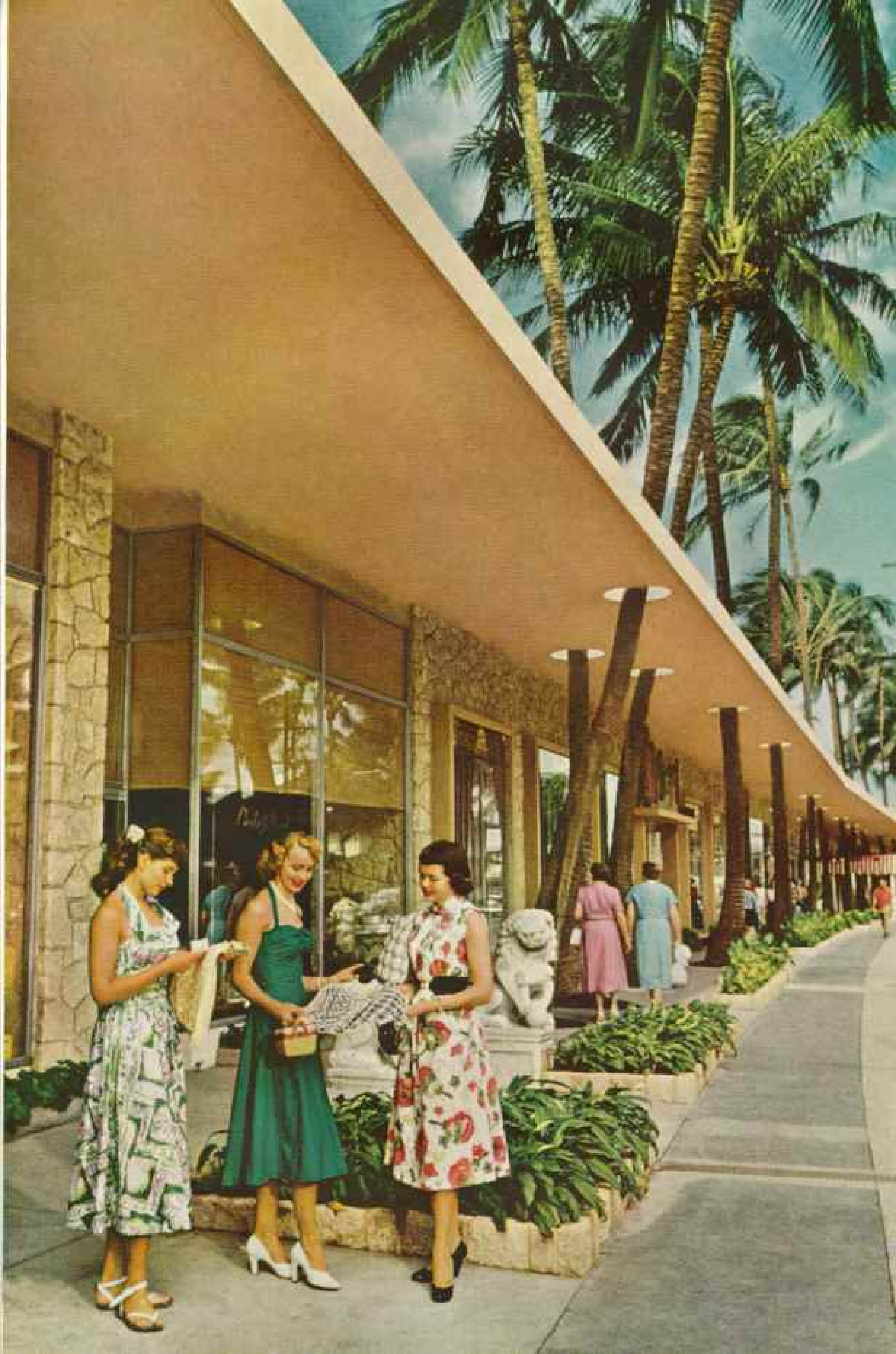
Small and jewellike vandas grow profusely. If counted in all varieties, they are the islands' leading orchid. Vanda leis range from 50 cents to $5, depending on number and variety of blossoms and method of stringing.

← Hawaii's orchid industry garners an average $1,200,000 a year. Aircraft daily fly blossoms to mainland distributors. Shipments sometimes run to 50,000 orchids a day.

These variegated orchids came from the garden of Mrs. Lester McCoy, who owns extensive greenhouses.

→ Kalakaua Avenue's shopping center displays modern fashions alongside venerable Oriental art objects. Shoppers examine mesh bags woven in the islands.

Kodachromes by National Geographic Photographer
B. Anthony Stewart



↑Picture Windows Look Out on a Movie in the Sky: Clouds Adrift Across Koolau Range

During World War II Honolulu's defense workers and military families accelerated the march to suburban living across the mountains. Together with later arrivals, they built ranch-type homes with wide windows to capture the view.

← Banks Do Business in a Holiday Air

Glass wall of Waikiki Branch of Bishop National Bank admits the sight of sun, palms, and flowers. Customers arrive in shorts, sandals, and aloha shirts. A new drive-in service permits motorists at the wheel to make deposits.

Jean Charlot's fresco above the tellers' booths depicts the history of Hawaii's first cultural exchanges with the West. The facing section contrasts the early method of cloth making with that of the newly introduced spinning wheel.

Bank Manager Frank G. Halstead (left) endorses a check for a traveler en route from Indonesia to The Hague.

Pearl Harbor, Powerhouse of the Pacific, Runs on Airfields, Ship Docks, and Supply Depots

Clouds, endlessly banking against the Koolau Range, gave cover to Japanese raiders in their sneak attack 12 years ago. Runways of the Naval Air Station streak Ford Island (center). Peninsula on the left stores Navy surplus.

605 Kodachrome by National Geographic Photographer B. Anthony Stewart

Hickam Air Base's Water Tower (Above) Suggests the Washington Monument on Its Mall

Red roofs mark the Air Force's living quarters. Hangars in lower right house MATS planes. U.S.S. *Arizona's* black hulk (near tip of Ford Island) memorializes 1,103 crewmen who lost their lives in the bomb attack.

↑ **Smoke Grenades Cover Marines and Tanks Charging a Mock Enemy**

Trainees at the Marine Corps Air Station, Kaneohe Bay, find Oahu's beaches ideal for landing drills. Climate permits maneuvers the year round.

↓ **Highways Roll Through Unblemished Country; Hawaiian Law Limits Billboards**

Serving the suburbs of Kailua and Lanikai, this superhighway joins the road over Nuuanu Pali, in the distant Koolau escarpment (page 599).

Kodachromes by National Geographic Photographer B. Anthony Stewart

Women and Machines Team Up to Peel, Core, Trim, Slice, and Grade 90 Pineapples a Minute

Hawaii produces 70 percent of the world's processed pineapple; last year it canned some 17,000,000 cases of fruit and 12,500,000 cases of juice. These girls work at Dole's Honolulu fruit cannery, the world's largest.

first try. Inexpert, they get tumbled in the surf, scrape shins and noses on the coral.

Love of fishing is common to all races in Honolulu (page 616). Every Sunday the reef before my house is dotted with tropic Izaak Waltons. Chinese cast in the turbulent surf for *ulua* (a jack) and Hawaiians with throw nets draped on shoulders prowl coral pockets for *moi* (threadfin). Inshore, Japanese lay nets and beat the water with their hands to frighten mullet to their meshes. Near by, graying Hawaiian women, their skirts rolled up, squat waist deep and search the shallows for *opihi*, a tiny island shellfish, or *limu*, a seaweed that serves as a tasty vegetable.

Japanese women peer through glass-bottomed boxes to find the squid they regard as a delicacy when dried. Goggled and finned, spear fishermen seek out the drowsy *uu* (squirrelfish) relaxing under coral heads. Trolling among these tense and stooped figures may be an outboard or two with haole fishermen, hoping for a plump *papiopio* (a jack) or a chance *kaku* (barracuda).

Many a Honolulu clerk uses his week ends this way to meet the payments on his car. A 30-pound ulua will bring 70 cents a pound at King Street's busy fish market.

Perversely, with reef fishing right before me, I enjoy deep-sea fishing best. Armed with seasickness remedies, six of us will charter a boat and troll the choppy banks off Diamond Head. We can usually count on a catch of the hard-fighting *mahimahi*, the blue-and-gold dolphin of these waters.

Fisherman Catches a Bird

In season, boats return with marlin and swordfish flags whipping in the trades. One day a wheeling booby, big as a turkey, plunged on my bait, took it, and tried to fly off with it. I reeled him in through the air. The skipper had no flag to herald that catch!

Sailing is highlighted by the biennial trans-Pacific race, starting from California. Winners usually take 12 to 14 days to cross the Diamond Head finish line, and a month to recover from the ensuing round of parties. Honolulu's Harold Dillingham has won the race with his 60-foot schooner *Manuiwa*.

Because Hawaiian waters are rough, smaller boats are confined to the sheltered swells off Honolulu Harbor or the protection of Kaneohe Bay. This last is favored by speedboat drivers. Here water skiers can drop their tow and glide to gentle stops on sand islets that are awash at high water but creamy, soft picnic spots when the tide is out.

Honolulu hikers carry no ropes or pitons on the trails that lead up to the Koolau's knifelike ridges. But sheer cliffs, rock slides, matted vegetation, and wild boar make these climbs dangerous. The reward is the classic view of two sides of the island.

Honolulu's planners have made ample room for parks. The Ala Moana, which fronts the sea on the way to Waikiki, draws picnickers, tennis players, and fishermen. Green Kapiolani Park, on the city side of Diamond Head, has added attractions in an archery range, bridle paths, and a zoo.

Baseball Champions Visit Japan

The 20,000-seat stadium does overtime business in sports-mad Honolulu. High-school football games draw capacity crowds, including many foot-loose servicemen. A baseball league, benefiting from the Japanese enthusiasm for the game, features teams named "Rural Red Sox" and "Portuguese Browns." Champions are rewarded with a trip to play Japan's leading nines.

As long as the United States and Australia contend for the Davis Cup, Honolulu will see good tennis, too. Rival teams stop off here to sharpen up their shots.

Earl Thacker, prominent businessman and the city's unofficial greeter, finds that Honolulu's position as the Pacific crossroads brings it more than its share of celebrities.

"Artists touring the Orient or Australia usually stay over for recitals," he says. "In past years we've had such diverse singers as Tony Martin and Marian Anderson."

True Hawaiian music is still sung here. The Glee Club of the Kamehameha Schools, for children of part-Hawaiian stock, preserves it in recitals. Polynesian chants are set to hymn tunes. Kawaiahao Church, built of coral blocks, and opened in 1842, has a choir of Hawaiians, most of them graying now, who sing at regular Sunday services.

But it is the modern *hapa-haole* (part-Caucasian) music that Hawaii's enthusiastic booster, Arthur Godfrey, has popularized. Adapting the haunting quality of Hawaiian voices to popular music forms, Alex Anderson, vice president of one of Honolulu's largest firms, led island composers to the Hit Parade with his "Lovely Hula Hands" and "Cockeyed Mayor of Kaunakaukai."

↑ Kimonoed Dolls Come from Japan; Trailing Sleeves Symbolize Girlhood

↓ University of Hawaii's Hina Matsuri, a doll festival, features a concert on Japan's koto, a zitherlike stringed instrument. These students chant rhythmically as they play.

Triple-domed Hongwanji Temple Brings the Orient to Honolulu →

With 85,000 members, Buddhism is the strongest Eastern faith in Hawaii. Several of its numerous branches are represented. Here Hongwanji's bishop welcomes two Japanese-American visitors.

Nearly everybody tries to write a tune. Paul Koy, chef at the Royal Hawaiian Hotel, has published several.

Honolulu listens to Hawaiian music less than you might think. The local 90-piece symphony, led by George Barati, presents a creditable season. William Merrill, architect of many of the city's newer schools and hospitals, is prominent in the nationwide Society for the Preservation and Encouragement of Barber Shop Quartet Singing in America.

Radio programs best reflect the city's tastes. Tinkling Japanese and Latin-style Filipino music run for hours each day. We haoles are often surprised to find ourselves listening to modern Japanese music. Just as "le jazz hot" won France after both wars, so it swept Japan, whose popular music is now Western and rhythmic. All tastes blend here. Immigrant Filipino laborers do the hula, and the Portuguese remind you they brought the ukulele to Hawaii.

In the lush gardens and cool courtyards of Honolulu's serene Academy of Arts are rare jades from the Orient and paintings of the modernists. Part of the noted Kress collection has been moved here, including the "Madonna and Child," by Segna di Buonaventura. Here, too, the city's own gifted artists have their displays. Irish John Kelly's etchings, Japanese Isami Doi's prints, and Swiss Fritz Abplanalp's carvings have won national reputations.

Honolulu's Community Theater gets a break by being 5,000 miles from Manhattan. "We get rights to stage hits that are still playing Broadway," Mrs. Louise Henderson, active theater booster, told me. "This far away, they feel we're no competition."

University Emphasizes the Practical

Since Robert Louis Stevenson lolled under a banyan tree at Waikiki to finish *The Master of Ballantrae*, Honolulu has proved congenial to many writers. Earl Derr Biggers is said to have found his Charlie Chan character on Honolulu's police force. Our present chief, Chinese-Hawaiian Dan Liu, is so called by the Honolulu public.

Honolulu's rainbowed Manoa Valley cups the campus of the University of Hawaii, a land-grant college supported in part by Territorial funds, where 5,000 students pursue conventional liberal arts, education, and agricultural courses (page 581). President Gregg Sinclair emphasizes the practical. Animal husbandry and industrial engineering draw larger classes than Plato.

University research is concentrated on strengthening and diversifying the Hawaiian economy. Under study are local sources of cattle feed and means for quick-freezing such Hawaiian delicacies as passion fruit and mango that may some day find their way to your table. Quick-frozen pineapple is already there.

Research Improves Pineapples

Scientific institutions cluster around the university. The Pineapple Research Institute staff of 108, supported solely by the industry, conducts research on the problems of the $100,000,000-a-year industry. Development of new and resistant varieties takes time, as one plant will produce in three years only enough suckers to set out four more plants. Seventeen thousand suckers are required by each of Hawaii's 73,000 pineapple acres.

Attempts are being made to devise a machine to eliminate tedious hand planting. Already developed is a monster plow, 5 feet long, that chops up the dense, waist-high pineapple plants and returns them to the soil at the rate of three acres a day.

Also on the campus is the laboratory of the United States Fish and Wildlife Service's Pacific Oceanic Fishery Investigations. When Honolulu became the headquarters of the Trust Territory of the Pacific Islands, following World War II, the only major resource of possible commercial importance accompanying the 3,000,000 square miles of water and 57,000 natives was fish, primarily tuna.

Remarkably little was known about the spawning habits, migrations, and life span of tuna. So POFI was established by Congress, acting on a bill introduced by Hawaii's delegate, Joseph R. Farrington. In three years and 15 carefully planned cruises, ranging up to 2,000 miles south of Honolulu, POFI's chief, O. E. Sette, thinks he's made headway.

"On each of these trips we have made carefully plotted stops along various meridians from 140° west to 180°. We find each time that the catch of fish increases abruptly as we approach 5° N, drops off when we pass the Equator. Thus, there is a 300-mile band that is reliably fertile, but it moves north and south a bit with the seasons."

(Continued on page 618)

Kodachrome by National Geographic Photographer B. Anthony Stewart

Swaying Dancers, Whispering Palms, and Murmuring Surf Create the Illusion of a Paradise

To the old-time Hawaiian, the hula was a temple art sponsored by royalty. All phases of life found expression in the dance. Missionaries at one time forbade it. Reborn, the hula speaks a light and laughing language.

Robert K. Burns

↑Honolulu Then and Now: 3 Decades Have Tripled the Population and Crowded the Valley Between Punchbowl and Diamond Head↓

Punchbowl, crater of an extinct volcano, served in 1920 as a cactus-trimmed lookout for the photographer, who drove to its top in a Model-T Ford, circa 1915. The air view opposite shows the Punchbowl landscaped to accommodate the graves of 14,000 servicemen who died during World War II or in Korea. War correspondent Ernie Pyle rests among them. Distant marsh in the older picture has been drained by the new Ala Wai Canal (opposite, right) to make way for the Ala Wai Golf Course (open space) and the adjacent area. Broad Kalakaua Avenue (page 579) intersects the canal, heads into Waikiki Beach, and ends beneath Diamond Head, the rim of another extinct volcano. Few but airmen see the crater's bowl.

Mullet Fishermen, Like Umpires at a Tennis Match, Sit in High Comfort and Await the Game

Hawaii's commercial fishermen catch nearly 16 million pounds of fish and shellfish annually. A sizable portion reaches the table by reason of father or son spending an afternoon at the beach with pole in hand.

Chairs on permanent stilts keep part-time fishermen above the tide at Ala Moana Park. The men bait hooks with bread or squid for mullet, a hard-to-catch white-meat fish. Baked in ti leaves above hot rocks, mullet is esteemed as a delicacy at the luau (pages 590 and 591).

Men and boys wear aloha shirts, Hawaii's gaudy sport attire.

Tuna Fishermen Mend Their Bait Nets at Kewalo Basin

Hawaii's deep-sea fishing industry is still an infant compared to the giant it could be, fisheries authorities say.

About 540 commercial boats, largely motorized sampans, operate out of the islands' ports. Biggest vessels go for tuna; annually they catch an average 10,000,000 pounds. Much of the take is canned locally and shipped to mainland markets.

Albacore command the best price; skipjack, or *aku*, are the most abundant.

Aku boats loaded with net-trapped fingerlings for bait cruise 30-odd miles offshore. Lookouts scan the sky for boobies and other winged companions of tuna schools. Sighting them, they give the signal to cut the motors. Then the fishermen toss out bait and drop barbless hooks. Tuna mistake the shiny hooks for their silver-backed food; and the kill is on.

Oahu fishermen have taken as much as 23 tons from a single school, which may run half a mile long and cover two or three acres of water.

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Sugar Sweetens the Commerce on Palm-shaded Merchant Street, Honolulu's Wall Street

Business houses here serve as management consultants to stockholders in Hawaii's $175,000,000 sugar industry. Castle & Cooke, Ltd., occupies the extreme left, Theo. H. Davies & Co., Ltd., the right center, and Alexander & Baldwin, Ltd., the extreme right. Bishop National Bank flies the United States flag.

"Why this concentration of fish?" I asked.

"The North and South Equatorial currents move westward under the impulse of the northeast and southeast trade winds," Sette explained. "In between is a gap where the countercurrent flows eastward.

"Near the Equator the surface water is deflected slightly to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. This leaves a trough that can only be filled by water moving up from the depths.

"This water is rich in nutrient salts—phosphates, nitrates, and the like. As it mixes with the warmer water near the surface, where sunlight permits photosynthesis, plankton grows quickly and abundantly.* This provides nourishment for shrimps and small fish. They in turn are food for tuna."

Atomic Tracers Solve Sugar Secrets

Oldest Honolulu research organization is the Hawaiian Sugar Planters' Association Experiment Station. Its nine acres of laboratories, greenhouses, and test plots nestle among homes at the foot of Manoa Valley.

Here scientists, directed by Leonard Baver, Ohio-born agriculturist, face the fact that

*See "Strange Babies of the Sea," by Hilary B. Moore, NATIONAL GEOGRAPHIC MAGAZINE, July, 1952.

Hawaii's limited soil has for years been producing the same crop without rotation or lying fallow. Their research has improved the productivity of Hawaii's soil while in continuous use—some of it for more than a century. They must satisfy the incessant demand for new and improved cane varieties —and so grow 1,000,000 new seedlings a year for selection.

These sugar scientists trace the movement of fertilizers through cane plants with radioactive isotopes supplied by the Atomic Energy Commission and plot the absorption of irrigation water in Hawaii's soils electrically.* One machine, just developed, cuts cane with a rotary knife, replacing 24 men. Another is now under design to take the stalks and blow them free of soil and trash before they leave the field for milling.

Many Hawaiian plantations have suffered from relatively static sugar prices and vastly increased costs, so HSPA is intensifying by-products work. They have learned to make paper from bagasse—what's left of cane when the juice is squeezed out. Mixing molasses with a fraction of the bagasse, they've made a good cattle feed. On the far horizon they visualize building materials from molasses and cellophane from bagasse.

Return to Soil Encouraged

Near by, the Territory's Board of Agriculture and Forestry studies the lesser uses of Hawaii's soil—for papaya, garden produce, and ranching.

With Colin Lennox, president of the board, I have hiked mountain slopes from which sandalwood was once cut in quantity, to study trial plantings of ash, redwood, slash pine, and eucalyptus from the board's arboretum. Some day the board hopes to find a forest cover that will both conserve water and provide a cash crop on Hawaii's mountains.

Working closely with the Department of Public Instruction, the board encourages Honolulu's youth to return to the soil. School gardens and 4-H Clubs are important activities among the city's 71,000 public-school students. Honolulu's big problem is to find jobs for a population that is predominantly young, 25 percent of school age.

When I came here, most Japanese and many Korean and Chinese children took private instruction, outside of regular school hours, to learn their parents' tongue and customs. Disappearing with the language schools is the dual standard of public education which put those with a mastery of English in one school, those without such fluency, usually of Oriental ancestry, in another.

Two big private schools, Punahou and Kamehameha, have campuses that rival New England's best. Missionary-founded Punahou includes the oldest American college preparatory school west of the Rockies. With an enrollment of 2,200, it is larger than any nonsectarian private school on the mainland. Kamehameha, restricted to students with some Hawaiian blood, is supported by the rentals paid one of the Hawaiian estates that owns much Honolulu land (page 620).

Language Difficulties Disappear

Good schooling has virtually erased language difficulties. English is now enough to reach all but the older Japanese and Chinese, who follow the ideograph sections of small daily native-language papers.

If language difficulties survive, it is with sentence structure. One old Chinese pleaded not guilty of violating a "No U Turn" sign because it should have said "You No Turn."

Congregationalism, brought here by New England missionaries in 1820, still flavors community thinking. But Catholic influence is strong and gained with the immigration of Filipinos, who learned the faith from Spanish conquerors nearly 400 years ago. Catholic schools teach 14,000 of Honolulu's youth, and the Catholic hospitals and charities reflect an energetic diocese.

Oriental beliefs are confused by all that has happened in Japan and China since World War II. A good Shintoist may properly divorce his wife with a word, but in Honolulu he will wait to meet the requirement of the courts before remarrying. A Young Men's Buddhist Association vigorously supports a big building and branches, complete with basketball teams and leadership courses, in the best YMCA tradition.

Social responsibility is strongly felt in Honolulu. It keeps up with mainland cities its size with a Community Chest contribution of $800,000 a year. The local Red Cross found ample work in tending Korean wounded. The Kindergarten and Children's Aid Association has served the community nearly 60 years.

* See "Man's New Servant, the Friendly Atom," by F. Barrows Colton, NATIONAL GEOGRAPHIC MAGAZINE, January, 1954.

Kodachromes by National Geographic Photographer B. Anthony Stewart

↑ Pineapples at 9 Cents a Pound Offer an Everyday Bargain in Honolulu

Grapefruit and lemons from California, cereals from the Midwest, canned goods from Anywhere, U.S.A.—all make an Oahu grocery much like its counterpart on the mainland.

↓ How Many Girls Should Bathe Baby? Kamehameha Schools Use Six

Seniors in home economics learn child care with a live model. The infant, on loan from parents for a time, lives with the students and their instructors in a training home.

The YWCA has had a program to orient the 1,000 war brides brought here from Tokyo and Berlin, Manila and Paris, by returning GI's. How confusing it must be to a flaxen-haired German girl from Bonn, married to a Japanese-American named Sakai or Yamaguchi, to settle in this modern American city!

No more confusing, perhaps, than it was to the prim wives of the first missionaries who found the sparsely clothed population emerging from idolatry. These missionaries, paid $500 a year to Christianize the polygamous Hawaiians, felt it a responsibility to Americanize them as well. Soon the natives were dressing in the full-length cotton Mother Hubbards that inspire today's fad for the *holoku* (a loose, princess-style dress), reading the Bible, and referring to their mud paths as streets with New England-sounding names like King and Hotel.

Russians in Hawaii in 1816

Many nations have played parts in Honolulu's history. In 1816 a company of Russian traders laid out the ground plan for a fort at the harbor mouth, thus giving downtown Fort Street its name. But rapid intervention by the native ruler forced them to withdraw to another island.

In 1839 the French sent a frigate to Honolulu to insure freedom of action for Catholic missionaries. Under the guns of the ship, all demands were agreed to, a bond was paid guaranteeing tolerance for Catholics, and Frenchmen were given extraterritorial status.

Similarly, there was a brief British "conquest" of Honolulu in 1843. British subjects had complained of unfair treatment in the native courts; a warship was sent to see that they received justice. The king, despairing of meeting the commander's terms, ceded the kingdom to Great Britain. London later repudiated the forced surrender, and the islands regained their independence.

The strong English influence exerted by early explorers like Vancouver is reflected in Hawaii's flag, which carries the Union Jack in the upper left corner (page 581).

Honolulu was the capital of the Hawaiian monarchy until 1893. Then, in a revolution of comic-opera proportions, the haole element led in overthrowing Queen Liliuokalani and establishing a provisional government. Failing to persuade the United States to annex the islands immediately, the revolutionaries set up the Republic of Hawaii. It took four years for this regime to achieve annexation by the United States, August 12, 1898.*

So Hawaii and Honolulu, its capital, have been a part of the United States for 56 years.

Gov. Samuel Wilder King has been a leader in the fight for statehood. "The process of becoming a State is simple," he says. "Getting action is what has caused delay. We had a convention in 1950 that drafted a constitution, later adopted by popular vote."

The statehood bill requires that the President proclaim Hawaii officially the 49th State immediately after the Islands have elected representatives to Congress.

"What difference will statehood make?" I asked. "We already pay all Federal taxes, are governed by all Federal laws."

"We will have the right to elect the man who sits here," Governor King said, tapping his leather chair, "and we will have representation in the Senate and the House. But, most of all, we will feel that a long-standing promise has been fulfilled."

Travel men wonder if statehood will detract from the islands' charm, make them seem prosaic. Or will mainlanders, reassured about currency and passports, inoculations and drinking water—which have caused some of the uninformed to hesitate—come in ever greater number?

Though there is a modern capitol on the drawing boards to replace baroque Iolani Palace, most attractions will remain.

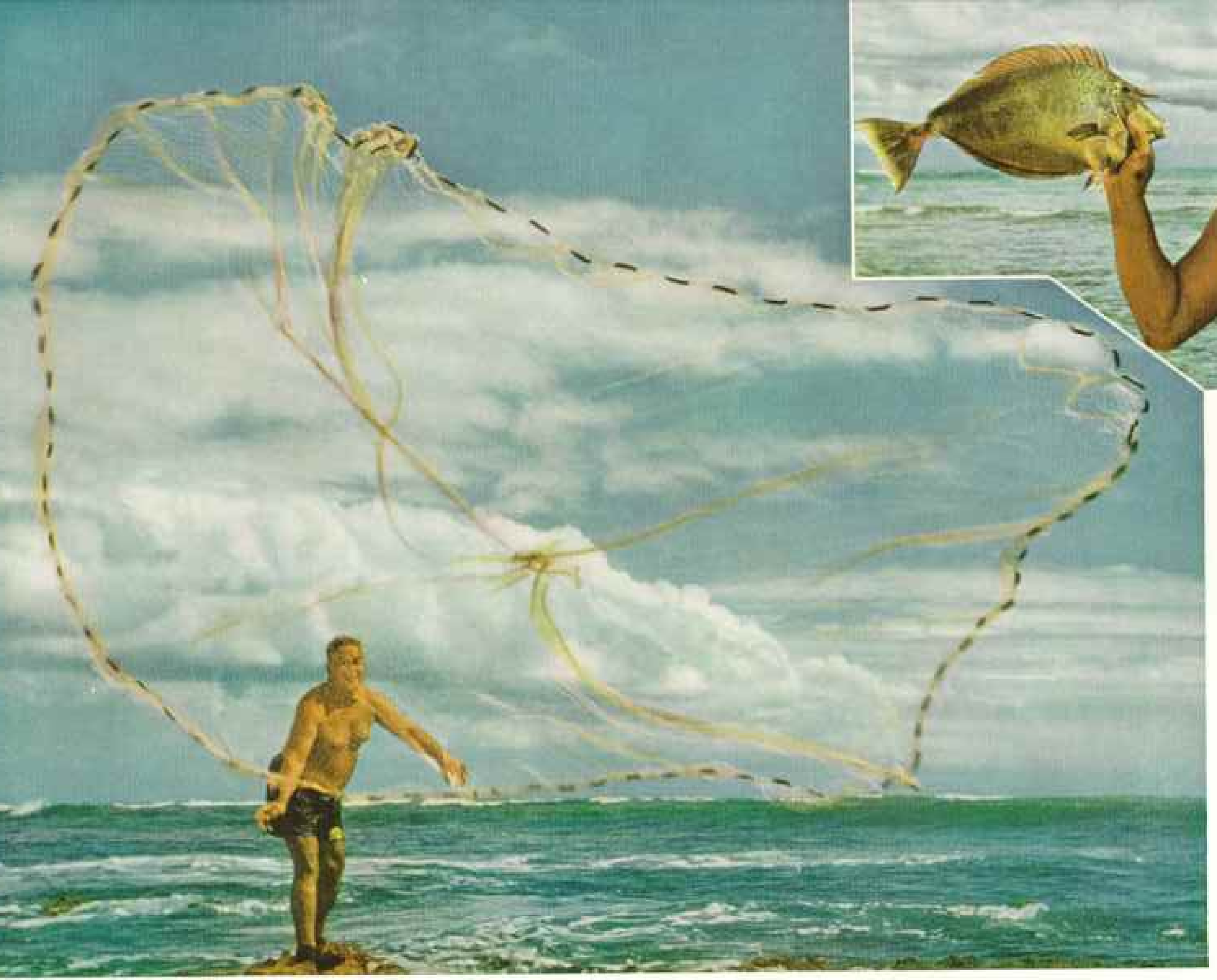
Museum Shows Feathered Cloaks

The Nuuanu Pali, the wind-blown pass to newer Honolulu, will still afford its exalted view of verdant pastures, Kaneohe Bay, and the blue-green Pacific (page 599).

The Bishop Museum's collection of Hawaiian artifacts is the world's best. Displayed are gold and red cloaks adorned with feathers for old Hawaiian kings (page 595), amulets of whalebone, spears carved by stone adz from ebony-black *kauila* wood, and tapa cloth beaten from paper mulberry bark and decorated with primitive designs with pigments from berries and plant juices.

Tourist cameras can still focus on early prefab homes that missionaries cut to size in New England and brought around the Horn. The houses are preserved now as a memorial in Honolulu's Civic Center.

* See "Hawaii, Then and Now," by William R. Castle, NATIONAL GEOGRAPHIC MAGAZINE, October, 1938.



Cast of the Net Snags a Unicorn Fish

Hawaiians in olden days wooed fishing luck with taboos. They departed for fishing grounds before dawn and in silence, shunning the good wishes of friends. Wives stayed at home and refused visitors during their husbands' absence.

In contrast, William Stephenson, who nets fish as a hobby, gives a party, and his guests, following him to the sea, watch him catch their dinner.

This four-pound unicorn was soon roasting over charcoal on the beach. The fish takes its name from the single horn growing out of the brow.

More Fanciful than a Child's Dream, Fishes Masquerade in Gaudy Colors at Honolulu's Aquarium

The deadly and the beautiful mix among these representatives of the islands' 600 fish species. A dark-barred Moorish idol (top) swims above two greenish unicorns (opposite page). Chrome-yellow *lauipala* (center) faces a blue-tailed surgeonfish, named for the lancet near its tail. A poison puffer, deadly if eaten, lies in a starfish's prongs (foreground). Two striped squirrelfish (right) would be abroad only at night if living in the sea. Six reddish *aa* with black bars near the gills sprinkle the throng. A *humu-humu nuku-nuku a puaa* rests immediately in front of the doll.

624 Castle and Cooke, Ltd.

A Mammoth Planting Machine Digs Furrows and Drops Sugar-cane Joints as Seed

Two decades of mechanization have halved sugar's farm-labor force and increased production, despite a smaller acreage. Loaded with bagged cane, this tractor plants 15 acres a day on Ewa Plantation, Oahu.

Pearl Harbor, where 2,335 lost their lives in the first major foreign attack on United States soil since the War of 1812, is one of our largest naval bases (page 604). Its historic role on that December 7th, 1941, is commemorated by a flag flown from a platform built over the battleship *Arizona*, still resting where Japanese bombs sank her.

On days when a big battleship or carrier ties up at Pearl (page 584), white-clad sailors on liberty dot the city like snowflakes. Some rent horses and gallop along Diamond Head bridle paths, their bell-bottomed trousers flapping like cowboy chaps.

From downtown Smith Street, where Negro performers play Dixieland jazz, to Waikiki's Hawaiian entertainment, transients find music, dancing, and everything to drink from Japanese sake to obscure South Seas punches served in coconut shells (pages 590 and 591). Gaiety goes on until 1 in the morning. Honoluluans start to work at 8, quit at 4, in a local version of daylight saving that leaves time to play tennis, fish, or garden. We who live here tend to forget the beauty around us, rarely swim at Waikiki. To us, Honolulu is just another home town.

Meet a plane inbound from Honolulu in a chilly San Francisco dawn, and you can spot my townsmen. They are the ones without leis.

The Goats of Thunder Hill

Forsaking City Streets for a Rural New York Retreat, Four Women Brave the Complications of a Cowless Dairy Farm

By Elizabeth Nicholds

With Illustrations by National Geographic Photographer Robert F. Sisson

NINE years ago, brimming with ignorance and enthusiasm, we bought a 200-acre farm in Otsego County, New York, named it Thunder Hill, and started raising goats. Our neighbors, of course, regarded us with scorn, mirth, or pity, according to their several temperaments and the depth of their compassion for misguided mortals.

"For land sakes!" they said to one another. "A goat farm! Anybody with a grain of sense knows it's cows and chickens makes the money around here. And females trying to run a farm, two of 'em old ladies besides! They'll find out farming ain't just pickin' posies."

We did find out. But we stuck to it, and we are still on a farm, though now a smaller, more manageable one.

To Author, Goats Are Like People

We wanted goats because we like animals and because goats are small enough for women to handle. Also, I remembered a brief period in my youth when I was happily dominated by two pet goats which I loved in spite of their bossy ways. Even as a child I suspected what experience has since led me to regard as fact: goats are more like people than any other animals.

They are not only bossy but lively, enterprising, affectionate, chatty, and very nosy. They so much regard themselves as folks, in fact, that they sometimes move right in with the family.

