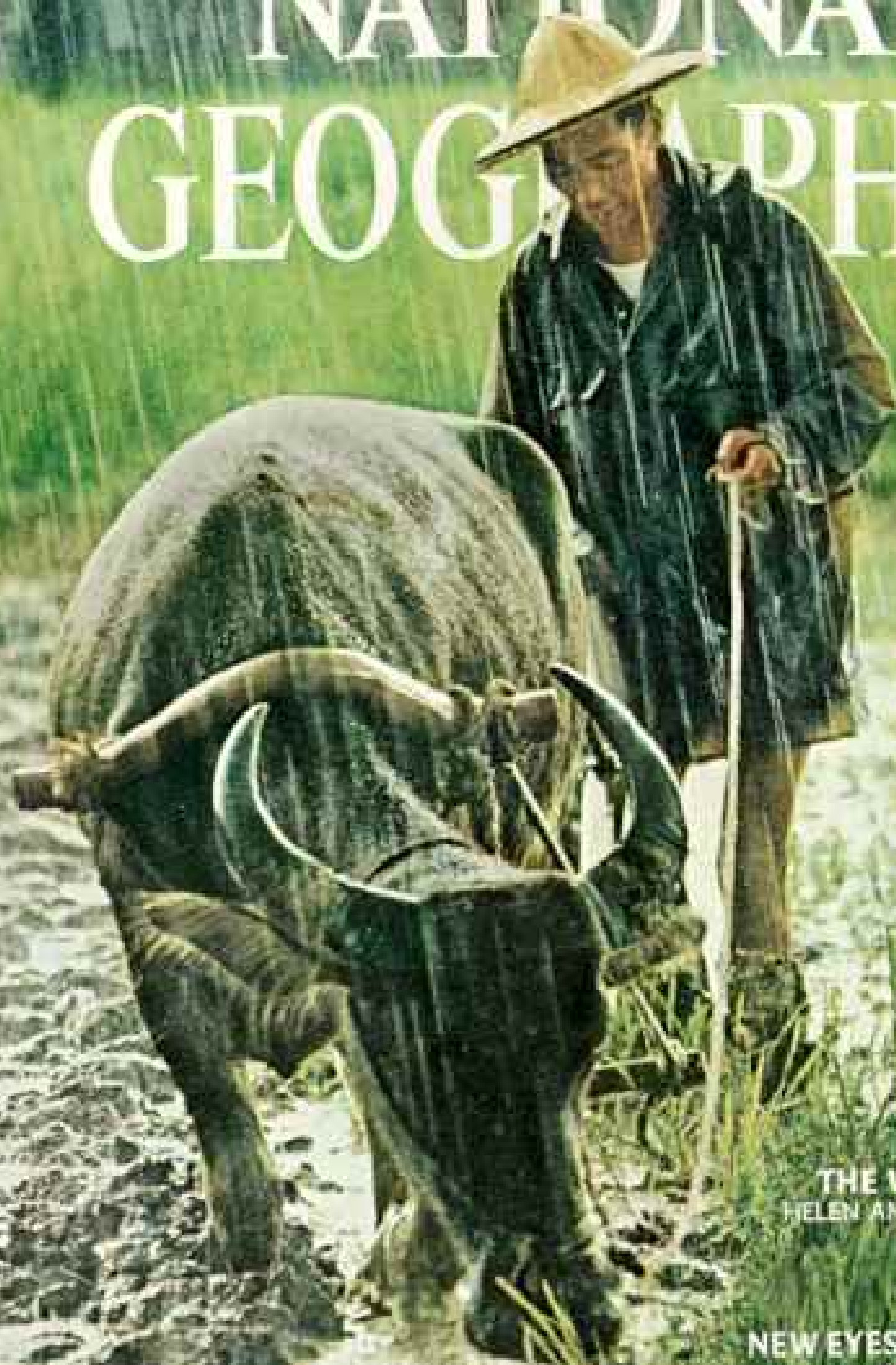


VOL. 135, NO. 1

JANUARY 1969

NATIONAL GEOGRAPHIC



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EXTACHROME (INSET), JAMES E. RUSSELL; KODACHROME, DAVID L. MOORE © N.G.S.

Mapping the Moon

GLEAMING GOAL of astronauts, a three-day-old crescent moon reveals a pocked surface against the blackness of space. To aid in following man's first lunar explorations, the National Geographic Society will publish a timely new map as a supplement to next month's issue. The **Earth's Moon** portrays not only the familiar face, but also the largely hidden far side, drawn from photographs beamed to earth by NASA's Lunar Orbiters. **GEOGRAPHIC** cartographer David W. Cook, above, studies one of hundreds of Orbiter photographs. He and his associates devoted two years to plotting the moon's barren "seas," rugged mountains, and myriad craters.

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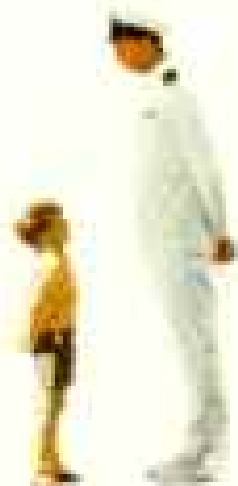
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TAIWAN

The Watchful Dragon

Article and photographs by HELEN and FRANK SCHREIDER

National Geographic Foreign Staff

THE INCREDIBLE THING is that it exists. It lies in the Pacific, a brave speck in the shadow of a colossus, only 100 miles from its implacable enemy—the world's most populous country, 700 million strong. For nearly 20 years the Communists on mainland China and the Nationalists on Taiwan have waged their quiet war.

Taiwan must be as tightly run as a battleship, I thought as we flew into Taipei. In a continual state of war, the island must be an austere place to live.

Austere? Hardly, though to judge by the machine-gun-like explosions reverberating through Taipei's streets, the quiet war had erupted into a shooting one.

"Firecrackers," laughed Chang, our driver. "Big holiday. Birthday of Dr. Sun Yat-sen, father of China. Big dragon dance at City Hall."

Chang raced the hired car away from the palatial Grand Hotel and penetrated the bedlam of traffic along Chungshan North Road. Exhaust fumes clouded the air. Cars, buses, and taxis clogged the four-lane boulevard. Taipei was suffering the pangs of progress.

"Few years ago only rice fields here," Chang said, waving toward the new high-rise hotels and office buildings. "Now too much cars. Too much motorcycles. Terrible, sir."

A taxi tried a left turn from the right lane. Chang cut him off with a glare. A motorcycle, all but hidden under its passengers, darted from a cross street, father, mother, two babies, dog in box on fender, all blissfully oblivious to the outraged horns.

A broom vendor halted his bristling pushcart and haggled in the middle of the street with a customer. Chang swerved and sped across the new overpass into the old Japanese-built section of town.

Pedicabs scurried like spiders through shop-lined alleys (they have been banned since last June as traffic hazards). Wares overflowed onto the sidewalks—refrigerators, rice cookers, television sets, textiles, a bewildering array of plastic toys and utensils, all Taiwan-made. Restaurants advertised the typical food of every province of mainland China. Medicine shops prescribed dried sea horses for virility and snake glands for the eyes.

Talented Dragon Steals the Show

We arrived in City Hall square with the dragon. Drums, cymbals, and a shattering blast of firecrackers announced him, a 100-foot-long, 30-manpower dragon of red-and-gold silk and papier-mâché. He postured coyly and slyly, fearsomely playful, turning his



ENTACHRONIS, WELLEN AND FRANK BEHNTECH, EDIMBURGH (FOLLOWING FREED), TOM GREENPORT © N.A.A.

awesome head, prancing toward each new flash of firecrackers, and frequently breathing fire (above). There were tributes to Dr. Sun, and flowers for his statue in the square. At last the gala day ended, the crowds scattered, and the magnificent dragon went into storage until the next celebration.

Symbol of power and good, old as China, the dragon is as much a part of Taiwan life as firecrackers, food, and frivolity; as much a part of the Taiwan scene as buffalo-drawn plows and the skeletons of hastily rising apartments. He roosts on temples and adorns jetliners. And in folklore the dragon is credited with the creation of Taiwan.

Long ago, says the legend, when mists still wreathed the earth and serpents swam the seas, dragons played off the coast of China. They played hard, as dragons do, so hard that their tails stirred the ocean bottom and an island rose. Here the dragons rested and slept, and here they reside still.

Old natives of Taiwan tell this tale and are convinced that it is true, for, in the northernmost part of the island, dragons' breath still colors the air with sulphur fumes, and from fissures and caves comes the rumble of their snores.

But I doubt that even an exhausted dragon could sleep through the frenzy of Taiwan's economic boom, maintained,

Fiery breath spews from the mouth of China's folklore favorite, the dragon, during a parade in Taipei, Taiwan. A dragon teaser deftly lights and tosses a combustible powder in front of the mouth to simulate flaming snorts. Chinese symbol of goodness and strength, the creature dances through the city on the legs of 30 men. The noisy celebration on November 12 honors the birthday of Dr. Sun Yat-sen, first President of the Republic of China.

Mythological lion joins the parade on Dr. Sun's birthday. A lion dancer, clad in leopard skin, holds aloft the head of the curly-maned creature that stands for valor and energy.

Mammoth outpouring of humanity (pages 4-5) hails the anniversary of Dr. Sun's successful revolution that swept the 268-year-old Manchu dynasty from power on October 10, 1911. Both Dr. Sun's portrait and that of his wife's brother-in-law, Generalissimo Chiang Kai-shek, lower right, fill the street. Streaming banner at top wishes "10,000 years to the Republic of China," a theme repeated by other placards. Yellow octagonal signs exhort the people to persist in the struggle against the Communists, and numbered flags identify marching units.

After Dr. Sun's death in 1925, Chiang assumed control of the Republican forces. Defeated in 1949 by the Communists, the Generalissimo and his followers retreated across Formosa Strait to Taiwan. Since then they have built an ever-stronger military and economic bastion on the island while continuing to hope for eventual return to the mainland.





歲

民國

萬歲

歲





中華民國
陸軍
女兵
第一師



says the Bank of America in a special report, at one of the highest rates in the world.

With six years of compulsory education, Taiwan's literacy rate exceeds 90 percent. With more than 40 percent of the people under 15, one out of four persons is in school. The young population has helped create what the Bank of America calls "Taiwan's most important and least expensive resource . . . its supply of diligent and intelligent working people."

Japanese, American, Overseas Chinese, and European firms are investing in Taiwan at a record rate. The value of industrial exports now exceeds that of agricultural exports. The increased production of electronics components, plastics, paper, cement, handicrafts, textiles, and canned goods spurred a 13 percent

rise in the gross national product for 1967.

While much of the continent wallowed in war and revolution, hunger and discontent, how did tiny Taiwan achieve a standard of living surpassed in Asia only by Japan and Hong Kong, an economy so stable that the United States has ended all but military aid?

Korean War Brings Reprieve

Historically and racially Chinese, Taiwan had been a part of China for more than 200 years when Japan occupied it after the first Sino-Japanese War in 1895. Liberated by Japan's defeat in World War II, the island became part of the Nationalist China of Chiang Kai-shek. But his newly appointed governor abused his position and brutally suppressed

an uprising by the people. Great numbers of Taiwanese died in the disorders. Many more were executed.

Another governor was appointed. In 1949, Chiang lost the mainland to the Communists and moved his regime to Taipei. With him came more than half a million officers and enlisted men and a million civilians—teachers, students, businessmen, industrialists, and artists.

Humiliated by Communist victories in the homeland, fearing an invasion of Taiwan itself, and smarting under the concerted attack of world opinion, the Nationalists were very close to extinction. But Communist China's intervention in the Korean War helped save them.

Aware that a take-over of Taiwan by the Communists

Few drop-outs here. Exercising Taiwan schoolgirls belong to an education-hungry generation that keeps 97 percent of its members in school, many in shifts. Schools, mostly coeducational, require uniforms. Nine out of ten islanders can read and write. But a brain drain hurts: One fifth of last year's 11,000 college graduates left for the United States, many to remain for high-paying jobs.

ILLUSTRATION BY TOM SAWYER © A.S.A.



would pose a grave threat to Allied efforts in Korea, the United States assumed defense of the island. With increased economic aid from the U. S.—almost \$1,500,000,000 over 15 years—President Chiang Kai-shek set out to build a new China on Taiwan.

The Nationalists still claim to be the legal government of all China. In their lawmaking body, called the Legislative Yuan, elderly representatives deliberate, but cannot act, on the responsibilities delegated to them when they were elected in provinces of mainland China 20 years ago. Only on Taiwan do the people remain free to elect new provincial representatives. Today, of the 115 countries that maintain diplomatic ties with either of the two Chinas, 67 recognize the Nationalists, 48 the Communists.

Helen and I found Taiwan, like so many developing nations, torn between the two worlds of transition and tradition. But unlike those that abandon the old to embrace the new, Taiwan embraces both.⁴

Veteran journalist James Wei, who directs the government's information services, explained Taiwan's plans for her future by introducing us to her past. We were on a first-name basis soon after meeting him at Taipei's new National Palace Museum, repository of the largest collection of Chinese art in the world.

"Only here," he told us, moving his hand to encompass the treasures around us, "do we preserve China's heritage. On the mainland the Communists with their

Cultural Revolution and their Red Guards are destroying the past.

"But we believe that no country can survive without respect for the arts. Men died to save these treasures. They were moved across China for decades, buried in caves, carried on sampans, hidden from the Japanese and then the Communists. More than 240,000 pieces finally reached Taiwan.

"They must be preserved at all costs—not only because they stand for 4,000 years of China's evolution, but also because we can learn from them for the future."

⁴See, in the NATIONAL GEOGRAPHIC: "Changing Formosa, Green Island of Refuge," by Frederick Simpich, Jr., March 1957; and "Formosa—Hot Spot of the East," by Frederick G. Vosburgh, February 1950.

EXTENDING BY HELLY AND YVONNE SCHREIBER © R.S.S.



Plastic portholes distinguish the product at the Fair Umbrella factory, one of 123 manufacturing plants in Kaohsiung's Export Processing Zone. Within a prescribed area, foreign and Chinese companies enjoy tax exemptions and Taiwan's cheap labor. Imported raw materials enter duty free; finished products go to export markets. Workshop signs stress the zone's spirit: "Quality fills our rice bowls."





Jimmy made way for us through the throngs of Chinese school children taking notes on the many jades and bronzes, porcelains and paintings. He led us to a 3,700-year-old Shang dynasty bronze vessel.

"Ask yourself, how would you design a bronze pot? It is to be used for cooking, so first you shape it. But it will be too hot to hold. So you add handles. Perhaps you want it to cool quickly. So you add knobs to conduct the heat away. But how many centuries passed before we learned these refinements? We learn by trial and error, but sometimes the trials are difficult."

On another bronze, Jimmy pointed out two horns protruding from the edge. "This is a wine cup. When we drain the cup, the horns touch our brows. We want to drink more, but the horns suggest we do not."

Legend Promises Reward to Those Who Strive

In one of the jade rooms Jimmy contemplated a magnificent carving of a carp turning into a dragon. The veining of the white-and-dark-gray jade accented each scale, fin, and claw (page 18).

"In Chinese legend there is a river whose water flows over a high cliff. Many carp swim in the river, and at the top of the cliff is the Dragon's Gate. One carp managed to swim to the top and pass through the gate. As a reward the gods turned him into a dragon.

"Yes, the past speaks to us of many things—trial and error, moderation, perseverance. On the mainland we made many mistakes. But we learned that the past alone was not enough. Now the Communists have found that the new ways alone won't work either.

"The only way to beat an idea or a system is with a better one. Here on Taiwan we must preserve our culture, but we must make it better by adding something new."

The first "something new" that the Nationalists added was land

Stripped of murk, Taipei sprawls under a rare rain-free sky. With more than 1,500,000 residents, a five-fold increase in 23 years, Taiwan's capital suffers from urban blight. But the face-lifting addition of modern buildings and subtraction of slums constantly changes the look of the century-old city. Shortly after its founding, walls of stone and rice mortar rose to enclose a town of half a square mile. Now only four gatehouses remain from the walls, torn down when Japan's 50-year rule began in 1895. The Japanese built the Grecian-style Historical Museum, center; the present government erected the park's pagodas. Through the distant mist above the Tanshui River looms a mountain called Kuanyin—Goddess of Mercy.

Motorbike generation: A proud father and his children ride on one of Taiwan's 300,000 motorbikes. Some 24,000 cars and taxis also crowd roads, in contrast to fewer than 4,000 when Chiang and his government arrived.



reform. The provincial government, with the assistance of the Chinese-American Joint Commission on Rural Reconstruction, administered the program. Dr. T. H. Shen, Chairman of JCRR, described it to us with enthusiasm:

"When Taiwan was freed from Japan in 1945 and returned to China, 80 percent of the people were farmers. Most of the land was owned by big landlords. The farmers were just tenants. Today, more than 90 percent of the farms on Taiwan are operated by their owners.

"The results speak for themselves. Since 1945 Taiwan's population has doubled—to more than 13 million people. Yet we're self-sufficient in food and have plenty left to export. Production of rice, sugar cane, sweet potatoes, and other crops has doubled, tripled, and in some cases quadrupled.

"JCRR helped farmers set up cooperatives and develop better seeds and irrigation methods and more efficient land use. We encouraged fishing, livestock raising, and health programs. Today, according to the World Health Organization, Taiwan is one of the healthiest, best-fed countries in Asia.

"Now we're sharing what we've learned with other nations in Asia, Latin America, and Africa by sending teams there and inviting their people here.

"With many countries we share a basic problem—limited land. Only about 25 percent of Taiwan is arable. But we learned that asparagus does well in the marginal land along rivers and seashore. And mushrooms can grow in layers, on trays in darkened sheds, in effect multiplying the land area. We're among the world's largest exporters of these two foods."

"But what's happened to the landlords whose property was taken for land reform?" I asked.

Dr. Shen smiled. "Why not talk to a few and find out?"

Ex-landlord Makes Cement

Mr. Chen-fu Koo, a Taiwan-born former landlord, greeted us in his plush, paneled office in Taipei (page 27). In his blue-silk mandarin robe he looked very much the country squire, Chinese style, but the modern desk with its futuristic telephones and the production chart on the wall were all business—as befitted the president of Taiwan Cement Corporation, one of the country's largest industries. I asked how he felt about land reform.

"I used to have 14,820 acres of good land and thousands of tenants. Now I have seven acres and no tenants. And I'm much better off. The government paid for the land. They did not confiscate it as in Communist China.