Take the time I spent hours polishing up our place preparing for city visitors. I was determined that there should be no snide remarks about goat farms. When I left to meet the bus, I was satisfied that the house was tidy, the plumbing in good order, the barn thoroughly cleaned, and the goats happy in their pasture, where their alert faces peering over the fence would surely charm all who saw them.

But when I returned with the visitors, the goat faces, alas, were not peering from beyond the pasture fence. They were laughing at us out of almost every downstairs window of the house.

Time has corrected some of our original ignorance, but, in spite of the unpredictable antics of our goats, has done little to diminish the enthusiasm. We have come to see, moreover, that goats also can be profitable.

Millions of people in the world today drink goat's milk. Think of sections of the Orient, think of the Mediterranean countries, of Switzerland, parts of France, parts of Central Europe, where the milk goat is the accepted foster mother of the human race.

In the United States, at the last official count, there were 33,000 farms harboring milk goats. On some of them goats are kept for family milk only. On others, sizable herds constitute the chief business.

Even more farms and ranches keep goats for wool. By the aforementioned count there were 25 times more Angora than milk goats.

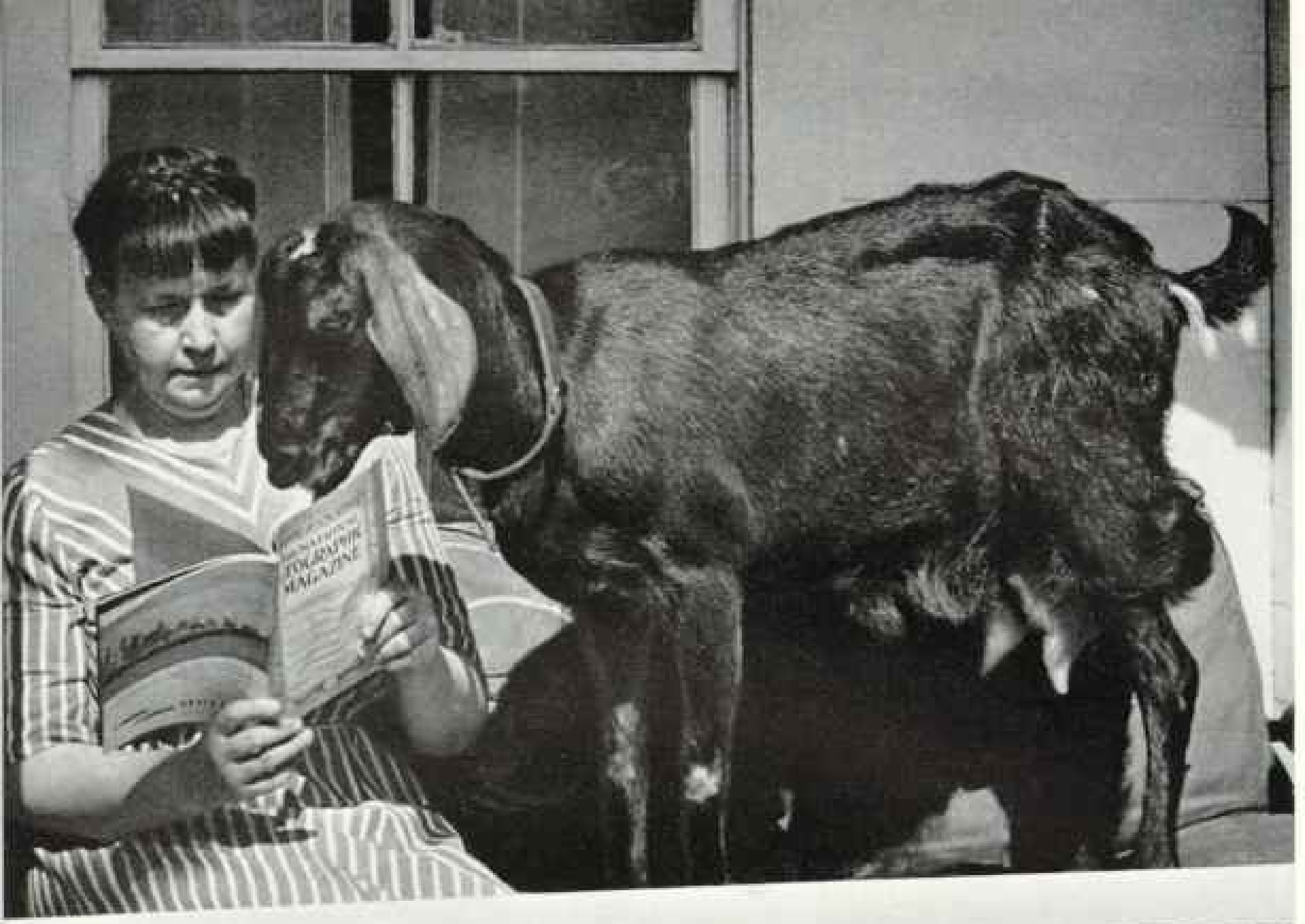
Middies Own a Famous Goat

Perhaps the most celebrated Angora in America (he's not really pure stock) lives on a dairy farm at Gambrills, Maryland—that is, when he isn't being kidnaped or paraded at football games. He's Bill XIV, the mongrel mascot of the United States Naval Academy (page 627).

Some dairies near large cities make good incomes by supplying people who need goat's milk because of digestive troubles or allergies. Babies sometimes cannot tolerate cow's milk; for them goat's milk is a necessity. Though goat's milk is almost the same as cow's in taste and composition, it has a softer curd and smaller fat globules which make it easy to digest.

It was nothing so practical as the food value of goat's milk, however, nor even the lure of financial reward, that prompted us to start the Thunder Hill Goat Farm. I wanted to make a home in the country for my mother and aunt, who are twins.

The twins were 76. Bobby, my young



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Ginger, a Nosy Nubian, Explores Her Mistress's Copy of the NATIONAL GEOGRAPHIC

Elizabeth Nicholds, the author, gave up a city job to raise milk goats at Thunder Hill, a New York farm. Goats, she found, regard fences as a challenge, shrubbery as a meal, and cars as shiny hills to climb. "With no encouragement," she says, "goats consider themselves folks and happily spend the day on the porch swing."

friend who joined me as a partner, was 24. We were all inexperienced. True, the twins had been raised on a farm, but since they belonged to a generation in which young ladies were carefully protected from the grim facts of breeding and birth, they were no help whatever in handling the stock.

However, they put up hundreds of jars of preserves, they knew how to make butter, and they had copies of luscious recipes that had never in my adult life been of any use to me, since they all seemed to start with "Take a quart of heavy cream . . ."

My own farm experience was limited to pleasant memories of summer vacations at my grandfather's place. Bobby also was city-bred and, like the rest of us, had much to learn. But she was healthy, energetic, and clever at the farm's small, inevitable repair jobs.

I was the one responsible for the selection of the farm, and I chose on the basis of the charm of the big, rambling house and the beauty of the view. We were on the edge of the Catskill Mountains; it was as rewarding as prayer to look, last thing at night, to the insubstantial hills across our moon-drenched valley.

At first, when we set out to buy stock, we found that there are four milk breeds common in this country (page 636). The twins favored Saanens, because Saanens are white, and nothing is lovelier than a herd of white animals drifting over a green pasture.

Bobby voted for Toggenburgs, basing her choice on practical rather than esthetic rea-

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C. H. Morris

Navy's Mascot Need Not Be an Aristocrat; Bill XIV Is Several Kinds of Goat

The U. S. Naval Academy preserves the stuffed body of Bill's most illustrious predecessor, 3-0 Jack Dalton, for having inspired Midshipman Dalton to kick two field goals that beat Army, 3-0, in 1910 and 1911. Bill has been kidnaped twice, once by Army cadets. Here in 1952 he leads Navy to victory over Yale at Baltimore.

sons. Togs, like Saanens, have for generations been bred toward heavy milk production. From either breed we ought to get quantities of milk, said Bobby, and Togs, being tan or brown, would not show dirt like the white Saanens.

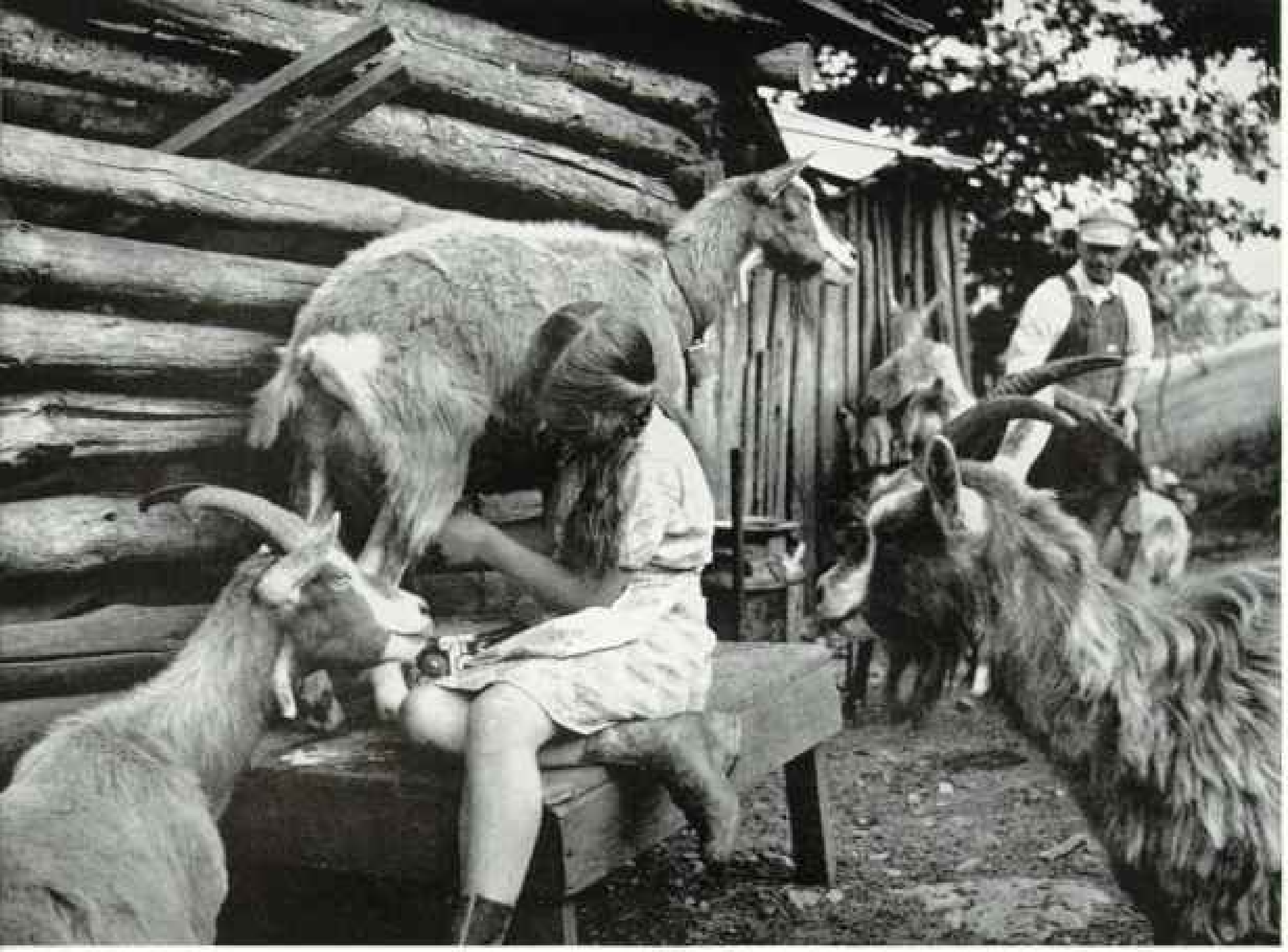
I objected to both breeds. I said I did not like all my animals to look exactly alike. I wanted individuals. (I need not have worried. I soon found out that no goat is ever identical with any other goat in manner, mood, or personality.)

I said that I preferred either Alpines, with their lean lines and varied coloring, or Nubians, which also come in almost any color, including spotted.

In the end, we settled for Nubians because their milk is high in butterfat, and because we thought their sleepy eyes and long pendent ears suggested a meek and docile disposition. By the time we discovered how deceptive this appearance could be, we loved them anyway, mischief and all.

We learned that goats do not eat tin cans, that they are surprisingly and frustratingly finicky about their food. This always surprises the person who has heard of the indiscriminate eating habits of the goats in the lands of the eastern Mediterranean. The scourge of the Near East, it has long been said, is the bite of the goat.

It eats almost anything—from root bark to woody shrub to the topmost leaf of a 5-foot tree—and churns the ground to dust with its hoofs. Though the animal itself is not the sole cause of severe land depletion



National Geographic Photographer Willard R. Culver

An Arkansas Farm Girl Milks a Toggenburg, One of the Most Popular Milkers

White boots, brown coat, and white stripes on the face mark the Toggenburg, a Swiss native. Wattles beneath the ears are stylish with this breed. Ancient Romans believed such appendages signified a prolific nature.

and though its hide, hair, meat, and milk are indispensable to the people of the Near East, it nevertheless has become a symbol there of erosion and ruin.

If the ration doesn't suit the goats on our farm, they tip over the feed pan. If there's the slightest film of dust on their water, they turn away from it with disdain. They all hate to get wet. And they have a strong tendency to consider fencing as a challenge, and to be astonished that their human companions expect them to regard it as a barrier.

Strays Are Hard on Shrubbery

At least once a week during our first summer every goat got under, over, or through our fences. Goats are sufficiently nimble to present no hazard to traffic, and they always know enough to come home at the end of the day. But while they are at large, they will denude the shrubbery, strip the flowers of their buds, and leap onto the cars of visiting dignitaries.

Goats will respect the bite of an electric fence if they are individually introduced to it at the start of every season, but at the beginning of our farming experience we did not know this. Electric fences looked frail to us, and Bobby built serviceable—but much more expensive—fences from 5-foot woven wire.

The arrangement of the buildings was, like the fencing, a result of live and learn. Bobby, remembering the original cow stanchions she had helped to tear out of the barn, built similar ones in goat size. They were neatly done, very stylish looking, and won admiring exclamations from visitors. The goats, however, took a dimmer view of the situation.

Goats are active creatures, suffering from confinement, and being held by the neck in a rigid wooden yoke put them in a deplorable state of mind. We replaced the yokes at some expense with metal swing stanchions. These were better, allowing more freedom; but although most of the goats were sufficiently agile to twist about and sit in their feed trough, they claimed one and all that they could not twist back again. We were forever rushing to the barn in response to wails for help from half-strangled goats.

R. A. Romanes

The Common Goat Seldom Suffers a Failure of Appetite

Goats are close relatives of the sheep, ox, and antelope, sharing with them the hollow horn, cloven hoof, and cud-chewing function. Among certain wild species it is impossible strictly to separate the sheep from the goats.

Man domesticated the goat in prehistoric times. Egyptians worshiped the animal at Mendes. Ancient Jews sacrificed it as an offering to Jehovah.

In the United States the mohair-bearing Angora leads the goat population with more than 3,000,000 individuals at last count. Milk goats number only 120,000.

Common, or American, goats such as these two total less than 1,000,000. They are valued chiefly for removing underbrush. In general, short legs, fleshy appearance, varied colors, and long horns (right) distinguish the average American goat.

➔ This billy eats from a tin pan. Contrary to popular belief, he does not gobble up the metal as a dessert.

A. W. Anderson

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Nubians, Too Independent To Be Driven, Follow Mrs. Florence Dorland Down the Road

Mrs. Nicholds (in rear) enlisted a dog as a herder, but quickly discovered that goats could not be driven like sheep. "If you urge them nicely," she says, "they merely look at you expectantly. Wave your arms and they disperse in 14 directions. But walk ahead and they follow, amiable and curious."

"Don't Do It Again!" The Author Vainly Lectures Expectation for Stealing a Snack

Ornamental shrubs, garden vegetables, and yard flowers tempt the average goat. Expectation, a Saanen doe, lets little grass or anything else grow beneath her busy hoofs. When she roams at large, Mrs. Nicholds trails.

Abandoning the stanchions, we tried pen stabling, putting the whole female contingent loose in a common enclosure and bringing them, one by one, to another room for milking. When we consistently took them in the same order, they soon caught on, and each appeared at the door in her turn.

To Each Doe Her Own Pen

The large enclosure answered the need for exercise. It was inexpensive housing, but it did present problems. There were always a few boss goats that pushed the retiring characters away from the hay racks. Expectant mothers, heavy with kid, can be badly injured by jostling. And a doe needs privacy at freshening time for her own peace of mind and the safety of the little ones.

Eventually we wound up with individual pens for each doe. From the goats' point of view the arrangement is admirable—sufficiently sociable to satisfy their natural gregariousness, yet offering security for the timid ones. The sociability is important, for a lone-some doe not only tells the world about it at the top of her considerable lung power, but she also holds up on her milk, refuses to eat, and sometimes mopes until she is seriously ill.

For us, the pens meant more work. Lacking the water buckets with which cow barns are usually equipped, we filled water pails for each individual pen. The pens themselves were awkward to clean. Also, in spite of our frequently reiterated resolutions not to be swamped by too many animals, there always seemed to be more goats than pens.

We compromised by using pen stabling for the unbred yearlings. Even so, there invariably were a couple of milkers tied along the aisles; or we were doubling them, two to a pen, and then having to watch them like a matron in a girls' school making certain that roommates are congenial.

The bucks, of course, have their own quarters in a separate building. At no time is the buck any hyacinth, but in the fall, during breeding season, his odor is appalling. Because of this, he must not be permitted to

consort indiscriminately with the does. The buck odor rubs off on whatever it touches, and, having rubbed off, will cling—as we who handled him discovered.

As every housewife knows, milk is quick to absorb odors. When a doe is to be taken to the buck for breeding, she must be milked out first.

Bucks, like males in general, can be arrogant and willful, but we learned that they sometimes develop what amounts to an inferiority complex. We once had a promising young buck who was something of a mamma's boy. Amber, the first doe I took to him, advanced sideways, with an inviting wag of the tail. But the buck blatted and turned away. Amber, not disposed to accept a snub, stopped her brazen flirting and butted the daylights out of him.

With an already shattered ego thus further demolished, the buck was in danger of permanent ruin. Clearly, he needed psychological treatment. I penned him with gentle little Ginger, whose cuddlesome admiration in time proved effective (page 626).

We learned almost at once that goats are individuals, with their own idiosyncrasies. Some are pugnacious with their own kind; others are like Bernadette, the gentle peacemaker, who could not endure a scrap. She always placed herself between any two goats that showed the slightest signs of raring and butting.

Butting Billy Practically Blushed

Once she stepped in front of a buck that had reared his eight feet of black menace over my head. I had learned by that time not to give him the satisfaction of dodging, aware that if I stood my ground he would come down about six inches from my chest. But with Bernadette walking into the situation he miscalculated and sprawled clumsily across her back. He was so embarrassed he practically blushed.

Goats, we found, appreciate attention from their human companions and often come to expect it. Soon after we got our stock a doe died, taking her kid with her. Too inexperienced to realize that her hour was so close, I had not been with her to help. Naturally I was upset. The experience, in fact, plunged me into such a welter of anxiety that the next expectant mother was not permitted a moment to herself.

This mother-to-be was Zest, a highly sensitive doe with a puffed-up ego. She resented even amenities from strangers, preferring to make all advances herself. She had not finally decided how she felt about me by the time she was due to deliver. But after I sat up two nights with her, she came to regard the service as her due. Every time I walked away from her, she bawled with abandon.

In short order she produced, with scarcely any help from me, one kid, which she promptly dropped from her consciousness. At the same time, however, she made it unmistakably clear that this birth did not absolve me of my duty to sit up nights with her.

From then on, Zest was a one-woman doe. Whenever she saw me coming she lifted her lip and howled. When I escorted the goats to pasture, she weaved back and forth in front of me, blocking the path. If I sat down, the others might disperse to find choice browsing. But not Zest. She stood by, leaning over my shoulder, breathing down my neck, chewing my hair.

Orphan Restores Maternal Pride

Zest's indifference toward her kid was not, we found, unusual. Mother love is not conspicuous among goats. A new mother may talk to her kid, will almost certainly clean it and fuss over it for the first day or so. But if the kid is removed from her sight immediately after birth, she does not seem to fret. Even if the kid nurses for a time, the mother forgets it less than a week after it is weaned.

Susie was an exception. Susie's kid died, and Susie mourned. Bobby, who had been reading veterinary books, said the doe was not mourning and that she very likely had worms, which would explain both the loss of the kid and her subsequent moping. But I wasn't convinced.

Once I saw Amber, shortly after she had given birth to husky triplets, walk up to Susie and sneer in her face. "Ya-a-a-h!" she blatted. "You haven't any kid! Ya-a-a-h!" Susie hung her head in humiliation.

A few days later I acquired an orphan lamb and gave it to Susie to nurse. At first Susie did not care one way or the other; but soon she cheered up and began to take pride in her lamb, calling imperiously if it wandered from her side, butting off any inquisitive doe or dog that ventured too close.

Later, when I had taken Amber's triplets from her to pen them with the other kids, I saw Susie swagger up to Amber, lamb in

♠ **Miffin, the Cat, Pays a Sick Call**

Thunder Hill's kitchen serves as hospital for ailing kids, its cat as director of nursing.

➔Whisky, Miffin's kitten, nestles against hook-nosed Amber, a Nubian and getter-into-trouble.

tow. I am sure I heard her say, "Ya-a-a-h! Who hasn't any kid now? Ya-a-a-h!"

As months slid by, periodicals, technical books, meetings of the local dairy goat association, and the goats themselves taught us what we needed to know of management.

Goats like to be brushed; brushing keeps coats shining and helps control parasites. About twice a year we clip their coats, partly for the comfort of the goat but chiefly for cleanliness lest loose hairs fall into the milking pail (page 635). Their hoofs—fashioned, I suppose, for leaping from crag to rocky crag—will grow uncomfortably long unless periodically trimmed.

This hoof trimming, clipping, and brushing are all the grooming needed to fit a doe for public appearance in show ring or county fair. As fair time comes round, we give an extra whoosh with the brush, an extra snip with the clippers, and we are ready to go—always supposing, of course, that our charges are in top health.

Usually they are. Our herd is tested regularly

for brucellosis and tuberculosis, though goats are but slightly susceptible to the latter.

As we learned to recognize danger signals for other ailments, we had fewer and fewer problems. Rapid, labored breathing may mean pneumonia, but, taken in time, it can be controlled with penicillin, infrared heat lamps, and plenty of warm goat's milk to drink.

Swollen sides and whimpers of discomfort mean that the greedy individual has eaten too much too fast and must be given prompt relief before pressure stops the heart.

We learned, we thought, to know when a doe was about to freshen, although it was not too long ago that I milked Star in the morning and was astonished to find twins in her pen that afternoon.

Usually a doe will pace the floor, and moan, and wish she had never been born. Often she screams when labor starts. She is certain to scream if she thinks that by so doing she can persuade somebody to come from the house and hold her hand. Rarely, however, does she need more than moral assistance.

Kids the Size of Cats

When they arrive, the kids are about the size of cats and weigh from 4 to 10 pounds. The size depends, among other things, on whether it is a multiple birth. They open their eyes within minutes of birth, and in half an hour are on their feet, asking for breakfast.

Like human infants, they are considerably tougher than they look. They need protection from drafts and dampness, but they can take a very low temperature without harm if they are dry and well fed.

In two days they are sassy and raring to go, and as playful as monkeys. They love a sham fight; they love a race. A seesaw in the kid yard will always be in use, and they adore a springboard from which they can leap with all manner of fancy twists and twirls (page 637).

Incipient horns are removed when the kid is four or five days old. Whether a goat is to be naturally hornless or not appears a matter of inheritance, or perhaps personal preference as to style of head gear. Certainly it has no relation to sex or breed. But the toss of a horned head, even in play, can be damaging to another goat or to a person, especially a lady goat keeper who wears glasses. So we always disbud.

We can tell immediately whether incipient horns are there. If they are, the skin on the horn spot is fixed rigidly to the skull; if not, the skin moves freely over the bone. The electric disbudder makes the atmosphere smell horribly of burning hair, but the whole operation is over in a minute. The kid, after the first cry of pain, gives no indication of discomfort. Hair grows quickly over the scar.

Four Kids Fed at a Time

Except for feeding, there is little work involved in raising kids. But the feeding is undeniably a chore. When the babies are small, they must have their bottle of warm milk at least four times a day. We use Coca-Cola bottles and lamb nipples, which are longer than baby nipples. In time we learned to feed four kids simultaneously, holding one bottle in the right hand, two in the left, and one between the knees.

Kids can be taught to drink from a basin, but then they almost always gulp too fast, with resultant tummyache. Besides, the long Nubian ears, like the ears of cocker puppies, can get very untidy from dragging in the milk. Of course the kids would thrive just as well, perhaps better, if they were permitted to nurse. But that is not possible if a herd is to be on official test for production.

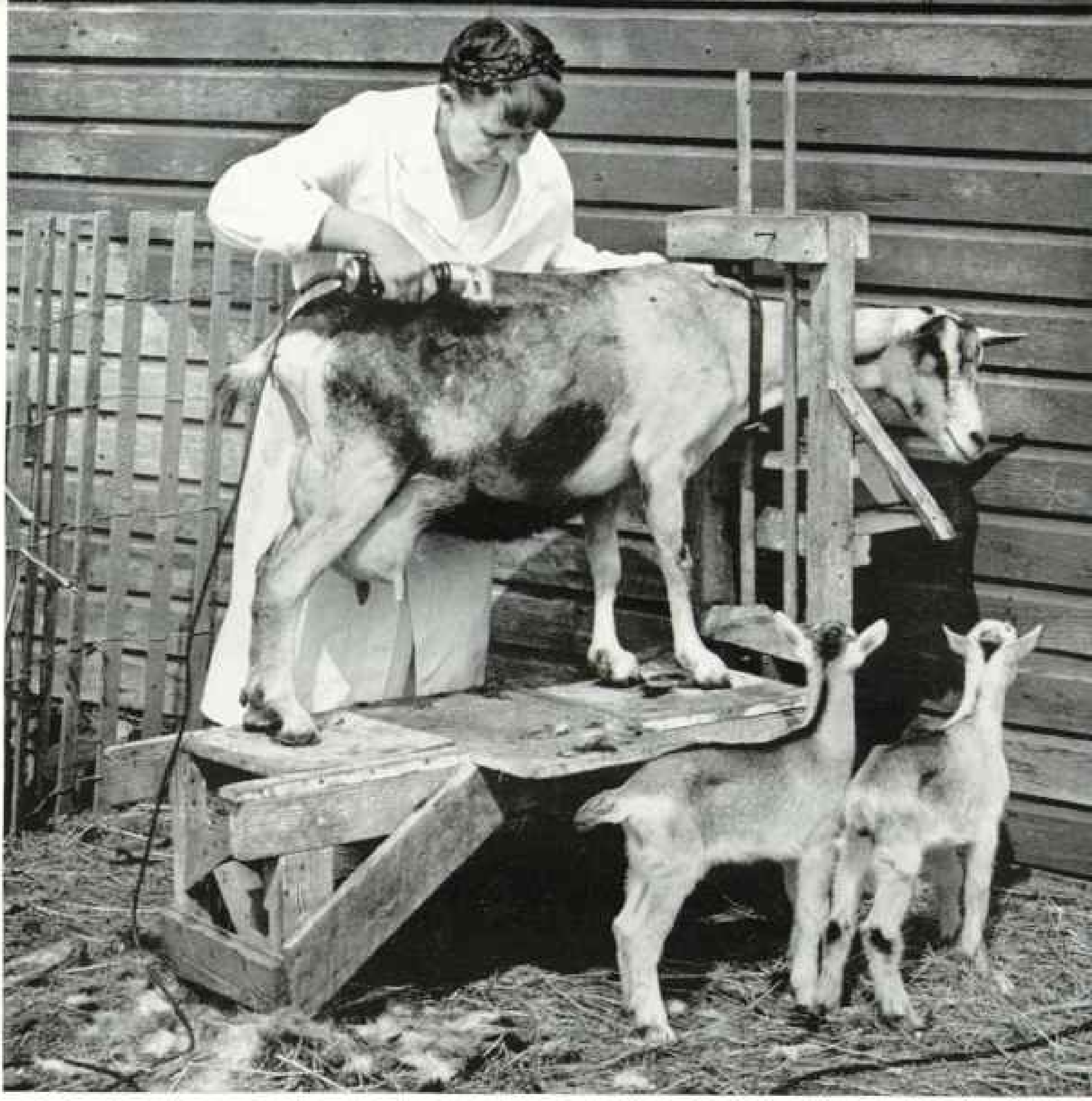
The official test is, we feel, good advertising. Even more important, it gives us information of use in our breeding program. The same tester who visits cow dairies in our vicinity comes to the farm once a month. He weighs the production of each milker, tests samples from each for butterfat content, and turns the records over to the Farm Bureau and the registry society.

Surplus Milk Is Problem

These reports give irrefutable evidence concerning which animals are the best year-round producers, both in quantity and in quality. They provide official, impartial facts to wave in the faces of doubtful customers. And, over the years, they tell us whether our bucks are improving the herd.

We found we could expect as much as six or seven quarts of milk a day from a good doe when she first freshens. A reasonably good one can average two quarts a day during a lactation period of about 10 months.

At the beginning of our enterprise, while we still had few animals, we used all the milk in the house; but by freshening time of the



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Juliette and Rum Butter, Day-old Twins, Watch Their Mother Get a Haircut

Mrs. Nicholds trims her does to promote their comfort and to keep loose hairs out of the milking pail. Lavonne, an Alpine, stands on a milking platform and enjoys the operation except when the clippers tickle.

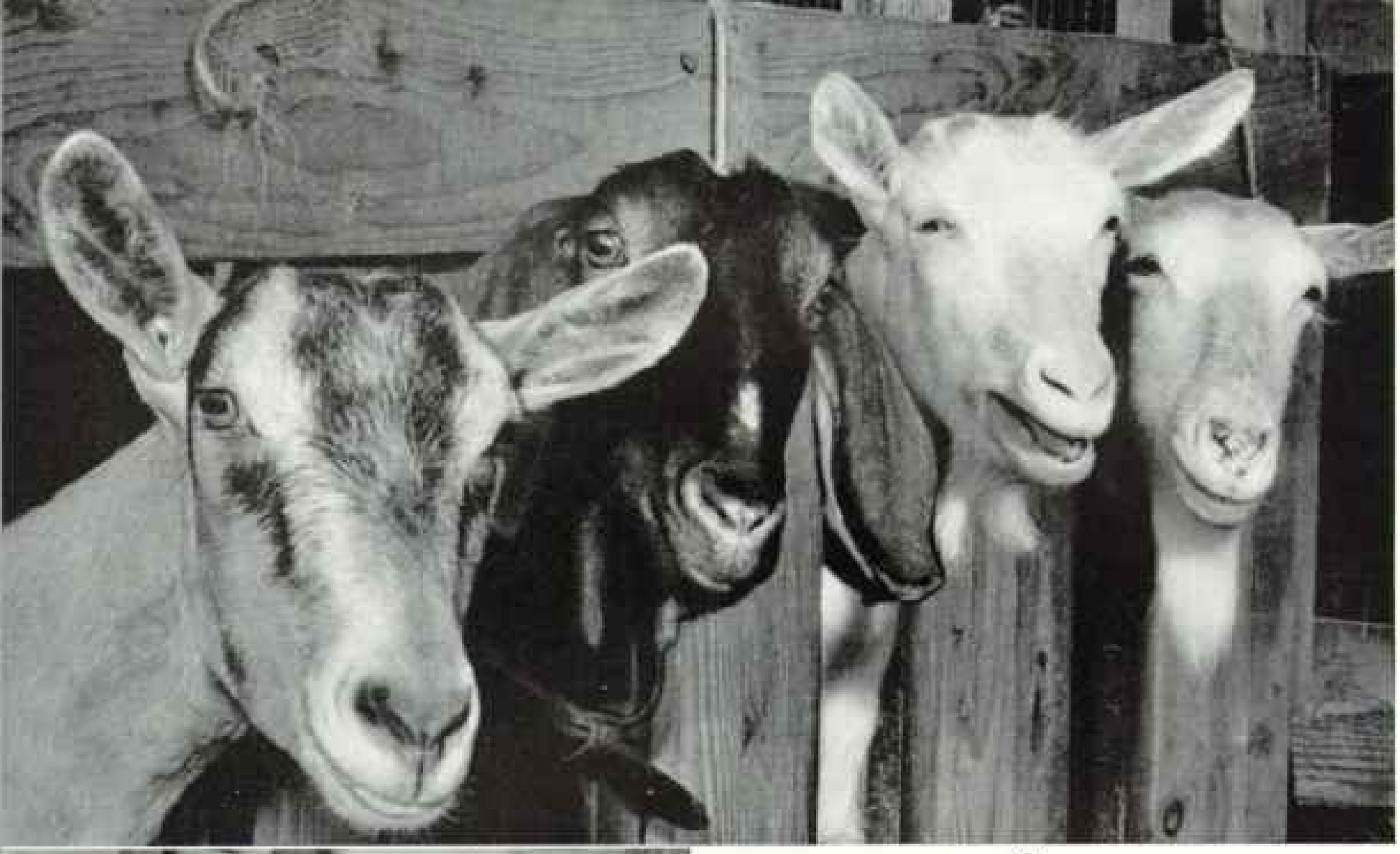
second spring we were putting surplus milk through the separator, happily using quantities of cream on the table, and feeding skim milk to a pig bought for the purpose.

Eventually even the cream got ahead of us, and we began making butter, white unless artificially colored, but of excellent texture and flavor.

We turned the crank of the heavy separator until our arms ached. We made butter until the walls of the freezer spread at the seams. We ate butter cookies, sour-cream cakes, whipped-cream desserts, potatoes fried in whole butter, and rich puddings piled high with hard sauce until we, too, were spreading at the seams. The time had come when we had to find a market.

I called on hospitals and was told that, yes, goat's milk was admirable stuff, that they bought it by the case—dehydrated. Next I covered the local cheese factories and was told that goat's cheese makes fine eating but cannot be produced domestically at a price to compete with the imported product. I also visited a number of doctors, especially skin and allergy specialists in Oneonta, our nearest city, only to be reminded of health regulations which prevent delivery of unpasteurized milk.

I made a few gestures toward selling butter,



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↑ Thunder Hill's Inspection Committee

This conclave shows three of the four principal milk-goat breeds imported into the United States (page 626). Rugged Faye represents France's Alpine; black Ginger, Egypt's Nubian; and white Star and Expectation, Switzerland's Saanens. Another prominent Swiss breed is the Toggenburg (page 628).

← Does rarely qualify as doting mothers, but for a couple of days after giving birth they are properly maternal. At maturity they often produce twins, occasionally triplets, sometimes quads or quints. Here Ursale, an Alpine, yearns for Mother, who fastens her attention on a distant attraction.

but gave up the effort when I found I could ship cream by the can to a butter-making concern that combined it with cow cream. They paid me more for it in the fluid form than I could get at home after transforming it into butter. However, that price still gave me a return of less than eight cents a quart for whole milk. I wanted more, as who would not? I would, I said, go into cheese making.