"But they did not pay in money—there wasn't much money then. I was paid in stock in Japanese-owned industries that had become government property when Taiwan was returned to China. One of those industries was cement.

(Continued on page 16)

Raised helmet unveils the grin of a welder at the Taiwan Shipbuilding Corporation in Chilung, the island's biggest shipyard. The yard launched three freighters, totaling 56,000 tons, last year and plans to lay the keel for a 90,000-ton supertanker this March. With Taiwan's continuing boom, the United States in 1965 ended its economic aid—altogether about \$1,500,000,000.







Portraits of patience, 81-year-old Chiang Kai-shek and his wife still long for home after nearly 20 years in exile. They watch a birthday salute to her brother-in-law, Sun Yat-sen (pages 2-3).



War of words. Balloons containing propaganda leaflets ride one-way winds from the island of Quemoy to the mainland. Nationalists also wage loudspeaker duels with the Communists.

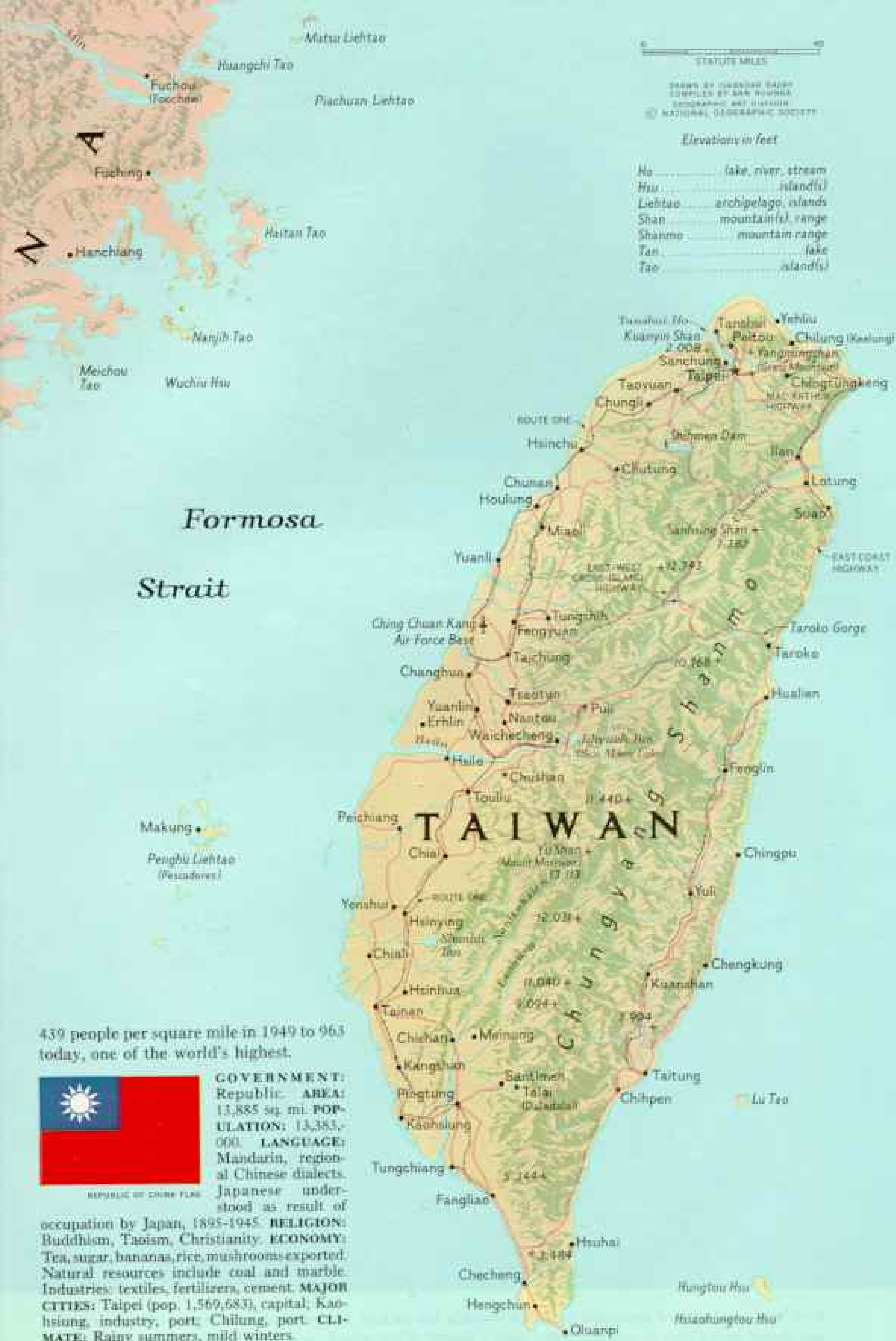


Eyeing the enemy, Nationalist troops on Quemoy stay on alert. They live under periodic shelling from Communist guns, some of them on another island only 2,500 yards away.



Taiwan

ILHA FORMOSA, or "beautiful island," Portuguese discoverers called Taiwan in 1517. Like a floating leaf, it lies 100 miles off the Communist mainland. With the Pescadores and offshore islands such as Matsu and Quemoy, Taiwan today serves as stronghold refuge for Chiang Kai-shek and the Republic of China Government. From the southern tip to the harbor of Chilung, 240 miles of rugged mountains wall off the dramatic cliffs of the east coast from the fertile plain of the west. Chiang's regime has brought prosperity and skyrocketing population—from a density of



0 100 200
STATUTE MILES

DRAWN BY JEROME BARRY
COPYIED BY ANN WOODHA
GEOGRAPHIC ART HOUSE
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Elevations in feet

- Ho lake, river, stream
- Hsu island(s)
- Liehtao archipelago, islands
- Shan mountain(s), range
- Shanmo mountain range
- Tan lake
- Tao island(s)

*Formosa
Strait*

439 people per square mile in 1949 to 963 today, one of the world's highest.



REPUBLIC OF CHINA FLAG

GOVERNMENT: Republic. **AREA:** 13,885 sq. mi. **POPULATION:** 13,383,000. **LANGUAGE:** Mandarin, regional Chinese dialects. Japanese understood as result of

occupation by Japan, 1895-1945. **RELIGION:** Buddhism, Taoism, Christianity. **ECONOMY:** Tea, sugar, bananas, rice, mushrooms exported. Natural resources include coal and marble. **Industries:** textiles, fertilizers, cement. **MAJOR CITIES:** Taipei (pop. 1,569,683), capital; Keelung, industry, port. **CLIMATE:** Rainy summers, mild winters.



Swirling contours of terraced paddies wrinkle the face of Taiwan north of Taipei. Rice growers use almost every inch of arable earth—only a fourth of the island—to feed an exploding population.



AGRICULTURE BY HELEN AND FRANK SCHAUER © R.S.S.

Thanks to land reform, more than 90 percent of the farmers now own their fields. Although 869,000 families still live on farms, manufacturing has passed agriculture as Taiwan's biggest enterprise.

(Continued from page 10)

Others were mining, lumber, and paper.

"In effect the exchange turned landlords into industrialists and tenants into landowners. With both land and industry in private hands, the economy prospered."

Mr. Y. T. Pan is one of those new landowners. We found him feeding his ducks beside a pond stocked with fish. Lacy bamboo and papaya trees and thriving banana plants dotted the hill behind his 12 acres of prime rice terraces.

With quiet pride Mr. Pan led us across a concrete threshing floor, past a motorcycle and several bicycles, into the sitting room of

his sprawling brick house. Dominating one wall was the family altar, like a massive sideboard of carved wood surmounted by paintings and images of the gods that the Taoist Chinese revere.

As we sat on a sofa between a television set and a hi-fi, Mr. Pan told us how land reform had affected him.

"My family has farmed here for generations. We used to live in a mud house. We paid half our crop to the landlord. If we had a bad year, we had to pay anyway.

"Then the government bought the land and sold it to us. We paid in rice, and in ten years the land was ours—for less than we



Plucked eyebrows, shaved hide, and red tax stamps glamorize the huge carcass of a hog for a *pai-pai*, or temple festival. This Taoist ceremony celebrates the refurbishing of a temple at Chungli (background in picture at right).

Handsome hogs earn much "face," or prestige, for families offering them in the *pai-pai* celebration at Chungli. Some weighing more than half a ton, the porkers arrive spread over bamboo frames to make them look even larger. Following prayers, the families carry them home for the main course of an elaborate feast.

The people of Taiwan practice a mixture of religions. Temples often serve both Taoists and Buddhists—in fact, most worshipers blend the teachings of Buddha with the mysticism and rituals of Taoism, liberally sprinkled with the philosophy of Confucius. Chinese ancestor worship pervades all faiths. While city dwellers may worship at temples that also double as community gathering places, rural residents offer their prayers at home shrines.



had been paying in rent. For the first time we could save money. We tore down the old house and built this one.

"The Gods Have Been Good"

"But most important, I can educate my sons. I didn't go to school, and I was too poor to spare my number-one son from work in the fields. But numbers two and three finished primary school and number four went to high school. Number five finished college and number six is still studying—that's his guitar—he likes your music. Me? I like Taiwanese opera."

Mr. Pan glanced toward the altar. "The

gods have been good. Each year I offer a pig at the *pai-pai*."

We saw a big *pai-pai* (temple festival) in Taiwan at the city of Chungli (below). Lanterns on a bamboo tower swayed high above the town to guide the spirits—and, it seemed, everyone else on Taiwan—to the temple. In the surrounding rice fields itinerant opera troupes and puppeteers performed the ancient plays of Chinese mythology, the high-pitched voices and whining music combining in a strident symphony.

In the main street huge pigs lay split, disemboweled, and spread over bamboo frames in front of shops and homes. Some pigs were





Fragile treasure, a 10-inch, 450-year-old bowl of the Ming dynasty depicts a dragon with the five toes of an imperial beast. Some 240,000 porcelains, paintings, jades, bronzes, tapestries, ivories, lacquers, and enamels at Taipei's National Palace Museum form the greatest known collection of Chinese art. Taken from two mainland museums, the collection began an odyssey of escape 30 years ago. Chiang's troops saved it first from the Japanese and later from the Communists.

Reward of the gods: In this 6-inch white jade carving, a carp turns into a good-luck dragon after leaping over a "Dragon's Gate" across a cliff-top waterfall, folklore relates. Scales and pectoral fins of the carp—standing on its tail—can still be seen; dragon's snout and mouth have already appeared.



having their eyebrows plucked, others their hoofs pedicured and their skins shaved. Tables were laden with cooked chickens and ducks, fruit and rice cakes, all offerings to the gods. Over the temple a neon sign proclaimed the occasion: After 40 years the structure had been refurbished.

We followed the shrill sounds of flutes and gongs into the temple. Paper, clay, and wooden figures—little men in mandarin robes, seated Buddhas, tigers, elephants, horses, birds—cluttered tables and benches.

"Looks like a toy shop at Christmas," Helen murmured.

"Confusing, isn't it," a voice behind us commented. Stephan Feuchtwang, an English anthropologist studying Chinese religion, identified the major deities: the goddess of the sea, goddess of mercy, and god of heaven.

"There seems to be a bit of something for everyone here," said Helen. "The Chinese appear rather relaxed about their religion."

In one corner a group of men were playing cards and drinking tea, while red-robed priests sang and danced in ritual worship before a candle-lit altar.

A Little Knowledge Can Cause Heartburn

From an adjoining room the clatter of dishes announced lunch. Everything stopped. One of the priests invited us to join them. We were delighted. Chang was alarmed.

"Pai-pai food terrible, sir," he whispered. "I no hungry."

We were, and we helped ourselves to a variety of soupy stews, ladling them over boiled rice. Afterwards Helen, an avid menu collector, asked Stephan what we had eaten.

"You may be sorry you asked," he grinned. "That one with the yellowish lumps, that's pig's bowel and ginger. And that milky one with the brown squares, well . . . that's coagulated chicken blood with turnips. And that . . ."

Happily, Chang's announcement that the pigs were coming interrupted a further tabulation of our lunch.

The crowd in Chungli's main street had parted for the procession. The pallid pigs, some with pineapples in their mouths, others with fish dangling from their jaws, were

In tribute to Buddha, two worshipers light incense, or joss sticks, during the February lantern festival in Taipei's big Lungshan Temple. Believers build elaborate lanterns like those hanging above to supplement the fading first moon of the year, in hope of seeing their ancestors' spirits.



Feast fit for an emperor draws diners to the Grand Hotel in Taipei. Friends raise glasses of warm rice wine in a toast before lifting chopsticks to honored delicacies that include many-colored soup flavored with lotus seeds and served in a melon shell, simmered shark fins, dragon-shrimp lobster, Chenchiang-style spiced pork, unicorn sea perch, and golden-coin chicken pagodas with lotus-leaf bread. Taipei restaurants serve specialties from every area of mainland China, home of the world's oldest tradition of fine cookery. White hexagons result from four strobe lights reflected in the lens of the Fisheye camera.

Simple fare suits a child who enjoys steaming noodles for lunch in her Quemoy kindergarten on a brisk December day.



DETACHMENTS © NATIONAL GEOGRAPHIC SOCIETY

borne on pedicabs, wagons, and wheelbarrows (page 17). Colored lights flashed like Christmas-tree ornaments on the vehicles, and raucous musicians led the way.

"Very big pigs," Chang exclaimed. "Look at that one. He weighs 800 catties [more than 1,000 pounds]. He'll earn much face for the family. Make big feast too. After gods see, people take food home to eat."

Fortunately, Taiwan's gastronomic adventures are not limited to pai-pai food. With restaurants serving food characteristic of every province of China, Taipei lays claim to being the Chinese culinary capital of the world.

Eating establishments range from sidewalk stand-ups strung with sausages and steaming with noodles to businessmen's bustling dumpling houses where the waiters loudly call out the tip, and to elegant hotel dining rooms where chopsticks rest on silver dragons and flowers grace the table.

What does it matter that most restaurants are crowded and noisy, that the waiters rattle the dishes, or that the happy group at the next table plays the Chinese finger-matching game, the loser downing his warm rice wine with a boisterous "*Kan-pei—dry cup*," the Chinese equivalent of bottoms up!

It is the food that counts, and there is nothing a Chinese enjoys more than eating—unless it is talking about





eating. With a seemingly inexhaustible variety—we counted almost 400 dishes on the menu of one restaurant alone—the Chinese never run out of subject matter. Nor do they run out of hospitality. As our circle of friends expanded, so did our waistlines.

Successively we were introduced to the crab with ginger of Shanghai, the roast duck and steamed bread of Peking, the spicy minced squab of Hunan, the sea foods of Foochow, and the peppery pork of Szechwan.

We learned to chopstick *chiao-tze* (a meat-filled ravioli) without puncturing its thin white skin and dribbling juice down our chins. We learned the grace of raising bowl to lips and scooping in the rice. We learned to be delicate when depositing chicken bones on the table.

As our skill increased, our cleaning bills declined. But we never learned to be blasé. Each invitation revealed a new and special treat—and sometimes a treatment.

For Cold Days, Soup With a Wiggle in It

It was a chill, wet day in Taipei. The waiter served a bowl of vaporous soup and a platter of white chrysanthemum petals. Our hostess added the petals, stirred, and served, commenting on the ingredients:

“Breast of chicken, sliced very thin, wild mushrooms from the mountains, wild herbs, ginger juice, fried rice crisp.”

“Delicious,” Helen acclaimed.

And so it was—even when our hostess concluded with what I thought was a touch of humor, “I knew you’d like it. It’s the snake



Ready-made harvest of herringlike fish washes ashore in the aftermath of a typhoon. Quick with chopsticks, a fisherman of Yehliu village collects his dinner. Late summer typhoons have taken 1,700 lives in the past decade.

In the grim wake of a typhoon, Yehliu fishermen return to bail out their boats, battered but safe behind the breakwater. With harpooners poised on rakish prows, the motor-driven craft set out daily in quest of the Pacific sailfish, a relative of the swordfish and marlin.



EXTRA NUMBER BY HELEN AND THOMAS SCHREIBER © U.S.S.





meat that gives it that special flavor. And it's very healthful on these cold days."

Though bountifully blessed with food, Taiwan has few natural resources for industry. It must import most of its raw materials. Chilung, northern Taiwan's major port, is rapidly expanding its facilities. We drove there with Thomas Hsueh, a young Chinese-American engineer whose Taiwan Argonaut Corporation is building boats for export.

Sleek Sloops Prove Growth of Skills

"If I didn't think the investment climate was good, I wouldn't be here," he said as we rolled along the new MacArthur Highway linking Taipei and Chilung (map, page 13).

"Taiwan is moving from the bicycle stage to motorcycles, and that's a good sign. But when a country begins to have more cars than motorcycles, labor costs are usually getting too high for industries that need little skilled labor and a minimum of capital equipment, and they sometimes feel forced to move on to a cheaper labor area.

"We won't be moving on. Our business requires years of costly training to develop a variety of skills. We simply cannot afford to move on when labor gets a little higher."

We saw those skills exemplified in sleek fiberglass sloops and other craft in various stages of completion.

"Our quality control is the same as in the U. S.," Tom said. "And all our materials come from the States too. Yet we can produce below Stateside costs. We can compete despite high transportation costs because our labor cost is low. How long can we do it? With the quality of labor we have, we can compete indefinitely despite the fact that labor costs will increase. We are also using the latest production techniques to stay

Fainthearted beware! This section of Taiwan's East Coast Highway gashes cliffsides for 75 spectacular miles, threading tunnels carved 300 feet above the sea. Alternating one-way traffic reduces accidents. Slides often close the Japanese-built highway, only road between Suao and Hualien. An equally breath-taking route through Taroko Gorge, chiseled in the flank of a marble mountain, links east and west coasts (map, page 13).

Headed for supper, a fisherman wades ashore from his seagoing bamboo raft with three scabbard fish.

ahead of our competition. Taiwan is like Japan 15 years ago, and Japan today is certainly still doing well despite tremendous increases in labor costs."

Chilung's fledgling shipbuilding industry is gearing for competition too.

"We're building 90,000-ton ships now, and we're planning even bigger ones," Mr. Christopher H. P. Yen of Taiwan Shipbuilding Corporation told us. "When Taiwan's new steel mill is completed, we hope to compete with Japan."

Optimistic though this may be, Chilung has its sights set high. The big news was containerization, the advanced concept in shipping that is reducing cargo-handling costs and loading times in major ports of the world.