Cottage Cheese Was Simplest

Having decided how I would spend my first $10,000, I read up on cheese making and soon was hard at it. Cottage cheese was the simplest and had the added appeal of being made from skim milk, permitting the sale of most of the cream.

To make it, the souring skim milk is held at 70°, or about room temperature, until it clabbers; then it is heated very slowly to 100°, being stirred just enough to distribute the heat evenly. The curd is now lifted out and drained, usually in a sugar sack suspended over the kitchen sink. Next morning the cheese can be

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Kids at Play: Ursule Sails Off a Springboard; Laura Awaits Her Turn

Ursule attached herself as a shadow to the photographer on his visit to the farm. Mischievously she nipped his shirt buttons, stole his tobacco pouch, investigated his cameras, and carried on unintelligible monologues.

salted and eaten, with or without the addition of cream. The whey can be fed to the pigs.

I got a good product at once, and in no time at all a food market in town agreed to take all I could turn out. This promised well, but town was 20 miles away. If the cheese was delivered every day, transportation costs ate up the profits. If it was held over to be delivered once a week, it spoiled. We never solved the difficulty, and in the end went back to making just enough cottage cheese for ourselves and feeding the skim milk to the pig.

A cured cheese was the thing, I decided—a Roquefort type, for example. True, in France the original Roquefort is made from sheep's milk and is cured in deep cold caves where the humidity is high and air circulates continuously. But I would use my cellar, which was cool and damp, as a substitute.

I followed directions—heated the milk with the required deliberation, added rennet, added penicillium mold, dipped the curd into homemade forms made from coffee cans whose bottoms had been cut out, turned them faithfully four or five times a day for three days, salted them carefully, and put them in the cellar for curing.

Cheeses Turn Yellow and Pink

As the weeks went by, odd things seemed to be happening. Horrid little black bugs got into the cheeses. Some of them turned a no-thank-you saffron yellow. Several turned deep pink. A good many of them developed a disgusting slime.

After months of effort I wound up with a scant two dozen cheeses that appeared possible. When we cautiously opened one, we

found it had a most dismaying authority. A visitor with a more sophisticated palate pronounced it delicious, but I could not bring myself to eat the stuff.

I would try another variety, I said. So I followed the directions for making a "small holder cheese," a Pont l'Evêque type. This turned out to be comparatively simple to make, although, unlike Roquefort or cottage cheese, it had to be pressed.

I used coffee cans again as forms and, for weights, Mason jars filled with wet sand. The flavor of the resulting cheese was excellent, although a bit mild for some tastes.

I invented a variation by adding liquid smoke and decided I really had a good thing. Then, just as I was dreaming of a nationwide mail-order market, I found to my discomfiture that, although this cheese remained tasty for a few days, it did not improve with time under any conditions I could provide.

Sadly I had to conclude that one could bring off a fine uncured cheese with very little trouble, but that only the best of luck and the most expensive of controls could ensure success with a cured cheese. I resigned myself to making no more cheese than we could eat ourselves.

Bobby Liked Cows Better

During all of this time, while I had been occupied with the problems of breeding, feeding, grooming of the goats, and with efforts to find a profitable disposition of their product, Bobby had, season after season, done the plowing and the planting on the farm. She had done carpentry work as required. She had even, singlehanded, put a new metal roof on our 90-foot barn. She dug a 4-foot ditch to carry water pipes from well to barn and fitted the pipes and welded the joints. She saved our financial lives more than once.

But Bobby liked cows and chickens better than goats. Besides, she was young and good-looking. So, a year or so ago, we realized that the time had come for Bobby to part from us and establish a life of her own. She went her way, and the elderly twins and I left the big farm to take a 20-acre place closer to town, reducing the goat herd from 50 to 15 to fit the smaller quarters.

Before this last move we had paid little attention to the sale of fluid milk. Goat dairies can be profitable if they are close to a consistent market, but we had no canneries available, no dehydrating plants, no goat-cheese factories. And a retail milk route was out of the question. So, except for the five or six quarts of milk a week which customers came to the farm to buy, we had confined ourselves to the sale of cream, which could be shipped either sweet or sour, and to the more profitable sale of stock, a less perishable commodity.

Then not long after we had moved and our herd had been reduced, an unexpected interest in goat's milk threatened to sweep us off our feet. This came about partly, perhaps, because we were now nearer town and more accessible, and partly as a result of the appearance of a book I had written with no thought of goat publicity but rather as a mildly amusing tale of experiences on a goat farm.*

Darkened Pens Fool Does

Whatever the cause, the new demand for milk brought a host of new problems.

For one thing, we must now pay more attention to securing a year-round supply of milk. The goats are not cooperative in this matter, preferring to breed in the fall, freshen in the spring, flood us with milk all through the summer, and dwindle off in winter.

This was all very well when we were making butter to be frozen and stored, or shipping cream to a plant willing to take much or little as it came. But a customer whose baby depends on goat's milk is not pleased by excuses in January even if there is a surplus in April.

We resort to trickery, such as keeping the doe in a darkened pen for a month or so before breeding. I do not pretend to know why this is effective, unless it fools the doe into thinking the short days of autumn are here again. Or we feed her a low protein diet for a month. Or we tie the doe where she can see and smell the buck. Or, in the case of unbred yearlings, we leave them with the buck night and day, trusting to his powers of persuasion.

Time Tells for Both Women and Goats

Nine years have slipped by since we started our goat ranch. It is hard to believe. Each year brings planting time and harvest time, and winter when we plan for another year, breeding time and freshening time and summer when we bring in the grain and hay to feed the goats through another winter.

Years march on, for woman and goat alike.

* *Thunder Hill*, by Elizabeth Nicholds, Doubleday & Company, Inc., New York, 1953.

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© Ballin, Rapho-Guillumette

Incredible as It Seems, Tree-climbing Goats Browse on Shaky Branches in Morocco

This sight is not new to Africa. A bas-relief discovered in a Pharaoh's tomb depicts goats 45 centuries ago feeding in argan trees such as these. Argans grow wild in orchardlike forests. Other parts of the world know nothing like them save a few imports. Kernels of the fruits yield cooking oil; foliage provides camel fodder. French Morocco, which taxes goats, has 8,000,000 like these two. Few mountain goats show a keener sense of balance.

640 R. A. Richardson

A Kid Atop a Mailbox Inspects His World

Goats, Mrs. Nicholds found, are as ornery as boys if permitted to feel unloved. "Capricious?" she asks. "Of course. Aren't they the caprine breed?"

The twins are slower, more stooped, and they no longer put up preserves. They can't decipher the recipes any more. Print, they say, is dimmer than it used to be. I was middle-aged when we started; now the half century is crowding me close.

Not one of the goats we had when we started is left. Gentle Bernadette has gone, and Susie, who mothered the lamb. Zest has gone, but Rusty, her equally arrogant daughter, is still very much with us. Rusty is the one who leans over the pen to twitch the kerchief from my hair and, when I turn indignantly, gazes out the window as if to say it must have been two other goats.

Rusty is the dowager now of the whole Nubian line at Thunder Hill. We have her daughter Ginger, who once was caught in the crotch of a tree and hung there, upside down, for hours before we found her. The accident left her paralyzed for a long time, during which we massaged her legs and fussed over her until, when she finally recovered, she had firmly fixed in her caprine mind that a limp and a wistful look would earn her all the special attention she craved.

For two years after that incident we did not get a healthy kid from Ginger. Finally, however, Karen was born—Karen with the long, silver ears that she persists in chewing, a habit as bad as biting fingernails.

Author Feels Amply Rewarded

We have aristocratic Alpines in the herd now, too. There are even five white Saanens to decorate our green pastures: Grandma, old and rheumatic but still giving us ample milk, and Grandma's daughters: Star and Expectation and Gloria, and Grandma's granddaughter, Nancy. Any day now there will be great-grandchildren.

These nine years have been rewarding, less perhaps in terms of cash than in terms of inner satisfaction. There is the thrill of successfully meeting the challenge of breeding and management problems. There is the deep satisfaction of being able to supply a commodity to people who badly need it and have no other place to turn for it.

But most important, there is the joy of living with fundamental things and knowing that living creatures depend on us for affection, for help, for their very existence.

Rhododendron Glories of Southwest Scotland

Admiral Sir Frederick Dalrymple-Hamilton, of *Bismarck* Battle Fame, Plays Host on a Tour of Floral Displays from Many Lands

By David S. Boyer

National Geographic Magazine Staff

With Illustrations from Photographs by B. Anthony Stewart and the Author

An air traveler circling the world eastward from Newcastle, England, along the 55th parallel of north latitude, would fly over some of the world's bleakest areas—including Siberia, the Aleutians, and Hudson Bay—a route for mufflers and mittens most of the way. If he touched down in southwestern Scotland at that latitude, however, his route would become a path of rhododendrons.

Here in the counties of Ayr and Wigtown an unusual and fortunate climate prevails—cool in summer, mild in winter, and heavy with humidity at all times. Here also are soils of loamy peat and sand. All this is just what the doctors of botany prescribe for the raising of evergreen rhododendrons and their usually deciduous cousins, the azaleas.

Gulf Stream Provides Mild Climate

Off these shores, in the narrow North Channel between Ireland and Scotland, flows a branch of the Gulf Stream System. Warm waters, exerting a genial influence over much of northern Europe, bathe the Wigtown peninsula on three sides (map, page 644).

The equable elements here are joined by a high Scottish esteem for flowers and an intense devotion to the care of gardens. The result is one of the most striking displays of floral splendor in either hemisphere.

At the invitation of a National Geographic Society member—Admiral Sir Frederick Dalrymple-Hamilton, a distinguished British naval officer now retired—chief staff photographer B. Anthony Stewart and I came to Scotland to make the photographs accompanying this article. Our host, as a native of the Scottish rhododendron coast, served enthusiastically as our mentor and guide while we recorded the gorgeous blooms at the height of their beauty and color.

Early in the morning toward the last of April, the conductor on the overnight train from London wakened us at Stranraer and brought us tea and biscuits.

Into a soft mist at the shore of Loch Ryan our train discharged passengers for the ferry to Larne in Northern Ireland, often visible from a height on a clear day across the North Channel.

A hotel limousine took us to Portpatrick on the channel coast (page 651), and from there we telephoned to the Admiral, who said he would drive down to meet us.

We had barely time to order breakfast and to survey from the hotel window the pocket-sized Portpatrick harbor. There nestled a trio of fishing boats of the herring fleet, and beside them, in bright new red and blue paint, the emergency craft of the Royal National Life-boat Institution.

The jovial Admiral bustled in, and soon we were skimming along the high road in his little gray estate wagon, while he regaled us with stories about the Scottish countryside.

In tweed and knickerbockers our host was a little difficult to picture commanding HMS *Rodney* when that British battleship helped sink the pride of Hitler's Navy, *Bismarck*, in 1941, or immersed in formalities as head of the British Naval Staff, British Joint Services Mission, in Washington after World War II.

Now he seemed just a gentleman farmer, thrilled that the rhododendrons of his neighborhood were making such a good show, and anxious to see the National Geographic's color cameras trained on them.

Lakes Unite Garden Layout

Within an hour's driving distance of each other, the Admiral told us, three truly fine rhododendron gardens were already aflame with the full glory of springtime bloom. He would take us first to the imposing, formal Castle Kennedy gardens. There one of the finest collections of "rhodies" was located just inland from Stranraer. They are known also as the Lochinch gardens, from the owner's residence (pages 642, 658).

Our first breath-taking glimpse of Castle

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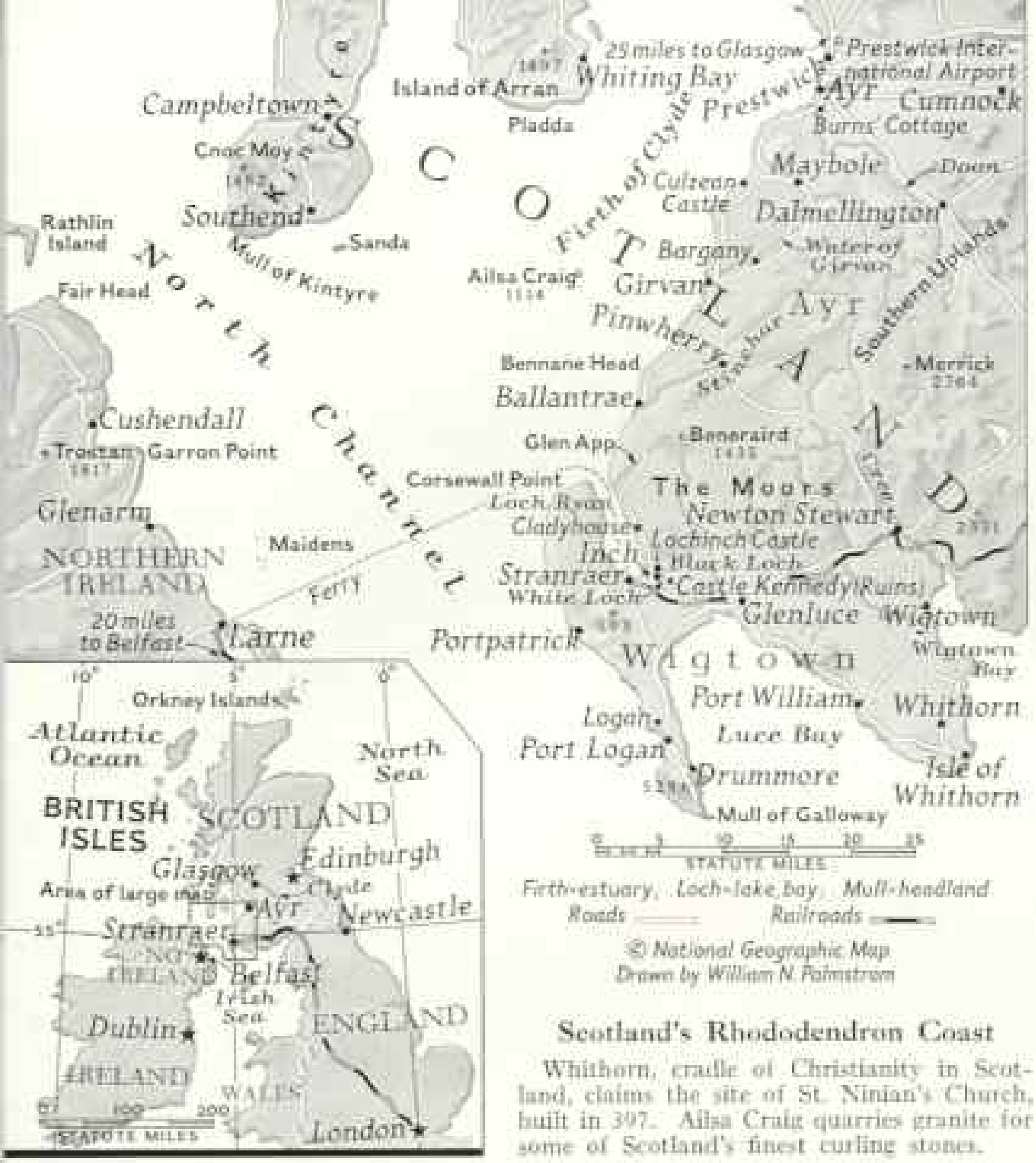
Tree-size Rhododendrons Burst with Color in Scotland's Castle Kennedy Gardens

Scotland lies in Siberian latitudes, but the warming Gulf Stream System turns her southwest coast into a greenhouse. Gardens of surpassing loveliness display rhododendrons and other imports, many semitropical.

643 Kodachrome by National Geographic Photographer B. Anthony Stewart

Grass-carpeted Avenues, Best Traversed by Car, Thread the Parklike Grounds

Lady Stair of Castle Kennedy chats with Admiral Sir Frederick Dalrymple-Hamilton. Rhododendrons are Loder's White; *arboreum* hybrids, including Altaclarense (upper left); and *nobile* (right), which bloomed a month earlier.



Scotland's Rhododendron Coast

Whithorn, cradle of Christianity in Scotland, claims the site of St. Ninian's Church, built in 397. Ailsa Craig quarries granite for some of Scotland's finest curling stones.

Kennedy's glories convinced us that our trip would be worth while. Here were rhododendrons from the Himalayas in India, burdened with blossoms to a height of 40 feet. The towering trees appeared even higher because of their commanding stations on banks and ridges.

The gardens surround and lie between a pair of lochs. I wondered how an angler, in the midst of such distracting beauty, could cope with a fighting trout.

Once called Loch Kryndil and the Loch of Inch, the lakes are now known as the Black and White Lochs. Pointing over the heads of a pair of wild swans nesting on the Black Loch, the Admiral directed our attention to the largest island. In primitive times it was the site of a lake dwelling, he told us. Only its inhabitants knew the location of the submerged causeway that was the sole means of access to it.

The White Loch's biggest island lies not far offshore from the old parish church of Inch, now a ruin surrounding a burial ground. Tradition has it, the Admiral said, that a small house on the island provided a retreat for the laird (the landowner) when he found the minister's sermon tediously long.

"Those were the days of 'hourglass sermons,'" he explained, "when the minister, in reprimand to his congregation for fidgeting, was wont to turn his hourglass upside down —and begin again."

Castle Kennedy's lochs, though they cover 280 acres and invest the estate with breadth and nobility, still are small enough to be wholly incorporated into the garden plan.

Behind them, to the east, Scots pine trees fade into purple-gray haze on the hills, a blended background for the scores of species of pine, cypress, sequoia, cedar, and other conifers brought here from around the world. Evergreens and many varieties of hardwoods are planted with taste and ingenuity. They form in their turn a natural backdrop to massed rhododendrons, terraces, and water.

Practically, they shelter the rhodies and other tender shrubs against strong winter winds.

Laird of Castle Kennedy vistas today is Sir John Dalrymple, the twelfth Earl of Stair, cousin of the Admiral and descendant of the second Lord Stair, who designed the original gardens.

The second Earl served as Commander in Chief of H. M. Forces in South Britain and also bore the honorary title of Vice Admiral of Scotland. He laid out Castle Kennedy during a period of retirement beginning in 1720, after ending a 5-year assignment as British ambassador to France.

Cavalrymen Laid Out Castle Kennedy

Despite the fact that his formidable 17th-century castle had recently burned, Lord Stair laid out his gardens geometrically about it. In the formal design he was no doubt influenced by the stately lines he had seen in the landscaping at Versailles.

Two cavalry regiments, the Admiral told us, the Scots Greys and the Enniskillen Dragoons, provided the labor force. With their

Kodachromes by National Geographic Photographer B. Anthony Stewart

Gardener and Admiral Cut Prize Rhododendrons for the Royal Horticultural Show

Robert Rye (left), Castle Kennedy's head gardener, has won honors for developing many rhododendron hybrids. The bell-shaped white blooms on the table directly in front of Mr. Rye are the hybrid Lord Stair, named for the estate's owner. *R. arboreum* here grows in its white variety; *R. augustinii* shines in lavender.

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Lady Stair Protects Show Blossoms with an Umbrella

"A gardener is Scotch as a French teacher is Parisian," wrote George Eliot. Nobody exemplifies this pronouncement better than Lord and Lady Stair of Castle Kennedy, who maintain acres of magnificent plantings set out by their family during more than two centuries. Each spring they lovingly crate dozens of their finest blooms and escort them by overnight express to the Royal Horticultural Society's Rhododendron Show in London.

help, Lord Stair cut avenues through woodlands and built and planted embankments.

Those early days, no less than modern times, offered wage-scale troubles. In April, 1731, Lord Stair's gardener reported: "Plenty has had a bad effect amongst the labourers, for they want great wages and care not whether they work or not." The going rate for garden hands 223 years ago was sevenpence a day!

Under succeeding earls the gardens prospered. Then came "Hobbling Jack," seventh Earl of Stair, nicknamed for a leg ailment. Under his regime trees were cut down for sale, and the gardens reverted to a wilderness of brier and heather. The design of terraces and vistas was not lost, however, and by 1860 his heirs had restored the grounds to their former beauty.

Today the gaunt, ivy-mantled ruins of Castle Kennedy (page 650) look out with empty-socketed eyes across a lawn which slopes to the Round Pond, the center of all the avenues and glades of the garden. Here are concentrated in late April, and again with later-blooming varieties in May, delectable feasts of rhododendron color.

Reflections in the Round Pond compound the display. For relief from this splendor one must turn his eyes from time to time toward the hills, or down a cooling corridor of waving, blue-green monkey puzzle trees (*Araucaria imbricata*).

Azaleas, their narrower and thinner leaves contrasting with the broad, leathery leaves of the rhodies, contribute to the radiance about the pond. Magnolias, holding up their extravagant bursts of creamy bloom, add to the profusion. Wherever we wandered throughout the garden, with its numerous unexpected rhododendron plantations behind hedges and amid sheltering trees, we could not forget the Round Pond.

"Rose Trees" of Greek Origin

Lord Stair himself escorted us down an avenue where ranks of dangling pine-needled monkey tails trailed from a colonnade of tree-tops to brush our shoulders. Striding up a bank, he rapped a 10-inch tree trunk with his stick, by way of demonstrating why rhododendrons are called "rose trees" (from the Greek *rodon*, a rose: *dendron*, a tree).

"Fifty years ago," the Admiral noted as we followed up the bank, "we children delighted in sliding down these slopes on tea trays."

The original banks and military-style parapets, carved by the cavalrymen out of rough heath and moss land, used to be mown as

Author and Hosts Enjoy a Spring Picnic at Cladyhouse near Loch Ryan

The accompanying story of Scotland's world-famous gardens came about through the hospitality of Admiral Sir Frederick Dalrymple-Hamilton, who entertained author Boyer and photographer Stewart and guided them about the rhododendron coast. Cladyhouse is the Admiral's home. Since the photograph was made, he has become Laird of Bargany, to which he recently fell heir on the death of his brother (page 656). Here Mr. Boyer (in sweater) listens while the Admiral with his wife and daughter Christian reminisce about their years in Washington, D. C., after World War II.

smooth as a bowling green. Today's austerity, to which the last war and postwar restrictions and taxes have accustomed landowners, prevents maintenance of the gardens in their former state of meticulous perfection.

But austerity does not extend to the love and care lavished upon the flowers themselves. We found Lady Stair, in heavy tweed skirt, out cultivating her flower garden at the side of the new 19th-century Lochinch Castle fronting on the broad vista of the lake (page 648).

Together the Stairs often lead a party of garden lovers through the groves and avenues a mile distant at the far end of the lakes. Since 1920 they have constantly added new varieties of rhododendrons and other shrubs and flowers to their gardens.

Tony and I caught some of their contagious excitement as they prepared for the annual rhododendron show of the Royal Horticultural Society. With head gardener Robert William Rye (page 645) they visited every section of the garden, selecting blooms for competition.

Over one choice specimen Lady Stair stopped to adjust an umbrella (opposite). This incongruous shelter guards the blooms against damage by rain and sun until the great day of picking and crating, when Lord and Lady Stair and Mr. Rye escort the entries in person on the overnight express to London.

Rain, wind, and sun are not the only saboteurs, however, which imperil the winning of blue ribbons. Roe deer attack rhododendron bark and leaves. Rabbits sometimes destroy the bark and are a real menace to softer things like seedlings.

Lochinch's Feudal Air Deceives the Eye; the Castle Dates Only from 1867

Gardens, terraces, and groves spread in magnificent but bewildering complexity for many acres around Lochinch Castle. Two cavalry regiments laid out the original design in the 1720's for the second Earl of Stair, commander of Britain's armies. A diplomat as well as field marshal, Lord Stair was inspired by the Gardens of Versailles, which he often visited while ambassador to France.

Today's owner, the twelfth Earl of Stair, lives amid the gray stone walls, pepperbox turrets, crowstepped gables, and gargoyles of this Scots-French-style château. Seventeenth-century predecessors lived in huge old Castle Kennedy, which still lifts massive crumbling walls on the estate.

Near-by Logan estate, like Castle Kennedy, has some of Scotland's finest rhododendron collections (pages 652, 660). This young lady relaxes amid *kaempferi* azalea (left) and two rhododendron hybrids, Grenadier (top) and Lady Rosebery (right).

↑ **Tales of Ghosts and Echoes of History Linger Around Castle Kennedy's Gaunt and Ivied Ruin**

The formidable 10-foot-thick walls of this keep were erected in James VI's time by the Kennedy clan, who lost both castle and lands to its hereditary enemies, the Dalrymples. Adjacent plantings relieve the grim lines of the structure, which has been forsaken since fire swept it in 1716 (page 644).

↓ **Ships Sailing for Ireland Once Kept Portpatrick Busy; Today the Harbor Shelters Only Fishing Craft**

Holidayers visiting Portpatrick to enjoy the wild seacoast and the near-by gardens are told that St. Patrick often leaped the 21-mile North Channel. Here early-morning light slants across rolling dairy pastures, fissured cliffs, and smoking chimneys. A few workmen plod to their chores.

Kodachromes by National Geographic Photographer B. Anthony Stewart

↑ **Giant Blossoms Excite the Pride of Olaf Hambro, Logan's Owner**

Logan is inseparable from the memory of the brothers Kenneth and Douglas McDouall, former owners who filled the gardens with trees, shrubs, and flowers from every corner of the world. Red rhododendron is one of their own hybrids, *griersonianum* x *kookeri*.

↓ **Spiny Hedgehog, an Insect Hunter, Earns the Respect of Scots Gardeners**

This small nocturnal mammal prophesies the coming of spring for Europeans just as the groundhog does for Americans. Some phonograph owners use hedgehog spines in lieu of steel needles. Rhododendrons Earl of Athlone (red) and *ponticum* flank the animal.

Scotland's rabbit population was decimated during the meat-hungry war years, but the animals are now back in force. They popped in and out of burrows on nearly every sunny pasture bank we passed. Gamekeepers on farms and estates still trap the rabbit crop for sale to game dealers and butchers, and they take a dim view of poachers.

Over coffee one night at the hotel we heard from hunters about the comparatively rare black rabbits. Because Scottish Presbyterian clergy wear black robes in the pulpit, black rabbits are called "ministers." Some gamekeepers, so the story went, mentally note where the black rabbits live. If the blacks disappear, it is time to see whether poachers are at work. This gives rise to the joking admonition, whenever one goes out to take a practice shot or two, "Don't shoot the minister!"

Gardeners, apparently, thrive in the moist and moderate Scottish climate and in the pleasant occupation of producing rhododendrons. For at least 87 of the past 101 years there have been rhododendrons at Castle Kennedy, and during all that period just four head gardeners have reigned over the estate's beauty. Mr. Rye, who has developed many new hybrid varieties among the large family of fragile, showy rhodies, is in his 28th year as head gardener.

We picnicked one noontime on the lawn of Admiral Dalrymple-Hamilton's hillside home, Cladyhouse, overlooking Loch Ryan (page 647). Our hostesses, Lady Dalrymple-Hamilton and her daughter, Christian, reminisced happily about their years in Washington while we munched homemade scones, oatcakes, and sandwiches and drank the Admiral's superlative cider.

Garden in Family 700 Years

He would take us in the afternoon, he said, southward from Stranraer towards the southernmost tip of Scotland. Here on a narrow finger of land grows a garden which has remained in one family for some 700 years. It is a mecca for garden lovers from around the world.

As we approached the house of R. Olaf Hambro at Logan, down a drive arched over by rhododendrons, the Admiral recounted a bit of Logan history (pages 649, 660).

Logan's gardens, with their high Old World walls and hedges, were started approximately in the year 1200 by the McDouall family. Their modern era dates from 1869, when the Mrs. McDouall of the time planted eucalyptus trees and introduced shrubs, liliums, and roses in large numbers. As in most gardens of that day, fruits and vegetables also were included.

In 1896, however, Mrs. McDouall's son, Kenneth, succeeded as laird. He soon shunted the fruits and vegetables outside his walled Eden. Their favored and sheltered spots he reserved for flowering shrubs, including rhododendrons. These and other delicate and decorative plants he imported from all parts of the globe.

Joined by his brother, Douglas, in 1910, he further transformed Logan, extending its flowered area to woodland spaces and through a glen which runs westward down to the sea.

Plants from China and Himalayas

From this glen one obtains beautiful views of the Wigtown coast, framed in a foreground expanse of primulas growing as if wild where McDouall flung handfuls of seed from an inverted umbrella (page 657). Stretches of *Primula japonica*, or Japanese primrose, as well as many of the rhododendrons which stand sentinel among them, came from China early in this century.

British botanists, including the late George Forrest and Francis Kingdon-Ward, and a British-born American known as "Chinese" Wilson brought these many species of flowers, shrubs, and trees from the Orient. Earlier varieties in Scotland came from the Himalayas. Others at Logan were natives of temperate regions in New Zealand, Tasmania, Australia, Africa, and Chile.

One of the most prolific collectors was Dr. Joseph F. Rock, leader of the National Geographic Society's Yunnan-Szechwan Expedition, 1923-24, and of The Society's Southwest China Expedition, 1927-30.* One rhododendron species, *rockii*, is named for him.

All the rhodies we saw had been introduced from abroad, for not a single species is native to the British Isles.

Where Logan's path emerges on the sea, the curving sand beach is backed by rocky screes studded with clumps of heather and sea pinks. In the spring the beautiful blue *Scilla verna*, or squill, blankets the area.

Admiral Dalrymple-Hamilton stopped here

* See "Through the Great River Trenches of Asia," by Joseph F. Rock, National Geographic Magazine, August, 1926.

↑ Bargany's Woodland Garden Stages an Extravaganza of Azalea and Rhododendron in May. American Cypresses Dot the Islet

↓ Scotland claims not a single native rhododendron. Her spectacular plantings came almost entirely from southern Asia, where hundreds of species thrive in the wet monsoon zone. Botanist-explorers such as Dr. Joseph F. Rock, leader of two National Geographic expeditions, brought out seeds from the mountain fastnesses of China, Tibet, Burma, and India. Rhododendrons (which technically include the azaleas) present infinite variety of color, shape, and size. Leaves of *R. sinogrande* (upper left) may measure nearly three feet. Other specimens are Ivery's Scarlet (red), *campanulatum* (mauve), Damaris (yellow), and Kewense (white).

before a curious old fish pond hollowed out of the rocks. Fed by the rise and fall of the tide, it supported numbers of large fish before the intake was damaged during World War II.

"We used to feed them limpets by hand," he recalled. "The fish were perfectly harmless, but they came for the delicacy with a rush and a splash that sometimes alarmed the timid."

Visitors who stroll through the walled maze to view the delights of Logan are escorted by Mr. Hambro, the present owner (page 652), or by his gardener, Mr. G. Steadwood. The inheritors of the floral riches accumulated by the brothers McDouall sometimes retell the story of a trusted old gardener who was showing an American lady around Logan.

"Well," the visitor declared on leaving, "I've seen all the best gardens in Britain, but I guess I'll have one like this."

The old Scot regarded his charge for a moment, then turned away to survey the ancient reaches of his garden, with its treasures of New Zealand tree ferns, Australian palms, eucalyptus, conifers, and the galaxy of rhododendrons and azaleas. Then he faced the lady again and in a Scottish accent underscored with reverence replied:

"Aye, but I doot ye'll ha'e to wait a thoosand years!"

One day the Admiral took us to call on his brother, Col. Sir North Dalrymple-Hamilton, at Bargany, in Ayr, northernmost of the trio of outstanding gardens on our tour. Since that time Sir North has died, and the Admiral has become Laird of Bargany.

Eisenhower Has Apartment at Culzean

The road leads along the east shore of Loch Ryan up the beautiful vale of Glen App to Ballantrae and thence along the coast to Girvan. When we were high on a sea cliff, the plum-pudding-shaped island of Ailsa Craig came into view. Here the best Scottish curling stones are quarried. On a very clear day, the Admiral told us, one could see the Irish coast and the Mull of Kintyre, the point of Scotland thrusting closest to Northern Ireland. Also visible sometimes is the Isle of Arran.

When Robert the Bruce, the Admiral continued, was summoned from Arran by flares to assault the mainland and fight for his throne, he landed near the Scottish residence of the Marquis of Ailsa, Culzean Castle. We visited the stronghold and saw the top-floor apartment, presented in 1945 by the National Trust for Scotland to General, now President, Eisenhower. The gift was for his lifetime use in honor of his leadership of Allied troops in World War II (page 662).

General Eisenhower first saw Culzean in 1946. In 1951 he took Mrs. Eisenhower and her mother to the crenelated towers overlooking the sea for a week's holiday.

Four miles from Girvan on a road that leads to Ayr, we reached the present house of Bargany, built in 1681 (page 664).

Here, deep in secluded woodland, the Laird of Bargany receives his friends—in the springtime, perhaps, from his terrace, where rabbits skitter through an acre of daffodils and dash beneath rhododendrons along woodland trails; in summer, it may be, beside a quiet lake, where gaudy ring-necked pheasants are dulled by contrast with the glory of massed azalea blooms (page 654).

Prize Salmon Adorn Den

In autumn, likely enough, the scene may be transferred to the seclusion of an old walled garden, where fall flowers surround the harvest of fruits and vegetables (page 663), and in winter to the fireside of the den, a room where salmon taken from Scottish and Norwegian streams with rod and reel merit mounting only if they weigh 40 pounds or more.

Although the gardens here in southwest Scotland are not officially open to casual visitors, neither are they officially closed. No admission fees are charged, and their owners are pleased when appreciative travelers and garden lovers stop to enjoy their beauty.

Scotsmen are aware that only a limited number of great estates of yesteryear can be preserved for future generations. They are anxious therefore to share their botanical treasures now.

Bargany, Castle Kennedy, Logan, and others like them in all their charm reflect the traditions of an earlier time. Today, at bay before heavy taxes and high costs of maintenance, their owners strive against odds to keep up their wonders and make them available for all to view.

In this, the National Trust for Scotland has lent a hand. At the invitation of this patriotic organization, an annual May-month tour of Scottish gardens may be joined by visitors from abroad.

Kodachrome by National Geographic Photographer B. Anthony Stewart

Logan's Enchanting Walk to the Seacoast Is a True Primrose Path

An American, "Chinese" Wilson, introduced these primulas, a type of primrose, from China. Kenneth McDouall broadcast the seed from an upended umbrella. Now the plants grow wild beneath arching rhododendrons.

↑ Rhododendrons Befit a Scottish Garden as Aptly as a Visitor's Kilt

Careful selection and planting create harmonious color schemes lasting six months; April and May make the most luxuriant displays. Here Castle Kennedy's Black Loch peeks between flowering mounds.

→One would scarcely be surprised to hear these burnished copper bells tinkling in the breeze. They are the species *R. dichrocanthum*, a name meaning two-colored flower. The explorer Forrest found this low, crouching shrub in 1906 along the Tali Range in China's Yunnan Province. Colors vary from deep orange to salmon pink. Some experts regard this as one of the best of the small scrub rhododendrons. Francis Kingdon-Ward, however, wrote in *Rhododendrons:* "I would not even grow it on my grave, lest its . . . debased colour of dirty orange peel reminded my spirit of hated marmalade."

Lower right: *R. xanthocodon,* aptly enough, means yellow bell. It is a slender tree reaching 15 to 25 feet.

↓R. Kewense, a hybrid of the well-known species *griffithianum* and *fortunei,* was developed at the Royal Botanic Gardens at Kew in 1874. Buds show deep rose when unexpanded, fading as they open to pale flesh and white. Another cross of the same parents resulted in the magnificent white Loderi.

Admiral Sir Frederick Dalrymple-Hamilton Points Out Logan's Beauties

Logan sits on a narrow neck jutting into the Irish Sea. Woodlands shelter its shrubs from salt spray blown by westerly gales. Ample moisture, even temperatures, and loamy soil make growing conditions ideal.

661 Kodachrome by National Geographic Photographer B. Anthony Stewart

Myriads of Flashy Blooms Set These Towering "Rose Trees" Ablaze

Rhododendrons thrive best when undisturbed by cultivation. Thus some of the most glorious displays have a jungle-like effect. Gnarled boles in this thicket of Russellianum and Altaclarense hybrids may span 10 inches.

General Eisenhower Slept Here: Scotland Reserves Culzean Castle's Top Floor as a Home for World War II's Allied Commander

Culzean, built on a seaside cliff in Ayr, was the seat of the powerful Kennedys. The National Trust for Scotland preserves the 18th-century structure as a showplace. Like near-by Bargany, Culzean exhibits treasures of exotic shrubbery (not shown). General Eisenhower visited the castle in 1946 and 1951.

↓ The late Col. Sir North Dalrymple-Hamilton, with his niece Christian, tours the walled garden at Bargany (page 664). Pear and apple climb the brick in espaliers. Flower beds sparkle with daffodils, wallflowers, muscari, forget-me-nots, polyanthas, and tulips.

Kodachrome by National Geographic Photographer B. Anthony Stewart

Daffodils at 17th-century Bargany Splash the Meadows with Pale Gold

This Ayr country home of the Dalrymple-Hamiltons stands by the Water of Girvan. A drooping Scots pine (left) breaks the vista between house and river. Robert the Bruce landed close by to fight for his throne.

War and Quiet on the Laos Frontier

Everyday Life Goes On Unchanged Within Earshot of the Guns as French-led Forces Battle Reds in Indochina

By W. Robert Moore

Chief, Foreign Editorial Staff, National Geographic Magazine

SOME of these notes are being jotted down in a sagging, stilt-legged Chinese restaurant on the Mekong River bank at Muang Nakhon Phanom, in eastern Thailand. As I write, the flimsy building shudders with the heavy explosions of sporadic mortar fire.

Along with hundreds of local residents who line the river bank, I have a front-row seat at that strange guerrilla warfare going on in Indochina (map, page 669).*

Directly across the half-mile-wide expanse of the muddy Mekong dividing Thailand from Laos perches the town of Thakhek, scene of the fighting. Plumes of smoke rise above the trees behind the town, and an observation plane circles in the sky. Unseen French and national troops are fanning out into the bush.

Towns Frequently Change Hands

Thakhek first came into the headlines in late December, 1953, when the Communist Viet Minh forces reached it in a surprise thrust from the Annam mountains across the narrow waistline of Indochina to slice the country in two.

Now, less than a month later, the French had moved in again. In an offensive mounted at Savannakhet, 60 miles downriver, land forces, supported by river craft and air cover from strategic Seno airbase, struck at dawn to reoccupy it.

As has happened so often in this 7½-year-old war in Indochina, the retaking of the town brought little heavy fighting. Again the Viet Minh guerrillas faded into the bush and the green limestone hills which rise in jagged lumps beyond the river.

In this hit-and-run war no one can say where the real battle will be.

With Thakhek retaken, however, the French were in position to reopen the Mekong for transporting supplies to Vientiane and other towns in northern Laos. Since late December, all goods and personnel had had to go by air. Only fishermen and a few Thai craft had ventured out on the river.

Before the Viet Minh push to the Mekong I had planned a trip along the river to northern Laos and eastern Thailand. "Can I still go?" I asked Thai officials in Bangkok (Krung Thep).

There was a shaking of heads. "We've closed the border and declared an emergency in our northeast provinces," I was told.

A few days later, however, courteous Thai officials gave me a letter asking the border police to grant me "all facilities" for travel.

I understood the officials' concern and caution. Thailand adjoins Laos for roughly 1,000 miles; for more than 500 miles of that distance the wide bend of the Mekong forms the frontier. Thai Government officials were well aware that any successful occupation of Laos by the Viet Minh would bring the Bamboo Curtain right to their border. Already Thailand has had a refugee problem; about 1,000 persons fled from Thakhek across the river, seeking safety.

I flew from Bangkok to Udon Thani in a Beechcraft Bonanza of the Thai Airways Company. From there I rode by bus to Nong Khai on the river, halting for police checks several times en route. Then, with the simple formality of having my passport stamped, I crossed the Mekong in a motorized sampan and rode the 13 miles to Vientiane with members of our United States Legation staff.

Fairs, Boxing, and Dancing Despite War

It is one of the odd experiences of this war to find that life goes on with no marked change, except in actual combat zones.

At Vientiane I found a temple fair in full swing. At night the town echoed with the blare of native orchestras. Through milling, celebrating crowds, I roamed among food stalls and gambling booths, watched Thai-style boxing in which kicking and elbowing were more deadly than fists, and saw taxi

* See, in the National Geographic Magazine: "Indochina Faces the Dragon," by George W. Long, September, 1952; "Portrait of Indochina," by W. Robert Moore and Maynard Owen Williams, April, 1951; and "Strife-torn Indochina," by W. Robert Moore, October, 1950.

W. Robert Moore, National Geographic Staff

The Mekong River Splits the Indochinese Peninsula into Zones of War and Peace

Springing from Tibetan highlands, the Mekong for more than 500 miles separates Thailand from Laos (*maps, page 669*). Laos has been ravaged by hit-and-run war against the French Union by the Communist-led Viet Minh. Here, north of Luang Prabang, the river runs low, but can rise over 20 feet with monsoon rains. The Mekong has thousands of narrow boats; one with an outboard, as here, is a rarity.

dancers reap a harvest of piasters acting as partners to local gay blades.

Every morning I awoke to the bustle of people going to market. Hundreds of vendors trotted along the streets to the central market square, carrying trays and baskets of vegetables, fruit, fish, live poultry, and rice (*page 668*).

In the parade, too, were numerous shoppers on bicycles. Not until I saw the bicycle parking ranks beside the market did I believe so many vehicles could be crowded into a single square (*page 680*).

The only person I saw in the market who was busier than the bicycle attendants was a woman trying to keep a large bowlful of squirming eels from escaping. Time after time she turned the slippery creatures back; finally, in disgust, she dumped them into a basket and firmly clamped down the lid.

Vientiane reminds one more of a country town than a capital city. Oxcarts creak along the streets, and water buffaloes wallow in pools fringing gardens and rice fields. Biggest buildings in town, except for a few government offices, are the Buddhist temples.

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French Department of Information

American Equipment Helps the French Union Fight Democracy's War Against the Reds

Viet Nam paratroopers won glory in January, when the Communists had a stranglehold on the narrow waist of Indochina north of Savannakhet. Dropping from the skies, they spearheaded a campaign that thrust the enemy back from the Mekong. These men wear uniforms and helmets supplied by the United States. The trooper on the parapet aims an automatic rifle. His companion holds a submachine gun.

The country, however, has little need for a large capital. Though the kingdom is twice the size of Pennsylvania, it has only about 1,186,000 people.

Capital Reflects French Influence

Thanks to the French, who built residences and offices facing the Mekong, there is a pleasant parklike spaciousness along the river front. During low water, however, one is scarcely aware that the river exists. All one sees is a wide expanse of sand bar covering the stream bed far below the level of the banks. The main channel, half a mile away, is almost completely hidden.

But in summer, when the monsoon rains pour into the 2,600-mile-long Mekong, a mighty brown flood sweeps past Vientiane. The channel is filled to the brim—a rise of more than 20 feet.

The port—if the riverside bank where barges, small motor launches, and a few steam-powered craft halt can be called a port—is at a bend about three miles downstream from town.

In language as in the buildings, the capital reveals marked French influence. Though the

W. Robert Moore, National Geographic Staff

War May Be Near, but It's Business as Usual in Vientiane, the Laotian Capital

Opening at dawn, the street market sells everything from fruits and vegetables to live eels and poultry. These women arrange heaps of chili peppers, a favorite Laotian condiment. White pans hold ground peppers sold by the tiny dipperful and wrapped in banana leaves. Government departments operate in Vientiane; King Sisavang Vong lives at Luang Prabang in the hill country to the north.

Laotians have recently gained autonomy, they have not changed the French street names. French, too, is essentially the language of government. Main mark of the new self-government in Laos is an imposing building now nearing completion for the Council of Ministers. It stands out boldly at the edge of town on the way to That Luang, largest and most venerated *stupa*, or shrine, in Vientiane.

I found that a few Laotian officials could speak English, and more now are studying it. One of the staff members at the United States Legation also has been asked to teach English to *bonzes* (Buddhist monks) in a temple school.

Though Vientiane is capital of Laos and seat of government, its King does not live here. Instead, he maintains his palace and court at Luang Prabang, located in quiet isolation in the mountains, 130 miles farther north on the Mekong.

Formerly one could reach the royal town only by slow river journey. Boats made the trip in one week or three, depending upon the stage of the water. Now one can fly. There also is a dry-season road through the moun-

INDOCHINA

Kingku
Kienshui (Linan)
Wenshan (Kaihwa)
Szemao
Mengtsz
Ha Giang
Yungning (Nanning)
Henghsien (Hengchow)
Muong Ou Neua
Lai Chau
Bac Kan
Tsungshan
Hoppo (Limchow)
Phong Saly
Dong Son
Keng Tung
Bun Tai
Tuan Giao
Thai Nguyen
Pakhoi
Mowming (Kochow)
Muong Khoua
Dien Bien Phu
Phuc Yen
Hanoi
Haiphong
Muong Sai
Hoa Binh
Do Son
Luichow Peninsula
Chiang Saen
Sam Neua
Phu Ly
Nam Dinh
Luang Prabang
Pak Hou
Phu Nho Quan
Ninh Binh
Thanh Hoa
Gulf of Tonkin
Muang Phan
Xieng Khouang
Cheongkong
Hainan
Hoihow
Kiungshan
Chiang Mai
Highway 7
Lokwei
Muang Lampang
Borikane
Vinh
Muang Phrae
Pak Sane
Kam Keut
Nape
Aihsien
Lingshui
Vientiane
Nong Khai
Lak Sao
Cap Mui Ron
Yulin
Cape Bastion
Uttaradit
Udon Thani
Muang Loei
Muang Nakhon Phanom
Thakhek
Mahaxay
Highway 12
Muang Sakon Nakhon
Tak (Rahaeng)
Muang Phitsanulok
Ban That Phanom
Hine Sin
Tchépone
Quang Tri
Highway 9
Seno Airport
Savannakhet
Hué
Paracel Islands
THAILAND (SIAM)
Mukdahan
Tourane
Highway 13
Ban Khemmarat
Muang Nakhon Sawan
Saravane
Khong Sedone
Muang Phimai
Muang Ubon
Plateau des Bolovens
Pakse
Quang Ngai
Chao Phraya
Nakhon Ratchasima (Khorat)
Attopeu
Ayutthaya
Dak To
Kontum
Krung Thep (Bangkok)
Meloupre
Khong
Pleiku
Binh Dinh
Sisophan
Angkor (Ruins)
An Khe
Siem Reap
Stung Treng
Song Cau
Phet Buri
Battambang
CAMBODIA
Tuy Hoa
Rayong
Pursat
Tonlé Sap
Ban Mé Thuot
Cap Varella
Chanthaburi
Trat
Highway 12
Ninh Hoa
Highway 14
Nha Trang
Dalat
Mekong
Baie de Cam Ranh
Phnom Penh
Highway 1
Cap Padaran
Kompong Som
Bien Hoa
Cho Lon
Saigon
Phan Thiet
Pathiu Chumphon
Kep
Ream
Long Xuyen
Baria
Phu Quoc
Cap St. Jacque
Isthmus of Kra
Sadec
Go Cong
Can Tho
Surat Thani (Ban Don)
Malay Peninsula
Ca Mau
Bac Lieu
Iles de Poulo Condore
Pointe de Ca Mau

0 50 100 150 200 250
STATUTE MILES

Baie=bay; Ban, Muang, Muong=town, village; Cap=cape; Iles=islands; Kho=island; Roads ═══; Railroads ═══

Drawn by Donald A. Jaeger and Victor J. Kelley

Indochina: Southeast Asia's Battleground

France heads the defense of Laos, Cambodia, and Viet Nam, which form Indochina. Chief fighting has centered around Hanoi, but Reds have also thrust deep into Laos; last winter they briefly cut it in two at the waist.

tains, but in these days of marauding guerrilla bands no one ventures to use it.

When I asked about flights to Luang Prabang, I learned that all civilian planes temporarily had been requisitioned by the military. But officials kindly arranged that I go in an army transport. So I experienced again, as I had in World War II, the familiar bucket seats and piles of cargo.

At the airports of Vientiane and Luang Prabang the grim business of war was most evident. Military planes came and went like suburban shuttle buses. Tanned, weary troops —French, Foreign Legion, and nationals— plopped down beside their infantry kits and paratroop gear. Some awaited transport to outlying camps; others dozed or smoked until crisp-voiced French officers called them to a plane that would take them on another strike somewhere in the bush (page 679).

"We have an operation on now and still have not the victory," a sweating French officer said, apologizing for the take-off delay.

Some Mountains Too Steep for Trees

It is a spectacular, not to say breath-taking, flight between Vientiane and Luang Prabang. Shortly after leaving the Vientiane airstrip on the flat plain patterned with rice fields, one sees the mountains begin to loom ahead. Even though the plane climbs higher and higher, the mountains seem to thrust still farther upward into the sky. Some are bulky, forest-covered peaks, but others are so sheer that trees cannot even find lodging there. Jagged crests tower to more than 8,000 feet. What an impossible place to track down guerrillas, I thought, as I looked down into narrow mountain-girt valleys.

On some of the hills I saw patches of cleared fields and tiny isolated clusters of huts. These are the homes of the Meo and other hill tribes. Years ago, in Thailand and Burma, I clambered up to similar mountain dwellings of these shy, gaudily costumed folk. Generation after generation these people have slowly migrated southward from China, progressing from one mountain ridge to another.

Reaching a new location, they burn off patches of bush for their crops of vegetables, corn, hill rice, and opium poppies. And when the first flush of fertility is gone, they clear other fields on the same hill slope or move on to the next. Their penchant for producing opium and selling it to dealers in towns on the plains creates a considerable problem for governments that try to restrict traffic in the drug. Current price for bootleg opium in Luang Prabang, I learned, is about $130 a pound. In Saigon it fetches two to three times that amount.

Later I saw a number of the red-and-blue-garbed Meo, wearing bulky loops of silver around their necks, in the Luang Prabang market and streets (page 675).

During the few dizzy minutes that it takes an airplane to spiral down to the Luang Prabang airstrip, one can discover virtually the entire setting of the town. It lies on a narrow plain extending no more than eight or ten miles in length and less than half that in width. Green mountains rear up on every side.

At one end of the town the winding Khan River joins the broad Mekong in a sharp V. To land on the airstrip a short distance beyond the junction of the rivers, planes have to sweep down over the Mekong, bank sharply around a steep pagoda-crowned hill known as the Phousi, and then let down in a tilting glide to the runway.

The royal palace, homes, shops, and numerous tile-roofed temples stud the bank of the Mekong and cluster in the greenery of gardens close around the base of the Phousi, whose sharp spire points skyward like a huge gilded finger.

During the cool-season months, from November to March, this Laotian Shangri La jealously secludes itself even from the sky. At night it hides under thick fog that does not vanish until midday. Only in afternoons can planes land safely.

Two-blanket Coolness Is Welcome

After the heat of tropic Bangkok and of the plains around Vientiane and southward, I found the coolness of Luang Prabang delightful and was glad of the need for two blankets at night.

To me the outstanding charms of Luang Prabang besides its climate are its quiet and the gentleness of its people.

For several days I roamed its markets, visited many of the 40 Buddhist temples, and wandered to surrounding village centers where women weave rich silver and gold lamé silk scarfs and where silversmiths hammer beautifully patterned bowls and trays. I also saw wood carvers at work; their art is largely confined to embellishment of the temples.

At other homes I watched men and women potters fashion humbler rice-cooking pots, water jars, tiles, and bricks from clay. Along

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Scouting the Laos Jungle, Viet Nam Troops Pass a Foe Who Will Fight No More

Viet Minh surged across the Annam mountains into Laos last winter and reached Thakhek on the Mekong River. It was a typical Red campaign. Jungle-wise Communist soldiers, supplied by trains of porters, moved fast and hard through sparsely settled country, sweeping poorly equipped Laotian militia before them. When French Union forces struck back from fortified Savannakhet, the Communists simply melted into the jungle. Frustrated French officers say the foe in some areas escapes in women's clothes or dives into tunnels whose entrances lie below the water of paddies. Breathing through tubes, native troops have been known to lie many hours under water.

W. Robert Moore, National Geographic Staff

♠ **Laotian Sentinels Keep Vigil High on a Lonely Hill**

Outnumbered defenders rule Indochina by day from strongholds like this one overlooking the Mekong and Hou River junction at Pak Hou. At night the Viet Minh spring out of nowhere to ravage and terrorize. Soldiers on outpost duty here wear floppy jungle hats for protection against sun and rain.

French Officers in Field Headquarters ➔ Plan a Foray Against the Reds

Gen. Henri-Eugène Navarre (seated, with 4-starred cap) took command of all French Union forces in Indochina last summer. Gen. René Cogny, commander on the northern front, holds a cane. The hatless colonel is Christian de Castries, noted horseman and possessor of 19 battle citations.

the steep banks of the Mekong gardeners carefully tended crops of fresh vegetables planted on narrow strip terraces they had leveled after the water had gone down.

During my visit the royal town had electricity only from sunset to dawn, but that was to be changed. I saw two new generators being installed as part of American aid to the country. The engines will be powered with gas generated from charcoal rather than from costly oil that would have to be shipped upriver.

"Would you like to go on a picnic on the river?" Tiao Rattanapanya, one of the King's sons, who is governor of Luang Prabang Province, asked shortly after I arrived. "I'm going on an inspection trip to Pak Hou, and you can see the grottoes there."

"Can one travel safely on the river?" I asked, having heard that guerrillas lurked everywhere outside towns.

The governor laughed. "Quite safe," he said.

We went, but I still wonder who fired the shot across the river just as we were starting!

Geniality of the governor and magic of the early morning were enough to stimulate confidence. Wispy veils of mist rose from the water, and the mountains hid their heads in a canopy of fog. We rode in a long, slender

outboard-powered dugout and carried several drums of DDT being taken to Pak Hou (opposite).

For three hours we cut a sleek path against the current, skirting sandbars and jagged rocks protruding above the water. Just after noontime, when clouds vanished abruptly from the hills, we came within sight of Pak Hou, literally "the mouth of the Hou River" (pronounced like the English "who"). A sheer vertical cliff rears beside the Mekong almost opposite the river junction, and on the far side of the Hou towers an even broader and higher perpendicular wall.

Grottoes Used as Buddhist Shrines

Two sizable grottoes penetrate the Mekong cliffside high above the winter water level. Both of them have been converted into Buddhist shrines; literally hundreds of images are perched on the limestone ledges and around the floors of the caves (page 676).

At the entrances, loops of barbed wire and sandbags still remained from defenses hastily erected for protection of Luang Prabang in April, 1953, when the Viet Minh first swept

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High Grass Hides a Deadly Weapon and Its Crew

A French soldier holds his country's counterpart of the American Browning automatic rifle. Beside him sits an Indochinese comrade, and a third member of the patrol stands guard in the background. Laotians thatch their homes with highland grass like this. The French call it "elephant grass."

into Laos, taking Sam Neua and pushing to within a few miles of the royal town.

"His Majesty comes here at the New Year in April to bathe the Buddhas with sacred water," the governor explained, pointing out gilded wooden channels, carved in the form of long serpent bodies, that led toward the crowns of some of the images.

I could not help admiring the devotion which brings the King here, for he, I am told, suffers from rheumatism. It is quite a feat to clamber up the steps to the caves when the river is at low level.

While some of us bathed in the Hou, the governor sped away in his dugout to a village round a bend of the Mekong. Returning, he brought back a dozen gleaming fish, each weighing three or four pounds—just to prove the point he had made earlier that there was fine fishing in the rivers.

"It is unfortunate that you cannot remain long enough to go with me up-river," he said. "In a few days I'm flying north to a place on the Hou, and then I shall come downriver by boat to do a little fishing."

"What do you use for lure?" I asked.

"Bananas, oranges, sometimes limes. Some fish will strike on a spoon. One tries many things."

Wily *Pa Beuk* Scorns Bait

There is one fish in the Mekong, however, that scorns such bait, as well as man-made lures. It is the *pa beuk*, which has to be netted. A few of these fish captured have weighed 500 pounds, though most are only about half that size.

"A large pa beuk will bring 5,000 to 6,000 piasters in the market," the governor said. "A small fillet costs 50 piasters (nearly $1.50). Last year fishermen netted only two of them."

We returned to Luang Prabang as a gold-red sunset flamed in the sky and purple shadows settled in the river trench.

Next day I visited Crown Prince Tiao Savang Vattana, whom I had met during a brief visit to Luang Prabang four years before.

We talked of the invasion of Laos.

"We want only peace," he said, "but since war has been forced upon our country, we will meet it in every way we can. Last year, in April, when the Viet Minh came toward Luang Prabang we had only a division of troops to defend ourselves. Now we have many more; they will strike from every side to destroy the enemy."

On my previous visit the Prince, after

dinner, had shown me the sacred Prabang, a 2-foot-high golden image of the standing Buddha, which is the palladium of the kingdom. From this figure the town of Luang Prabang gets its name. *Luang* means "yellow."

Statue Held Prisoner in Wars

The statue has had many adventures. Cast perhaps in the 13th century, it has several times been "captive" in earlier wars, mainly between the Laotian kingdoms and the Thai. Its facial features are softened from the partial wearing away of the gold, caused, it is said, when the figure remained for some time submerged in a river.

Before it was brought to its present place in the palace, it occupied a high gilded altar in the nearby temple of Wat Mai. Another figure, cast in imitation of the sacred statue, now has been placed in the temple in front of a huge seated Buddha.

There is also a temple in Luang Prabang and another in Vientiane called Wat Phra Keo. In them another famous statue of the Buddha, the Phra Keo, or Emerald Buddha (actually of jasper), once rested for a time on its many peregrinations throughout Thailand and Laos. Now the small seated image occupies prime position in the royal temple at Bangkok.*

Laos often has been called the "Land of a Million Elephants," and its flag bears the figure of the triple-headed elephant of classical religious legend. But I saw not a single elephant. When I asked about the big palace beasts I previously had seen in Luang Prabang, I was told that they were out in the forest. Kept hobbled, but allowed to roam and feed at will, they are brought into town only for New Year's ceremonies and special festivals.

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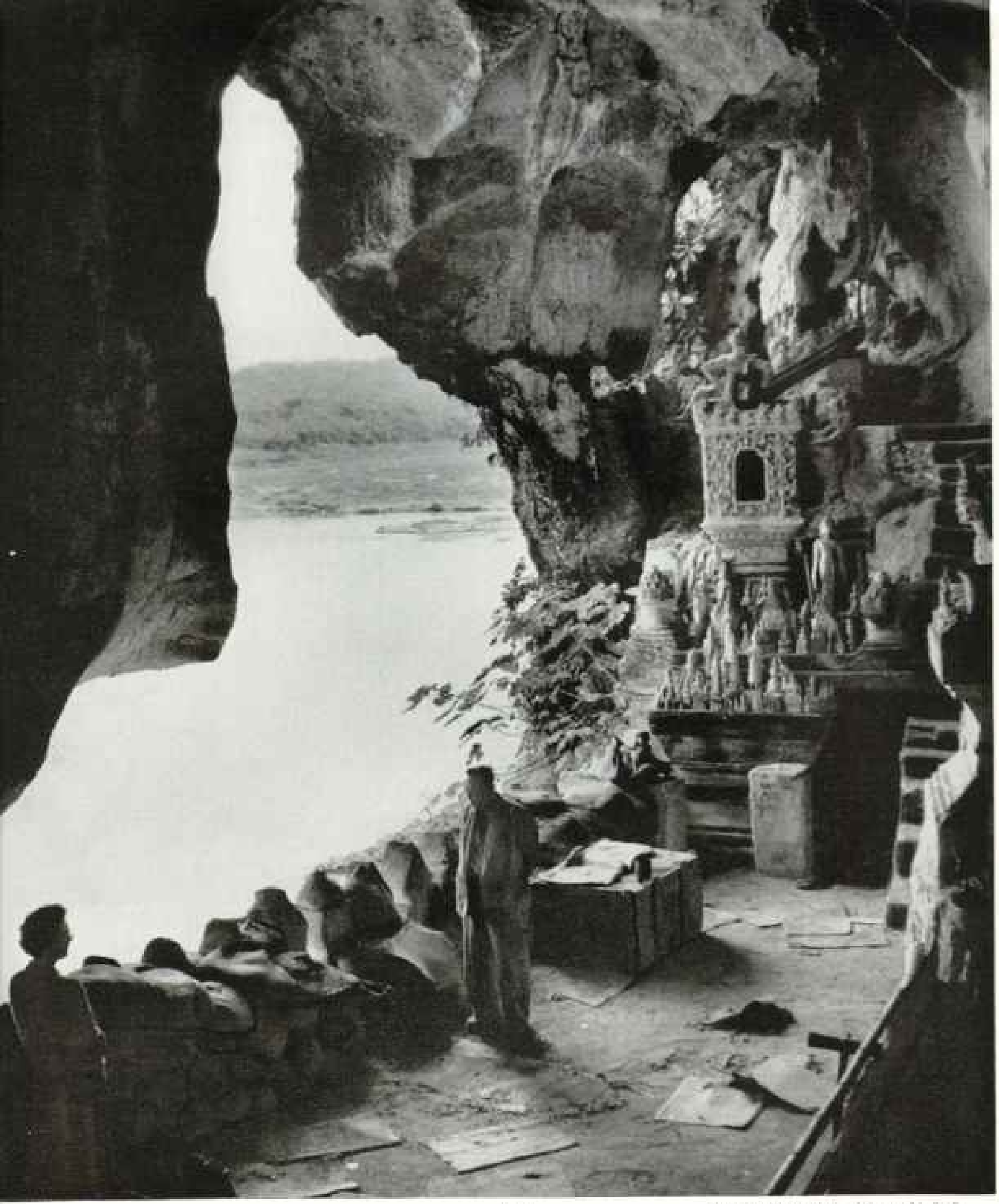
A Car Intrigues Two Meo, Mountain Men of Laos

Students of the Indochinese war suspect some Viet Minh raids are made to hijack opium grown by the Meo. Lowland Laotians laugh at the idea of anyone's stealing from these shrewd people. Meo ancestors came out of the north centuries ago. These men wear silver neck rings.

Leaving Luang Prabang, I flew back to Vientiane and then recrossed the Mekong into Thailand. At Muang Nakhon Phanom, where I arrived in time to hear mortars banging across the river during reoccupation of Thakhek, I found that the Thai had set up searchlight batteries along the river front in order to spot any night movement across the Mekong.

I was surprised to discover that several thousand Vietnamese, or Yuan as the Thai refer to them, had crossed the Mekong to settle in the Thailand border country. Some 8,000 are located in the Muang Nakhon Phanom district and, with 5,000 or more in Mukdahan,

* See "Scintillating Siam," by W. Robert Moore, National Geographic Magazine, February, 1947.



W. Robert Moore, National Geographic Staff

Peace Pervades a Buddhist Grotto—but It Lies on a Natural Invasion Route

Loyal troops fortified this place when it was threatened by Communist invaders marching on the royal town of Luang Prabang, residence of the King. The author, on a visit with the governor of Luang Prabang Province, found approaches to the grotto guarded by barbed wire. They picnicked together not far away (page 672).

King Sisavang Vong of Laos makes a pilgrimage to the cliffside caves each year to wash the Buddhas with perfumed water.

This grotto stands at the junction of the Mekong and Hou Rivers. Flowing out of the troubled north, the Hou forms a logical route for invading Viet Minh Communists.

With Luang Prabang threatened, fortunetellers did a rushing business. "I interviewed one, a Buddhist priest at one of the temples," reports the author, "and asked him the burning question. He sat with eyes closed, slowly chewed on his quid of betel nut, and finally opened his eyes. 'Luang Prabang will be safe,' he said. 'The enemy will not take it. It is impossible for them to do so.'"

they actually outnumber the Thai in that town.

The newcomers arrived as refugees immediately after World War II, when the trouble in Indochina first began to froth over. Many of their homes are easily recognized. Unlike the traditional stilt-legged structures of bamboo and thatch normally used by the Thai, they are built close to the ground and have their bamboo-latticed walls plastered with clay.

Some Have Communist Sympathies

These energetic people quickly found a place in the life of the towns where they settled, for the Thai by nature cling mainly to the soil as rice farmers. The Yuan, on the other hand, become the artisans, builders, and tailors. Some already are challenging the Chinese, who have long carried on the major local businesses and shopkeeping.

In the market places, too, one finds many Yuan women, usually garbed in their characteristic short jackets, black or brown trousers, and toadstool-like straw hats. They bring to market the vegetables that one sees them patiently watering and weeding in their gardens.

Unfortunately for the Thai authorities who generously allowed the Yuan to settle on this side of the river, many of the latter have sympathies that not only linger on the opposite side of the Mekong but on the opposite side of the political struggle to what the Thai believe best for Thailand's own interests. Consequently, some of the Yuan are subject to close watching.

Before the Thai police clamped down, not a few of the Yuan displayed pictures of Communist Ho Chi Minh. I saw one of the gilded, almost shrinelike frames of his picture occupying a corner of one shop, but the picture itself was concealed behind a heavy veil.

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Youngsters Ride Hip-saddle in Laos

Older sisters learn early to tend families in Vientiane, as in all the Orient. Mothers, freed from children underfoot, keep busy weaving rattan matting, making sarong cloth, and preparing food. Umbrella and baby's cap, no Laotian products, came from a store.

Geographically, the big bulge of eastern Thailand partially bordering on the Mekong is a plateau sloping toward that river. All its rivers drain into the Mekong system.

Red Dust Covers Everything

With the dry season upon the land during my visit, my most vivid impression was of the red laterite dust of the highways. It colored my clothes, my cameras, my skin, and even covered the green of foliage along roadsides.

Rust-colored laterite underlies much of the region. Large lumps are dug and crushed to build highways and to surface airstrips. The rock provides a good surface even during monsoon rains.

It was with laterite, cut into rectangular

↑ A French Bomber Sears Phu Nho Quan, an Enemy-held Village, with Flaming Napalm. Wreckage Litters the Pond Bank

↓ Upper panel: Seno airport in narrow central Laos was fortified by French engineers last winter. Now it mothers a fleet of American-made transport and combat planes, including the Grumman Bearcat fighters ranged at far left. A twin-engined Beechcraft taxies onto the runway.

Lower: A Vietnamese paratrooper ducks snipers' bullets as his comrades man a parapet facing the jungle outside Hine Siu village.

French Department of Information

W. Robert Moore, National Geographic Staff

Vientiane's Bicycle Parking Lot Can Always Find Room for One More

Laos, with few automobiles, goes to market on two wheels. Some bikes have motors. Vientiane recently set up parking lots where attendants give riders numbered tickets, then stack the machines like cordwood.

blocks, that the Khmers, ancestors of the present-day Cambodians, built many of their temples, terraces, walls, and bridges. It was even used as the core of some of the ornate shrines at the capital of Angkor and other centers of the Khmer kingdom.

Through rice lands and open forested areas, I rode more than 100 miles southward along the main highway to Muang Ubon. Reaching it, I suddenly felt as if I had arrived at a metropolis.

To Catch a Train, You Take a Boat

Muang Ubon, a busy market center and one of the larger eastern Thai towns, lies near the junction of the Si and Mun Rivers, two sizable streams that drain the greater part of eastern Thailand.

Scores of sampans, barges, and ferries ply the broad span of joint rivers. While the town has grown mainly on one bank, the railway station lies on the opposite side of the stream. A new bridge is under construction across the broad water gap, but until it is completed one has to cross by boat.

Despite all the river craft that clutter the water front, apparently there were not enough when we wanted to cross to get the twice-weekly express train to Bangkok. Everybody seemed to be going to the train.

Finally we crossed over, caught one of the decrepit, overworked buses, and got to the crowded station platform. Having come merely to see friends off, most of the throng stayed behind when the bell clanged and the train started moving on its 19-hour journey to Bangkok.

In eastern Thailand, across the river from war, I had found no panic. People seemed confident that, if Viet Minh Communists crossed the Mekong, Thai troops could drive them back.

Split Seconds in the Lives of Birds

Color Film and High-speed Flash Stop Whirring Wings and Show Details Too Fast for Human Eyes to See

By Arthur A. Allen

Laboratory of Ornithology, Cornell University

With Illustrations from Photographs by the Author

YEARS of preparation, months of planning, hours of effort, and then a split-second decision determines success or failure in photographing birds in action.

The color photographs accompanying this article were three years in the making, but all 26 of them together required a total of only five and a fifth thousandths of a second to register on film. Each was made with a speed-light flash lasting only 1/5000 of a second.

Selected from hundreds of photographs taken in several parts of the country, these pictures give us those evanescent poses that are impossible for the human eye to discern, but, in the aggregate, give such charm to those animated bits of color that flit about our gardens or enliven the shade of our forests.

Ever since Dr. H. E. Edgerton discovered the possibilities of the speed light in all sorts of high-speed photography, I have been intrigued by its use in the study of birds and have endeavored to apply it to situations in which sunlight or flash bulbs have proved inadequate in the past. The accompanying photographs are part of that record.*

Bird Battle "Frozen" by Speed Flash

An example of the motion-stopping effect of the high-speed flash is the photograph of the evening grosbeak on page 682. There was so much action that ordinary exposures would have recorded only a blur.

In my boyhood these beautiful birds were practically unknown except in the Northwest. But in 1890, according to E. H. Forbush, evening grosbeaks made a great flight eastward and on through New England to the Atlantic coast. They did not appear again until 1910, but by 1920 they were regular winter visitors throughout New England.