Tom explained how it works: Massive 200,000-ton ships—specially built to handle cargo in sealed standard-size containers—would leave European and American ports bound for Asia. But instead of stopping at



EXTACARDONE (ABOVE) AND BOUKECHIONE © N.S.A.

each Asian port along the way; they would head for Taiwan and transfer their cargo to smaller ships.

"By using small ships for the shorter runs, the huge container ships with their high overhead costs would lose less time in port. With the cargo in sealed containers, pilferage and breakage would be minimized. Insurance costs would go down.

"And Taiwan is geographically ideal to serve as a feeder station. We're only 380 miles from Hong Kong, 550 miles from Manila, 725 miles from Nagasaki" (inset map, page 12).

Typhoon Gilda Brings Tragedy

Taiwan's location has its drawbacks too; for three months of the year typhoons pose a continuing threat. Chang's usual good humor was noticeably lacking when we discussed a drive along the East Coast Highway.

"Maybe so you find other driver?" he suggested hopefully.

"But this is November," Helen assured him. "The typhoon season is over."

Season or no, Typhoon Gilda caught us at Yehliu, a small fishing port near Chilung. Sweeping out of the east, rain charged in horizontal sheets. Lightning slashed the sky. Like sheep in a storm, boats huddled forlornly in the narrow harbor. Gray spindrift fogged the air, tugging at slickered fishermen as they fought to secure their craft (pages 22-3). We raced back to Taipei in a raging thunderstorm that flooded east coast towns, leaving two dead, hundreds of homes destroyed, and crop damage totaling millions of dollars.

The debris of Gilda's wrath still littered the graveled East Coast Highway when it was reopened to traffic. Workers—men and women—scooped fallen rock from the narrow track scratched along cliffs rising in places to a thousand feet (page 24).

Formerly the most dangerous road on the island—Taipei's streets today claim that dubious distinction—the East Coast Highway is now one way. Moving alternately north and south in timed convoys, traffic detours the old sheer-drop bends and runs instead through new hand-cut tunnels. Forbidden to stop along the road, we caught only glimpses of the soaring mountains to our right and the pounding, rock-studded sea below. We were as relieved as Chang when the road dipped down to Hualien, east Taiwan's largest town and only deepwater port.

Hualien is near the eastern end of the East-West Cross-Island Highway (map, page 13). Intended to open inaccessible timber and





KIDMACHINE (ABOVE) AND EXTRACTOR (TO R.S.)

WIGMAKER COMBS A HAIRPIECE in the Export Processing Zone at Kaohsiung. Human hair, much of it imported duty-free from other Asian lands, is made into wigs for sale abroad.

LANDHOLDER TURNED TYCOON: Land reform took the property of Chen-fu Koo (left). In exchange he received a confiscated Japanese concrete firm, now Taiwan's leading private enterprise. Twin one-piece telephones link him to far-flung markets.

MOVING FROM FARM TO FACTORY, young women in new jobs (opposite, above) bond electronic microcircuits in the Philco-Ford factory at Kaohsiung.

MAN-SIZE INSULATOR for a transformer (opposite, below) gets a bolt-tightening at the Tatung Electric plant in Taipei. The firm shares profits with employees.

farm lands of central Taiwan, the road passes through dramatic Taroko Gorge, a river-cut canyon in a mountain of marble.

James Yu, manager of Hualien's largest marble works, showed us through his plant. Chips were flying from lathes turning out lamp bases, vases, and ashtrays for the growing number of tourists. More important economically, multibladed saws rasped through truck-size chunks to produce slabs of green, rust, black, or white marble for buildings and monuments.

"Marble is one of Taiwan's few exportable

raw materials," Mr. Yu said. "We estimate there are billions of tons in these mountains, much of it excellent quality. We even export to Italy."

South of Hualien the highway turns away from the sea to enter a long, narrow valley. We paralleled a narrow-gauge railway, sometimes driving across its revetment-protected trestles where highway bridges had been washed away by rain-swollen streams. Settlements were mere clusters of wood or cement buildings; farm houses were grass huts.

At Taitung ripening pineapples tinted con-



volute hills—a successful use of marginal land. And then we were along the sea again. Sisal stripped from the sandy dunes lay drying like witches' white hair on the road. A fisherman surfed his bamboo raft through frothy breakers and unloaded his catch: three silvery, squirming scabbard fish, meager reward for a morning's work (page 25).

Taiwan has been compared in shape to a tobacco leaf. On the southernmost tip of the tapering stem, near Oluanpi, Helen and I stood braced in the wind that had followed us since we left Taipei. Like most of the east

coast the country had an air of desolation, as though the typhoon-tired land could provide little more than sustenance, as though the winds of storm were winning out over the winds of progress sweeping the rest of Taiwan.

KEPZ Lures New Investors

Now our road led northwestward toward Kaohsiung, Taiwan's southern industrial center, where the winds of progress blow strongly indeed. Still miles from the city, we passed the Chinese Petroleum Corporation's refinery. Then a silver snake of a pipeline paralleled our route, leading us to the harbor of a city white with the dust of cement plants, fragrant with the sawdust of plywood factories, acrid with the fumes of plastics industries.

On 170 acres of reclaimed land beside Kaohsiung's protected harbor, 123 investors from Japan, the United States, and Europe are erecting factories to produce items ranging from wigs to wire, pearl necklaces to paper containers, integrated circuits to umbrellas. Kaohsiung Export Processing Zone—KEPZ for short—is part of Taiwan's master plan for transforming an agricultural society into an industrial one (pages 26-7).

By encouraging the development of "labor-intensive" industries—those where hand labor is more practical than machine—Taiwan is capitalizing on its most abundant resource, low-cost labor.


In the new Administration Building, Mr. Thomas T. C. Kuan, an executive of KEPZ, tallied for us the advantages it offers to Taiwan and to investors.

"Outside the zone foreign investors sometimes encounter archaic red tape. Here we minimize it. There's no import duty on machinery, equipment, or raw materials, no income tax for the first five years, no tax at all except for a small revenue-stamp tax to cover administrative costs.

"We also help the investor build his factory, guarantee plenty of water and electricity at low rates, and help him recruit labor."

"Sounds like a one-way street for the investor," I said. "How does Taiwan benefit?"

"It's Taiwan's low-cost labor that brings foreign investors here," Mr. Kuan replied. "But as our labor becomes more expensive, other countries—South Korea, for example—will be more attractive. In the meantime Taiwan's domestic industries are absorbing new techniques in management and production. We're developing a pool of trained workers



Searing belch of a blast furnace erupts as a workman tosses in another shovelful of lime. The Taiwan Iron Manufacturing Corporation in Taipei produces pig iron, foundry products, and steel from scrap purchased abroad. Unlike some other developing lands, Taiwan has deferred constructing a large-scale modern steel mill, preferring to concentrate its effort and money on agricultural reform. Says the author: "Taiwanese reason, 'We have to learn to feed our people first, then we'll have a steel mill.'" The government has now approved plans for a giant steel plant to be built within the next few years.

STYLING BY HELEN AND FRANK SCHROEDER © N.Y.C.



Fishing fleet, freighters, and ships of the Republic of China Navy share dock space at Kaohsiung, Taiwan's main port. Good-luck flags flying on bamboo staffs



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beneath the national colors herald the launching of new fishing boats. Kaohsiung, buoyed by the success of its export zone for light industry, is enlarging the harbor.



with a high regard for quality control. As our wage scales rise to the point where foreign investors look elsewhere, we hope that our increased efficiency will keep us competitive in the world markets."

How productive are these workers? Lorain Tinnés of General Micro-Electronics, a subsidiary of Philco-Ford, was more than enthusiastic. He led us along lines of benches where blue-smocked ex-farm girls peered into microscopes and assembled Space Age electronics components (page 26). He stopped beside a shy Taiwanese girl who was bonding wires 1/1000 of an inch in diameter to a circuit printed on a tiny piece of silicon.

"Theoretically, the maximum capacity of these bonding machines is 400 units a day. After three weeks of training this girl produced 340 units. We named her Worker of the Month. The very next day she produced 414 units. These girls just like to work. They make a game of it."

World of Aborigines Still Remote

Most of the workers at KEFZ are Taiwan-born Chinese from the western plains. The lure of factory jobs has not yet penetrated the central mountain range where most of Taiwan's aborigines live.

Divided into nine tribal groups, the aborigines claim Malayan origin. During Japanese administration they were isolated in reservations, partly because of their inhospitable habit of hunting heads.

They are far less isolated now. Where the tourists have not reached, the missionaries have. With John Whitehorn, an English Pres-

Cherished bridal dress, a family heirloom, stirs wedding-day memories for an aboriginal girl. Cowrie shells—a fertility charm—and boars' tusks—for strength—decorate her headdress. Member of a tribe of onetime headhunters, the girl, a kindergarten teacher, had returned to visit her home village of Daladalai after the army drafted her husband.

Shaky shortcut, a primitive suspension bridge spans a mountain river on a twisting trail used by Taiwan's aborigines, whose ancestors may have come from the Malay Peninsula area of Southeast Asia. Numbering about 200,000 and making up only 1.5 percent of the population, the aborigines are fast losing their tribal ways, including the tradition of elaborate facial tattoos. But their dancing and pageantry, intricate weaving and wood carving have become major tourist attractions.

byterian, we hiked into Daladalai, a Paiwan tribe village some three hours' climb from road's end at Santimen (map, page 13).

For much of the way we followed a foot trail over mountainsides covered with bamboo, juniper, and cedar. Few lances of light broke through, and we walked in gloom until the trail ended abruptly at a gorge crossed by a narrow suspension bridge. Hundreds of feet long, strung dizzily above rock-studded, milky-green streams, it spanned the abyss like a spider web (below). We walked with cautious steps, watching for rotten boards, clinging to trembling handrails, pausing briefly to glance down the valley at the crudely cultivated patches of Paiwan farms.

The few people we met—pipe-smoking,

EDDACHHINES © N.S.S.





Winnowing soybeans, farm girls depend on breezes to blow away pods falling through the wicker sieve. Beans piling up below may become soy sauce—the favorite Asian condiment—or bean curd, the cheap but protein-rich dietary staple. Scarfs protect against dust and unfashionable suntan.

Early risers: Mushrooms and picker must meet between 5 and 7 in the morning, when humidity and temperature bring the mushrooms to just the right size—about an inch across. An hour later they will have grown too big for marketing. To get maximum yield from minimum space, mushroom farmers use tiers of earth-filled trays in darkened sheds.

Lunch and gossip fill a break for sugar-cane cutters in southern Taiwan. The Dutch introduced the crop more than 300 years ago.

betel-nut-chewing men and women, heavily laden with firewood and medicinal herbs for lowland markets—nodded pleasantly as we passed. Those coming up the trail moved with springy stride, despite their massive loads of rice, salt, and bottled drinks from the plains.

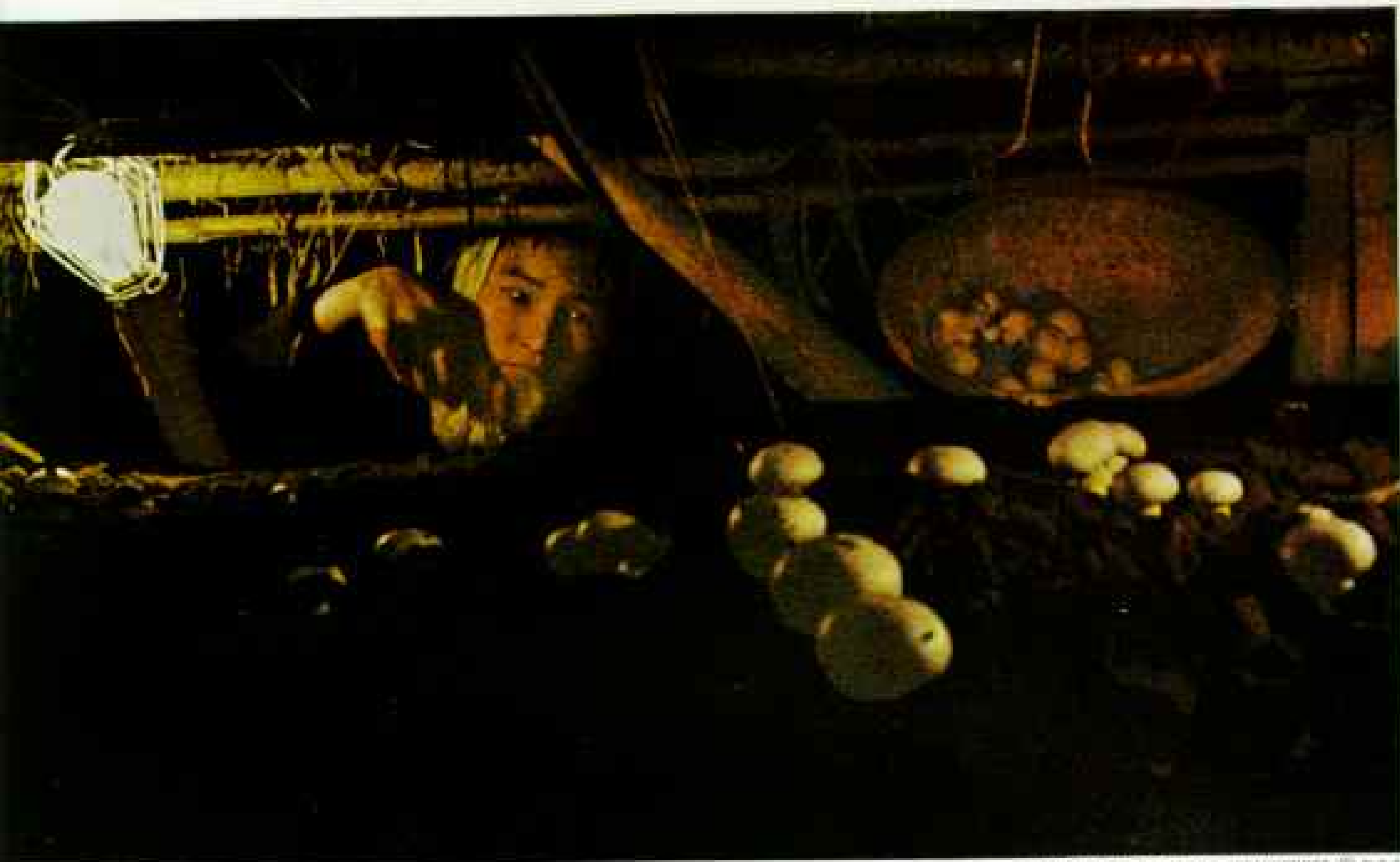
A flight of stone steps led us the last hundred yards to Daladalai. Rows of houses stood on terraces cut in the hillside; on each terrace were elevated barns and rows of spindly betel-nut palms. Paths between the houses were paved with fine slate, and slate walls reached to the eaves of grass roofs, each roof weighted with stones against typhoon winds.

It was Sunday, and the small concrete church was full when we arrived. Men in shirts and trousers, some with ties, sat on one side of the aisle, women in shapeless cottons on the other. All were singing, and the Paiwan words seemed incongruous, set to the familiar hymn tunes played on a foot-pumped organ. The atmosphere was relaxed. Babies suckled, children played, and a dog strolled in.

We stayed that night in the house of a chieftain's family. The daughter, a kindergarten teacher, had "come up from the plains" for a visit, but she insisted we have her bed while she stayed with a friend.

In the large one-room house, the slate floor was swept clean, and the two sleeping areas were separated by sacks of onions that added their own character to the smoke from a wood fire smoldering in a corner. In contrast to the





EXACHRIME (ABOVE) AND KIDACHRIME © N.B.A.





parents' simple sleeping platform, the daughter's end of the house was papered with Christmas cards and calendar pictures of Chinese movie stars. Enclosed with curtains, her platform boasted red-satin pillows and a pink puff spread over Japanese-style sleeping mats.

The old mother squirted a stream of red betel-nut juice out the window. Her stained lips cracked in a smile like a sliced tomato.

"She brought those ideas up from the plains," she snorted with that mixture of pride and contempt the old reserve for the young.

We sat on low stools close to the fire and shared the family's bean-and-rice gruel. An oil lamp glowed orange on a beam overhead, throwing in bold relief crude carvings of snakes and human skulls, mark of a family that had once hunted heads.

The old mother grunted in pleasure at our interest. She pulled a basket from beneath her bed and unfolded a coarse black-cotton jacket embroidered and beaded with symbols like those on the beam. She showed us a headdress heavy with bells, cowrie shells, and boars' tusks; a bridal costume passed down through generations. She had been married in it, and—for all her new ways—so had her daughter (page 32).

We left Daladalai and turned north across the fertile plains that produce most of the island's food. Route 1, Taiwan's western artery, was the usual madcap race track.

Timber trucks contested the right of way with bullock carts teetering under high loads of sugar cane. Buses bullied automobiles, and tiny taxis with locomotive-size horns blasted bicycles and motorcycles off the road in a well-established pecking order. In a continuous stream of traffic, the highway pulsed with the press of people of one of the most densely populated lands in the world.

Centuries-old servant of the rice farmer, a water buffalo draws his master's plow through a field soaked by the monsoon's deluge. Despite 340,000 buffaloes on the island, they remain in short supply.

Farmer's new friend, a power tiller equals the efforts of five water buffaloes. Here a man plows soybean stubble under before planting his rice. Some 21,500 of these small tractors, manufactured in Japan and Taiwan, are now in use.

The fall rice harvest was well underway. Coolie-batted girls in skintight pants, their faces protected from the dreaded darkening effect of the sun by bandit-style bandannas, helped their men cut the golden grain and feed it into foot-operated threshers.

Ducks Follow the Harvest

Sheaves of threshed rice stalks lay waiting to be collected for making paper, for feeding livestock, or for fuel. A duckboy was fattening his flock on the scattering of kernels left by the harvesters. His face creased in a smile when we stopped, and he offered us tea from a pot steaming on a rice-stalk fire.

"Harvest no come same place same time," he said. "We take small ducks, move from field to field. Ducks eat. Walk long way long time, sleep in fields with ducks. Soon ducks big. Very fat. Bring good price."

The ducks moved on in a close-packed mass, flowing like a river of feathers over the dikes between the fields, the boy guiding them with a flag on a slender bamboo.

We moved on too, turning east toward Sun Moon Lake, Taiwan's major tourist attraction.



FOODALBUMS BY HELEN AND FRANK SCHNEIDER (ARTIST), CHARLES WOODS, BLACK STAR © W. & J.

We left the plains, their irregular fields shimmering in the sun, and climbed into the misty world of the mountains along a river valley pink with plum blossoms and bright with oranges and bananas.