In recent years evening grosbeaks have increased greatly in the eastern United States. Nearly every winter large flocks of them come south from their northern nesting grounds to visit in villages and gardens where sunflower seeds are offered. They appear as far south as North Carolina and recently have been found nesting in northern New York and New Hampshire. Plainly, the species has changed its migration and distribution within the memory of many persons still living.

Incidentally, the pleasing name is based upon the mistaken notion of the original collector that the bird dwelt in dark woods and came out only at evening to sing.

In spite of their friendliness at our window sills, evening grosbeaks are quarrelsome among themselves and chivalry is unknown, at least during the winter. One could guess this from the photograph on page 682, in which the yellow male claims for himself the whole dish of sunflower seeds and drives the gray female away.

Georgia Goldfinch Challenges Cardinal

An equally animated encounter is that of the goldfinch and cardinal on page 683. Again the speed light stopped the action, and we have a graphic picture of David and Goliath at the diner.

Unlike the cardinals and the evening grosbeaks, in which the males wear their bright plumage in winter as well as in summer, the male goldfinches during the winter wear a dull suit similar to the female's (page 698). Like the grosbeaks, they assemble in large flocks when not nesting, frequenting weed-grown fields from the Gulf coast to New England, and ordinarily feed on seeds.

At Herbert L. Stoddard's plantation near Thomasville, Georgia, where this photograph was made, such a flock took over his feeding

* Hundreds of Dr. Allen's remarkable photographs of birds have appeared in his 16 previous articles in the National Geographic Magazine and in his 328-page book, *Stalking Birds with Color Camera*, edited by Gilbert Grosvenor and published by the National Geographic Society ($7.50 in United States and Possessions; elsewhere, $7.75 in U. S. funds. Postpaid). This unique book reflects Dr. Allen's many years of experience and research as Professor of Ornithology at Cornell and as the leader of expeditions sponsored in large part by the National Geographic Society. It contains 331 illustrations from natural-color photographs, 264 of them by the author.

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↑ Ladies Last! A Male Evening Grosbeak Drives Females from the Feast

Evening Grosbeaks, traveling in flocks, have spread to the East from the Northwest within memory of the present generation of bird watchers (page 681). This New York State male shows scant chivalry to females (left) hungry for coveted sunflower seeds.

↓ Papa Grosbeak, in Cranberry Vest, Tends His Children

Sometimes the **Rose-breasted Grosbeak's** melodious warble rings in gardens, but he usually prefers bush lots near forests. His seed-crushing beak often nabs insects; hence the nickname, potato-bug bird. An elderberry bush holds this nest at Ithaca, New York.

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↑ Winter-plumaged Goldfinch Defies a Much Bigger Cardinal

Male **Cardinals** stay red, but cock **Goldfinches** change in the fall from golden yellow to brown. This "wild canary," ordinarily lighthearted, became irascible when the cardinal trespassed on his lunch of pecan bits. Spanish moss drapes this Georgia background.

↓ Fashion-plate Oriole Sports a Vest of Flaming Orange

Baltimore Orioles wear the colors and take the name of Lord Baltimore, Maryland's founder. Their flutelike calls delight the ear. One says, "Oh, see here, see me up here!" These crybabies at their pendent nest near Ithaca complain "Tee-dee-dee" all day long.

station and registered great enthusiasm for the mixture of suet and Pecano (waste pecan fragments from the processing plants).

But each goldfinch insisted on a private dining room, or at least on plenty of elbow-room. It mattered little whether it was another goldfinch or a towering cardinal: the goldfinch would do his best to intimidate any intruder.

Two Hats—One for the Owls

We ourselves were attacked as intruders when we photographed a screech owl family in a hollow apple tree in central New York (opposite). The old birds did not hesitate to pounce on us from the rear and try to bury their talons in our scalps.

Finally we thought to provide ourselves with double hats, one for the owls and one for ourselves. It seemed to give the owls great satisfaction to pick off a hat and carry it 10 or 15 feet away.

The screech owl of the eastern United States occurs in two color phases, red and gray, irrespective of age, sex, or season, and one of these owls was red, the other gray. Of the youngsters, one was red and three were gray, which seems to be the approximate ratio among the screech owls of central New York State.

At night the owl's irises are greatly distended to admit as much light as possible, but during the day the pupils are of pinhead size. The speed flash naturally caused the irises to contract, and it was amusing to discover that whenever one eye was closer to the flash than the other, its iris would contract much more than the more distant one. This striking difference would then be revealed by a picture taken a few seconds later (page 686).

During the two evenings that we worked with this pair of owls, they fed their young nothing but June beetles, abundant at the time and easy to catch. Observations of other screech owls, however, have taught me that they feed upon almost anything that flies or crawls after dark, provided only that it be of a reasonable size.

Some years ago I kept a nightly record of a pair of screech owls nesting near my home in Ithaca, New York. The young were transferred from the nesting box to a wire cage, and the parents fed them through the netting where they could be observed by the light of a lantern. This continued from just after dusk until just before dawn over a period of six weeks. Fortunately an ardent student volunteered to relieve me from midnight until 5 a.m.

The young owls were fed on a great variety of animal life. Insects were identified on 28 days, crayfish on 24 days, amphibians on 15 days, mammals on 12 days, fish on 6 days, spiders, snails, and reptiles on one day each. Bird remains were identified on 33 days, the count being 77 individuals of 18 species.

The owls had chosen a bird box on a tall pine near the house and were one of the 40 pairs of nesting birds on our 4-acre sanctuary, on which we had censused the nesting birds for the six previous years.

At the end of the nesting season this curious truth was revealed: In spite of the number of birds eaten by the owls, there were nearly as many birds in the sanctuary at the end of the season as at the beginning. This was because the survivor of each pair secured a new mate very rapidly. Only when both members of a pair were taken the same night did the species disappear.

In this way we lost our Baltimore orioles and chipping sparrows, but the other 15 species and 38 pairs were there at the end of the season. The following year there was even a slight increase in the total number of birds nesting on the four acres.

The owls, therefore, in their unobtrusive way, were merely helping to maintain the balance of nature which we had upset by making other conditions so favorable for birds that an unnatural concentration existed in our sanctuary.

"Cheese Cake" Attracts Arizona Birds

On a recent trip to the winter home of the Lyman Stuarts, near Tucson, Arizona, we found that they had built up the avian population about the house to 300 or 400 boarders. The birds paid no more attention to the blinds and speed lights than to the bristling cacti and spiny shrubs that had been added to the normal sparse desert vegetation. The resident pyrrhuloxias and the wintering Gambel's white-crowned sparrows perched on the blinds and lights as readily as on the paloverdes and barrel cacti.

In the mornings and evenings Mr. and Mrs. Stuart scattered 5 or 10 pounds of chick feed on the ground to maintain the population of mourning doves and Gambel's quail which served as decoys for all the other birds. They replenished the water in the bird bath and

Kodachrome by Arthur A. Allen

Eyes Dilated to Catch Night's Faint Light, Screech Owl Carries a Midnight Snack

Screech Owls sleep by day with ear tufts erect as camouflage; they lay tufts back at night. Smallest of the eared owls, they are excellent mousers and insect destroyers. They do not screech, but utter low, tremulous whistles. Some eastern specimens are red-brown, others gray like this June-beetle hunter in his apple tree (opposite).

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Camera Flash Catches an Owl's Eyes Off Balance

Oddly ill-matched pupils result from a speed flash fired 15 seconds earlier. The bird's left eye, closer to the flash, contracted much more than the other (page 684). This Screech Owl, photographed near Trumansburg, New York, is the same apple-tree dweller shown in color on page 685.

filled the food trays in front of the speed lights with "cheese cake," as we called it, diligently baked by Mrs. Stuart according to the formula devised by Mrs. E. D. Morton, of Tucson, as the one most alluring to Arizona birds.*

Once the birds were accustomed to the general setup, we could get into either of the two blinds and plan ways of arranging perches or accessories so that the birds would pass, at least momentarily, through the plane of focus of the waiting cameras.

Ingenious electric eyes have been designed by Mr. Crawford H. Greenewalt, of Wilmington, Delaware, Mr. George Blake Johnson, of Framingham, Massachusetts, and others to activate shutters at the exact instant when the bird passes through the plane of focus and is in the center of the film. Mr. Stuart, however, an old-time duck hunter, prefers to give the birds a sporting chance by matching his reaction skill against the varying speeds and angles of their flight, and I was glad to join him in this sport. Of course we occasionally cut off a head or a tail through misjudgment, but that merely piqued our interest and stimulated our competition in this fascinating game.

Many Nests Guarded by Cactus Spines

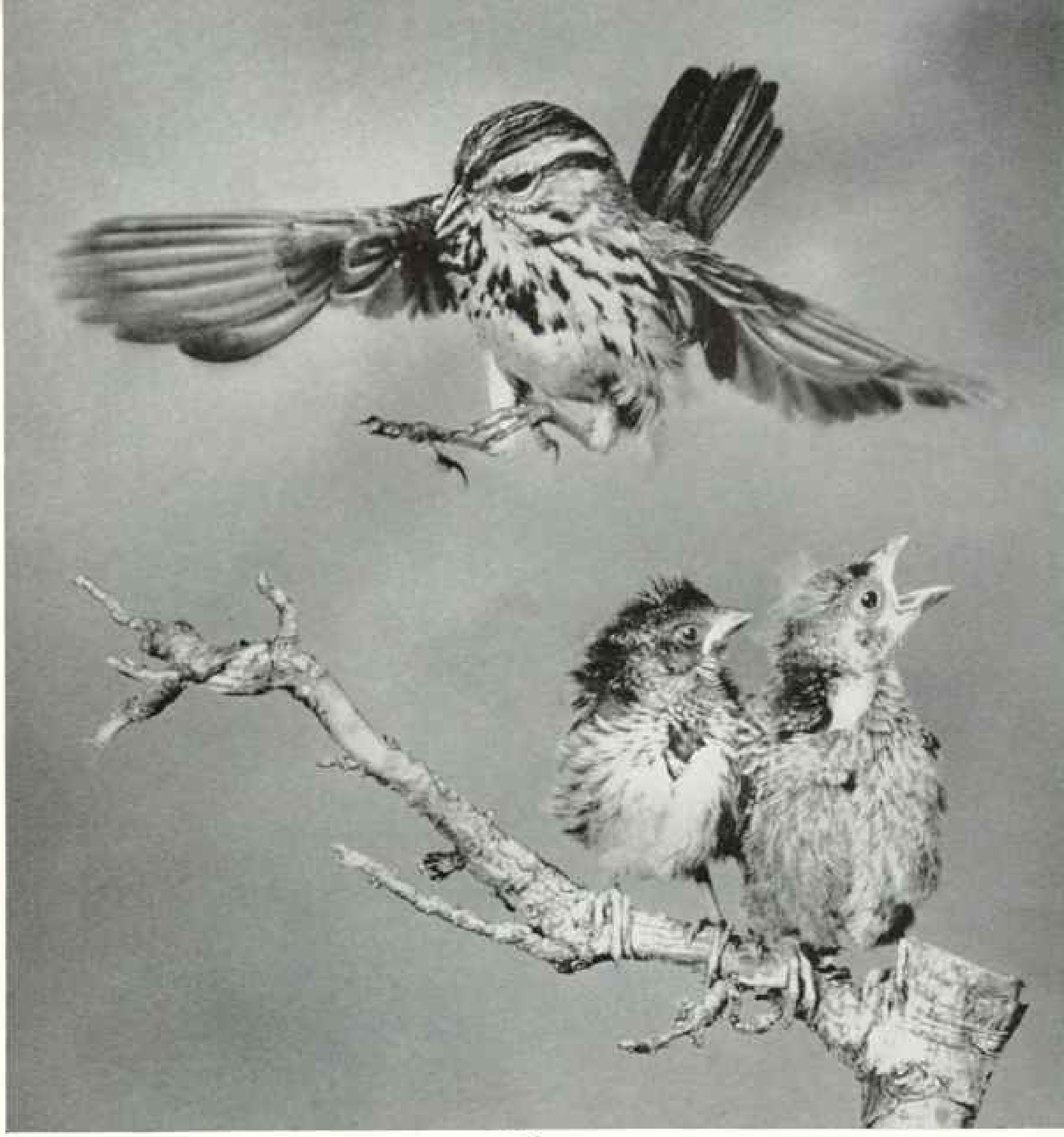
It was the last of March when Mrs. Allen and I arrived at the Stuart home, but only a few of the birds had started nesting, among them the Palmer's thrashers, brown towhees, and cactus wrens.

Like other wrens, cactus wrens have the habit of building dummy nests, or "cock nests," to mark out the territory which the pair is ready to defend. In one of these dummy nests the male usually spends the night, going to bed somewhat earlier than the busy female.

It is not always easy to determine whether a nest is occupied or not, for many are built in the cholla, or "jumping cactus," where it is impossible to insert one's finger without having it impaled on at least one of the sharp spines. Likely as not, the whole joint of the cactus will then break off and remain attached to your finger.

When you try to remove the spine, a finger on the other hand becomes impaled on the opposite side of the same burr. Then you must hunt a real friend—or perhaps two—to release you.

*A mixture of 4 parts cornmeal, 1 part flour, 2 parts suet, and 2 parts sugar, boiled to the consistency of a thick mush.



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Fledglings Alerted by Mother's Dinner Bell Scan the Sky in the Wrong Direction

From Virginia to Labrador and from California to Alaska, the Song Sparrow inhabits areas where it can nest in bushes or shrubbery. Even in the northern States the bird's cheerful notes enliven winter's bleakness as early as February. Here a parent near Ithaca carries food to one of her own children and to a larger cowbird whose lazy mother laid her egg in the sparrow's nest for foster care. The greedy cowbird has starved out two or three rightful nestlings. Both youngsters heard the mother's call, but misgauged her landing spot.

Jumping cactus is so called because it seems not to wait to be touched before sticking into your clothes and fingers.

After several bouts with this cholla, we finally found an occupied wren's nest with young half grown, all being raised on the Stuart cheese cake. A brown towhee with a home in a cactus a hundred yards away, was likewise stuffing his family with the cake, although he alternated this tasty fare with a wide variety of caterpillars and beetles.

Brown towhees are gentle, friendly birds, very different from the spotted towhees of the West and the red-eyed towhees of the East that scratch so busily in the leaves and seldom permit a close approach. The red-eyed towhees' call, "Chewink," has a nervous, petulant quality, and when singing they seem to be giving orders to "Drink your tea."

The brown towhees, however, go about

A Study in Scarlet: Father Tanager, Suspended by Speed Light, Aims His Catch at a Row of Gaping Targets Near Ithaca

Whose Turn? Yellow Warbler (Left) and Chestnut-sided Warbler Face the Same Dilemma

Birds do not feed their young in rotation. They give each catch to the hungriest—the one with longest neck, widest mouth, and loudest cry. A nervous mechanism prevents any youngster from monopolizing: as he gets full, his throat muscles refuse to work. The parent, checking open mouths after each feeding, sees the unswallowed bug, fishes it out, and gives it to a more responsive chick.

Wood warblers, dainty, active, and highly colored, are found only in the Americas. In most United States woodlands one bird in six is a warbler (page 705). None actually warbles. **Yellow Warbler** is the best known species. **Chestnut-sided Warbler,** rare in Audubon's day, is now abundant. Both nest near Ithaca.

The Author Aims 2,000-volt Speed Lights in Front of His Photographer's Blind

Dr. Allen, seen at his home in Ithaca, New York, made most of the pictures in this series with the equipment shown here. When birds found no food in the feeding station, they flew to pecan fragments on the foreground post, passing through the camera's range. A lens peeps from the middle window in the blind; plywood sheet provides a painted background. The speed lights are normally set two feet from the subject.

their lives quietly. They seldom call, and their subdued songs could easily go unnoticed. Around the feeding stations and even near their nests they quickly accept the observer as just another cactus and pay scant attention to him. Their nests of dried grasses and weed stems in the chollas look much like song sparrow nests, and the behavior of the youngsters also is much the same.

Greased Pole Foils Ground Squirrels

The young Palmer's thrashers were already out of the nest and coming to the feeding stations, sometimes sitting on the cake itself but still demanding to be fed by their parents. Before our two weeks' stay was up, however, they were helping themselves with such avidity as to become almost as much of a nuisance as were the ground squirrels.

At first these squirrels cleaned out the feeders nearly as fast as Mr. Stuart could fill them. Then we tried greasing the chrome metal posts on which the trays were fastened. After that it was amusing to watch the squirrels take a running start and get halfway up the post, only to slide down again.

We found some Palmer's thrasher nests with eggs which may have been second broods even as early as late March, before many of the Arizona birds had even considered nesting for the first time.

Palmer's thrashers, with their dull-brown backs and plain gray breasts (opposite), are not as striking as the more familiar eastern brown thrashers, and their songs have less musical quality. Their rough nests with an outer layer of twigs, however, are very similar. They usually build in the center of a cholla, and it is still a mystery to me how they flitted in and out and how their active youngsters managed to survive, surrounded by thousands of sharp spines.

The phainopepla, in glossy black plumage set off by a high crest, red eye, and white-banded wings, is a very characteristic bird of the Arizona desert; likewise the beautiful pyrrhuloxia with its amazing topknot,

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Pinions Opening Like a Parachute, Palmer's Thrasher Lands on a Perch

Usually nesting in a dense cholla cactus, the Palmer's Thrasher is a familiar figure throughout the thorn-brush country of the Southwest. This remarkable camera study shows the tail lifted stiffly while wing feathers, opening in louver fashion, begin the upstroke.

→The same bird lands in a flurry of feathers.

red stripe down a gray breast, and red wings and tail (page 699).

Pyrrhuloxias were not yet nesting, but they came regularly to the feeding station and perhaps were the favorite targets for our cameras. They are rather closely related to the cardinals, which, incidentally, have longer crests and more fiery-red plumage in Arizona than in the East. The curiously arched bill of the pyrrhuloxia and the elegant gray and red plumage give it a patrician appearance less evident in the rollicking cardinal. Its song, likewise, though similar, is more subdued, or perhaps one should say more refined.

We managed to find a nest of one of the phainopeplas, containing a homely black-skinned youngster, 10 feet up in a dense paloverde tree where photography was impossible. We waited until almost the last day of our stay, when we were sure the youngster had developed a strong food call so that his parents could find and feed him. Then we lowered the nest a few feet at a time between feedings, until we had it on a branch three feet from the ground and 10 feet in front of our photographic tent.

The problem then was to provide a perch so conveniently placed that the phainopepla would use it in preference to all other perches before flying to the nest to feed the little one. After a few trials we found exactly the right spot for the perch and trained our cameras and lights on the two feet of space between the perch and the nest so as to catch the bird in mid-flight.

The male bird seemed engrossed with another female a hundred yards away and would not feed our baby; but the grayer female took good care of it and gave us many chances to catch her wings in the best position as she returned with a throat full of mistletoe berries (page 706).

Wood Thrush Rams Food Down a Hungry Maw

Mourning doves, goldfinches, and petrels give partly digested food to their young. Pelicans and cormorants simply open throat pouches and let the youngsters rummage around inside. But most birds follow the practice of this **Wood Thrush,** placing solid food far down the chick's throat to start the swallowing process and prevent a live insect's escape.

Because metabolism is so rapid, many young birds need half their weight in food daily just to survive. One house wren was observed feeding her young 1,217 times in less than 16 hours. These wood thrushes live near Ithaca.

Largest of the North American wrens, the **Cactus Wren** nests among yucca bayonets and cactus thorns in the Southwest (page 686). Its whirring song calls to mind a New Year's Eve noisemaker.

Kodachromes by Arthur A. Allen

Among the many birds that came to the Lyman Stuart dining hall were large flocks of western mourning doves. They fed on the chick feed scattered over the ground and regularly visited the bird bath to drink. With them came an occasional small brown Mexican ground dove or the equally small but longer-tailed Inca dove with its scaled gray plumage. It was interesting to watch them drink, for, unlike most birds, doves drink with the bill submerged and swallow without lifting their heads (page 703).

Bright-colored house finches, Brewer's sparrows, and black-throated desert sparrows were much in evidence. More noisy and more conspicuous, however, were the woodpeckers, both gilded flickers and Gila woodpeckers.

The gilded flickers resemble the eastern flickers in having golden linings to their wings and tails, but they resemble the western red-shafted flickers in their browner heads and in the red mustaches of the males, those of the eastern flickers being black. All three species have the snow-white rump feathers which make an excellent identification mark as the birds go bounding from one saguaro cactus to another.

It was a little difficult to secure a photograph that would show all of these distinctive marks, but we were finally successful by stopping the flicker in mid-air on his way to the food log (page 694). To catch him in normal pose, we stuffed the dried skeleton of a cholla branch with the cheese cake, of which both he and the Gila woodpecker were inordinately fond.

Busy Bills Drill Holes in Cactus

The Gila (pronounced heela) woodpecker gave us many chances to catch him in flight as he flew from the prepared perch in the paloverde tree to our narrow food tray decorated with flowers and plentifully supplied with cheese cake (page 702). The little red cap of the male is never worn by the female, but otherwise they are much alike. They resemble the eastern red-bellied woodpecker and the Texas golden-fronted woodpecker, to which they are rather closely related.

Both the flickers and the Gila woodpeckers apparently had young across the wash from the feeding station in the treelike saguaro cacti. In these they had drilled nesting holes, and they flew back and forth almost continuously with bits of cheese cake.

The saguaro cactus forms scar tissue around the entire woodpecker cavity. Since this tissue is very resistant to decay, one can find in prostrate logs, long dead and more or less skeletonized, hard, plasticlike bags, the old homes of woodpeckers, that can be removed intact.

Anhinga Trail Abounds in Birds

During the Christmas holiday prior to our trip to Arizona, we drove to Florida and visited the famed Everglades National Park with its thousands of water birds, a paradise for the bird photographer. The speed lights, however, were of little use, except for supplementary lighting, because one has little control over the action of the water birds and must snap them wherever found, with no chance to set speed lights closer to the subject than the camera.

One of the most interesting spots in all North America for observing water birds is the Anhinga Trail in the Everglades National Park. There Superintendent Daniel B. Beard has built a boardwalk from the road out into the glades along a slough frequented by alligators, gars, turtles, and water snakes as well as by many kinds of water birds.

These creatures have all become accustomed to the throngs of people observing them and are as tame as zoo animals. Indeed, the purple gallinules—ordinarily wary birds—fly up to the boardwalk and take crackers from the fingers of the tourists. The pictures of the anhinga and purple gallinule on page 704 were made here.

On the way north we stopped near Thomasville, Georgia, at the home of our friends the Stoddards, and found that they were maintaining their year-round snack bar for birds just outside the living-room window. Some 15 different kinds were feeding on Pecano, the specialty of the house.

Among the guests were such unusual feeding-station visitors as ruby-crowned kinglets, oven-birds, hermit thrushes, and even pine, palm, orange-crowned, and yellow-throated warblers. They mingled with the cardinals, mockingbirds, towhees, white-throated sparrows, and other more familiar species in an almost continuous parade.

We could visit with our friends in the living room while we photographed through the windowpane, enjoying a sort of blind de luxe. The lights were set outside, two feet from the feeding table on which we had

↑ **Arizona's Gilded Flicker Flies Past an Ocotillo Blossom . . . and Perches on a Dead Cholla Cactus to Eat Cornmeal Cake**

The "Yuk! yuk! yuk! O!" of this **Gilded Flicker** rings often through Arizona's cactus parks. Red mustache distinguishes it from the black-marked eastern flickers.

↓ **Spotted Sandpiper** (seen in upstate New York) is the country's most widely known shore bird. The "teeter-tail" of farm boys, it seesaws constantly.

limited the action of the birds by putting the Pecano in a narrow line on a small log and covering up all the other food.

I am not sure that a bird photographer and his paraphernalia would always be welcome at an afternoon tea, but there is never any question at the Herbert Stoddards or at the home of their neighbors, the Ed Komareks. The guests always take part in the game with a "Here he comes" or a "Did you get him?" as the flash announces another exposure.

Perhaps some ingenious host can devise a parlor game, on the order of trapshooting, in which various photographers take turns flashing the lights and the results are scored according to rules. At any rate, it is a good sport, if one has the equipment, and the results at least are more durable than those of bridge and gin rummy.

In photographing nesting birds with the speed flash, the possibilities are boundless for one with a good knowledge of birds and of the limitations set by their instinctive reactions. But it never pays to be in a hurry, and the photographer, to be successful, must be able to sense how soon he can start and how far he can proceed with preliminaries and still maintain the cooperation of his subjects.

Bird Photography Calls for Care

A sensible photographer never tries to work with birds that are building their nests or laying their eggs, except under unusual conditions where no arrangements are necessary. Not until incubation is well under way, or until the young are four or five days old, is it normally satisfactory to put up a blind. Even then it is much better to set the blind at a distance of 15 or 20 feet for overnight, or at least until the bird returns normally to its nest. Then it can be moved up to the necessary distance required by the focal length of the lens used.

In no case should any of the natural vegetation about the nest be disturbed until after the bird has accepted the blind. Thereafter any branches or leaves that obscure the bird at the nest can be tied aside, and if a backdrop is desirable it can be fastened in place. One must be careful to replace all the natural concealment when photography is over.

If it is necessary to move the branch on which the nest is built, as was the case with the scarlet tanager (page 688) and the phainopepla, already described, the blind should be in place at least overnight before any moving is attempted; and the young should be seven or eight days old, with strong food calls which the parents will have no difficulty in hearing.

Curiously enough, in birds the feeding of the young is a cyclical instinct that is released only by the sight of properly colored mouth linings or a properly enunciated food call.

Colored Cards Can Fool a Parent

In some species the mouth lining is pink, in others yellow or black; or it may be spotted with distinctive white markings. Whatever the hue, the purpose, apparently, is to stimulate the feeding reaction. Dr. Konrad Z. Lorenz of Vienna, Dr. Nikolaas Tinbergen of Oxford, and others have demonstrated that colored cards matching roughly the color, size, and shape of the open mouths of the youngsters will stimulate the feeding instinct in some birds as readily as the mouths themselves. The old birds even attempt to feed the cards!

With most birds, however, the calls of the young are necessary to release the feeding instinct, and the parent birds may wander aimlessly about with food in their bills or may swallow the food themselves if they do not hear the nestlings. This food call becomes very loud and insistent after they have left the nest, because they soon get scattered; and of course the old birds have to find the youngsters before they can be stimulated to feed them.

As long as the little ones are in the nest in its normal location, the sight of open mouths is the stronger releaser of the parents' feeding instinct; but when the young leave the nest or when the nest has been moved to a new location, the auditory releaser becomes the stronger. Young cowbirds have such loud, insistent food calls that foster parents will follow them long distances if they move or are moved between feedings.

When young birds are small, their food calls are very weak. Any disturbing factor, like a person or a blind, that keeps the parent birds so far away that they do not hear the food call, will automatically prevent feeding. On the other hand, when the nestlings are older and the food call is stronger, the same factors may seemingly be unnoticed by the old birds, so irresistible to the parent is this call of the young.

(Continued on page 705)

Kodachrome by Arthur A. Allen

Father in His Scarlet Wig Offers a Full Line of Groceries to His Family

Most of his cousins prefer dead timber, but the **Hairy Woodpecker** drills a nest in live trees, as in this New York State cherry. Like his smaller copy, the downy woodpecker, he probes for larvae with a long barbed tongue.

Excited Fledglings Can't Wait for Breakfast as Mamma Goldfinch Swings Home with a Throat Full of Cereal: Ithaca, New York

Three brothers and sisters have already left home, and these 2-week-old **Goldfinches** will soon be feeding themselves. Only yesterday they sat contentedly in the thorn-apple-bush nest; today they teeter daringly on the edge of the abyss. They accept partly digested seeds.

An Unruly Pompadour Is Always in Style for Arizona's Pyrrhuloxias, the Gray Cardinals

Pyrrhuloxias inhabit mesquite thickets of the Southwest, living on weed seeds, caterpillars, and grasshoppers. Mrs. Pyrrhuloxia (left) arrives at the feeding tray a moment later than her ornate spouse, who sports blushes of rosy red on his soft gray plumage.

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Nashville Warbler Nests, Not in Tennessee, but in the New York Woods amid Lady's-slipper, Solomon's Seal, and Cinnamon Fern

← Madame Kingfisher, Unlike Most Birds, Outshines Her Mate

Belted Kingfishers range throughout the United States wherever there is good fishing. From early spring to late fall solitary birds patrol their mile of stream or shore, uttering a call like the chatter of a heavy fishing reel and occasionally diving headlong into the water to seize a small fish. This New York mother swoops home with a minnow for her hungry youngsters, who wait in a tunnel just above her head as she flies up the vertical sand bank. She wears the rich brown breast band found only on females of her species.

↓ **Veery** nests on the ground in moist northern woodlands. It resembles the wood thrush (page 692), except that breast spots are much fainter and the back is uniformly cinnamon. Song is an uninterrupted downward spiral of rich liquid whistles, sounding like the bird's own name repeated again and again. These 9-day-old youngsters, seemingly unhappy over being placed on a branch for portrait taking, do not yet see well. Mouths fly open automatically when a parent's feet touch the branch.

Gila Woodpecker Opens the Checkerboard Beneath His Wing

Gila Woodpeckers, like Gila monsters, inhabit the arid Southwest. They are closely related to the red-bellied woodpeckers of the humid Southeast, with similar calls and habits, but the Gila has much less red on head and belly and more brown on the underparts.

◆ Despite his portable checkerboard, this cock did not stop to play, because a table of delicacies spread by the author stood near the ocotillo spike.

◆ Just as he is about to alight, the speed flash explodes again and registers another 1/500 of a second in the Gila woodpecker's eventful life. Toes, as in all common woodpeckers, point two in front and two behind. Most other birds have three in front and one behind.

Like the gilded flicker (page 694), this zebra-striped woodpecker commonly nests in Arizona's giant cactus.

↑ Dinner Arrives for Mother Redstart Brooding in Her Elm-sprout Home

Orange wing and tail patches on satiny black and an incessant fidgeting make the diminutive cock **Redstart** a butterfly among birds. Cubans call him *candelita*, "little torch." A faithful provider, he does not choose to sit on his mate's nest near Ithaca.

↓ Mourning Doves, Unlike Most Birds, Can Swallow While Bills Are Down

A melancholy call, pointed tail, and arrowlike whistling flight characterize both this **Western Mourning Dove** and its eastern counterpart. Both are often mistaken for the extinct passenger pigeon. This beauty sips from a granite bird bath in Arizona.

Snakebird Hangs Silvered Wings Out to Dry

Anhingas, close relatives of cormorants and pelicans, inhabit swampy bayous and sluggish rivers of the South and Southwest. Webbed feet make them efficient swimmers in pursuit of fish under water. A curious triggerlike arrangement of neck tendons and vertebrae permits the bird to shoot its sharp bill forward to spear fugitive fish.

In soaring flight the tail spreads fanwise, suggesting the name water turkey. The snakebird nickname seems apt when the bird swims with only its long head and neck exposed.

This bird, seen beside Florida's Anhinga Trail, measures three feet from tip of bill to tip of tail, but its body is no larger than a duck's. Like cormorants, it lacks water-resistant feathers and must dry off in the sun.

"And Her Shoes Were Number Nine"

Purple Gallinule, jewel of the dense southern marshlands, glows in the Florida sunlight with blues, purples, and olive greens. Elongated toes let the bird skip daintily on floating plants in quest of food. The "purple meadow hen" must ever be alert for lurking alligators in Everglades National Park.

Kodachromes by Arthur A. Allen

If the parents lose interest in their offspring, it is usually because they do not hear the food call, and a good photographer then removes his paraphernalia and returns a few days later when the nestlings are older and noisier.

One of the more satisfactory groups for study and use of the speed lights is the wood warbler family (Parulidae). There are 160 species in this family, which is confined to the New World, and about 55 of these nest in the United States or Canada.

Strange Use for a Wastebasket

Most species of Parulidae are highly migratory, spending the winter in Central or South America, although some winter in the Gulf States, Mexico, and the West Indies. A number of them, like the Swainson's and yellow-throated warblers, confine nesting activities to the southern States; others, including the Tennessee and Wilson's, do not stop until they reach northern Canada. But in between there are plenty of subjects to test the photographer's skill, first in finding the nest and second in securing the photographs.

Unfortunately, the brightly colored males do not venture near the nests until after the eggs are hatched, so that with each subject one is limited to a rather short period when photography is satisfactory. Nest finding is easier, however, when the parent birds are making frequent trips with food, and this helps to compensate for the short time ideally suited for photography. This, at most, is no more than a week, for the young must be over 4 days old and younger than 11, at which time they get so restless that they flutter from the nest at the slightest disturbance.

For such cases the photographer needs a wire wastepaper basket, in which the youngsters can be placed for a "cooling off" period. The parents will not, ordinarily, hesitate to feed them through the wire or even to go down into the basket; nor will the young attempt to fly out of the top.

After an hour or two and many feedings in the basket, the young birds will lose their restlessness and can be replaced in the nest or on a perch with some assurance that they will stay put. Then one can adjust his procedure to catch the parent bird in mid-air or in cramming insects down a youngster's throat, or in any other pose that seems interesting or characteristic of the species. This was the method used in securing the photograph of the veery on page 701.

Whether or not one should use a backdrop will depend on the character and nearness of the natural vegetation, but it is desirable to have something to reflect light from the background to the film, unless it be a night picture, where a black background is appropriate (pages 685 and 690).

In the photographs of the Nashville (page 700) and chestnut-sided warblers (page 689) there were enough leaves in the immediate vicinity of the nest to make a backdrop unnecessary. With the yellow warbler (page 689) and redstart (page 703), however, a reflector was needed; hence a blue card was used behind the yellow warbler and a green one behind the redstart. In viewing the other speed-flash pictures, it is easy to see whether or not a backdrop reflector was used.

In the case of the hairy woodpecker (page 697) it would have been difficult to arrange a backdrop. The live cherry tree in which the birds had dug their nesting hole was on a very steep slope, and the opening was nearly 20 feet up from the base of the tree, although only about six feet up from the top of the embankment. Photography would have been unsatisfactory without the speed lights, because the nest opening was in the shade and on the north side of the tree.

There were four youngsters in the nest about ready to leave home, but there was room for only one at a time in the opening. Three of them had red feathers in the crown, which is usual with the hairy as well as the downy woodpecker; yet it was the odd black one that posed best.

Young May Outshine Parents

It is a curious fact that, although most birds in juvenile plumage resemble the female or have a dull plumage all their own, young woodpeckers usually resemble the males or have a still brighter plumage, as is true of the young hairy woodpeckers. Adult females have no red on the head; adult males have a spot of red on each side of the nape; and juveniles usually have the whole top of the head suffused with red. Young flickers of both sexes wear the mustache which in the adult plumage is reserved for the males.