Still higher, the hillsides were stubbled with tea bushes; higher yet, bamboo spread its fairy fronds in trembling patterns as though a Chinese landscape painting had come to life. Between them we glimpsed Sun Moon Lake, an expanse of cobalt water cradled in cloud-lost mountains (opposite).

Traffic Jam on Sylvan Waters

"Sun Moon Lake really two lakes," said our driver Chang. "One shaped like sun. Other like new moon. Japanese build dam. Now one lake. Very popular. I come here after marry."

A launch carried us across the wind-dusted water to a small aboriginal village. We waited while the boatmen untangled a minor traffic jam as some 200 Japanese tourists scrambled aboard launches. Tour leaders, waving little flags like duckboys, hurried a few stragglers being photographed with a group of blasé aboriginal girls.

A sign near the dock advised us that pheasants, flying foxes, and deer are protected wildlife and not to be hunted. We ran a gantlet of shops displaying stuffed pheasants and flying foxes on our way to the Aborigine Museum, Aborigine Village, and Aborigine Stage Show, all identified in English and Chinese.

Dutifully, a score of heavily made-up, red-costumed girls trooped into the thatch-and-bamboo theater for the performance. To our surprise, we enjoyed it. In the true spirit of show business, the girls' bored expressions became animated as soon as the recorded drum-and-flute accompaniment boomed from the loudspeakers. With growing enthusiasm, they performed the Harvest Dance, Hunting Dance, Marriage Dance, and War Dance, the latter spiced up with a symbolic blood-drinking ritual, a wooden head, and several flares that threatened to ignite the grass roof.

The costumes—particularly the leggings, head feathers, and tunics—resembled those of North American Indians. We sought the old chief to ask about their authenticity.

We found Chief Mao Hsin-hsiao in white shirt and tie sitting under a thatched pagoda near a larger-than-life concrete horse. He looked more the successful businessman than hereditary tribal chieftain.

"Horse for tourist take picture," he explained. "I think it myself. But girls' dress like always. Make-up new. Very modern."

"And the dances?" Helen asked.

"Dances same. Stage new. Before we dance outside. Dance for fun. People watch. No pay. Now pay. Good business."

So it seemed. Half the village, Chief Mao told us, earned its living from tourists.

"But government give us many new things too," he added. "Have electricity, concrete houses, school, clinic. Watch television. Have new seed for better rice. Many pigs. But many girls now leave village. Go to cities. Work in night clubs."

They find plenty to do. With almost 300,000 visitors a year swelling Taiwan's foreign-exchange coffers, more and more night spots are featuring aboriginal dances. A fair percentage of those tourists, however, find other aspects of Taipei night life more exciting. Peitou, a nearby hot-spring resort with massages, has long been visited by Japanese businessmen. And Taipei's bars with their mini-skirted hostesses are popular with U. S. servicemen on Rest and Relaxation leave from the front in Viet Nam.

By Boxcar to a Shell-pocked Bastion

Taiwan's armed forces take R & R from a quieter front. Early one morning Helen and I boarded a camouflage-painted Fairchild C-119 "Flying Boxcar" for the 1½-hour flight to the island of Quemoy, Nationalist China's outpost only 2,500 yards from Communist China. We had been waiting since 6 a.m.; not even the crew knew when we would leave until just before take off, which came at 7:10.

"The flight times are varied each day," our escort, Lt. Comdr. Hollington Cheng, explained. "Technically, we're still at war. If we flew a regular schedule, the Communists could cause trouble."

To prevent just that, jet fighters patrolled high overhead, and we swooped low over the

By dawn's misty light on Sun Moon Lake, aboriginal fishermen set out on bamboo rafts with dip nets poised on the bows. Taiwan's chief tourist lure, Sun Moon was twin lakes until a Japanese-built dam raised the water level and merged the two. At a lakeside village the authors watched aboriginal girls perform ritual dances. But, the tribal chief bemoaned, too many of his young stage stars desert the hill country for the bright city lights.



water to avoid Communist radar. The Pescadores, a group of islands named by the Portuguese nearly four centuries ago and now part of Nationalist China, passed under us in a sweep of flat brown earth ringed with wave-rumpled blue. Thirty minutes later the big transport landed gently on Quemoy.

Quemoy has been a thorny issue ever since the Communists suffered 10,000 casualties when they attempted to capture the island in 1949. Later they subjected the 8-by-13-mile island to intensive shelling.⁹

On odd-numbered days since 1958 the Communists have lobbed in shells, most of them filled with propaganda leaflets, as a reminder that they are still there and waiting.

The Nationalists are waiting too. We found Quemoy on a wartime regime. Guns were loaded. Gas-masked sentries with fixed bayonets patrolled classified storage depots. Tanks were deployed in strategic areas. And yet over the whole island we found the serene air of a national park.

"Years ago Quemoy was a barren rock," said Commander Cheng. "There was little water, few trees. Food was shipped in. Look at it now. Our motto here is to beautify above ground and fortify beneath."

Beautified it is. Some 40 million trees have been planted. Colorful pagodas grace hilltops and roadside groves. Dams, reservoirs, and deep wells provide abundant water.

Vegetable and sorghum fields produce enough to feed Quemoy's 58,000 civilians and a large garrison of troops.

The fortifications were less obvious, but everywhere signs advocated "Counterattack to the Mainland." Deep in the granite hills we saw a maze of tunnels, barracks, radio stations, even a theater. Military experts claim that Quemoy's subterranean fortifications could withstand even a nuclear assault.

Quemoy Has Eyes and Ears—and a Ready Tongue

I asked Commander Cheng why Quemoy is so important to Nationalist China—and to the Communists. He answered by taking us to the peninsula closest to the mainland.

From a bunker we saw the Communist port of Amoy, the black sails of Communist junks like bats' wings against the glittering water. Through binoculars we watched Communist soldiers on a rocky island only a mile and a half away.

"For us, Quemoy is a listening post, and a vantage point to speak back. The prevailing winds here are in our favor. They carry our balloons filled with propaganda leaflets to many

⁹See "Life Under Shellfire on Quemoy," by Franc Shor, NATIONAL GEOGRAPHIC, March 1959.

Chiang's leathernecks attack behind the scorching lick of a flame thrower in a practice landing. Live machine-gun fire and simulated mortar blasts add battlefield realism to the Marines' infantry drill.

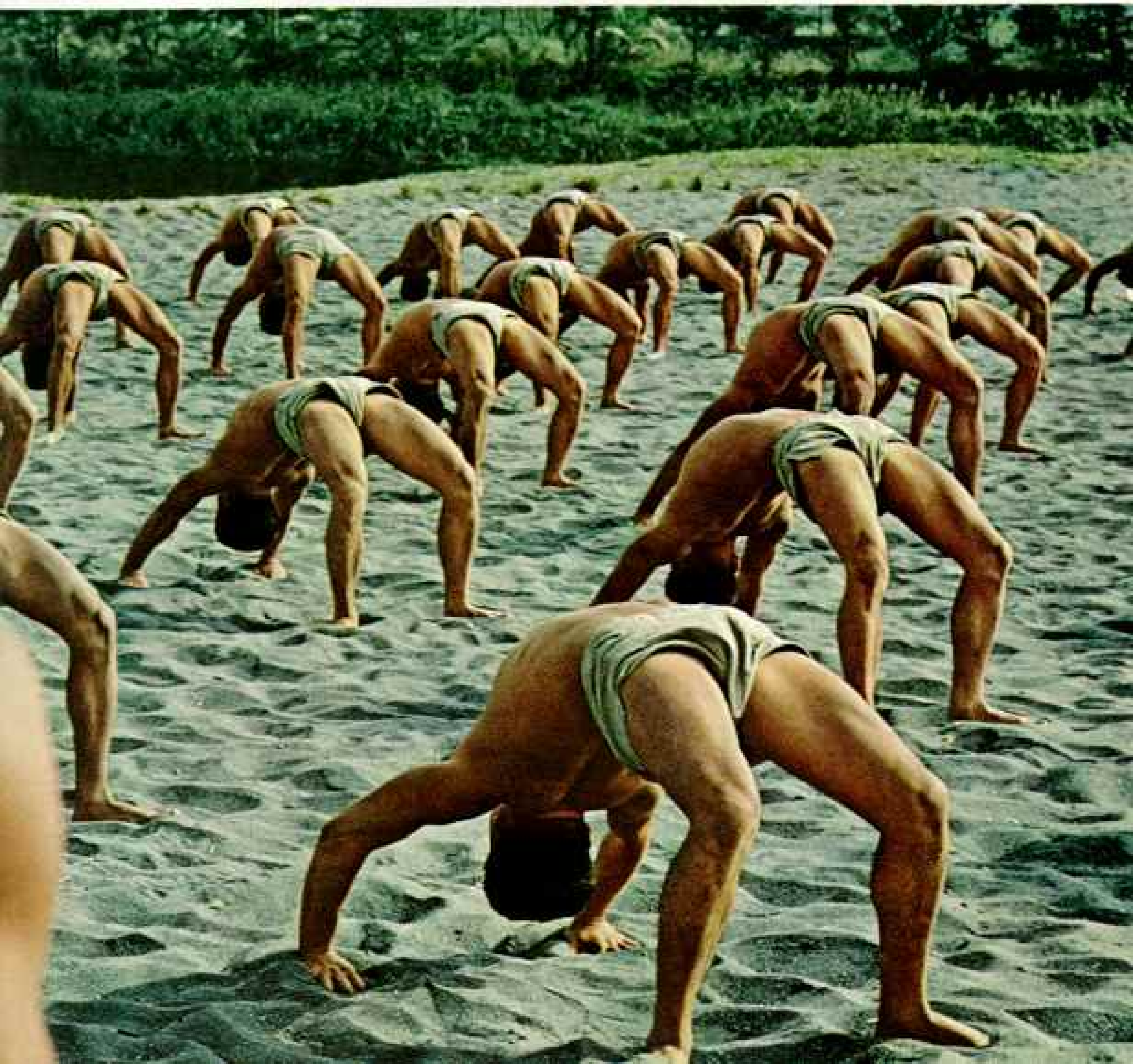
Muscle-building backbends toughen frogmen trained to clear away underwater mines and hit the beach first during amphibious assaults.

Troop indoctrination stresses retaking the mainland. But Chiang's 600,000-strong army, built with more than two billion dollars' worth of American aid, is primarily defensive. It lacks the ships and planes needed for invasion. Defense takes half the national budget.





RESEARCHERS © NATIONAL GEOGRAPHIC SOCIETY





"Flying Dragon" Squadron Lockheed F-104 Starfighters of the 100,000-man Republic of China Air Force flash past Taiwan's highest peak, 13,113-foot Yu Shan, or Jade Moun-

parts of the mainland [page 12]. Our loudspeakers are clearly heard. But the Communists have speakers too. Listen."

From across the narrow strait we heard the Communist announcer. Commander Cheng translated:

"We are the workers of Mao Tse-tung. We completed a bridge two months ahead of schedule."

As in a duel, the Nationalist loudspeaker boomed back:

"Here on Taiwan the farmers own their land. They have electricity, motorcycles, more food than they can eat. Your families are

separated. You live in communes. You are hungry. Mao is your enemy. He is our enemy too. Revolt. We promise that in six hours we will send you help."

That evening when the shelling began we returned to the bunker. The night was clear and the lights flickering on the mainland were like pale, yellow stars. A Taiwanese soldier paced his post, a dog barked, and the moon silvered the water. True to their pattern of many years, the Communist guns fell silent after dropping a score or so of shells, strewing propaganda leaflets over the landscape but causing no damage.



RODNEY © N.A.S.

tain. Also called Mount Morrison for an early sea captain, it became Niitakayama, or New High Mountain, to the Japanese when they found it 725 feet higher than Fujiyama.

Back on Taiwan, we toured many military installations. No one, regardless of position, wealth, connections, or education is exempt from military service. Some 600,000 men are in uniform, 5 percent of the population, and they are among the lowest paid in the world, about \$7.50 a month for privates. Yet we found high morale and enthusiasm.

We flew with paratrooper recruits, swam with frogmen practicing underwater demolition, rode amphibious tanks in simulated landings. Everywhere we met members of the United States Military Assistance and Advisory Group (MAAG), which has been working

with the armed forces on Taiwan since 1951.

Maj. Gen. Richard G. Ciccolella, Chief of MAAG, China, explained MAAG's role: "Our job is to assist Taiwan in defending itself. We've almost worked ourselves out of a job. We no longer teach the basics. We're advising now on the highest levels—logistics, strategy, maintenance, coordination. As fighting men, the Chinese on Taiwan can, I believe, match any military force in Asia."

At the huge Ching Chuan Kang Air Base in west-central Taiwan I began to appreciate Taiwan's first line of defense—the Chinese Air Force. For weeks we had been trying to

photograph: 13,113-foot Mount Morrison—Yu Shan in Chinese—highest mountain in Taiwan. But snows, landslides, and clouds had frustrated every attempt to view it from the land.

"How about from the air?" suggested a Chinese Air Force friend. "You can photograph a flyby past Yu Shan."

"Wonderful. What kind of planes?"

"F-104's—Lockheed Starfighters. You'll fly in a trainer—just like the fighters, but with two cockpits. Fine aircraft. Supersonic."

With less enthusiasm I strapped myself into a parachute and was instructed how to eject from the stub-winged silver plane.

"Just routine," the pilot, Lt. Col. Joseph Chen, assured me. "Our squadron won Lockheed's award for safety."

My qualms were replaced by exhilaration when the trainer joined the other Starfighters on the runway and we rocketed up to 14,000 feet. I felt the surge of acceleration when Joseph ignited the afterburners and the Starfighter leaped through the sound barrier. His voice crackled over the intercom:

"Keep talking, Frank. I want to know that you're all right, that you haven't blacked out."

Smoothly, Joseph rolled his jet until we were flying upside-down. The vast panorama of Taiwan unfurled like a Chinese scroll painting. My eyes swept from the wind-tossed gray of Formosa Strait across the rice-green plains and factory-studded cities to the snowy peaks thrusting through a flat sea of clouds.

Upright again, I saw the other Starfighters flash past the crystal-white crag of Yu Shan, flying so precisely they seemed almost lashed together (preceding pages).

Back on the ground, I complimented the pilots on their skill.

"We fly every day," Joseph said. "We never forget we're only 8 minutes from Communist China. We never know when we'll be needed."

Madame Chiang Serves Tea

Perhaps nowhere is news of Asia watched more closely than on Taiwan. Headlines banner the war in Viet Nam and North Korea's growing belligerence; guerrilla raids in Laos, Cambodia, and Thailand; riots in Hong Kong; purges in Communist China. With each new

upheaval editorials hint that the time is near for Nationalist China's return to the mainland.

In a rare audience, Chiang Kai-shek summed up Nationalist China's viewpoint:

"As long as the Communists occupy the mainland, there will be no end to the disturbances in Southeast Asia. The Republic of China here on Taiwan must return to the mainland to clear up the mess."

The President and Madame Chiang Kai-shek (page 12) had received us in their Grass Mountain home on the outskirts of Taipei. Carpets the color of rubies accented an array of Ming dynasty oxblood porcelain. Roses glowed in the light of a fire, and Madame Chiang's own paintings graced the walls. Despite its large size, the reception room radiated warmth and friendliness.

Tea was served with sandwiches, cake, and dumplings. In the cultured English that reflects her Wellesley College background, Madame Chiang discussed Chinese painting with Helen; the President, speaking through an interpreter, asked me about our tour of Taiwan.

Progress a Weapon in Quiet War

So relaxed was the atmosphere that more than an hour passed before we realized it. President and Madame Chiang Kai-shek rose to bid us goodbye, and at the door I looked back. The President was standing with hands on hips and an alert twinkle in his eyes. For all his 81 years he was still lean and straight, but I wondered how—or if—his lifelong dream of a united China would be realized.

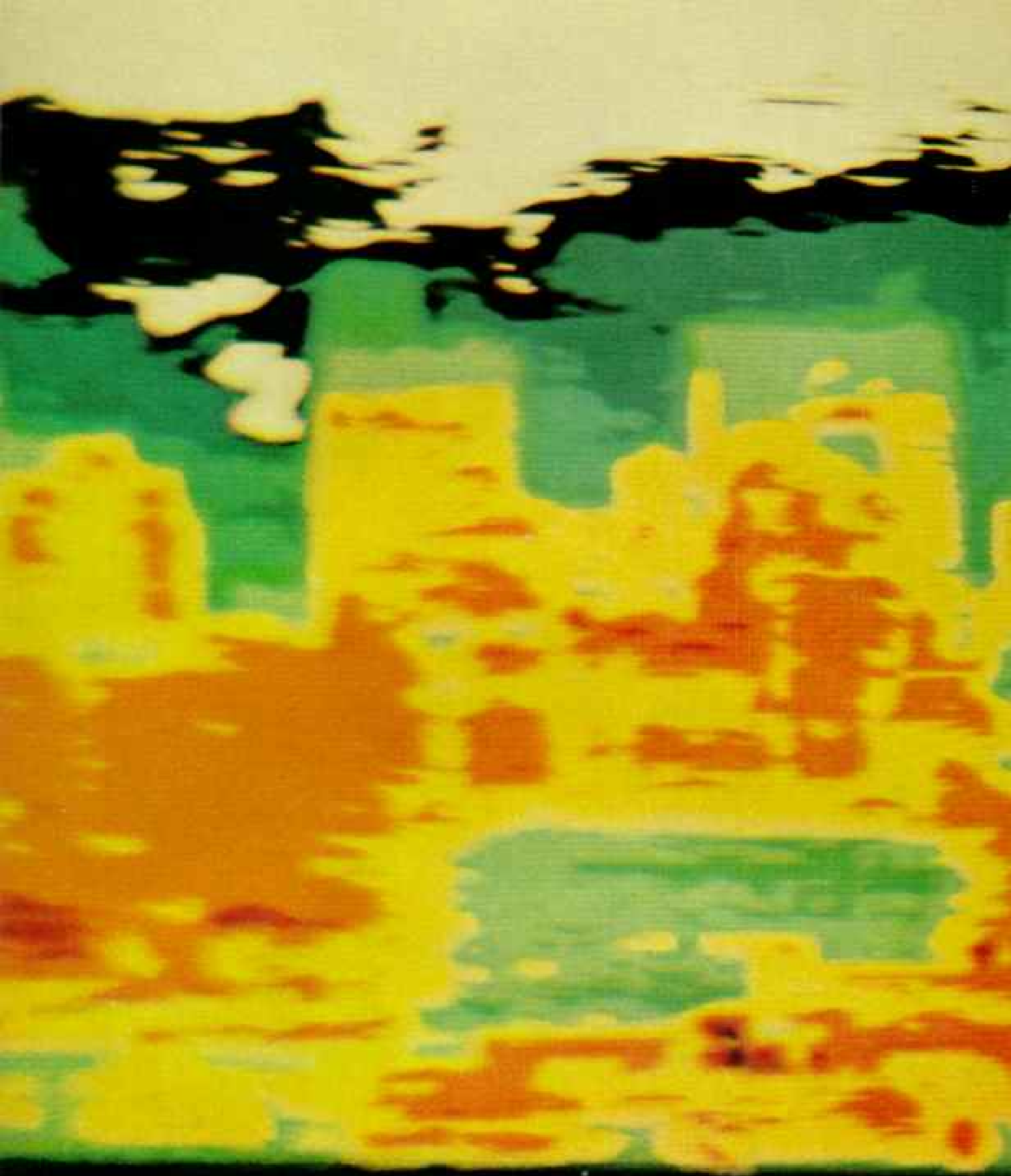
Not even the most optimistic Nationalist Chinese believe that this goal can ever be achieved by military action alone. They point to the government's "70 percent political—30 percent military policy."