In the redstarts the males and females are very differently colored (page 703). The immature birds resemble the females not only in juvenile plumage but in their first breeding

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Phainopepla with Mistletoe Berry in Mouth Spreads Her Wings Like a Japanese Fan

No other bird looks like the male Phainopepla, a slim glossy-black creature with white wing patches and a slender crest that jerks high as an alarm signal. This female somewhat resembles a cedar waxwing except for her uniform gray and lack of yellow tail bands. Only member of the silky flycatchers to cross the Mexican border into the United States, she nests in arid lowlands of the Southwest. The ear-shaped alula, or false wing, stands out clearly on top of the wing just back of the head. Its small feathers, borne on the thumb of the bird's "hand," appear to facilitate landing by breaking the air's flow like an airplane's flaps.

plumage as well, although they sometimes have a few black feathers on their throats. The characteristic yellow spots in wing and tail likewise may be a deeper yellow or orange.

It is difficult to make generalizations about the plumages of warblers, because there is so much seasonal and sexual variation in the different species. The chestnut-sided (page 689), for example, wears a very different plumage during the winter, although the male and female are much alike in summer. The yellow warbler (page 689), the redstart, and the Nashville (page 700), however, wear the same bright colors winter and summer.

The same difference occurs between tanagers and orioles. The male scarlet tanager (page 688), for instance, wears a yellowish-green livery like the female's during the winter, but the male Baltimore oriole's winter feathers are just like those he wears in summer (page 683).

It is the rule in birds for the male to wear a brighter plumage than the female. There are a few exceptions, however, especially among the group of shore birds known as phalaropes; here the sexes are reversed in this particular, since the females wear the brighter colors. Parental duties are also reversed; males incubate the eggs and rear the young without any help from their mates.

The belted kingfisher falls into this category also, so far as plumage is concerned, for the female wears an extra chestnut band across the breast, as shown on page 701, and this is always lacking in the male.

A bird photographer is usually considered a specialist, and a specialist has been defined as one who knows more and more about less and less. Since a good bird photograph is now secured in 1/5000 of a second, a good photographer should be able to write on indefinitely concerning how he secured it. To avoid such a calamity, the present photographer had best write finis to his five and a fifth milliseconds.

We Captured a 'Live' Brontosaur

Ancient Footprints in Texas Rock Bring to Life a Grim Prehistoric Drama and Help Answer a Tantalizing Scientific Riddle

By Roland T. Bird

THIS story really begins 135,000,000 years ago. I didn't enter it until the fall of 1938.

Above me in one of the huge halls of New York's American Museum of Natural History towered the gigantic skeleton of a brontosaur, typical of the sauropod dinosaurs. Some of these plant eaters were the largest animals that ever walked the earth. Fifteen feet high at the hips and nearly 70 feet in length, the museum's famous brontosaur was truly awe-inspiring. Visitors milled past, gesticulating, gaping.

The brontosaur's relatively small head, no larger than a bushel basket, was suspended eight feet above me at the end of the great snakelike neck. The forelegs rose like heavy pillars beneath the forward end of the huge rib-enclosed body cavity.

I could have walked easily beneath the belly. To me it always suggested a hayloft, for it must have held prodigious amounts of vegetation pulled from the earth with the brontosaur's peglike teeth. The hind legs stood with knees level with my head; from the high-thrust rump near the ceiling drooped the tail, its slender tip lying some 30 feet farther on.

Could the Brontosaur Walk?

It excited me to imagine this mountain of animal, weighing perhaps 30 tons, walking into the hall alive. But in that vivid apparition I saw only what I wanted to see; how he actually had moved in life was still a mystery.

Early paleontologist O. C. Marsh had named him *Brontosaurus*, meaning "thunder lizard," on the dramatic assumption that the ground thundered under his tread.

But had this dinosaur actually been too big to have walked on land? The legs of a dinosaur were very large, but it was hard to believe they had borne so many tons. Had he crawled, instead, like an alligator, with legs projecting laterally? Or had he lived his whole life in the water? Scientists were uncertain.

It is even possible to "prove" mathematically that a brontosaur could have grown too big for his legs to have supported him on land. If a growing sauropod doubled in length, his weight would increase eight times, though his legs—if they grew in proportion—would become only four times as strong.

Nostrils of a brontosaur skull, set high up on the crown, suggest a life spent largely in water, for the dinosaur could have breathed with just the top of the head above the surface. When thus immersed and buoyed up, his great body would have floated readily.

I passed the rounded forefeet, each provided with a long claw on the inner toe. I approached the hind feet, from which the term "sauropod," or "lizard foot," originated. The framework of each contained five metatarsal bones of the toes, three of them terminating in heavy claws. What function had these feet served if the dinosaur had not walked? It was difficult to imagine an animal always living in water not eventually losing such appendages in favor of fins or flippers.

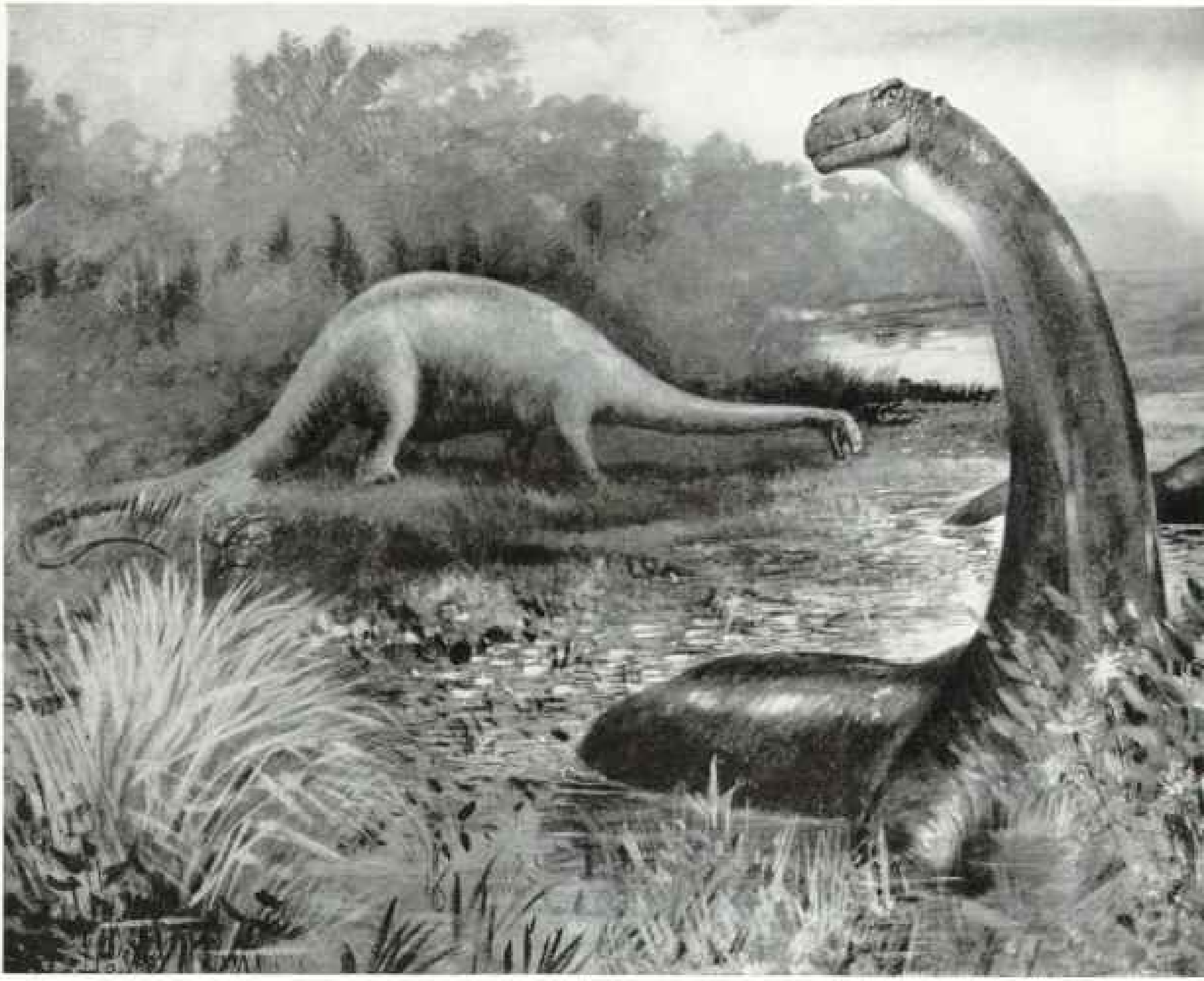
Preyed Upon by Dagger-toothed Foes

Elsewhere about the hall stood other dinosaurs, the various plant eaters and flesh eaters, large and small, some with flesh-tearing dagger teeth, some with defensive horns, some with great plates of dermal armor. But the brontosaur seemed not to have been provided by Nature with any offensive or defensive device other than tremendous bulk.

As I walked out, I could not help but wonder what a plant-eating brontosaur's chances might have been if caught on land by one of the huge theropod dinosaurs, the prehistoric flesh eaters.

The Author

Roland T. Bird began his career in the natural sciences at the age of 9, when he helped his entomologist father collect moths and butterflies. Later he turned to dinosaurs, entering that field under Dr. Barnum Brown. About 80 tons of dinosaur bones and fossil-bearing rock, now in the American Museum of Natural History and other institutions, are the results of their expeditions together throughout the western United States and Canada. During World War II, Mr. Bird's knowledge of fossil-bearing rocks helped him serve as a geologist in the Federal Government's quest for uranium.



American Museum of Natural History

← **Biggest Animal That Ever Walked Here Made Tracks for His Life**

Leaving the large turtlelike footprints in mud now turned to stone, a brontosaur 135 million years ago apparently fled the teeth and claws of a cousin, a flesh-eating type of dinosaur. Stalking erect on hind legs, the savage hunter left birdlike 3-toed tracks, some atop those of his quarry. The author uncovered these trails beside Paluxy Creek in Texas (page 720).

↑ **Placid Brontosaur Ate Swamp Plants and Lived in a Watery World**

Weighing some 30 tons, the snake-necked sauropods stood about 15 feet high and 70 feet long. Unarmed and unarmored, they stampeded into deep water at the approach of carnivores. Nostrils on top of their heads suggest they lived mostly in water. Dinosaurs existed so long ago that no man ever saw one. Charles R. Knight painted this scientific reconstruction.

Soon after, I left for a summer of fossil collecting in the Rocky Mountain States. The summer's work was over and I was reluctantly planning a route back to the museum when, at a Gallup, New Mexico, filling station, a young man noticed some huge broken bones on the floor of my car.

"Dinosaur fragments," I told him.

"What about footprints? An Indian trader near here has a lot of them," he volunteered. "You ought to have a look."

Many of the "dinosaur footprints" then being sold by traders, I was sure, had been sculptured by the hand of man. Among Jack Hill's, though, were three fine specimens from the trail of a carnivorous dinosaur. Each track of the savage flesh eater lay in a neatly quarried "biscuit" of stone a couple of feet wide.

Mr. Hill told me they were from Glen Rose, in Somervell County, Texas, some 40 miles southwest of Fort Worth (map, page 710). Checking a geological map, I learned that Glen Rose lay in an area whose rock formations date from the Cretaceous period. Since this is the last of the three periods in which dinosaurs existed, Glen Rose is a logical place for fossil footprints of this sort.

Here was a welcome answer to my routing

Roland T. Bird

This Creek Proves . . .

Some experts once doubted brontosaurs were able to walk unless supported by water. Then an American Museum of Natural History expedition to Texas bared huge tracks pressed deep by ponderous, unbuoyed weight, showing that the reptiles lumbered like elephants over firm ground. These men clean a brontosaur

← Giants' Home: Texas

Here, during the Cretaceous period, tropic jungle bordered beach and bayou and covered swampy islands. Dinosaurs, lords of creation for 140 million years, throve in a humid climate like that of the Amazon Basin. Many left footprints in Bandera, Somervell, and other counties.

problem. Going home by way of Glen Rose might produce something worth while; it would also put off for a few more days my annual surrender to indoor laboratory work.

Jim Ryals, a local man, served as my guide. In a flat rock ledge partly flooded by Paluxy Creek, a tributary of the Brazos River, we encountered one particularly well-preserved dinosaur trail. The carnivore's tracks were three-toed and splayed like those of a gigantic turkey. It gave me a wincing tingle to see the deep marks of the murderously sharp talons at the ends of the toes.

The length of each track, about 26 inches, together with that of the great biped's stride, around seven feet, furnished an excellent vision of the living reptile. His scaly form not only towered two and a half times my height and measured around 33 feet from nose to tail tip, but bore enough resemblance to that fiercest of all carnivorous dinosaurs, the king tyrannosaur, to have been a strapping younger brother (pages 708, 712, 721).

Three or four inches of silt had been left on the high portion of the ledge by the last high water; now it was dry, and little depressions showed the positions of more tracks where the trail continued under the brown and powdery carpet.

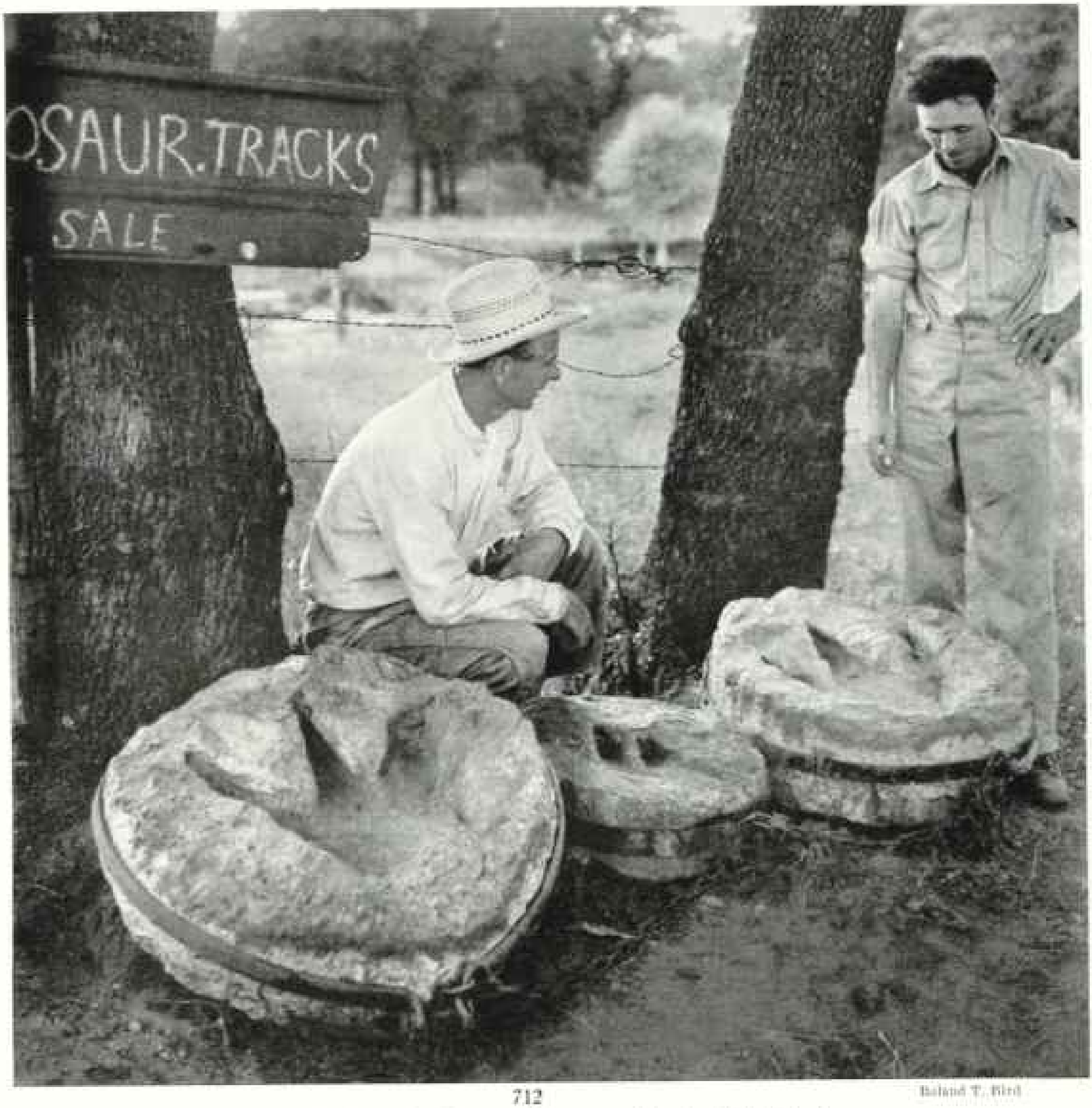
When animal tracks were preserved in prehistoric times, the process was a simple one. Here dinosaurs—in this case large carnivores—had crossed the muds of shoreline flats in quest of prey; later, gentle water

. . . Brontosaurs Walked trail in the bed of Paluxy Creek; a sandbag dam holds back the water. Tracks vanished beneath a rocky ledge near the end of the dike. Not realizing that the top stratum had been deposited above the trail ages later, one of the workmen wondered how the animal had walked "under all that rock" (page 720).

Bath in a Footprint →

When Paluxy Creek runs low, farmers catch catfish stranded in depressions made by the tread of dinosaurs. This 3-year-old's foot would hardly fill even one of the huge brontosaur claw marks left by a hind foot. About a yard long, the track holds 18 gallons of water.

Roland T. Bird



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Roland T. Bird

Weighty Business in Texas: Dinosaur Tracks Sell Slowly

Rock gardeners sometimes paid $25 to $50 each for quarried tracks of tyrannosaurlike carnivores. This merchant seated near the Paluxy Creek diggings keeps his wares chained to discourage pilfering.

currents covered the still-distinct tracks with layers of settling silt and marine deposits. Layers continued to accumulate upon the subsiding surface. In the course of millions of years the whole eventually solidified into stone. Erosion and re-elevation of the land laid the tracks bare again as impressions in hardened rock.

After Ryals left, I noticed a much larger depression in the ledge a few feet away, but thought little of it. The November sun struck wan sparks from the dancing wavelets of near-by Paluxy Creek. For some time I shoveled silt from the carnivore trail into this great cavity. I wanted to clear several of the tracks for a photograph.

I had made the picture and was gathering up my equipment when I again thought of the cavity, now completely buried. What was it doing on a ledge surface that had been a mud flat marked only by the carnivore trail?

I stepped to the spot with my shovel, trying to suppress a feeling of wild expectancy. Surely no living creature, certainly no footed reptile, had made a track like this! The mark was big enough to have been made by a brontosaur—the dinosaur that was

thought to have been too big to walk on land.

Digging for the hole, I struck instead the rim, which was not level with the rest of the ledge but rolled up, like a great welt of displaced mud. When cleaned, this welt still failed to make sense unless its general outline, that of a lizard's foot, meant something.

I tried to tell myself I must not believe my eyes; that in the end I would find only a large pothole, worn perhaps by the creek.

To put an end to the suspense, I shoveled quickly into the cavity. Nearing bottom of the wide front end, the shovel banged against a stray rock. I pried at it frantically. It was wedged in a broad crack that surely could not be the mark of a huge claw—but was! Moreover, it indicated the end of a stumpy but monstrous toe.

After getting rid of the rock and the rest of the dirt, I brushed loose crumbs from a second claw scar with my whisk broom. This proved slightly smaller than the first, while a third was smaller still. Next appeared the print left by a stumpy fourth toe that had its blunt end protected only by a coarse nail. A fifth metatarsal element, encased within the great flesh pad containing all the toes, had left a bump. I could sit in the depression left by the heel.

Discovery of a Lifetime

The dinosaur hunter lives for moments like these, spending weeks, months, and sometimes years before he makes a worth-while discovery. A major one like this may happen only once in a lifetime.

I don't know how long I remained in the footprint, staring at the unmistakable features of a sauropod's 38-inch hind foot. The region was an isolated one, with the creek bed bounded by 30-foot banks and tall live oaks. Presently dark clouds hid the sun, but I did not notice them; nor did it occur to me that, if it rained, the half-submerged ledge soon might be flooded.

Where had this great sauropod stepped next? The hind print was that of a right foot. I stood up and looked ahead along the still-littered area. Had I covered more of these big tracks in clearing the carnivore trail?

I probed about, but hit only solid ledge. Not until I realized that a walking brontosaur could have stepped all of 12 feet did I strike the next cavity indicating a track, another print of the right hind foot. Oriented by these two, I quickly located the rounded right forefoot impressions, two of them; and next some badly waterworn irregularities in the rock at the water's edge that could be nothing but the remains of two opposing lefts.

The complete trail proved to be about six feet across. Though I knew instantly what that meant, I pretended to let my mind toy with the discovered measurement and its relationship to the width of a sauropod's body. Here was the trail, not of a crawling sauropod, but of one that walked staunchly upright with four legs under him!

Tracks Held 18 Gallons

From this point the tracks continued under water off the flooded end of the ledge. After an hour of wading barefoot and locating more of the trail by feel, I returned to the dry rock to face new problems. How could I make of this discovery a possible museum exhibit? Where, even in one of the vast dinosaur halls of the museum, could a series of washtub-size tracks like these be placed? Some, it was later proved, would hold 18 gallons of water.

I climbed the bank to my car to plan the only task now possible: to cast in plaster of paris a pair of fore-and-hind-foot impressions. Along with photographs, these casts would be evidence I could preserve against any emergency, including possible destruction of the trail by the creek. For even as erosion had uncovered the tracks, so it could in time destroy them.

The now dark and stormy late-afternoon sky made me realize I must work far into the night if I was to complete the casts before a possible rain and rise in the creek.

Back from town with an additional 100 pounds of plaster and a gallon of thin oil to prevent it from adhering to the rock, I studied the waves of displaced mud around the tracks to determine how much area I must cast beyond the cavities. This certainly must be held to a foot or two, for even with thin burlap incorporated as a strong weight-saving backing for the inch-thick film of recording plaster, I must not make either cast too heavy to drag up the 30-foot embankment.

Darkness descended as I assembled supplies on the ledge and built a bonfire for light. Time and again I paused to warm my cold, plaster-wet hands.

Just before midnight, with a good portion of the second print to cast, I ran out of oil. The porous rock drank it like a sponge. What

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Front Feet of a Swimming Brontosaur Tracked a Lagoon; His Hindquarters Floated

Aquatic sauropods spared their legs by staying afloat. Better swimmers than their enemies, they submerged like submarines, popping snorkel necks up for air. The brontosaur that made this trail near Bandera moved toward the camera. Kicking into a turn, he left the print (right) of one clawed hind foot (page 718).

to do? I couldn't get a new supply in Glen Rose at this hour. I drew off some oil from my car's crankcase to complete the casting, leaving enough to reach town safely.

I got away just after daylight with the two casts on top of the car. They must have looked like two white bathtubs to the owner of the adjacent farm as I drove into his yard.

As I explained what they were, the farmer regarded first the casts, and then me, in awe.

"Well, this beats me," he said at last. "I've known about the ordinary 3-toed tracks all along, but I guess these were just too big for me to see."

A neighbor farmer chuckled at my mention of the big cavities in the ledge.

"Why, many's the time I've caught fish in those things," he said. "Every time the creek gets real low, catfish get stranded in them."

At the museum the casts created almost as much stir. Dr. Barnum Brown, then Curator of Fossil Reptiles, began to talk at once of acquiring a 30-foot section of the complete trail, a solid mass of rock to contain at least

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Dinosaur Footprints in the Sands of Time Present Transport Problems

The museum expedition quarried more than 40 tons of print-bearing stratum from Paluxy Creek. It shipped much of this rock to New York in numbered chunks and thousands of fragments (page 719). Work on this section of the trail was interrupted twice by 6-foot rises in the creek (page 710).

12 footprints and all intervening open space.

"We'll mount it on the brontosaur base," he said, "right behind the skeleton. That way we can create the feeling of having captured a 'live' brontosaur."

Such an exhibit promised to be the most spectacular dinosaur show ever placed before the public.

Another student of dinosaur tracks asked the shrewdest question: "Were there any noticeable signs of tail drags?"

I had been expecting this. There were no signs. "The mud flat over which the sauropod walked," I explained, "was covered by enough water to float the tail."

"How deep do you think the water might have been?"

I wasn't sure. Judging from the great depth of the sauropod tracks, it had been low. The carnivore trail had been made at a low stage, and the spot was undoubtedly close to shore. But had the sauropod come along at the same time? I only hoped the next Glen Rose expedition might clear up the mystery.

The venture was eventually financed in part by the Sinclair Refining Company, which uses the dinosaur as a trademark. Aid was given also by the Texas State-wide Paleontological Survey, which was being carried on under the direction of Dr. E. H. Sellards, University of Texas. The university was to share in the collections made.

No one could have foreseen the next development. Two young assistants from Dr. Sellards' office reported a second discovery of sauropod tracks in Bandera County, about 200 miles southwest of Glen Rose. The find occurred in rocks of exactly the same geological period and age.

Dr. Sellards wrote that the Bandera site was less subject to floods than was the one at Glen Rose, and that the task of removing overburden, always involved in any search that includes quarrying for tracks unworn by weather, would be easier. He suggested that I collect our material there.

I agreed and arranged for 12 workmen to be engaged.

In Bandera County I found live oak- and cedar-covered hillsides with the hard white limestone of prehistoric sea floors projecting like staircases from their flanks. Here were streams identical to the Paluxy that, in shearing into these masses, revealed again the shore-line flats on which dinosaurs once roamed.

"How long ago were these animals around?" one of my workmen asked.

Rate of Decay Measured

"Oh, about 135 million years," I said casually, watching his face for the reaction I knew must come. "We can estimate the time fairly accurately by measuring the rate of decay of radioactive elements found in the rocks."

I took along only one man, Fred Berg, on the first reconnaissance trip down onto a long rock ledge in the wide and comparatively dry bed of Hondo Creek.

The ledge extended as flat as a field for a quarter of a mile downstream, acres and acres of it. Except for low bordering banks of overlying deposits, the gashed edges of overburden not yet removed by erosion, every feature was the same as it had been in the Age of Reptiles. Like a treasure chart in my hand, the map drawn by Sellards' men showed the sauropod trail to be on the east side.

No one except the initiated can realize the magic thrill of stepping from the 20th century into the Age of Reptiles. Fred and I did it simply by leaving the car. Sun, air, and sky remained the same, but we were on ground that, except for having been changed from mud to rock, might still have been populated by live dinosaurs. Even before we reached the point marked with an X on the map, we came upon the 3-toed tracks of a big carnivore.

In my mind I saw the monster moving off in front of us. Like all carnivores of the formidable tyrannosaur type, he seemed largely head and tail until you realized the great supporting hind legs were attached to a gross body. The head was largely jaws. Grasping forelimbs were small and negligible by comparison. The sun glinted on its skin. When he turned, his open mouth glittered with rows of dagger teeth.

A Muddle of Carnivore Trails

His trail, traceable for many yards, led to the sauropod site. I saw it cross and mingle with more carnivore trails; there was a confusing muddle of them in the gray mud. Checking near-by landmarks against the map, I began to search for washtub footprints.

Nothing was here except the carnivore trails. I couldn't believe I had reached the right location; yet no error showed on the map. I noticed where two carnivores had stepped in nearly the same spot, creating a double impression that resembled a 5-toed print. There were several more like it near by. I struggled with the unhappy suspicion that 12 men had been engaged for a nonexistent job.

I explained to Fred: "It's just a place where the university boys mistook masses of carnivore tracks for sauropods'."

I turned toward the car, wondering if this fiasco might in some manner be made to pay off. Here was a whole county of dinosaur territory that I had never prospected.

Looking off in imagination beyond the mud flat, I saw palm trees waving above the fringe of shore-line jungle where the carnivores had gone. Around in the other direction was a broad, deep lagoon, filled with aquatic vegetation. In my mind's eye I thought I saw the dark bulk of a partly submerged brontosaur feeding far out; then not one but a dozen heads lifted on long necks, and a whole herd moved closer.

↑ Curious Visitors Hear a Lecture on Dinosaurs

Some 10,000 sight-seers came to watch scientists dig tracks of prehistoric monsters from the bed of Paluxy Creek. Workmen, overwhelmed with questions, asked the bystanders to gather in groups of 50 or more and took turns giving impromptu lectures so that the rest of the diggers could work without interruption.

Hammer and Chisel → Trim a Print

Expedition workers spent long hours breaking the Paluxy trail into chunks for shipping. They dressed down the bottom of each quarried piece to save as much weight as possible. Even after trimming, this fragment when crated weighed 660 pounds. It had to be manhandled up a 30-foot bank to a waiting truck. The workman's left knee rests in a cross section of a dinosaur footprint.

Roland T. Bird

Imagination? Who could fail to see these sights here with the aid of the dinosaur tracks?

Only one question remained: Could I find another mud flat over which that herd of sauropods might have walked? Returning to Bandera, I began to feel not too sure of my chances. In all the years that men had hunted fossils, only I had ever identified a Glen Rose sauropod trail. Compared with the commonness of other types of dinosaur tracks, what had caused this rarity? Had sauropods so shunned land that they seldom crossed even an adjacent mud flat?

Next day the curator of Bandera's Frontier Times Museum told me of some "elephant tracks" reported to him by an amateur geologist. In a flat space of rock on the Mayan Ranch I identified them as the round forefoot impressions of a sauropod dinosaur.

Though this sudden success was overwhelming, I was at a loss to explain the strangeness of the new discovery. Had the monster been swimming in deep water, merely bumping bottom with the forefeet, to leave this fantastic 2-footed trail? I was haunted with a vision of a brontosaur walking with hind feet in air, trying to confuse me and succeeding admirably! Yet the full story must be here, if I could find it.

Deep Furrow Indicates Tail Drag

The shallow tracks showed that no great weight had been applied to the mud. After a dozen paces the trail disappeared under heavy ledges of overburden. Obtaining permission to quarry this off, I assembled my men and set them to work.

Prospecting later on the Davenport Ranch on West Verde Creek, I followed a carnivore trail into a third discovery of sauropod tracks.

But here were sauropods again walking on all fours. As if to make up for past disappointments, a whole herd was indicated. In a trail on a second ledge there was even a suggestion of tail drag, a deep furrow made as if by a fire hose pulled across the mud. This was, however, isolated from the main exposure and somewhat waterworn.

The ranch owner, Mrs. Cleora Davenport, gave us permission to work this area. Meanwhile, on the Mayan Ranch, my hardy rock crew had uncovered enough trail to show that the sauropod there had indeed been swimming. One hind footprint had been exposed where, in kicking down sharply, the monster had swung into a turn. Slowly the picture was clearing (page 714).

A week of quarrying at the Davenport site revealed a jackpot strike, so many tracks it seemed impossible to count them, along the 200-foot exposure. As winter merged into spring, and as ton after ton of limestone was moved aside, no fewer than 23 sauropod trails were followed.

The final revelation proved both gratifying and disappointing.

In the beginning, there had been a wide mud bar, firm and hard, undisturbed by tracks. The opened quarry and adjacent strata revealed this as having stretched for some distance between two broad lagoons, one to the east, the other to the west.

Flesh-eaters Also Frequented Bar

Much more conjectural were the far ends of the bar. The north end was probably attached to land. The other, the seaward extension, may well have been connected with an island. Tracks showed that the bar became the haunt not only of plant-eating sauropods but also of carnivores.

The oldest carnivore trail, of the common tyrannosaurlike type, with the tracks quite worn, led southward in unhurried steps toward the invisible island.

The second carnivore surprised me. By turning toward the east lagoon, he showed, I think, a little more than passing interest in the sauropod herd perhaps already feeding on the aquatic vegetation there. His fairly fresh tracks, exceptionally large and broad-toed, indicated not only great size but a heavy body, a monster quite capable of attacking and perhaps even killing the biggest of brontosaurs. In imagination I watched his broad back move off with great tail bobbing ridiculously behind. I wondered if he had actually spotted the herd and hoped to trap one in shallow water.

The trails of the third and fourth carnivores led suggestively in the same direction. The smallest, a lithe, small-headed form with ostrichlike body and legs, seemed only large enough to slip in and steal bites from a kill after the others had made it.

The day the sauropod herd came walking in from the east lagoon to cross the bar, the water was low. Why the leaders hadn't waited for a current to float at least some of them over the bar, I shall never know. The water was so low that even the smallest

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American Museum of Natural History

Reassembling Brontosaur Tracks Gave the Author's Crew Five Months' Work

Despite his size, this *Brontosaurus* in New York's American Museum of Natural History hails from Wyoming, not Texas. An enlarged photograph guides reconstruction of the Texas trail (page 722).

sauropod, a mere baby, was forced to wade.

A herd of 80 elephants could not have splashed more noisily up into the shallows. Water streamed from monstrous bellies. Shadows cast by the bodies moved across the crown of the bar as if from a sky full of clouds. The baby sauropod, in the wake of the biggest giant, was forced to step quickly to keep up. Not more than four times the size of a baby elephant, he was perhaps afraid of being singled out by the carnivores in case of attack.

I followed the herd across a landscape no man had ever seen, watching with my mind's eye these sauropod dinosaurs alive, 23 altogether, big, little, and in between.

The black mountainous forms moved off toward the west lagoon, bothered only by the intense stickiness of the mud, which was snowballing on their feet and ankles. It increased the effort of walking, though the falling away of great lumps often relieved the weight. Gobs remained whole in the tracks like irregular chunks of leftover concrete.

Nor was this the last incident. Shortly afterward, a big new carnivore clumped heavily into view from the north, crossing the fresh sauropod trails like a runner who fails to reach an objective and turns aside in failure.

He had hardly continued south toward the

island when two more appeared, this time returning from the very direction the sauropods had taken. What did this mean? Had this pair gone after the herd across ground I hadn't seen, and, after a lengthier chase than that made by the preceding carnivore, were they just coming back? Whatever the answer, they headed south, stepping in the other's tracks. Water currents later had deposited upon the bar layers of silt that were to preserve the tracks and even the shapes of the mud gobs that fell off the sauropods' feet.

Because the sauropods had all crossed the bar together like cows meandering down a lane, I still lacked a suitable clear-cut trail of the brontosaur. I gave up the Davenport quarry to return north to the Glen Rose tracks.

Soon our activities got into the newspapers, and hundreds of visitors began pushing loose dirt down our quarry banks and plaguing workers with endless questions (page 717).

One spectator, standing beside me, asked, "How did you know where to start uncovering this trail?"

Tracks Disappear Under Rock

"The first tracks were exposed where you now see a sandbag dike," I explained. "It was only necessary to dam back Paluxy Creek, clean off the mud, and follow the dinosaur to where the tracks disappeared here under the overburden."

William Eaton, a new workman prying at a block of rock below with a crowbar, glanced up and grinned. "Tell him what one workman thought," he said.

Though the most amusing personality among my new working crew, the man he mentioned was not the best informed on dinosaurs.