"First we must make Taiwan an example for all Asia of progress through free enterprise," a friend in Taipei told us. "We must capitalize on the broken promises of the Communists. Our intelligence reports indicate that many people on the mainland are already disillusioned. We must encourage revolt. When it comes, we will be ready."

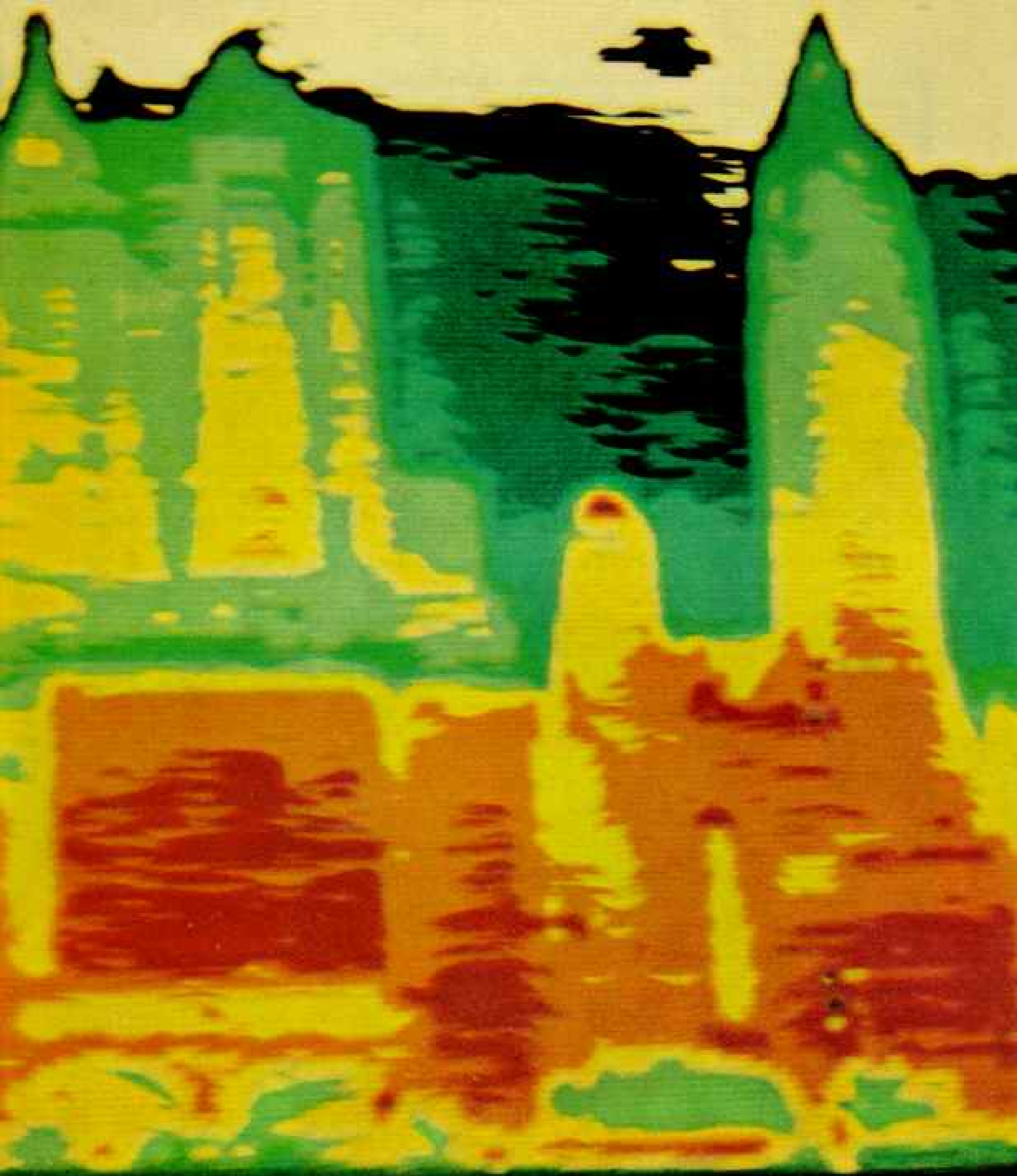
And so the quiet war goes on, amid the rumble of factories on Taiwan and the roar of rockets from the mainland. THE END

Wading yet another step, swooping down yet another time, a rice planter performs an age-old ballet as she spaces the seedlings to assure maximum yield. In this flooded paddy the only sounds are the ripple of water and the squish of mud, striking contrast to the roaring industrial plants of Taiwan's cities.





REMOTE NEW EYES TO
SENSING



SEE THE WORLD

BY KENNETH F. WEAVER
ASSISTANT EDITOR

Weird hues wash a familiar skyline in a "heat picture" of New York City. A thermograph (next page) measured the city's emitted infrared radiation on a summer day, recording degrees of heat as different colors. A windowless building glows a hot red; slightly cooler areas show up yellow. Airy skyscrapers appear a still-cooler green, as does a building under construction, foreground. Thus, with marvelous new instruments, man broadens the range of his senses.

THERMOSGRAM BY BARNES ENGINEERING COMPANY

IN THE DARK of the moon, a deer mouse scurries softly across a forest floor. Virtually invisible and soundless, he seems safe from danger—but the unerring strike of a rattlesnake brings his journey to an abrupt end. Faint radiations of heat from the mouse,

The universe is full of magical things, patiently waiting for our wits to grow sharper.

ELLEN PHILLIPPS (1862-1947), ENGLISH NOVELIST AND PLAYWRIGHT, FROM "A SHADDER PASSES"

reaching two sensitive pits in the viper's head, have betrayed the exact location of the tiny mammal's warm body.

In a desert cavern, bats returning from a night's feeding swirl in apparently chaotic swarms. They seem doomed to collisions on a massive scale, yet miraculously they avoid hitting one another or the cavern walls. Each bat utters streams of ultrasonic squeaks that echo from obstacles and warn it to change course.*

The rattlesnake, with its sensitivity to in-

frared radiation, and the bat, with its skill at echo-location (comparable to sonar and radar), are natural examples of what scientists today call remote sensing. Simply defined, that means getting information about things at a distance, or about things one cannot touch.

Man, too, uses remote sensing; in the broadest meaning, he has done so since his earliest ancestors climbed a hill and scanned the distant plains for game, or listened in fear to noises of the night forest. But man's normal senses are unremarkable. A dog's sense of smell, for some odors, is a thousand times more sensitive.

So, since the days of Galileo and his telescope, man has greatly augmented his senses with instruments. Now the Space Age is producing a torrent of improved techniques and devices to extend man's ability to perceive.

These all-seeing "eyes" range from multi-lens cameras to scintillometers. They use



KODACHROME BY TERRILL D. ELLER © N.A.S.C.

Taking New York City's temperature, an engineer on Governors Island adjusts a thermograph to make the picture on the preceding pages. The camera, designed by the Barnes Engineering Company in Stamford, Connecticut, registered some 60,000 heat readings for the thermogram.

In this view of lower Manhattan Island, the solitary Cities Service skyscraper rises to the right of the First National City Bank building and adjacent 40 Wall Street tower. Girders of the unfinished Atlas-McGrath building appear as a dark mass above ferry slips.



Wide window of the spectrum

Viewing the world with the naked eye, man peers through a narrow slit—the visible-light portion of the electromagnetic spectrum. Most radiant energy travels

sound and light, radio and radar, heat and X-rays, magnetism and laser beams.† With fantastic versatility they pierce clouds and smoke, penetrate the earth, and scorn darkness and camouflage.

Some even see the unseeable, and take ghostly pictures of the past.

Instruments Scan Earth and Space

This revolutionary new technology (one might almost say black art) of remote sensing is providing scientists with all kinds of valuable new information to feed their computers. It is a source of quite legitimate excitement today in many quarters, for it offers a veritable cornucopia of benefits for the future of the human race.

Remote sensing will help improve the food you eat, the water you drink, the air you breathe. It promises aid in averting famine, flood, fire. It may find new natural resources,

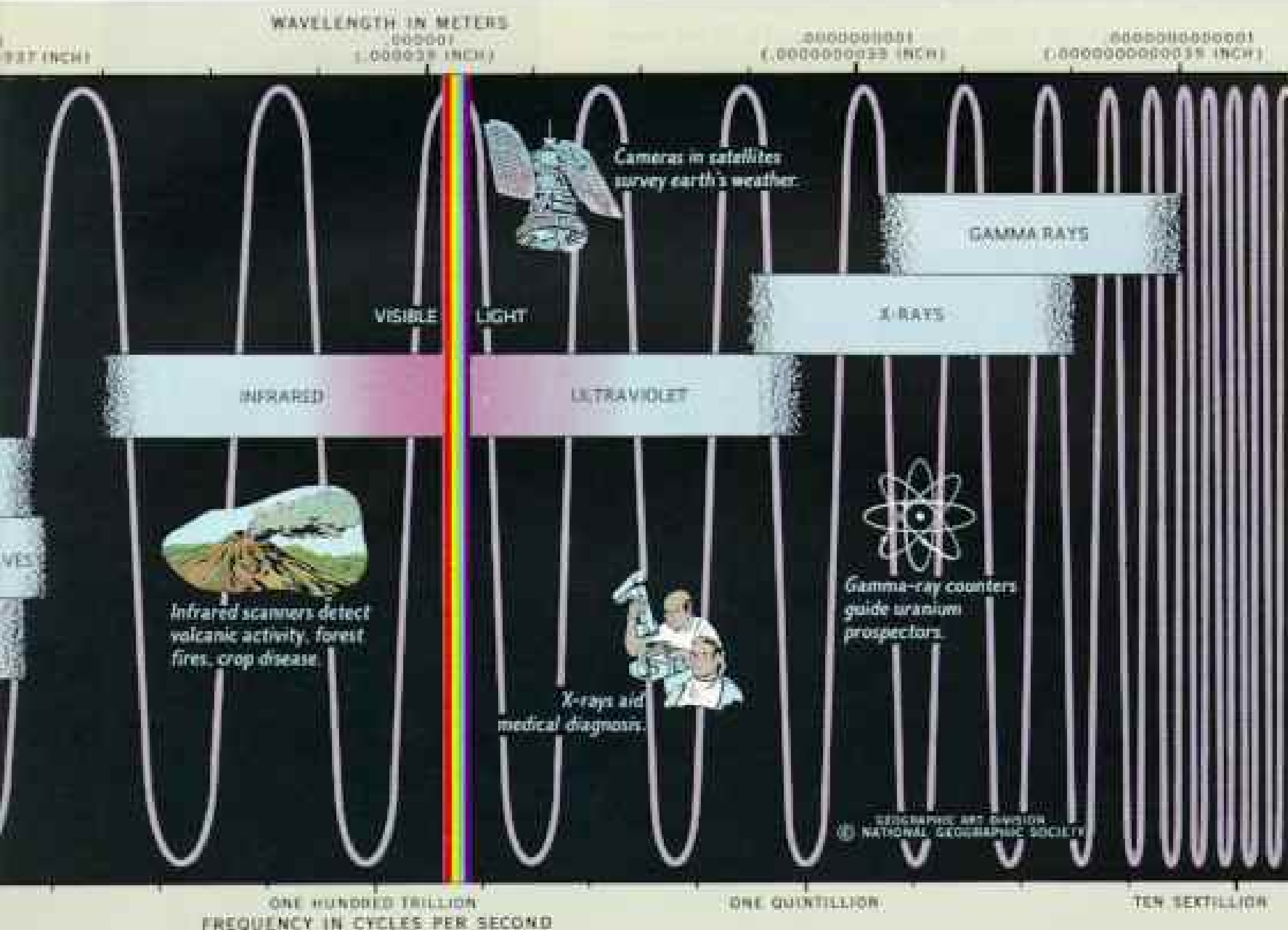
as well as long-lost cities and buried treasure. Ultimately it may help determine whether man will be able to continue to live on his planet, the earth.

Two major developments are spurring this revolution. One is the ability to place sensing instruments into orbit. In the past 11 years some 800 spacecraft have rocketed out from earth. They have, among other things, measured the powerful wind of particles blowing from the sun; explored the giant magnetic shield protecting the earth; taken the temperatures of Venus and Mars; and captured virtually all the surface of the moon on film.

They have also looked earthward. Photographs taken from Gemini and Apollo spacecraft and Nimbus, Tiros, and ATS satellites

*See "How Bats Hunt With Sound," by J. J. G. McCue, NATIONAL GEOGRAPHIC, April 1961.

†See "The Laser's Bright Magic," by Thomas Meloy, NATIONAL GEOGRAPHIC, December 1966.



in wavelengths and frequencies that he cannot see. Generated by matter's atomic and molecular activity, radiation streams from every object in the universe in units of energy called photons. Remote sensors can span this entire spectral range. Radio telescopes gather "noise" from the depths of the universe, and radiometers detect natural micro-

wave emissions of icebergs near sea lanes. Radar, bouncing pulses off the earth, yields topographic maps. Infrared sensors warn when volcanoes "run a fever," a prelude to eruptions. Satellites photograph weather in visible light, X-rays give doctors and dentists inside information. Gamma rays striking scintillometers locate radioactive ores.



INFRARED PHOTOGRAPHS BY FRANKLIN E. MANZER AND GEORGE W. COOPER © W.S.S.

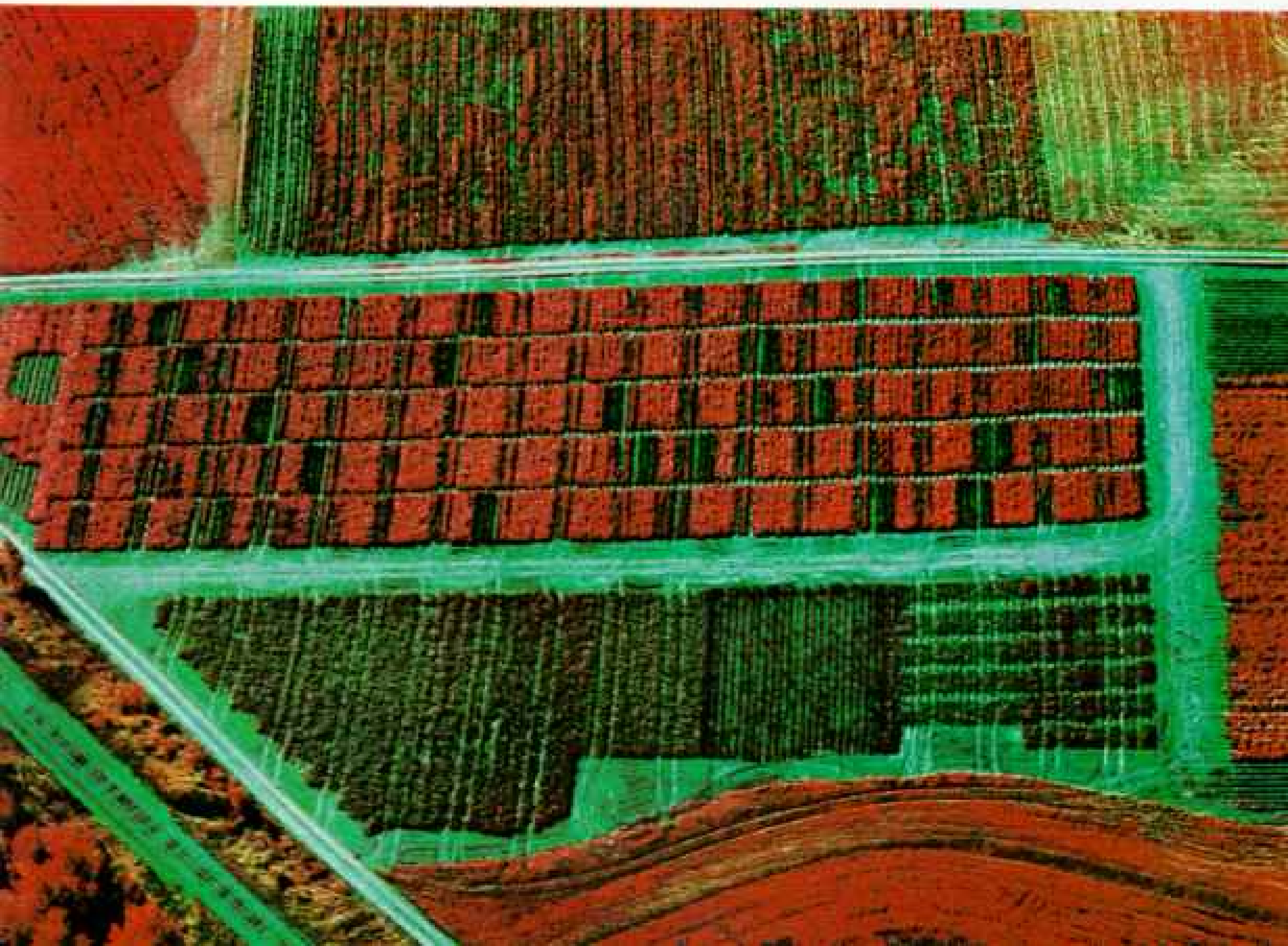
Spotting sick potatoes

Like flower beds aflame with bloom, potato fields blaze scarlet in an infrared photograph taken at the Maine Agricultural Experiment Station near Presque Isle (above). To help farmers detect plant diseases, pathologists introduced late-blight fungus, then made successive infrared photographs. In about a week smudges clouded a picture—evidence of diseased leaves that reflect less IR. Two more days elapsed before damage became evident on the ground (right). Blight checkerboards the center field three weeks later (below); fungicides saved the healthy plots. Other fields lie darkened by a spray that withers plants to hasten ripening of the potato tubers.

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SCOUTING FOR BLIGHT BY FRANKLIN E. MANZER © W.S.S.



have given us revealing new views of our abode and stirred the imagination of scientists and laymen (pages 54-5, 59, and 65).*

As I have traveled about the country, I have found university laboratories, aerospace corporations, and Government agencies deeply involved in finding ways to study our environment from space. The Geological Survey, Department of Agriculture, Naval Oceanographic Office, Environmental Science Services Administration, and Bureau of Commercial Fisheries—all these pursue the subject for their special interests.

So, too, does the National Aeronautics and Space Administration. From the Manned Spacecraft Center in Houston, Texas, NASA planes regularly fly sensing instruments in experiments that may lead within a few years to an "earth resources satellite."

Radar Gets Down to Bedrock

Perhaps even more significant a spur to this growing technology is the extraordinary development of hot- and cold-war reconnaissance. Secrecy, of course, shrouds the most advanced techniques for ferreting out hidden knowledge, yet the veil is being gradually lifted.

One of the most valuable military instruments to become available in this way to civilian scientists is side-looking radar. Originally developed to look sideways from a reconnaissance plane as it flies behind battle lines, it produces remarkably clear images even through clouds or darkness, when photography is impossible. Its antenna, in the side of the plane, is larger and its electronic techniques far more sophisticated than those of ordinary navigation radar.

The images reveal details not evident in photographs and have all sorts of uses for map makers, geologists, oceanographers, farmers, and hydrologists (pages 70-71). Side-looking radar of long wavelength can penetrate to bedrock through dense vegetation or as much as three feet of dry soil.

Other highlights in the current art of surveillance give an idea of some of the eventual possibilities of remote sensing. No secrets are revealed here; these facts are all now public.

- Aerial cameras today achieve focal lengths (distance from lens to film) of 20 to 60 feet by means of folded optics—that is, by bouncing the light between mirrors inside the camera before it reaches the film. Since a longer focal length increases scale and thus magnifies detail, such cameras, with improved films, can

pinpoint objects smaller than a Volkswagen from altitudes of 100 to 300 miles.

- Today's highly sophisticated surveillance satellites fly at these 100- to 300-mile altitudes. The U.S. versions are launched into orbits roughly from Pole to Pole, so that they survey every square mile of land and sea as the earth turns majestically beneath them. They watch for the telltale heat trails of rocket launchings and nuclear submarine wakes; photograph suspicious areas such as missile sites, using radiations from different parts of the electromagnetic spectrum. They can send their pictures and information back by radio, or actually return the film to earth in parachuted capsules that are snagged from mid-air over the Pacific.†

- At Clouderoft, New Mexico, an Air Force electro-optical device known as AN/FSR-2 could spot an orbiting basketball 20,000 miles up. It is but one of a variety of powerful space surveillance sensors.

- In war the enemy may be detected by electronic devices that sniff his body odor, sense the vibration of his passing on a trail, pick up the heat radiation from his body even in dense jungle (pages 72-3), or turn radar echoes from moving troops into clearly identifiable whooshing sounds.

- Starlight scopes in Viet Nam have denied the night to the Communists. These light intensifiers magnify starlight 45,000 times, producing images as bright as day and letting GI's see the enemy without being seen.

Everything Emits Infrared

When Gaspard Félix Tournachon, who called himself Nadar, snapped the world's first aerial photograph while ballooning over Paris in the late 1850's, he could hardly have imagined such refinements as these. Nor could he have foreseen the widespread use of sensing that does not depend on visible light. I think he would have been particularly intrigued by infrared radiation, which most of us think of as heat.

What makes infrared so useful is the fact that every physical object on earth—your body, a rock, a tree, a piece of iron—continuously gives off electromagnetic radiation in proportion to its temperature, because of oscillations of its atoms and molecules. If the

*See "The Earth From Orbit," by Paul D. Lowman, Jr., NATIONAL GEOGRAPHIC, November 1966.

†See "Countdown for Space," by Kenneth F. Weaver, GEOGRAPHIC, May 1961.

Earth Parts of three states bare their features to an infrared camera, carried 40 miles high by the National Aeronautics and Space Administration-U.S. Air Force X-15 aircraft. Las Vegas lawns glow red in the Nevada desert, foreground. The Colorado River, backed up by Hoover Dam to form Lake Mead, flows southward between Arizona, left, and California into Mexico on the horizon. Infrared has knifed through ground haze to reveal earth's every wrin-

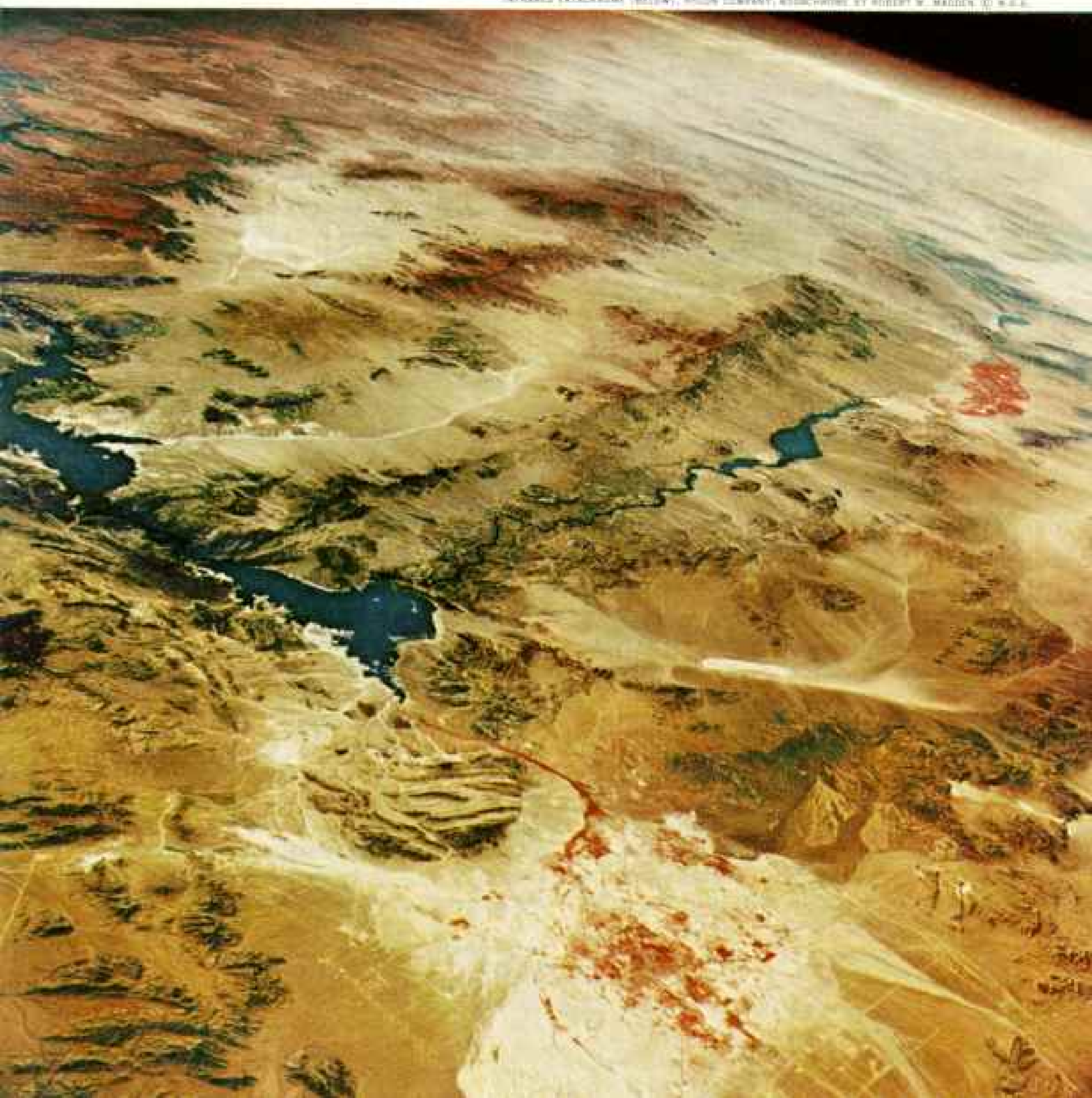
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kle to map makers and geologists.

Mountains leap from flat paper (right) under a stereoscope used by Paul Ulmer, noted Swiss cartographer. The instrument optically combines the images of two photographs taken at slightly different angles and gives a three-dimensional view of terrain. Reading the photographs, Mr. Ulmer charts glaciers and rock outcrops for a National Geographic Society map of the Mount Kennedy area of Canada.



INFRARED (EISENHARTZ/REDFER), PHOTO LIBRARY, BOSTON/OWEN ET ROBERT W. MADDEN © N.A.S.A.



Water

Colors give clues to water conditions in an infrared photograph taken from a mile above Brownsville, Texas, right, and Matamoros, Mexico. Pallid blue of the Rio Grande, beyond a silvery patch of reflected sunlight, reveals the presence of silt (see also page 66). Contrasting hues of an oxbow, once part of the river, and an adjacent black lagoon stem from variations in IR reflectivity, suggesting differences in water clarity.

In the topsy-turvy world of infrared, hedge-rows and citrus trees appear as red stripes and polka dots against green plowed ground. Golf-course greens and agricultural test plots show up red at lower right.



INFRARED PHOTOGRAPH, AGRICULTURAL RESEARCH SERVICE, USDA

temperature is high enough, part of the radiation becomes visible as light. At lower temperatures the huge bulk of the radiation falls in the infrared (below the red) portion of the spectrum, just below visible light, with much smaller amounts still lower, in the microwave radio region (diagram, pages 48-9). Though invisible, these radiations may be detected and measured. Just as the eye distinguishes a green object from a blue one, so infrared detectors can note subtle temperature changes.

Crystals Keep Watch for Forest Fires

The rattlesnake has no difficulty perceiving temperature differences of a few tenths of a degree a foot away; one of man's more sensitive devices can feel the heat from an ice cube a mile away!

Obviously, infrared detectors can be used to spot forest fires (pages 68-9). A crystal of indium antimonide in a plane at 20,000 feet can see a tiny fire only one foot across, long before even a wisp of smoke shows. Since 1965 the U. S. Forest Service has been using such a device in hopes of reducing the Nation's losses from 110,000 forest fires a year.*

"With our detector, we have spotted forest fires which were so well hidden that aerial

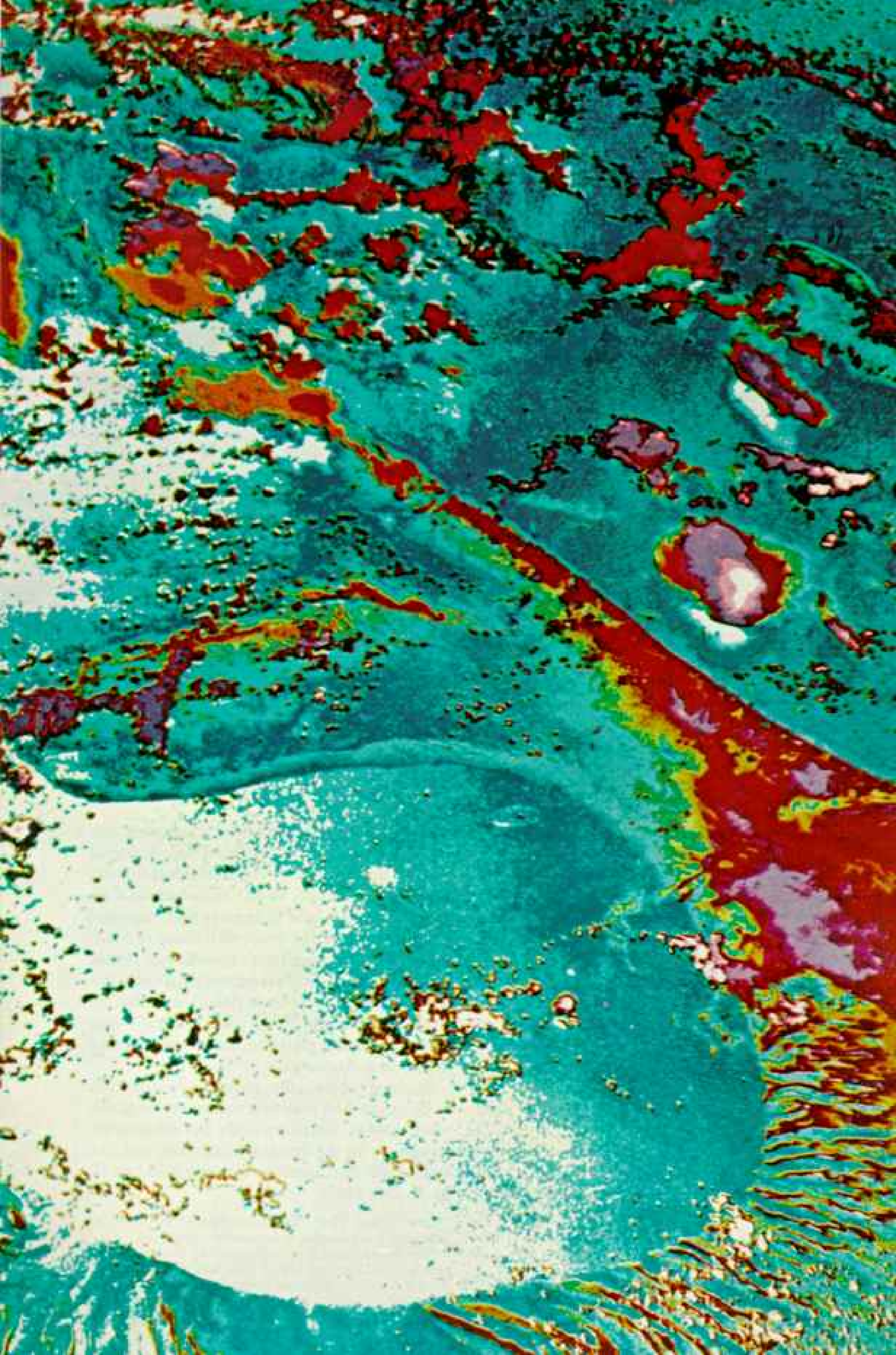
observers were never able to find them, even though they knew where to look," says Stanley N. Hirsch of the Forest Service's Northern Forest Fire Laboratory in Missoula, Montana.

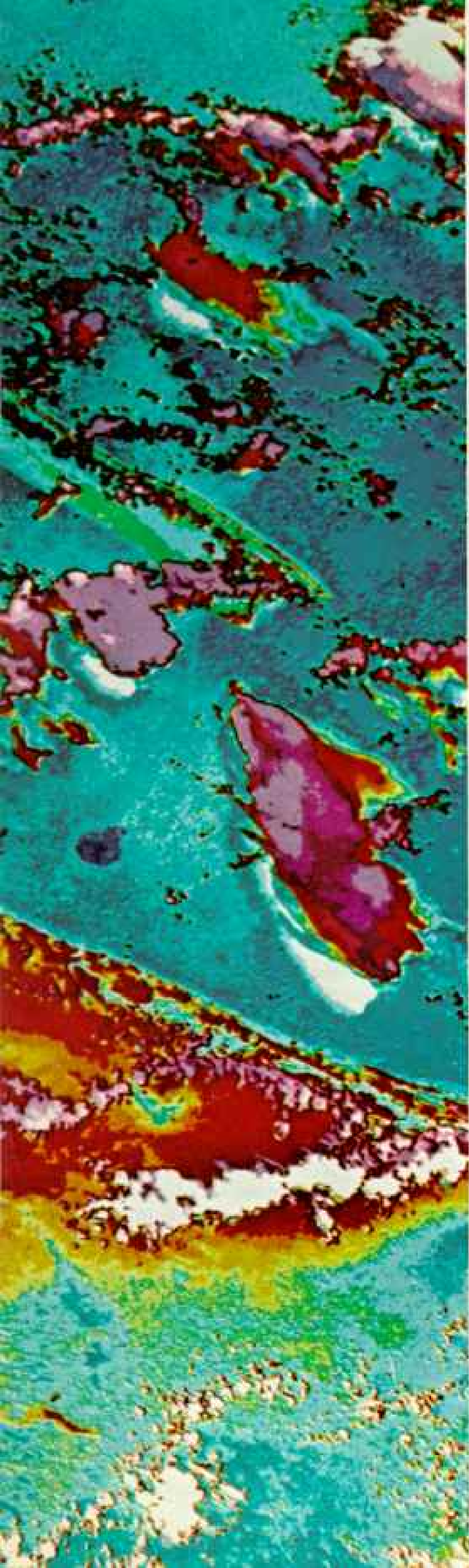
If infrared can detect fires, it can also survey hot spots in the earth's crust. Infrared studies made by the U. S. Geological Survey of Kilauea volcano, on the island of Hawaii, and of the new island of Surtsey that exploded from the sea off the coast of Iceland in 1963, reveal subterranean lava channels not visible on the surface.† Such readings help tell if underground temperature is rising—whether, in effect, the volcano is "running a fever"—and thus may make possible better warnings of impending eruptions.

Surtsey, incidentally, enjoys the distinction of being the first erupting volcano to be monitored almost simultaneously by infrared instruments on the ground, in aircraft, and in a spacecraft (the weather satellite Nimbus II, in August 1966).

*See "Forest Fire: The Devil's Picnic," by Stuart E. Jones and Jay Johnston, *GEOGRAPHIC*, July 1968.

†See "Fountain of Fire in Hawaii," by Frederick Simpich, Jr., *GEOGRAPHIC*, March 1960, and "Surtsey: Island Born of Fire," by Sigurdur Thorarinnsson, *GEOGRAPHIC*, May 1965.





EXTACHURRE, NASA

Bahamas from space

With psychedelic splendor, a color-coded photograph highlights depths on the Great Bahama Bank. Tongue of the Ocean, a mile-deep trough at lower left, licks a corrugated lip; red and yellow shallows separate it from Exuma Sound to the northeast. Prototype of a new map-making art, the garish composite grew from a soft-toned Gemini 5 photograph taken from an altitude of 140 miles (above).