"He saw the tracks in the creek bed," I recalled. "But when we told him we would have to remove this ledge to expose more, he only laughed. 'Why, that animal didn't walk under all that rock!' You should have seen his face when the quarrying revealed the next track" (page 710).

The sauropod trail seemed perfect until continued quarrying revealed an even better one near by. Here, indeed, were the finest, deepest, freshest, and best preserved sauropod tracks I could possibly hope to find.

Moreover, as the men uncovered more of this second trail, another Age of Reptiles drama was revealed.

The huge brontosaur, in crossing the high crown of a mud bar, had attracted the attention of a carnivore lurking on near-by land. There had been the crash of jungle underbrush, the pound of heavy feet, and along the bar a chase was on! Or so the trails suggested (page 708).

The discovery electrified even the most phlegmatic workman. Would the giant flesh eater overtake and overpower the even more gigantic sauropod?

Presently the lumbering sauropod, as if to dodge his pursuer, was seen to turn sharply. Never have I seen workmen sweat harder with sledge and hammer, crowbar and shovel. Great rivalry existed as to who might uncover the next carnivore track. Would the lunging flesh eater leap to the attack beyond?

Floods Rebury Footprints

Meanwhile, we experienced the first of several troublesome rises in Paluxy Creek. Each swept higher than our highest dike. Every rise brought in distressing quantities of mud; it became particularly galling to re-excavate, from under this tonnage, portions of the trails already explored.

These lengthy delays reminded me that I still faced the problems of specimen removal.

The tracks occurred in a layer of rock some 16 inches thick, a depth of matrix sometimes pierced by the deepest claw imprint in the deepest tracks. Underlying and overlying the layer were similar thicknesses of firm clay.

Even as the upper clay freed easily from all track cavities and adjacent surfaces, so did the one below promise to expedite the lifting of the huge trail slabs. But how would we handle such slabs? The one for the brontosaur base alone was estimated at 15 tons.

We made experimental cuts and discovered that the track layer contained innumerable cross fractures, suggesting removal of the blocks in numbered sections. This would work, I knew. But in dealing later with these masses, some promising to weigh a quarter of a ton, how could contacts be recemented strongly enough to hold?

After still another rise in the creek I abandoned all further exploratory work to concentrate on the lifting of specimens.

As we sectioned the first block, a familiar voice rang out above the clang of hammers. "These pieces will never in this world go back together and make anything," predicted the man who thought dinosaur tracks could not be under rock.

National Geographic Photographer Robert F. Sisson

Brontosaur Walks Again! A Prehistoric Drama Lives Anew for Museum Visitors

Twelve feet at a stride, "thunder lizard" pounded into limbo. All other dinosaurs shared his fate. Most experts believe that their extinction came through inability to adapt to changing conditions such as colder climate, the rising of land masses, and the draining of swamps.

Since no marks of tail drag showed between the Paluxy Creek tracks, the author concluded that the animal making them was wading in shallow water. The museum therefore mounted the tail two feet in the air, as if afloat.

Behind *Brontosaurus*, a flesh-eating *Allosaurus* flexes savage foreclaws and bends to devour a fallen victim. Such a dragon-toothed killer made the tracks paralleling those of the brontosaur in Texas. The display case holds bones of three other dinosaurs—a partial framework of a *Diplodocus* and skeletons of two smaller reptiles.

I watched a big sauropod track fall apart in four irregular shapes, with smaller pieces dropping from the contacting edges, and wondered if the old man might not be right. Reassembly of 15 tons of this material presented a problem so staggering in terms of time and money that I was afraid the museum might never undertake it.

The brontosaur slab broke down into 118 sections large enough to have edges protected by burlap and plaster jackets, and several thousand other fragments, numbered and wrapped in newspaper. Moving all this tonnage up the 30-foot embankment was a welcome if backbreaking change.

Summer's end arrived on the heels of one last flood. But with University of Texas and Southern Methodist University also obtaining a specimen block, more than 40 tons had at last been wrested from the water (page 715).

Prehistoric Jigsaw Puzzle

In 1952 plans were made to reorganize the exhibits in the museum's dinosaur hall. Walls and ceiling were to be repainted a glamorous space-reaching blue; a new system of concealed overhead lighting was to highlight a great new island in the center of the hall. On that island, with two other dinosaurs, Dr. Edwin H. Colbert, now Curator of Fossil Reptiles and Amphibians, decided to place the brontosaur as the dominating figure.

Into the hall with me from the masonry department I took two excellent men—big, good-natured Paddy Grady, and Gwynne Payne, an ex-coal miner. Both cast critical eyes on the litter of uncrated rock specimens. By comparison, the 300-square-foot space provided for them within the island behind the brontosaur seemed small.

"It looks as if you've brought back enough for two brontosaurs," Paddy commented.

So that we might set sections together right up to the brontosaur's hind feet, the tail was temporarily removed.

Though no longer haunted by my pessimistic workman's prediction, I longed for a few days to work out in private a method by which the sections might be cemented together.

It was now evident that some substitute for the supporting clay once underlying the rock must be used to set and hold level the uneven sections—something that could be compacted into the various vacancies beneath them. The only suitable material would seem to be excelsior saturated in plaster of paris. When the plaster sets, this combination is fully as tough as solid wood and about as hard to cut. If it should serve our purpose, our only concern would be to avoid mistakes in the piecing.

Slowly the sections went together. By fall, more than four tons of plaster and countless bales of excelsior had been used. Right beside the trail leading to the brontosaur the partly superimposed footprints of the carnivore were placed.

There remained the remounting of the 48 joints of the brontosaur's tail. But in what position had this appendage hung on the Glen Rose sauropod as he lumbered across the wide bar ahead of the charging carnivore? Evidence showed it had not dragged the surface of the earth, nor had it floated high up in a swimming position.

As preparators Carl and Walter Sorensen and George Whitaker hoisted the first heavy vertebrae into position, I could see again the prehistoric drama of the chase being enacted in the Age of Reptiles.

Killer Close Behind Its Prey

If Charles R. Knight, that great painter of prehistoric life, had set it upon a huge canvas, the green jungle in the background and the long shore line and bar could not have seemed more real. In the foreground was the brontosaur, great black flanks and belly streaming water, long neck weaving as it tried to escape an openmouthed lunge of the powerful killer. You felt all would be over if those dagger teeth should grip a point behind the brontosaur's snakelike head.

The Age of Reptiles sun glistened on the distant palm leaves and the shallow churned waters. Suddenly, however, it seemed to me that the chase was less important than the fact that the brontosaur was walking upright on four massive legs. He was alive now with a new reality.

The completed exhibit shows the brontosaur striding across the central island with the tail mounted to suggest two or three feet of water washing about his ankles and curved to one side, thus making the tracks fully visible (page 721).

Did he escape the carnivore? The outcome is still hidden under the other end of that rock ledge near Glen Rose, a ledge extending for hundreds of feet under thousands of tons of clay and limestone.

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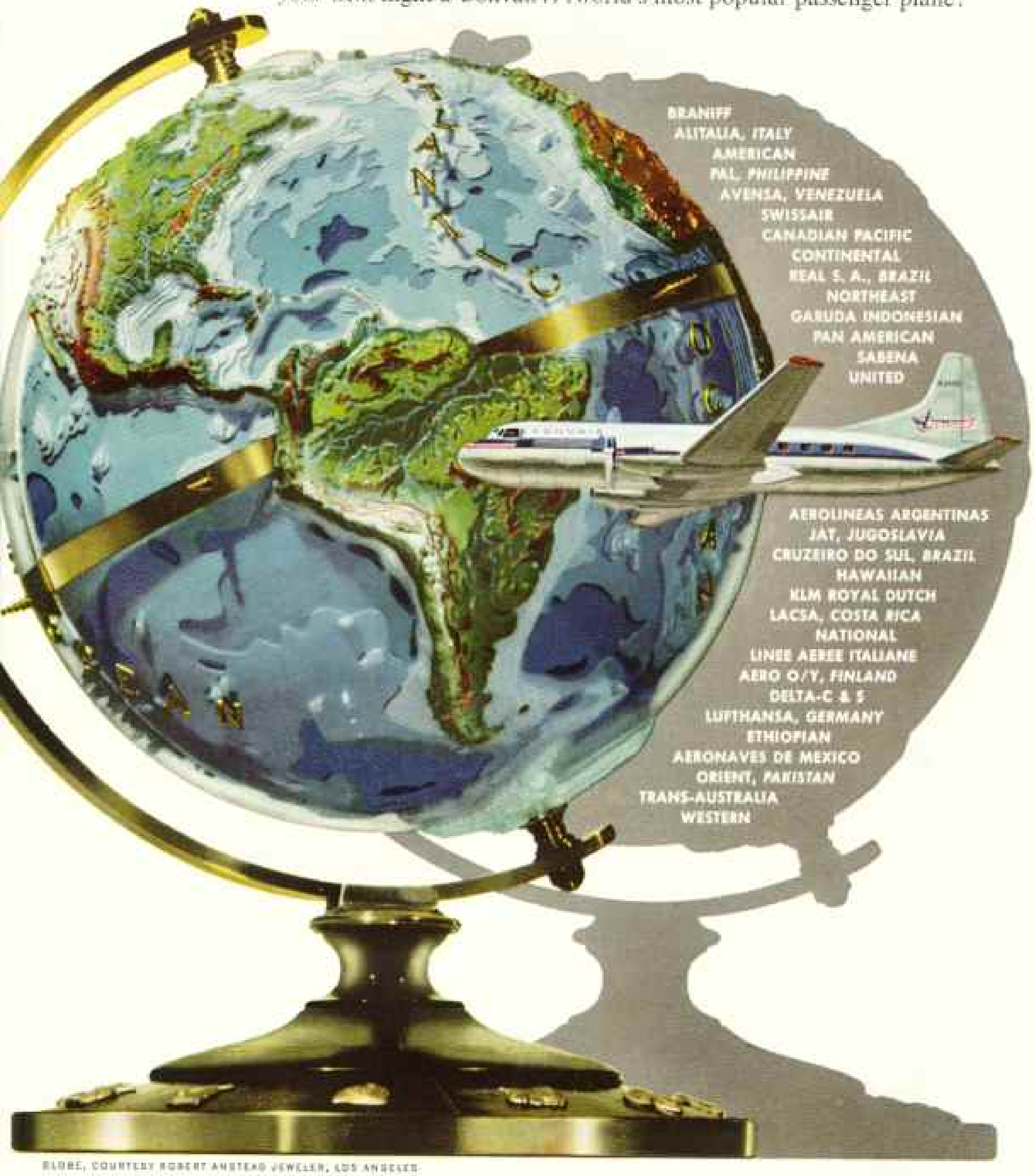

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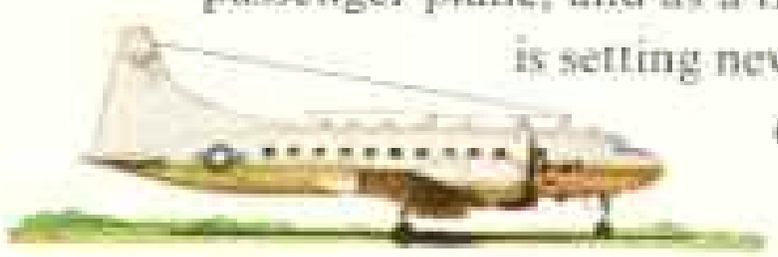

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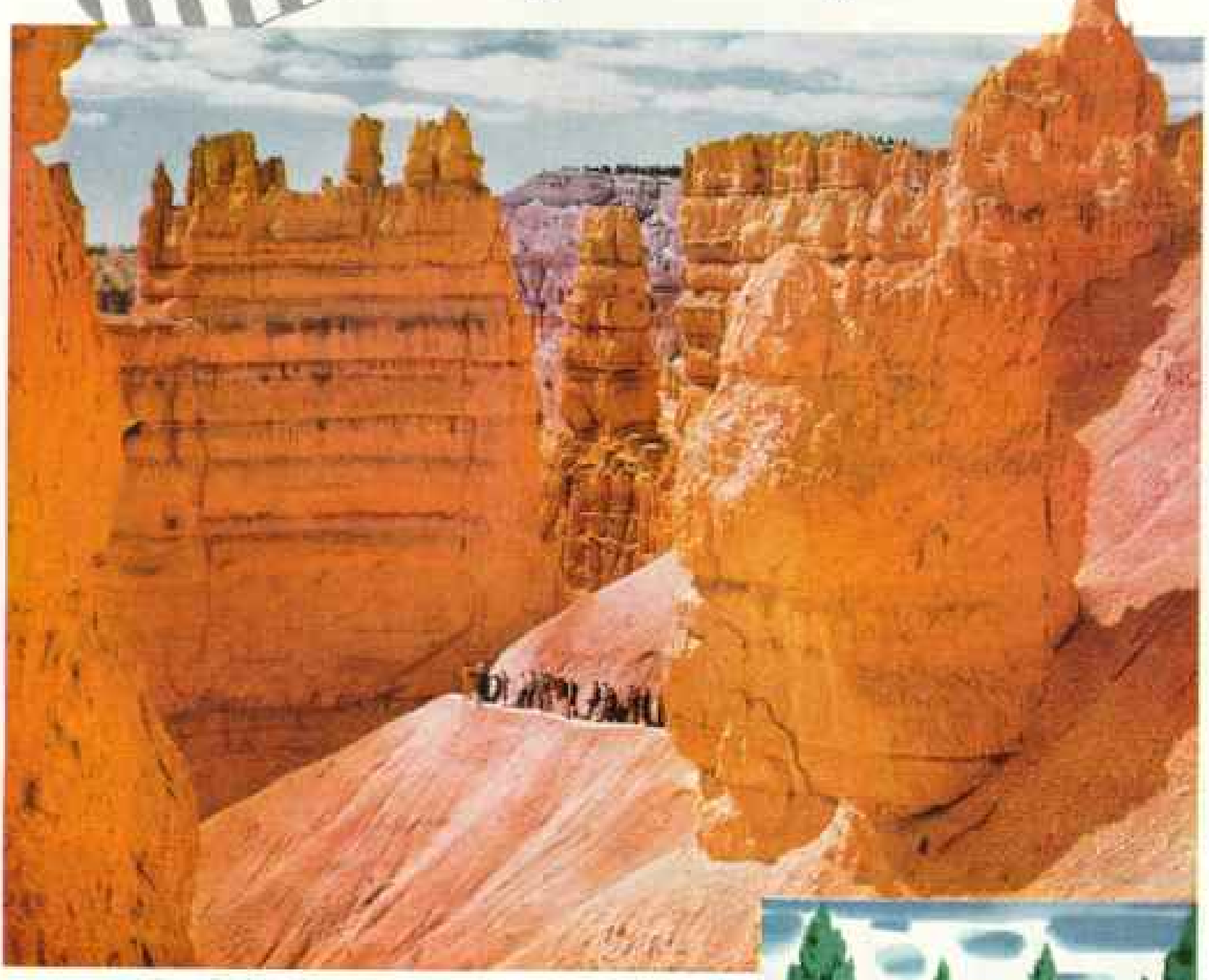

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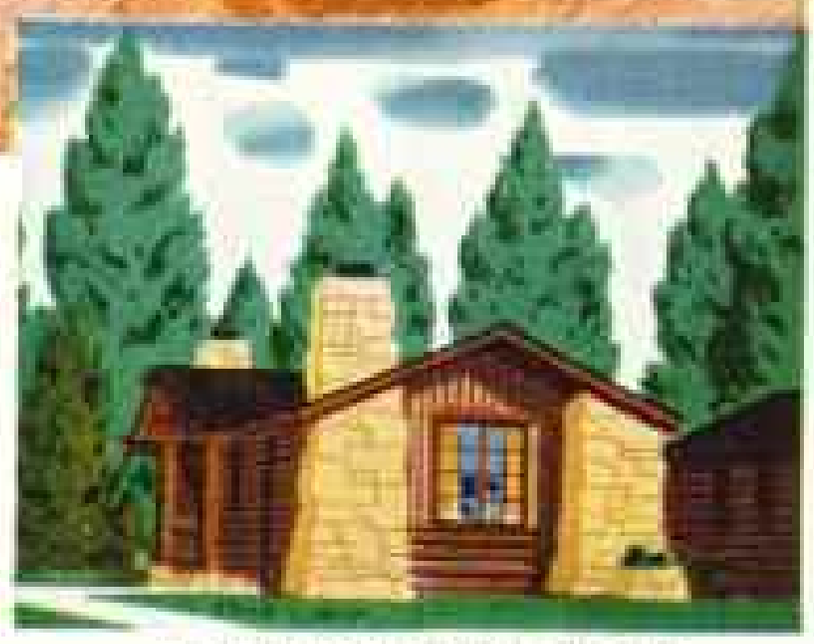

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A thrilling panorama of history, beauty and romance unfolds before you like the pages of a dramatic story when you visit Old Virginia — the birthplace of the nation.

It's a glorious land with the spirit of the Old South in many historic cities, towns and shrines . . . a majestic wonderland of scenic mountain splendor and highways "in the sky" — Blue Ridge Parkway and Skyline Drive . . . a dreamland of fantastic natural wonders . . . a playland of gay ocean beaches . . . a friendly land of hundreds of hospitable hotels, motels and resorts . . . a memorable land for one of the best vacations you've ever had.

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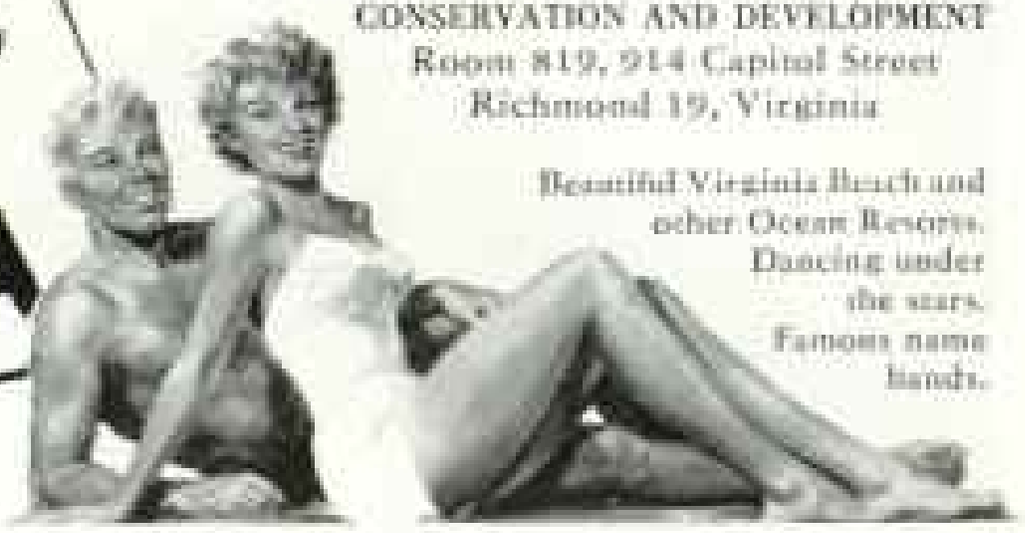
Richmond 19, Virginia



Beautiful Virginia Beach and other Ocean Resorts. Dancing under the stars. Famous name bands.

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- Stows away in 2 easy-to-carry packages, fits into car trunk. For all water sports. Used by famous explorers.

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- Easy to set up in minutes; new snap-lock fittings!
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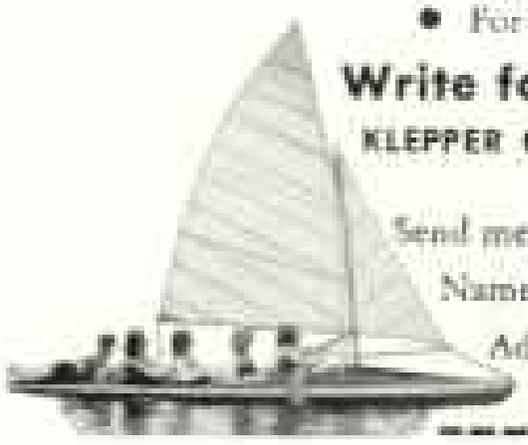

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SATOUR

At what age should a man retire from business?

ONE THING IS SURE. You want to plan for your retirement . . . not be "retired!" prematurely by a disastrous fire which destroys the records your firm must have to stay in business.

It couldn't *happen?* Don't be *too* certain about that. Even if you're keeping your accounts receivable and other vital records in a big-solid-looking safe . . . even if that safe is in a fireproof building . . . even if you're completely covered by fire insurance —it could happen overnight.

Scores of "retired" businessmen can tell you that an old safe, or *any* safe without the Underwriters' Laboratories, Inc. Label will *incinerate* its contents when the temperature inside gets above 350° F. They can tell you a fireproof building will just *wall-in* an office fire, too. Make it *hotter*. And they can show you where your fire insurance policies say you must provide "proof-of-loss within 60 days" to collect fully—which takes *records!*

See how deadly this danger really is? It's so deadly that 43 out of 100 firms that lose their records by fire never reopen. And the rest have years of difficult readjustment problems.

How do you know *your* firm isn't among the 70% now risking disaster because of inadequate protection? Check on it! Get a *free* Mosler FIRE "DANGERater." Find out your "DANGERating" and get the protection it *calls* for. But don't trust anything less than the *best*. Mosler is recognized as the leader for styling as well as protection features. Consult classified telephone directory for the *Mosler* dealer in your city. He has a full line of famous Mosler Record Safes. See *him*. Or mail coupon for "DANGERater," today!

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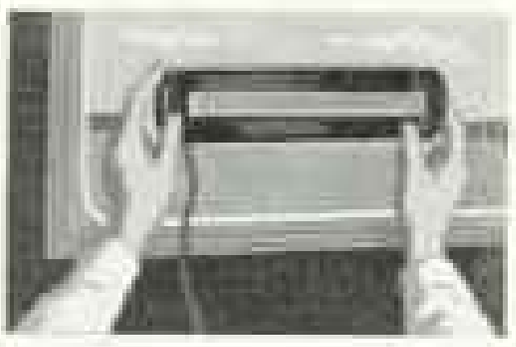
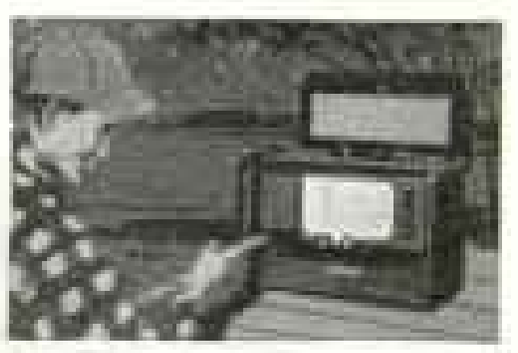
Announcing the New Zenith Super Deluxe TRANS-OCEANIC Portable

7 NEW features added to the World's only 13 year proved Shortwave Portable Radio

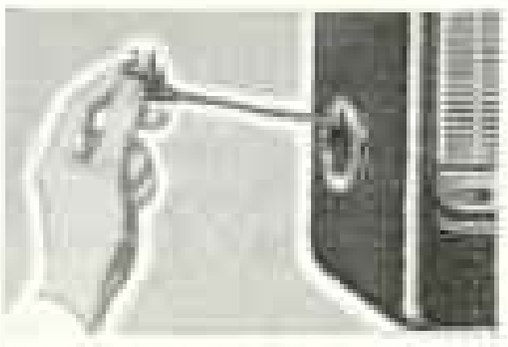


1. New Powerized Detachable Wavemagnet® Antenna . . . plus powerful new circuits increase sensitivity on the standard broadcast band up to . . . three times!

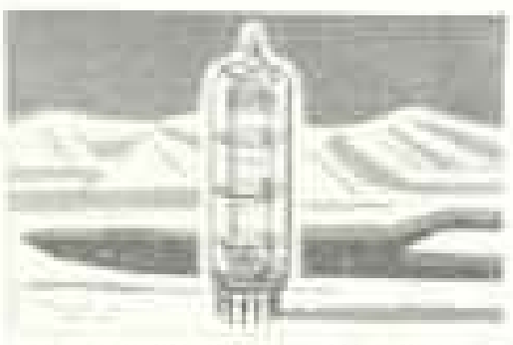
2. New International Tuning Dial permits far easier reading! Simplifies locating and tuning stations all over the world on shortwave or standard broadcast bands.



3. New Spring-Button Dialite illuminates entire face of dial. You can easily tune in your station in pitch darkness. Automatic release avoids excessive battery drain.

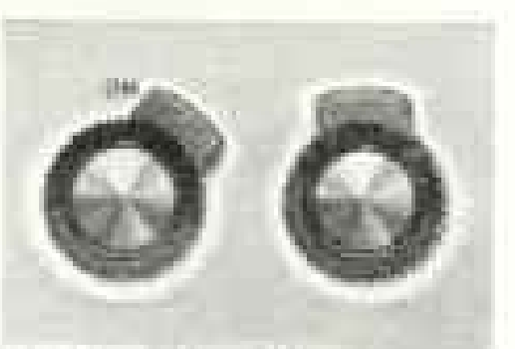


4. New Reelaway Power Cord reels out from side of case. Plugs in for AC or DC power. Springs back when not in use, readying set for battery operation.



5. New Voltmatic Regulator automatically maintains constant power flow through set, regardless of fluctuations at power source. Extends tube life!

6. New Log-Chart Compartment includes 24 pages full of complete weather and marine information. Lists data about all major short-wave stations in the world.



7. New On-Off Indicator further guards against excess battery drain . . . provides extra safety check against power loss when set is not in use.

ZENITH SUPER DELUXE TRANS-OCEANIC RADIO

Model shown in durable Black Stag, $139.95. Also available in luxurious top-grain cowhide at additional cost.*

Zenith POWERIZED Features!

- Tropically treated against humidity, to prevent loss of sensitivity. AC, DC or long-life batteries.
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- Super-sensitive electrical spread-band tuning . . . brings you ship-to-ship conversations, marine and weather reports, amateur broadcasts, popular programs from all over U. S.
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One of these battery-operated portables is as necessary in your home as a flashlight in case of power failure caused by air raid or other emergency.

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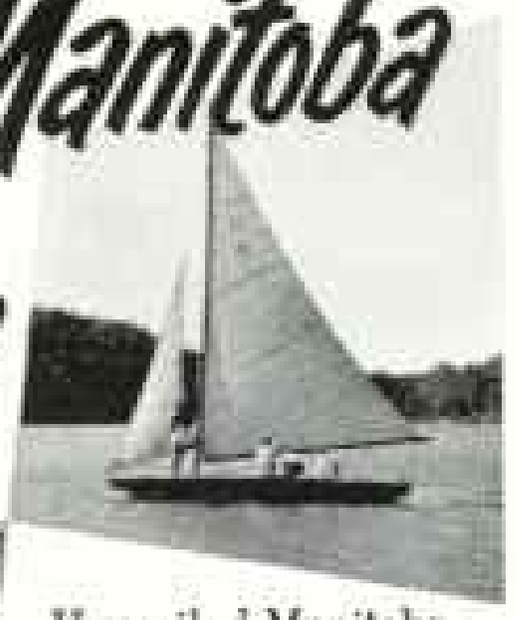

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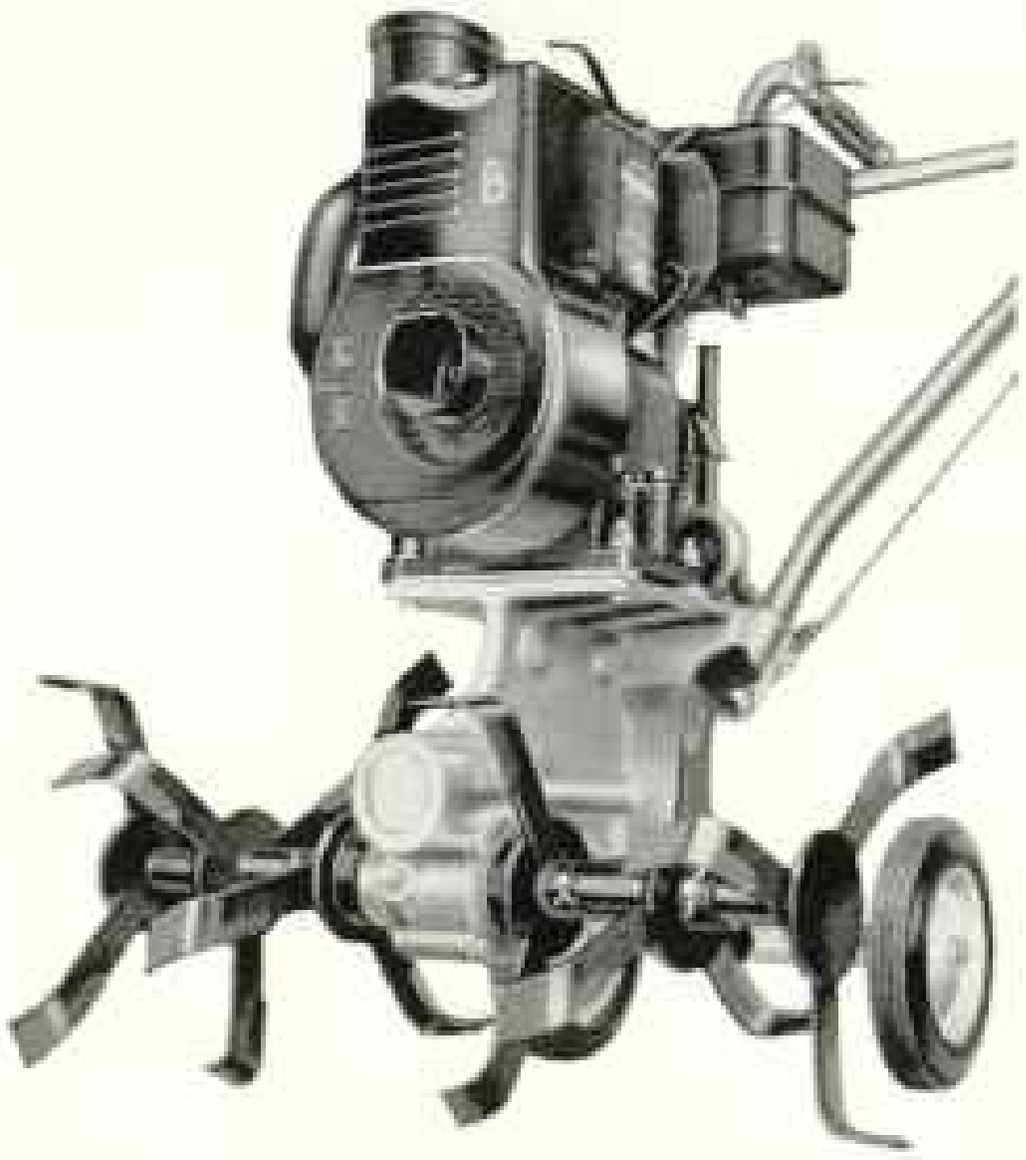

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GET IN AND TRY IT—You'll find Mercury's entirely *new* V-161 engine *smoother, quieter*. And with new ball-joint suspension, you'll enjoy greater handling ease.

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MAKE DRIVING AS EASY AS YOU WISH with optional 4-way power seat, power steering, power brakes, power windows, Merc-O-Matic Drive.

How often have you wished for more "go" from the car you now drive—especially when passing or hill climbing? How often have you been annoyed by sluggishness in traffic, stiff handling when parking, or wheel tug on curves?

Now—you can solve driving problems like these with Mercury's completely new V-161 engine teamed with new ball-joint front wheel suspension. The combination gives you a new feeling of safety in driving—smoother, easier power, unique in a popular-priced car. Road test a 1954 Mercury.

THE CAR THAT MAKES ANY DRIVING EASY

New 1954 MERCURY

MERCURY DIVISION • FORD MOTOR COMPANY

Paris can be the first stop on your round-the-world Clipper trip—or, if you are flying around westbound, *you can save it for the last!* Across the Atlantic you have your choice of the distinguished extra-fare *President Special;* luxurious regular-fare *President* service; or Pan American's famous tourist-fare *Rainbow* service.

India, once "far away," is now linked directly with New York by Pan American's famous "Super-6" Clippers. Choice of comfortable *Rainbow* Clipper Tourist service—or regular-fare *President* service, with wide, luxurious berths available...like the one shown at right!

Around the World on a 2-week

Only Pan American flies 'round the world . . offers you a choice of deluxe or tourist service . . . in double-decked "Strato" Clippers and giant new "Super-6" Clippers!

Believe it or not, the present flying time of Pan American's big, modern, 4-engine Clippers* makes it possible for you to fly 'round the world and spend *only* 90 hours in the air . . . *that's less than 4 days!*

So, on a 16-day trip (beginning Friday evening), you can have 12 days for sightseeing in fascinating places like Paris, Calcutta, Hawaii.

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Wouldn't it be fun to come home with stories, photographs and souvenirs from 20 lands most people never see? If you wish, you may take an inclusive *Pan Am Holiday* . . . know the costs of hotels and sightseeing tours in advance. One low price includes almost everything.

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ROUND TRIP	First class	Tourist
Havana or **Nassau** from Miami	$ 36	—
Mexico City from Houston	—	$ 74
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San Juan from New York	180	128
Guatemala City from Los Angeles	—	240
Hawaii from the West Coast	318	258
London from New York	720	522
Rio de Janeiro from New York	828	723
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Only Pan American offers you berths 'round the world, on first-class flights of *President* service. Modest surcharge. You'll arrive really rested and refreshed at each destination. Have breakfast in bed if you wish!