To enhance readability of Gemini photographs, whose delicate shadings often conceal details, scientists at Philco-Ford in Palo Alto, California, isolated each subtle tone in the Bahamas picture. Projecting 12 tones one at a time, they assigned a color to each, producing 12 separate overlays. At left, red shows depths to six feet and yellow, six to nine, while clouds appear in shades of purple, according to brightness. Great depths in the Tongue and cloud shadows appear white, because no color was given to darkest tones.

An 18-diameter enlargement of the lip of the Tongue (below) shows water depths from a few feet in purplish red to more than 30 feet in blue.



DONALD E. ROSE (LEFT AND ABOVE) FOR THE NAVAL OCEANOGRAPHIC OFFICE



KIDNAPING BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES E. RUSSELL © N.G.S.

Infrared detectors are nothing if not versatile. They can:

- Locate geothermal springs to tap for steam to run power generators. Italy, New Zealand, and the United States now produce electricity in this fashion, and other countries would like to find such subterranean natural power.
- Serve as a sort of divining rod for finding fresh water. On the island of Hawaii, airborne scientists trying to detect hidden lava rifts were startled to find areas of water along the coast 12° colder than their surroundings. The discovery—a happy one for the water-poor island—proved to be large springs of fresh water issuing into the sea. Since 5 percent of the world's water runoff is under the level of the ocean and goes to waste, such discoveries could help substantially to solve our ever-increasing water shortages.
- Show up, on the human body, a slightly warmer-than-normal region that may hide a malignancy.
- Monitor the thickness of hot metal in a rolling mill, holding it to a tolerance of .001 inch as it flashes by at 90 miles an hour.
- Expose the surreptitious night-time dumping of industrial wastes that pollute streams and raise their temperature.
- Identify pollutants from automobile ex-

hausts and chimneys that poison the air.

- Detect temperature differences in earth's atmosphere that may represent invisible clear-air turbulence, and—if the technique is perfected—warn pilots in time to take evasive action and thus avoid disaster.
- And photograph on runways the cool ghostly shadows of planes that have taken off as much as an hour earlier!

Detector Requires Intense Cold

These are all valuable uses. But from a scientist's standpoint, one of the most promising attributes of infrared is its ability to identify many things from afar—notably minerals and plants.

I saw how this can be done at the School of Earth Sciences at Stanford University in Palo Alto, California, where Professor Ronald J. P. Lyon, an Australian-born geophysicist, has developed an idea for "fingerprinting" the landscape. He uses an infrared spectrometer that measures the pattern of heat radiations peculiar to various kinds of rock.

On a warm morning last June, Professor Lyon and his associate, Dr. Roger S. Vickers, set up their instruments for me on the campus lawn. It took a bit of doing; the detector must be cooled in liquid helium to a temperature of

Warning of a stroke

A heat picture reveals an abnormally dark, or cool, area on the right side of the patient's forehead. The coolness, resulting from a blocked or narrowed carotid artery, often foreshadows a stroke.

TV for the moon

Though near darkness (left) shrouds the subject, a miniature television camera zeroes in, and a screen flashes a faithful, luminous image. Such black-magic defiance of normal photographic lighting becomes a reality with "low-light" TV, a creation of the Westinghouse Aerospace Division in Baltimore, Maryland.

Capable of capturing bold night images in the glimmer of a quarter moon, the camera converts weak light rays into photoelectron beams and amplifies them into a strong TV signal. Designed for use by astronauts on the moon, low-light TV will be able to record their explorations even during lunar nights, provided earthshine casts its glow.



TECHNOGRAM BY BARVCS ENGINEERING COMPANY

about 452° below zero Fahrenheit, or only 7° above absolute zero.

While we laid slabs of quartz, limestone, feldspar, basalt, and granite on the grass, Professor Lyon explained the process.

"When sunlight strikes these pieces of rock, they absorb most of the light and re-emit the energy in the form of infrared," he said. "A number of things affect the way the heat energy is emitted—the chemistry of each mineral, the particle sizes, and so on. So we get a different sort of reading from each mineral. Those readings in the form of a curve on a graph, or a series of digital bits in a computer, can be used as a sort of spectral fingerprint."

"We're going to measure the radiation from these samples between 6.5 and 12 microns, and the voltage curve will show how the radiation varies between those limits," he went on. (A micron, one millionth of a meter or $1/25,000$ of an inch, is the unit by which wavelengths of infrared are measured.)

By this time the instrument had cooled and was clicking merrily. It looked a bit like a white television camera on a heavy tripod, with a shiny cylinder projecting from the top. A thick electrical cable connected the detector with recording instruments in a nearby truck. There I watched a small green blip trace a

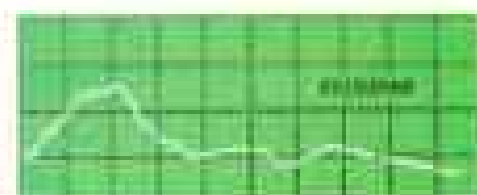
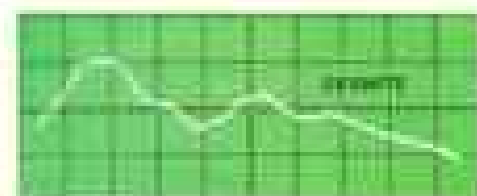
roller-coaster curve on an oscilloscope screen as the spectrometer was aimed at the first sample. This was the voltage curve to which Professor Lyon had referred.

"That's quartz we're looking at now," said Dr. Vickers. "It's Mother Lode quartz—the source of the gold found in California by the forty-niners."

The quartz curve on the screen looked like the profile of a mountain peak, falling off into a deep valley, rising again to a sizable foothill, and then tapering off gradually.

The second sample was granite. This time the valley between mountain peak and foothill was much shallower. And in the case of the third sample, potassium feldspar, there was neither valley nor prominent foothill—just a mountain peak falling steeply into a gently rolling plain.

Dr. Lyon explained that the curves, to be fully meaningful, have to be compared to a standard "black-body" curve. Nevertheless, I



© F.E.L.

could see substantial differences in the curves and could understand how they might be used as "signatures" or "fingerprints" to identify different minerals.

A hinged Polaroid camera could be swung in front of the screen to make a photographic record of each curve. But the significant record was being made by a tape recorder, which steadily locked the information on magnetic tape that could be put into a computer.

Back in his laboratory, Dr. Lyon showed me thick sheafs of computer-printed records, each page reproducing data and a curve for a single mineral or rock sample.

"A lot of people are still enamored of imagery—or pictures—for this sort of thing," he said. "They like to compare photographs. But that takes trained specialists, and we don't begin to have enough of them. In my view it's much better to get the information in the form of voltages, or numbers, that can be analyzed at great speed in the computer.

"By putting our detectors in airplanes, or eventually, someday, in a spacecraft, we could take readings of rock formations anywhere on earth, or even on the moon. The data are easily fed into the computer, which in no time can compare the findings with all the spectral signatures of minerals we have previously stored there. The computer will print out sheets like these, which will tell us the mineral make-up of the rocks our instruments have been looking at."

From a practical standpoint, Professor Lyon's work is of growing interest to oil companies and mining concerns, and it should be extremely useful in mapping the earth's geology. But NASA, too, is vitally concerned and has financed the research in the hope that someday this infrared technique will help analyze the composition of soils on the moon and the inner planets.

In the southernmost tip of Texas, at Weslaco, I caught a glimpse of the impact remote sensing is having on agriculture. There, in a palm-shaded laboratory, the U. S. Department of Agriculture carries on extensive experiments involving infrared.

Victor I. Myers, director of the project, showed me how an instrument known as a spectrophotometer could analyze leaves we had picked from nearby cotton plants by measuring infrared intensities in different parts of the spectrum.

Clamping a leaf securely in the instrument, Mr. Myers explained: "We're not concerned just now with the infrared wavelengths emitted from a plant; rather we're going to meas-



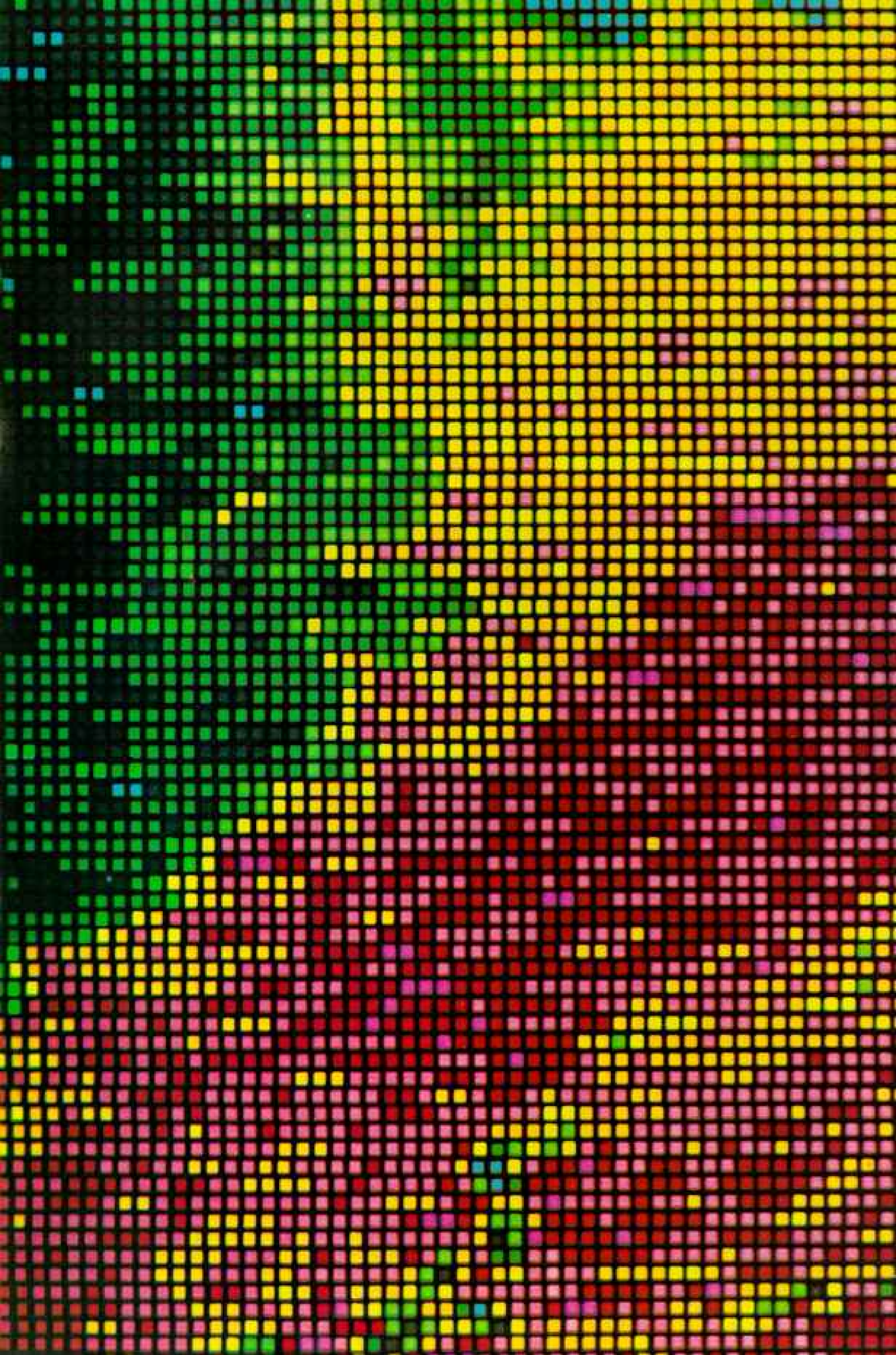
Thermal map

Veteran tanker captains, wise to the Gulf Stream's might, ride its five-knot current, thus saving as much as eight hours in a run from Miami to New York. Their problem: Where precisely does the meandering current flow? In an experimental IR tracking technique, a radiometer in Nimbus II, a NASA weather satellite, senses the sharp boundary between the 75° F. Gulf Stream and cooler waters. A computer calculates temperatures for five-mile-square areas, and an optical device converts them into a color-enhanced mosaic (right). It shows land as green, cool water as yellow, warmer ocean as red. Splotches south of the boundary are clouds, shown above in blue. Future satellites might read 200-foot squares and pick up subsurface temperatures from instrument-carrying buoys, thus yielding heat maps useful for navigation.

ure the amount of the sun's infrared that is transmitted through the leaves. The intensity of the transmitted infrared tells us whether the soil is too salty."

In the instrument a tungsten lamp substituted for the sun. Its light was split by a prism into different wavelengths, each in turn aimed at the leaf. The spectrophotometer measured the amount of light transmitted through the leaf at each wavelength. Simultaneously, a pen traced a red-ink curve on a long sheet of graph paper, showing the intensity of transmission in different wavelengths.

"This leaf is a healthy one," Mr. Myers





Wheat Wheat Wheat Wheat

Hoisted 70 feet above the ground by a crane, a scientist at Purdue University trains a spectrometer on bearded Indiana wheat. He records the cereal's spectral "signature," a pattern of radiation that helps identify each kind of plant. Collecting signatures of other crops,

as well as weeds, woods, bare soil, and water, he programs them into a computer for use in making aerial crop surveys. In a survey, an airborne scanner senses radiation along a flight line and feeds the information into the computer. Then the computer prints out a map showing precise crop distribution (left). In a typical sweep over Indiana's Tippecanoe County, wheat and soybeans dominate (right), amid patches of corn (C), alfalfa (A), oats (O), red clover (R), and rye (Y). With its swift scanning and computerized data processing, spectral sensing may enable the Department of Agriculture to make rapid crop-acreage surveys of wide areas.



CHERRY-PICKER (LEFT) AND EXTRACTOR (BY DAVID Z. COFF) © P.H.S.

explained, "from a field where the salinity is not too high. Now let's try a leaf from another field, where the salt content has risen."

This time the curve drawn by the instrument was noticeably lower. The reason: Salinity had affected the plant's physiology, making the leaves thicker and increasing the spaces between the cells. This in turn affected the way the plant transmitted IR.

The scientist pointed out that irrigation water holds far more mineral salts than does rain water, and tends to deposit these in the soil unless drainage is good. Some of the world's most flourishing irrigation projects, such as those in the ancient Tigris and Euphrates Valleys, died for this reason.

"Plain old table salt—sodium chloride—is one of the worst things we have to worry about," he said. "But if we can detect an increase in salinity in time, the farmer can improve his drainage, or spread gypsum on the soil to combine with the sodium so it can be leached away."

Crops Reveal Their Signatures

Mr. Myers explained further that laboratory studies like this determine "ground truth" by which information from aerial or spacecraft sensors can be evaluated. That is, by testing known plants under controlled conditions, the laboratory can build up a spectral-signature bank, or library, just as does Dr. Lyon with his minerals.

The next step is to confirm the laboratory findings in the fields, by aiming the instruments at growing crops from a 70-foot-high elevated platform known as a cherry picker (left). Signatures obtained in this way often refine or correct those from the laboratory.

Finally, instruments go up in aircraft. At Weslaco planes regularly cover 65 miles of flight line,

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carrying aerial cameras, thermal scanners, and other "black boxes." Thus they get records of infrared response of sorghum, cotton, and other crops at every stage until maturity.

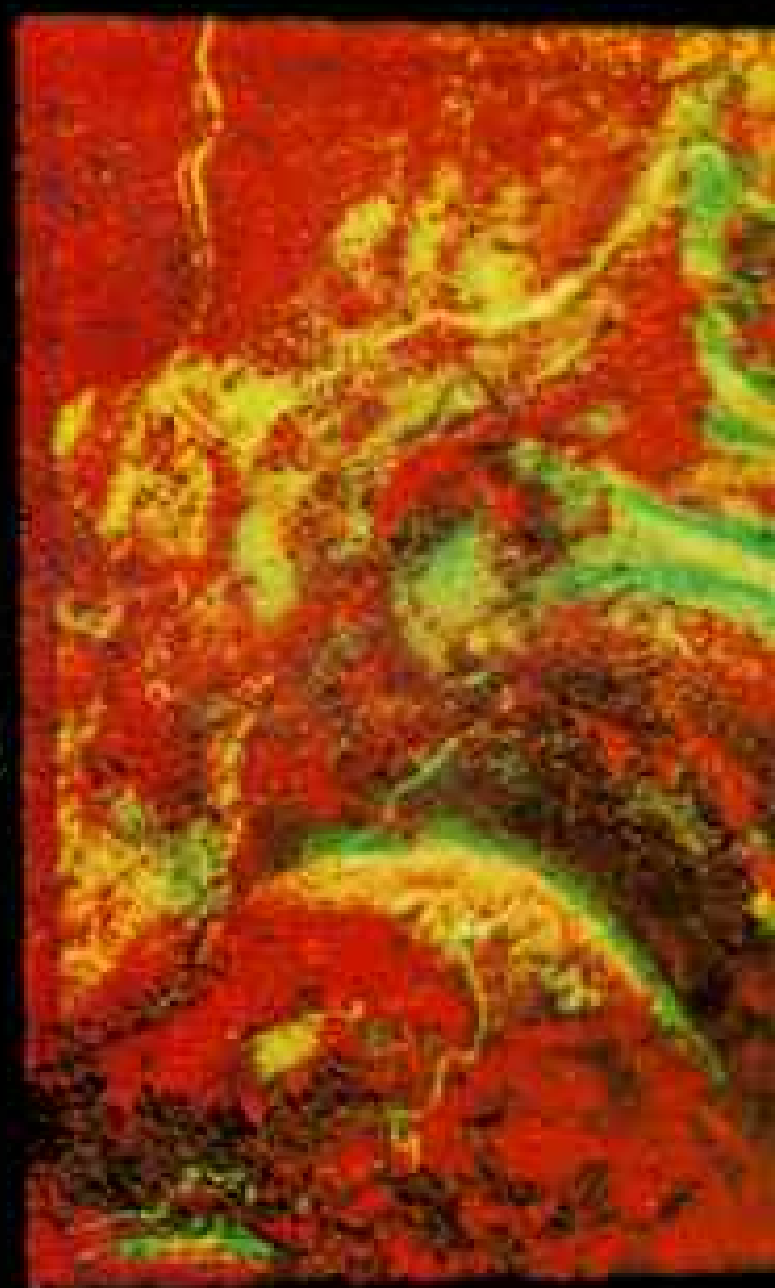
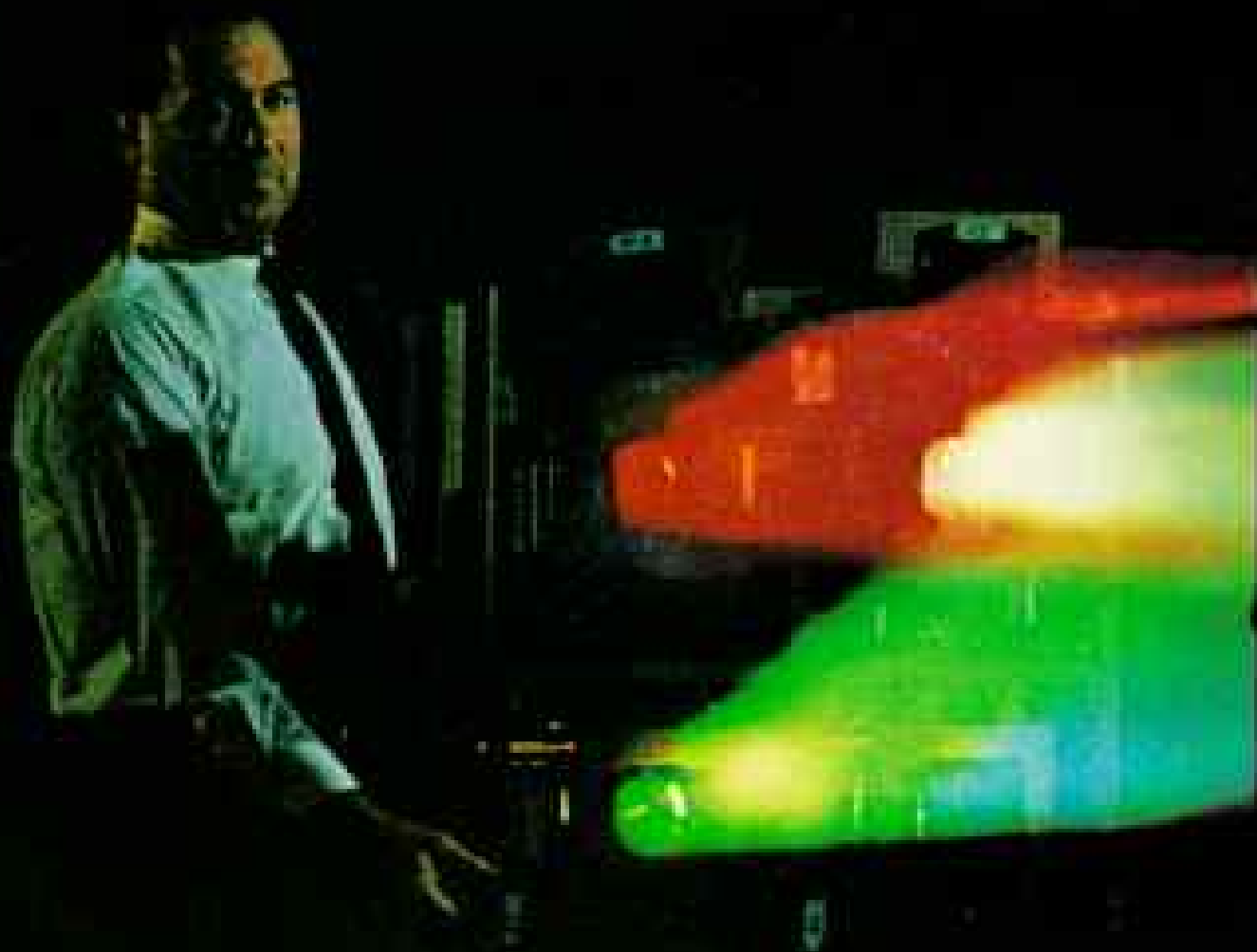
Infrared Warns of Blights