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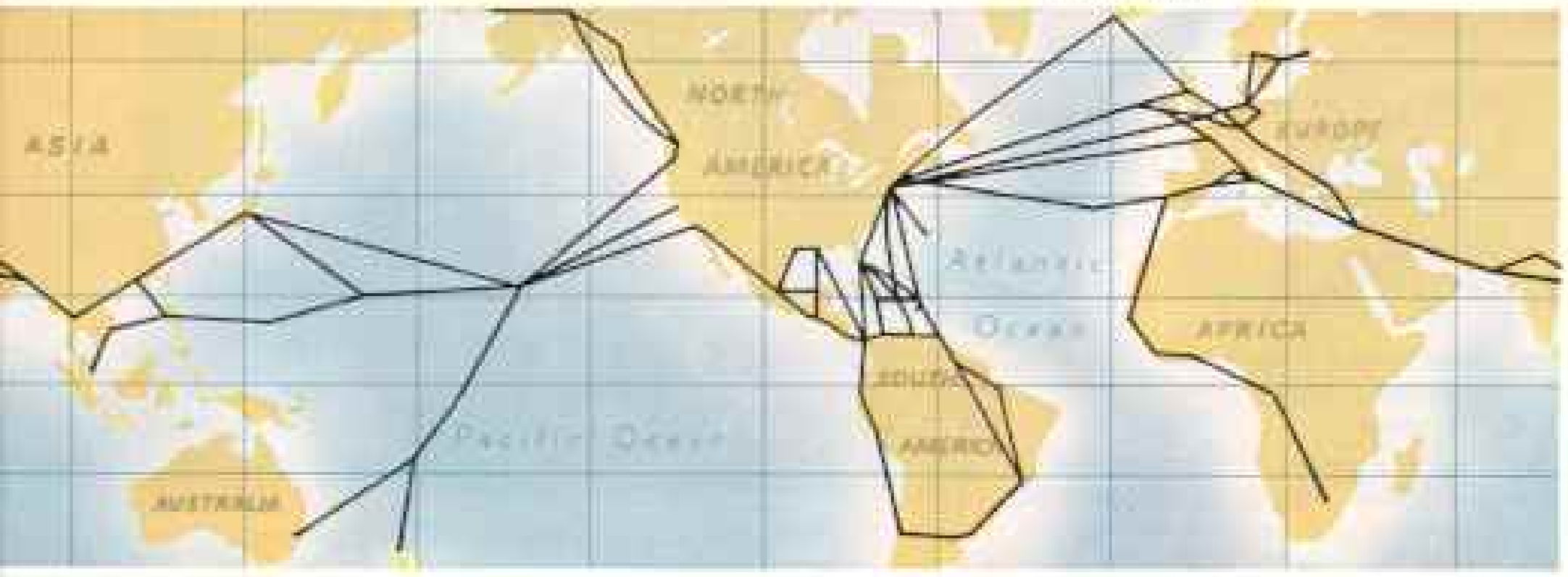
plus tax on U. S. portion of your trip only. Fare above is typical from most U.S.A. cities, based on new Round-the-World Clipper Tourist service



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Power-Lift Windows. Ford is the only car in its field with push-button control of all four side windows! **Fordomatic Drive.** It's the only "automatic" in Ford's field that combines torque converter smoothness and the "Go" of an automatic intermediate gear!

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With all the power assists you'd expect to find only in the costliest cars, the '54 Ford really puts the fun *in* and takes the work *out* of driving.

Yet power assists only begin to tell Ford's fine-car story! Ford offers a choice of new engines, too: a new 130-h.p. Y-block V-8 and 115-h.p. I-block Six. Both are low-friction, deep-block engines which deliver increased "go" and greater gas savings. And you ride and steer easier with revolutionary new Ball-Joint Front Suspension.

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Your Ford Dealer cordially invites you to Test Drive the '54 FORD

Master-Guide Power Steering. It does up to 75% of steering work yet leaves you with natural steering "feel" on straightaways.

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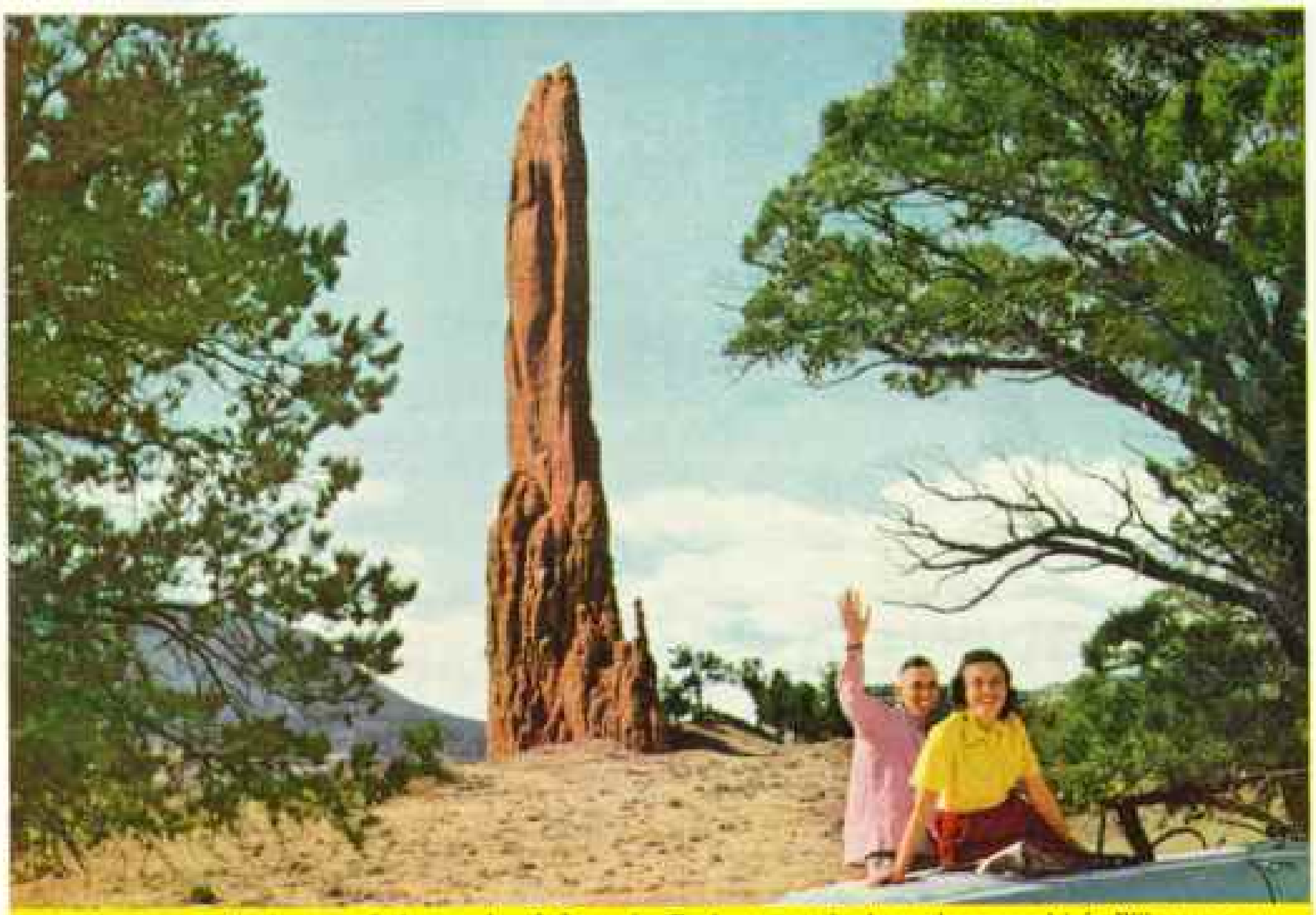
Power assists optional at extra cost.



Cleopatra's Needle is one of thousands of fantastic rock formations you view while traveling New Mexico's vast network of paved highways. This Land of Enchantment is closer than you think. Wherever you live in the U. S., you can drive to New Mexico, tour the state and return home within two weeks.

TAKE A TRIP "ABROAD" RIGHT IN THE COMFORTABLE U.S.A.

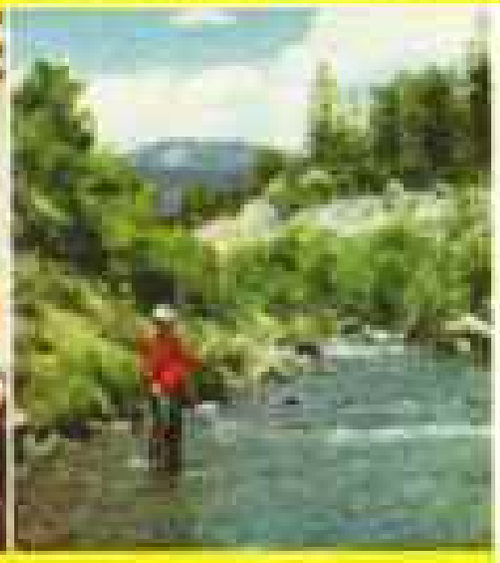
If you're tired of ordinary vacations, visit charming, spectacular New Mexico this summer.

Old Town Plaza, Albuquerque, is lined with quaint shops—a bit of foreign flavor in this modern city.

Navaho Cradleboard. Visit pueblos and reservations—see Indians at work.

Carlsbad Caverns dwarf all other caves in size and grandeur. Easy conducted tours daily. Also plan to see White Sands.

Discover western hospitality in New Mexico's 1600 hotels, motels, resorts and ranches.



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LAND OF ENCHANTMENT

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Fort Nassau CUPBOARD

Stickley American adaptation reflecting the Dutch influence in Cherry Valley furniture

Fort Nassau on the Hudson River was built by the Dutch in 1615. Later as Albany, N. Y., it became the base from which pioneers pushed westward along Cherry Valley . . . today's home of Stickley cherry furniture.

Dutch patroons and yeomen left their imprint on the land . . . in freedoms granted by Peter Minuit, and in the sturdy, practical and beautiful furniture built for Rensselaerwyck farmhouses. Stickley's *Fort Nassau Cupboard* is a representative piece. Its simplicity, fine proportion, thoroughgoing workmanship and hand-executed details are likewise typical of all Stickley furniture. Timeless in charm and appeal, the Fort Nassau is suited for contemporary or traditional surroundings . . . as cupboard, sideboard or cocktail bar. The Stickley rocker shown makes an ideal companion piece for a period setting.

See these and other Stickley pieces at leading furniture stores and departments. *Cupboard No. 5051–H52", W 30¾", D 13¾". Rocker No. 5075 B–H 38", W 30", D 33" overall.*

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with many modern uses. Typical of Stickley finish and craftsmanship! In this quaint "conversation piece" construction that endures is brought out by the same painstaking fitting and joining, the same hand rubbing to a glowing sheen, that you will discover in all Stickley cherrywood furniture. 14" L. x 10" W.; sides 2¼" H. By post paid mail only . . . $10.00.

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Cherry Valley WORKSHOPS

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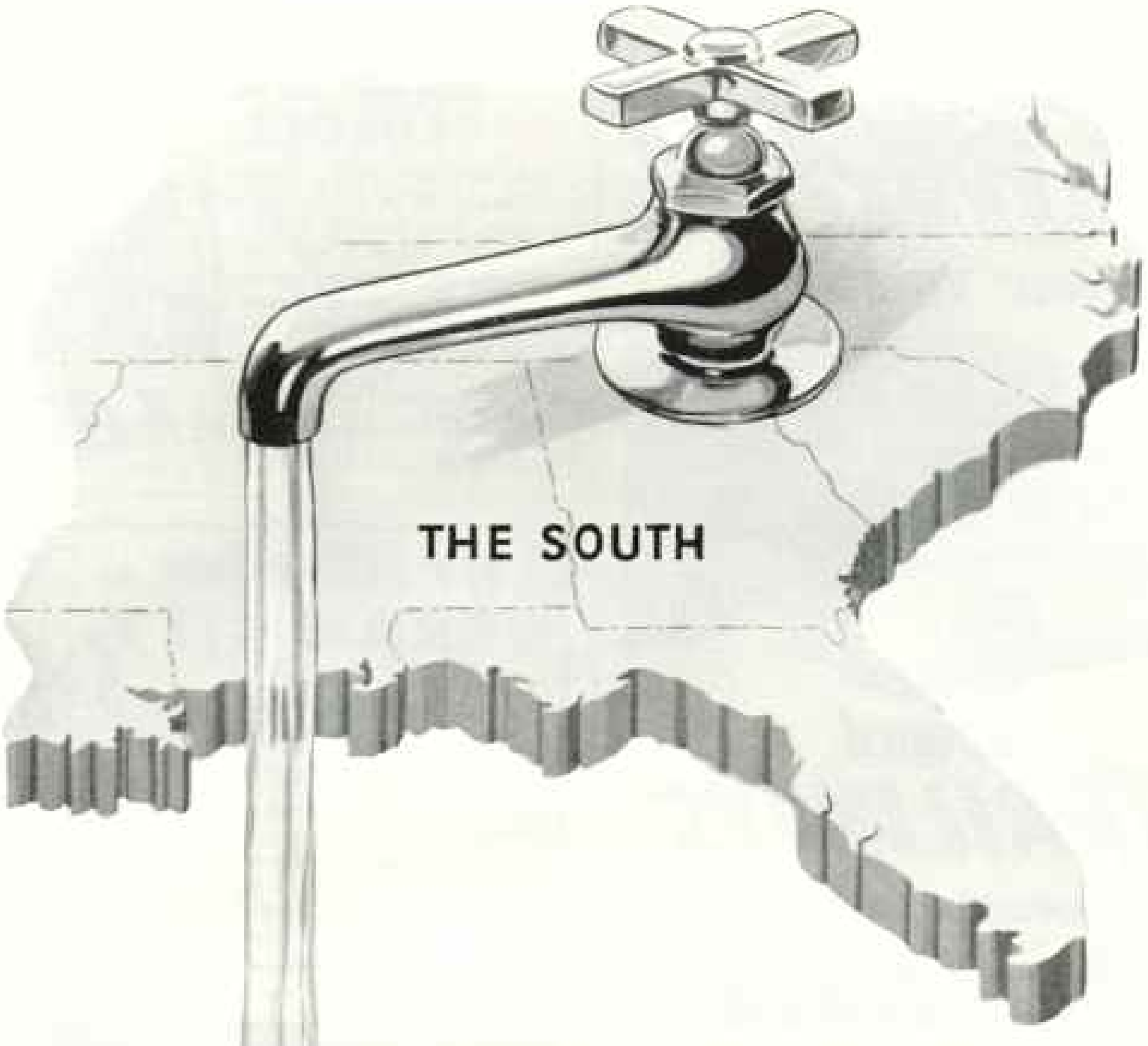

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THERE'S good water and plenty of it in the South—both on the surface and underground.

Mapping potential sources of *underground* water for industries of every kind is now an important part of Southern Railway's comprehensive industrial development program. Our industrial geologist and his water-location team are compiling data in the field to pinpoint areas along the Southern where heavy supplies of underground water may be found, the anticipated yield and the quality.

An abundant and dependable supply of various kinds of water is just one of the South's basic advantages for industry. There are many more. To see them *all* . . .

"Look Ahead—Look South!"

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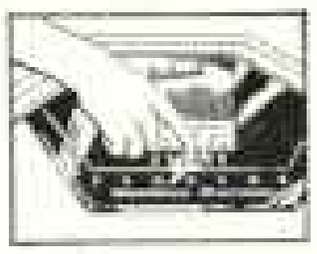
FEDDERS gives you Push-Button Weather!



Fedders makes you the boss of all this cooling power. Exclusive Built-In Weather Bureau gives you the cool, clean weather you want at the touch of a button. Lets you ventilate, whisk away stale, smoky air . . . both independently of cooling. Rotatable Grille sends air in any direction. Exclusive new Reverse Cycle Heat Pump* switches from cool to heat to cool *automatically* to maintain the temperature you set. See Fedders in action — best engineered room air conditioner on the market. Also sold throughout Canada.

**At extra cost on 5/4-ton Deluxe and 1-ton Window Models.*

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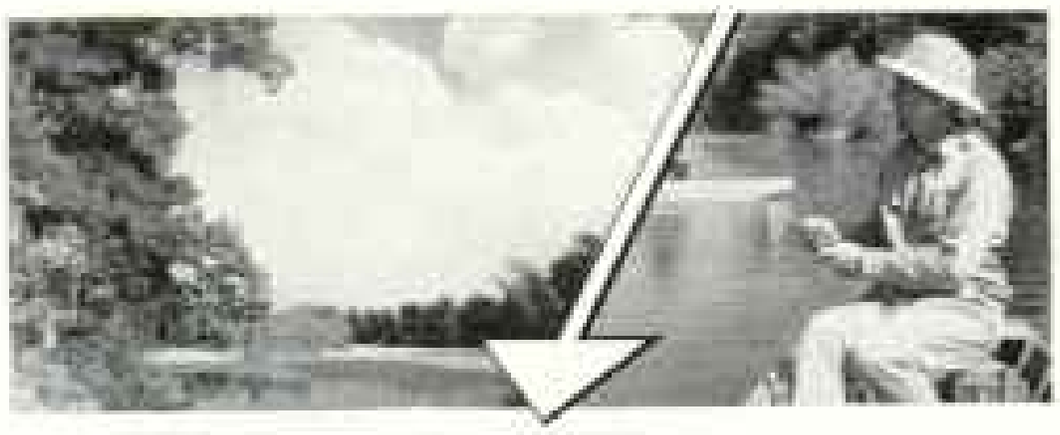

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TRY S.P.'s CALIFORNIA STREAMLINER

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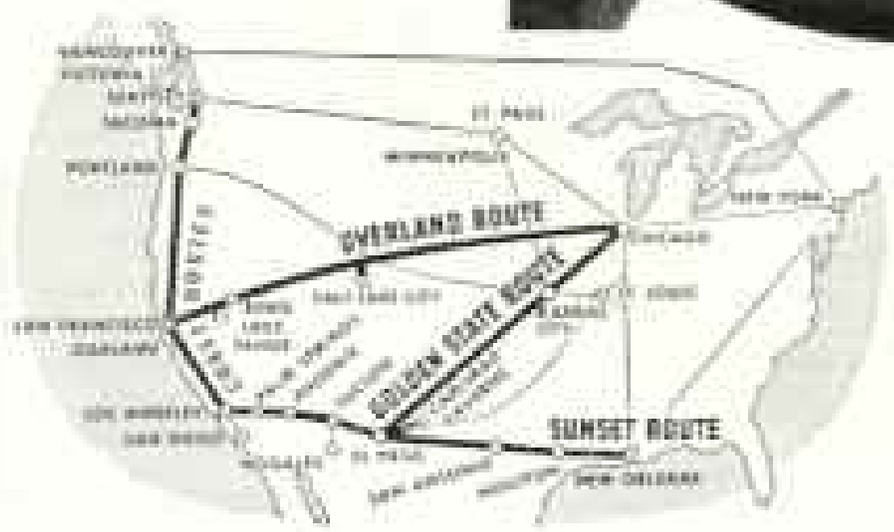

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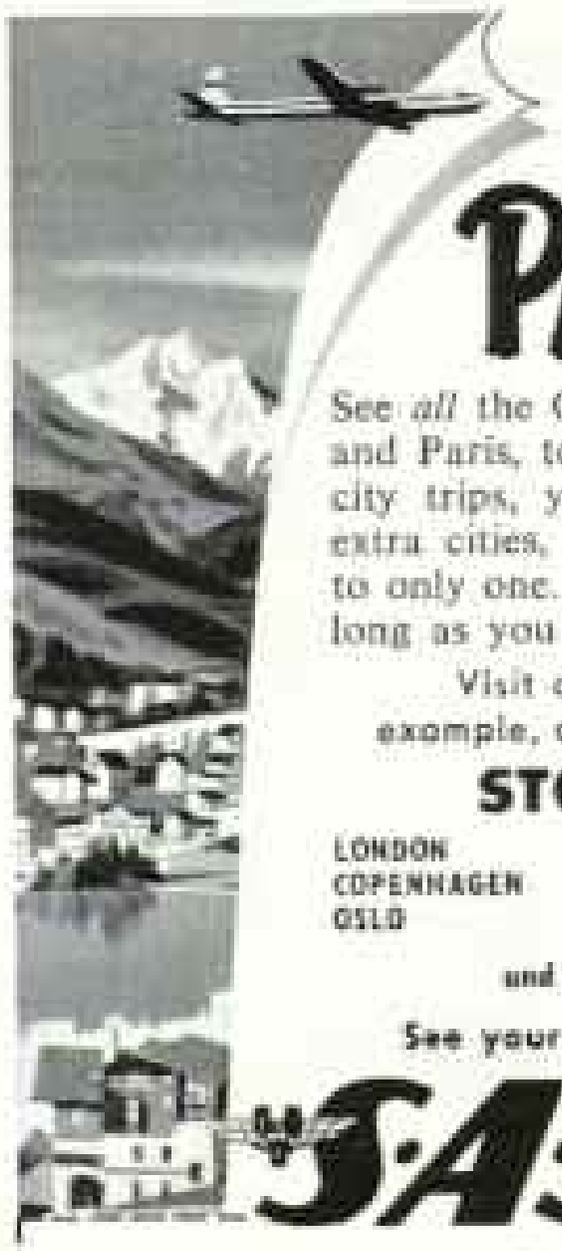

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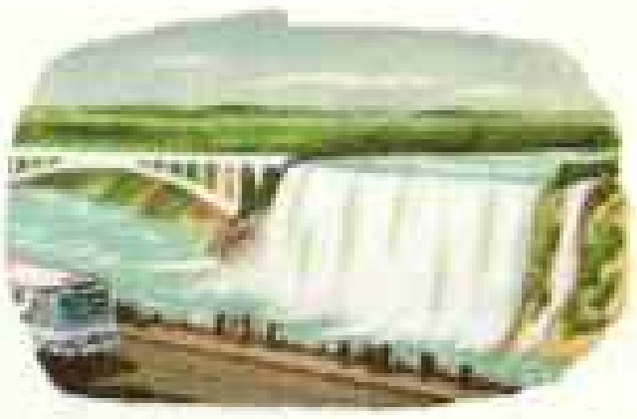

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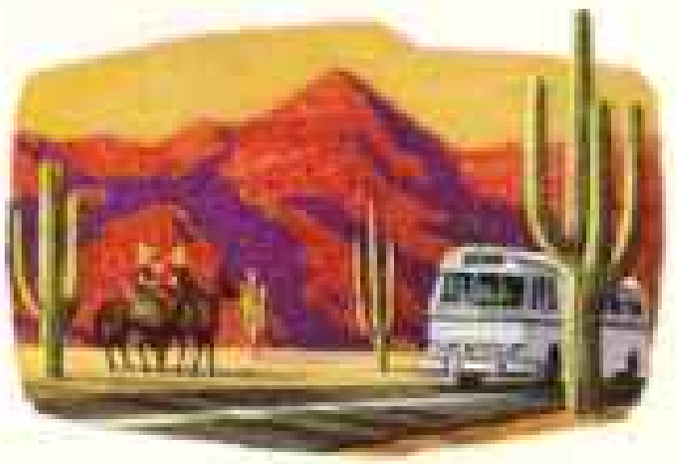

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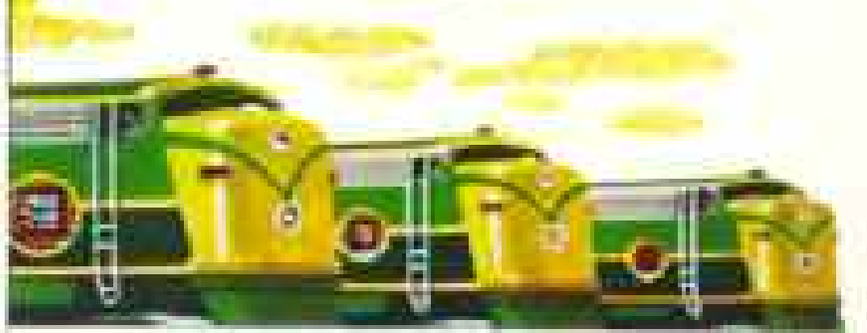

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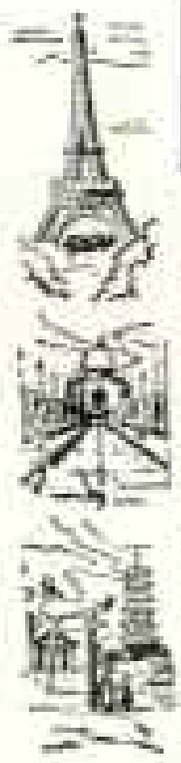

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THE CONQUEST OF TUBERCULOSIS

FIFTY YEARS AGO, tuberculosis was the leading cause of death in our country. If it had continued to kill at the same rate as in the early 1900's, more than 300,000 Americans would die of the disease this year.

Our fight to control tuberculosis, however, has been so successful that its annual toll in the United States has dropped to about 20,000 lives.

Despite the dramatic decline in the *death rate*, the number of tuberculosis cases remains high. Today more than a million Americans are affected by the disease . . . and over 400,000 of them have tuberculosis in an infectious form so that it can be spread to others.

Worse still, at least 250,000 of these potential spreaders of tuberculosis *are not under medical supervision*. These cases account for many, if not most, of the new victims discovered each year in our country. The number of cases with active, or probably active, tuberculosis found in 1952 was over 85,000.

How can we reduce the tuberculosis death rate still further and prevent the development of new cases? Here are some of the ways which authorities recommend:

1. See your doctor for regular health examinations and follow his advice about how to keep in the best possible physical condition. *The higher your level of health, the better your resistance will be to tuberculosis.*

2. If you notice any of the possible symptoms of tuberculosis—persistent cough, constant fatigue, loss of weight, pain in the chest—consult your doctor promptly. Through an X-ray of your chest, he can usually tell whether tuberculosis of the lungs is present. *Early discovery is the best road to early recovery.*

3. If tuberculosis occurs, your doctor will recommend treatment . . . probably in a hospital . . . where the most modern care can be given. While rest in bed is still an important method of treatment, doctors now have many new weapons to combat tuberculosis, including surgical operations and new anti-tuberculosis drugs. In many cases, these bring rapid improvement.

Once the disease is brought under control, you can usually resume your normal way of living, with periodic check-ups to make sure the disease does not become active again.

If everyone observes these and other safeguards and precautions recommended by health officials, the number of tuberculosis cases could be even further reduced.

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All your feelings so beautifully expressed . . .

Words can never say what a gift of Sheaffer's conveys. Here is a gift from the heart, to make every milestone a glowing memory. For when you give Sheaffer's new Snorkel pen, you give more than superb writing smoothness, more than matchless filling ease, more than years of pride-filled service.

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This is the magic of Kodachrome Photography

Some wonderful day you'll load a **miniature camera** with **Kodachrome Film** and shoot. When your pictures come back they're **color slides** . . . breathtakingly beautiful when you project them on a **home screen.** And you can have sparkling **color prints** made from them, too. This is the magic of Kodachrome photography.

Easy, low-cost way to Kodachrome pictures . . . The "Pony" is a dream to load—no film threading required. Average settings marked in red give you box-camera simplicity. Automatic film stop, film count. The fine, fast *f*/4.5 lens means crisp, clear color pictures indoors as well as out. All this at a surprisingly moderate price.

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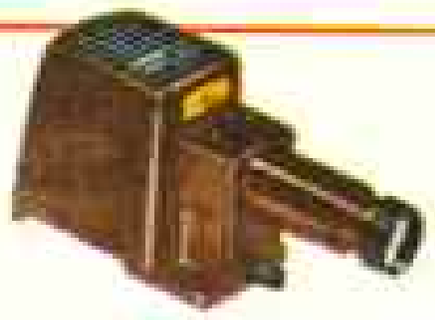

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Frankly, what would these people really say about the new Chevrolet?

We're frank to admit it. Most people really don't talk about cars the way the manufacturer would like them to.

So, we wouldn't actually expect those folks around the firehouse to comment about the new Chevrolet's "smoother lines and smarter styling." But you might well hear something like "It's a swell-looking job," or even "Best-looking Chevrolet ever turned out."

No one up there is likely to go in for technical engineering talk about "higher compression ratios resulting in increased horsepower and finer performance with outstanding fuel economy." But that new Chevrolet owner would probably point out the same things to his friends in his own words. Something like this, maybe: "This new Chevrolet's got a lot more stuff in it. And it's the easiest car on gas I ever owned."

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I had *one* good break that morning. My neighbor Mr. Landis was late starting for work.

I was home alone, my nose buried in a book. First thing I knew, he came dashing in. *My house was on fire!*

With my bad leg, I'd never have been able to get out. Mr. Landis saved me, while another of my good neighbors turned in the alarm.

The fire department finally got the blaze under control. But I could see that repairs were going to cost a lot of money.

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Wouldn't *you* like to be equally well protected if your house were damaged by fire?

Then make sure *now* that it is insured for its present value. Seven out of ten homes, the records say, are substantially under-insured. What may have been enough insurance for you five years ago, may not be nearly enough today.

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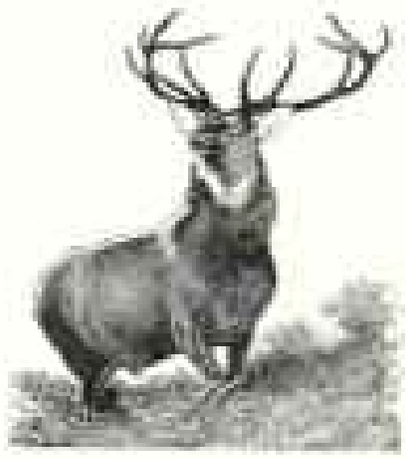
Year in and year out you'll do well with the



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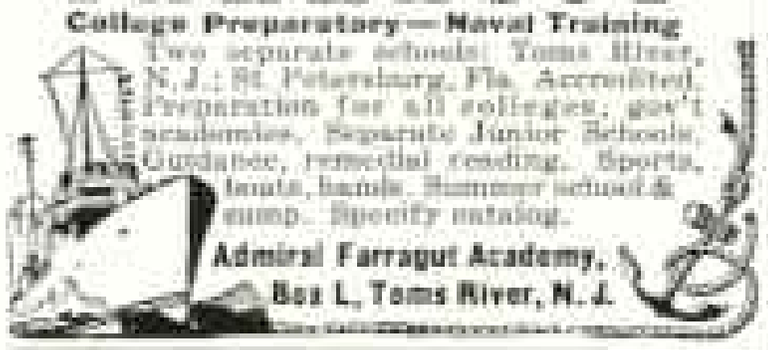

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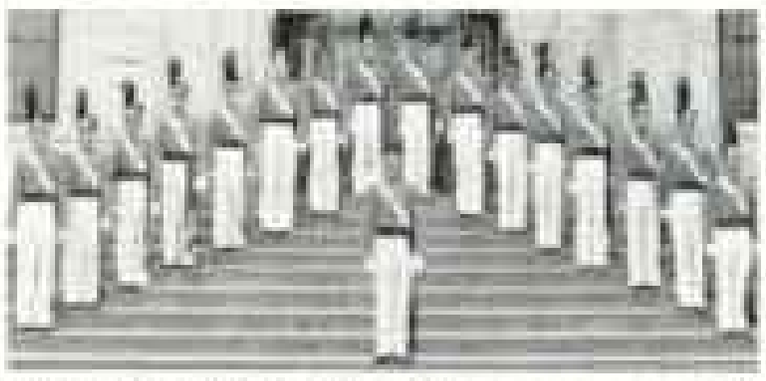

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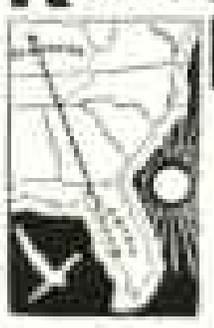

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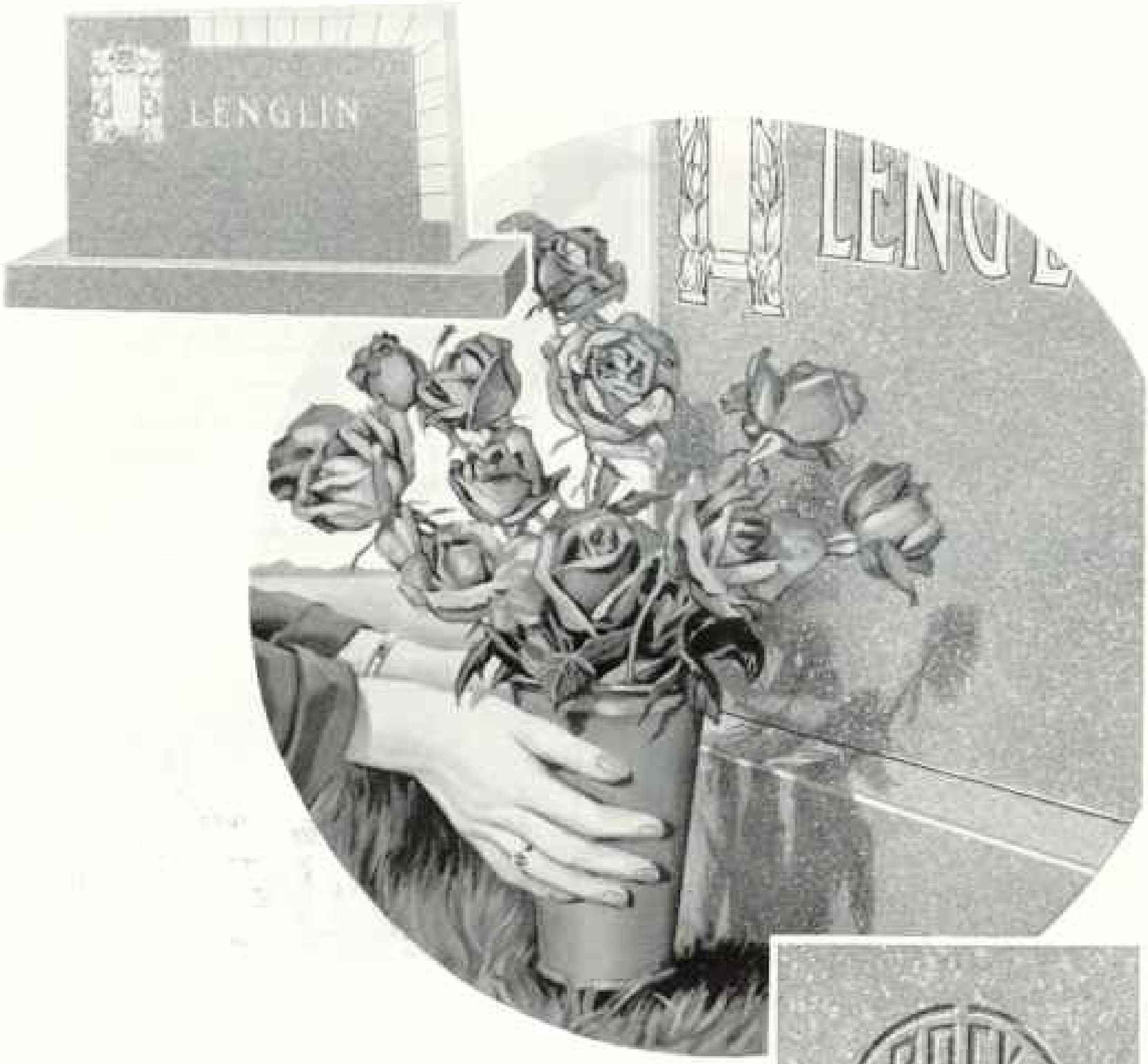

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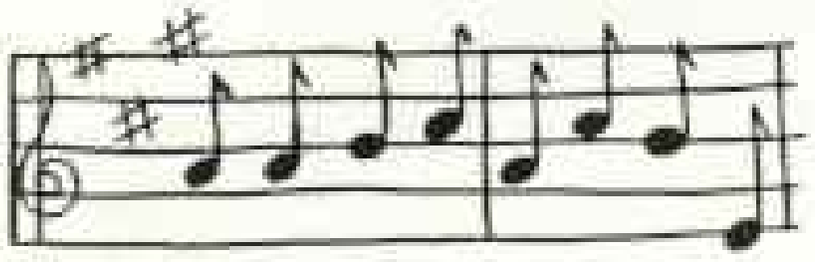

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