The fact that infrared photographs can spot diseased plants was demonstrated nearly 20 years ago by Dr. Robert N. Colwell, Professor of Forestry at the University of California at Berkeley. He was concerned at the time with black stem rust, a fungus that strikes both wheat and oats and that can wreak enormous damage. He showed that photographs on film sensitive to infrared would reveal the disease before it was apparent visually.

No one paid much attention to his prediction until recently. Now it is well established that wheat plants when only slightly infected will appear darker than healthy plants in an infrared photograph. This knowledge gives the farmer time to dust with sulphur to retard the effects of the disease until the grain has matured.

Dr. Colwell showed me infrared pictures of wheat fields where black stem rust had just started. There was no mistaking the normal plants; they appeared bright red, as healthy, well-watered vegetation always appears in infrared photographs; the diseased plants showed up as ugly dark blotches.

I saw the same thing in infrared photo-



PHOTOGRAPH BY JAMES E. RUSSELL AT FORESTRY WORKSHOP

False color Brilliant beams from four projectors paint an unreal scene: California's Silver Lake resembles an ink blot, forests glow red, granite outcrops appear green. Such a false-color picture, here seen in reverse from behind the screen, vividly highlights terrain for Professor Robert N. Colwell of the University of California at Berkeley. For the gaudy landscapes above and at right, he

uses color filters in projecting aerial photographs made by Professor Edward Vost of Long Island University with a four-lens multispectral camera; in other cases, Dr. Colwell takes simultaneous pictures with multiple cameras, each with a filter admitting a different wavelength of infrared or visible light. The composites contrast sharply with conventional photographs, such as the one at top right

graphs of citrus orchards damaged by brown scale, and potato patches suffering from late blight (page 50). Similarly, infrared can detect invasion of insects such as the southern pine beetle, which killed 40 percent of the pines in Honduras in 1963-64.

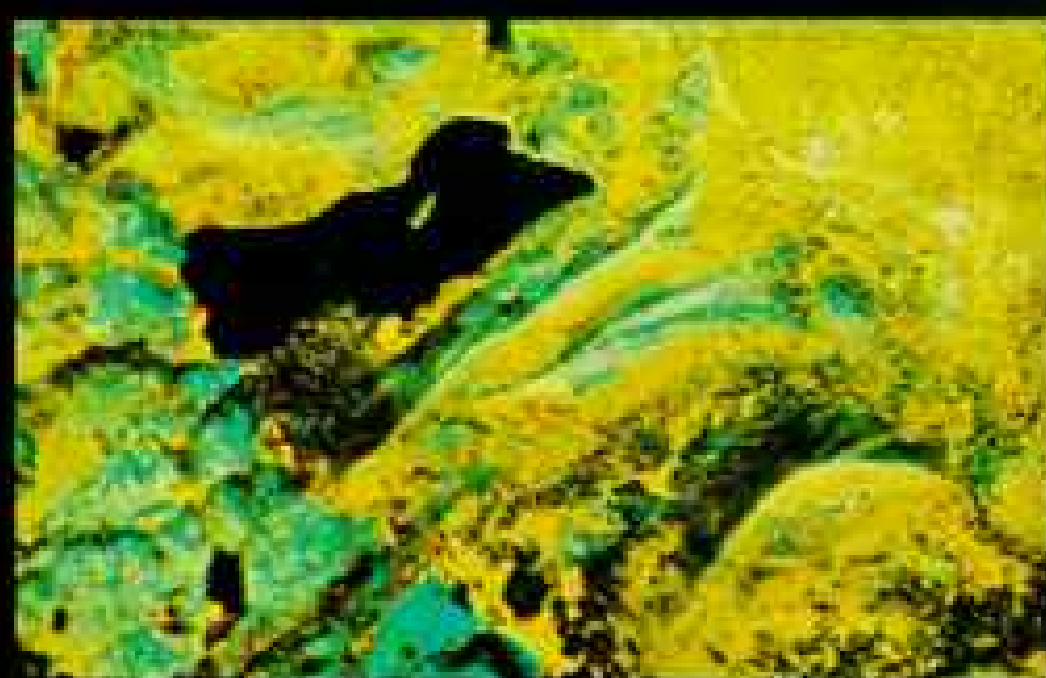
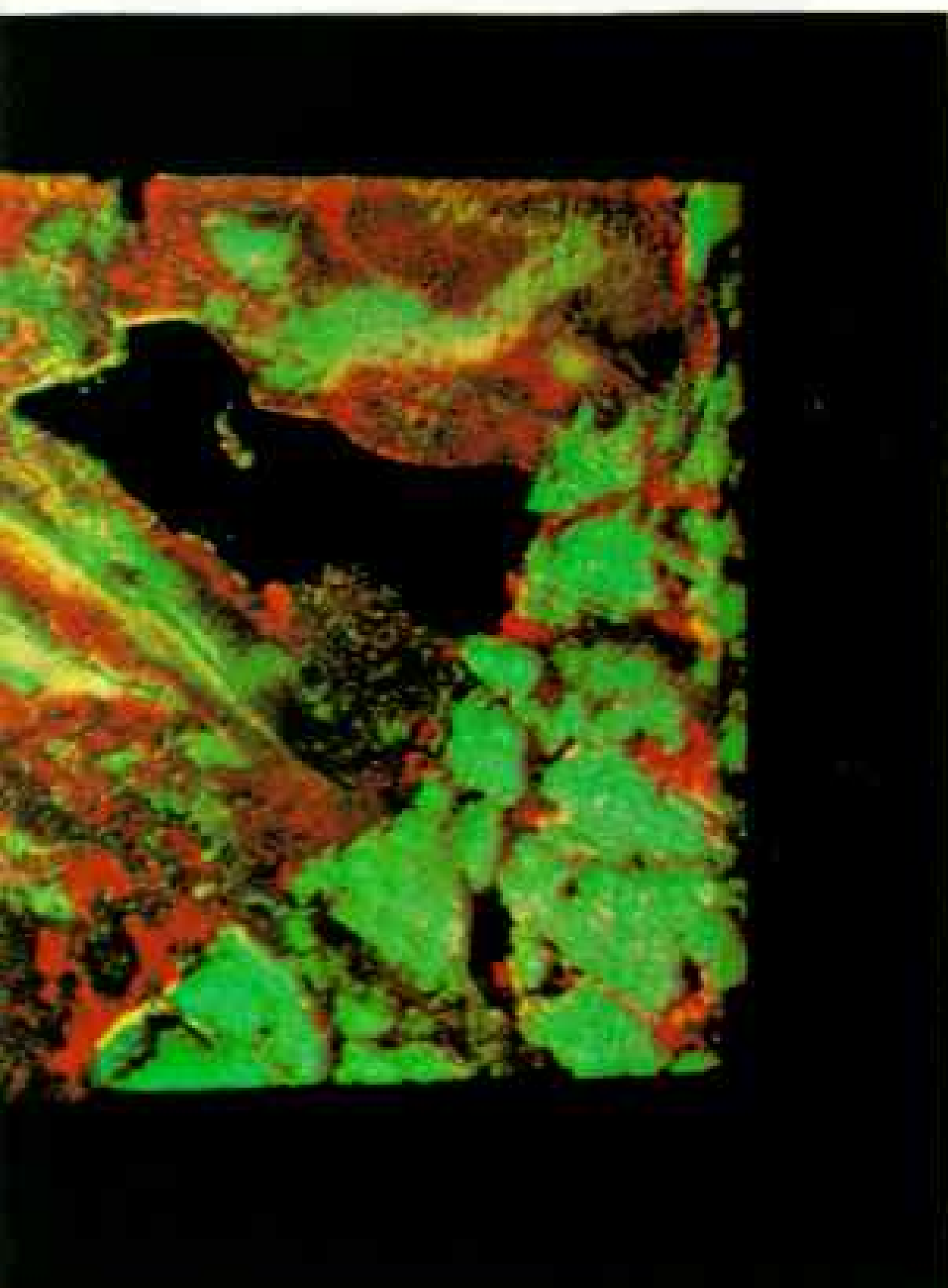
And Robert C. Heller of the Forest Service's Remote Sensing Project in Berkeley, California, told me of another infrared technique that may help to identify sick trees. These usually run from 5° to 15° F. warmer than healthy trees, and therefore register differently on infrared scanners.

Will these techniques work from orbit? Dr. Colwell is sure that they will, although they have not yet been tested in spacecraft.

No one can measure the economic implications of remote sensing for world agriculture. But it is estimated that fire, insects, and disease cause from 13 to 20 billion dollars of agricultural damage yearly in the United States alone; clearly, some of that toll can be saved by early detection and remedial measures.

And at a time when the global population explosion is adding more than a million new mouths to feed every week, while starvation threatens large parts of the world, any crop-saving measures have prime importance. Dr. Arch Park of the U. S. Department of Agriculture estimates that every dollar spent on remote sensing can yield \$5 in savings.

I asked Professor Colwell if infrared could



that obscures the lake shore but brings out roads and trails. In a two-color combination (middle), hardwoods appear yellow while groves of conifers form dark smudges. Rocks stand out in a red-blue composite (bottom). By using such false-color combinations, Dr. Colwell suggests, aerial surveyors could make comprehensive inventories of a region's crop, forest, and water resources.

identify plants in the way it picks out different minerals. He nodded. "Sometimes the infrared curves of wheat, oats, rye, and barley look almost alike. But there is a trick we can play. We can make photographs in several different wavelengths of both visible light and infrared simultaneously, using filters on a multispectral camera with several lenses, or with several cameras. Then we can superimpose those pictures, and the different crops often show up in different colors."

With still other techniques and the aid of a computer, scientists at Purdue's Laboratory for Agricultural Remote Sensing have made identifications with 95 percent accuracy (pages 60-61).

Taking me into his laboratory, Dr. Colwell showed me an optical combiner that he and his students have devised. It is an arrangement of four projectors, each with a wheel of different filters that can be positioned in front of the lens, and each aimed at the same screen.

Dr. Colwell put four images of Silver Lake, part of a test area in the northern Sierra, in the combiner and projected them simultaneously on the screen. As he substituted filters, trying first one, now another, pictures of striking but unrealistic colors flashed on the screen (preceding pages). In one, groves of hardwoods showed up in strong yellow, conifers in dark brown. In another, granite stood out clearly in comparison to other kinds of rock. In a third, roads and trails were heavily marked, although they had been almost invisible in many other combinations.

Almost any feature the researcher might want to study can be made to jump out of the screen with the right combination. Limitless possibilities offer themselves with such use of multispectral photography and projection.

Radio Waves Ferret Out Icebergs

Infrared, of course, is only one part of the electromagnetic spectrum. Other wavelengths, although not as adaptable or as well explored, may also be useful for remote sensing:

MICROWAVE These shorter wavelengths of the radio region (which account for the frying-egg sound one hears between stations while tuning a radio) radiate more from ice than from water. Oddly enough, therefore, ice shows up hotter than water in microwave receivers. The U. S. Coast Guard ice patrol takes advantage of this fact, and microwave detection devices have become highly efficient iceberg spotters along the shipping lanes of the North Atlantic.*

Microwaves can also map heavy rain-bearing clouds in weather studies, and soil-moisture and water-distribution patterns in hydrological and

*See "Tracking Danger With the Ice Patrol," by William S. Ellis, NATIONAL GEOGRAPHIC, June 1968.

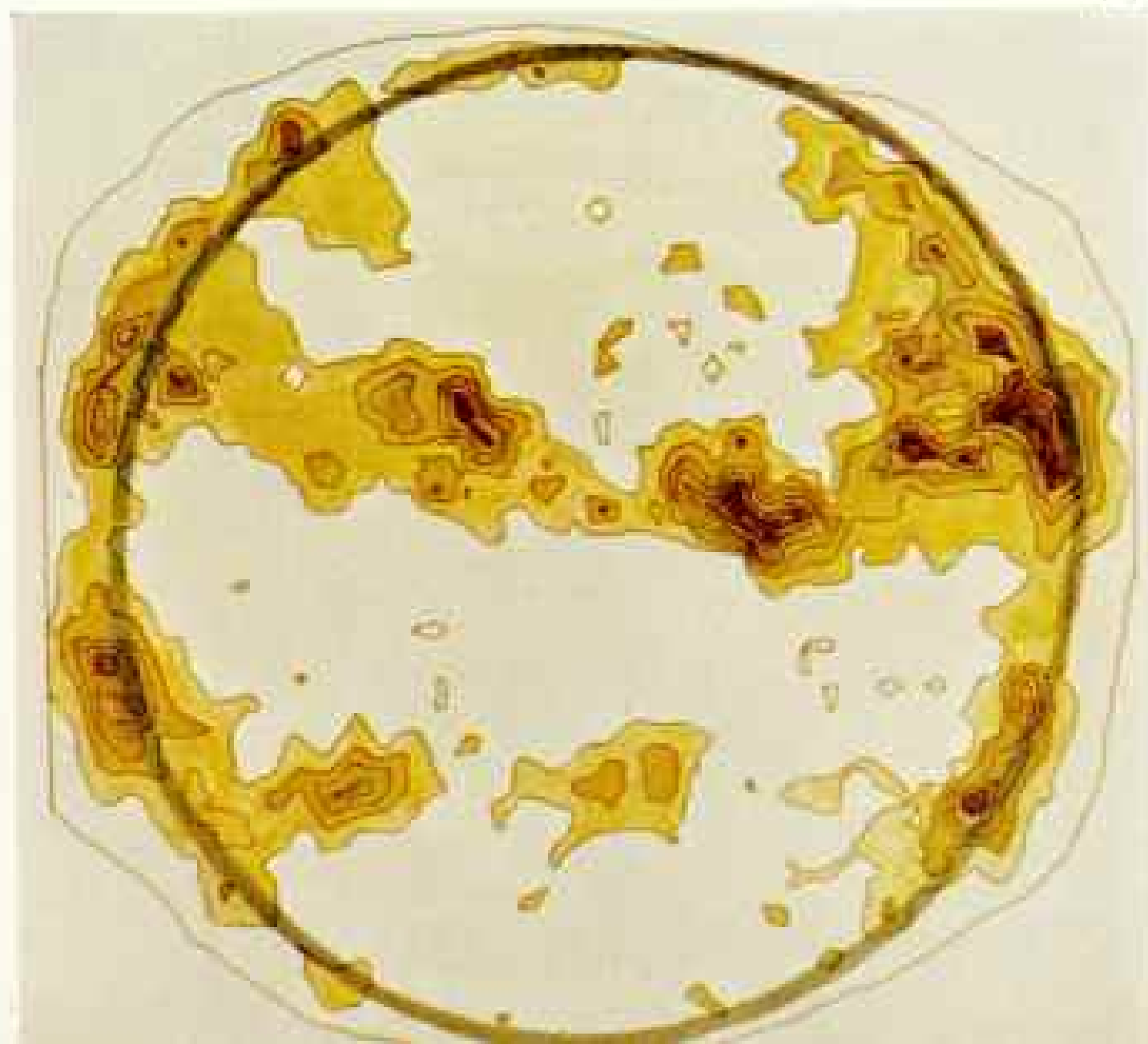
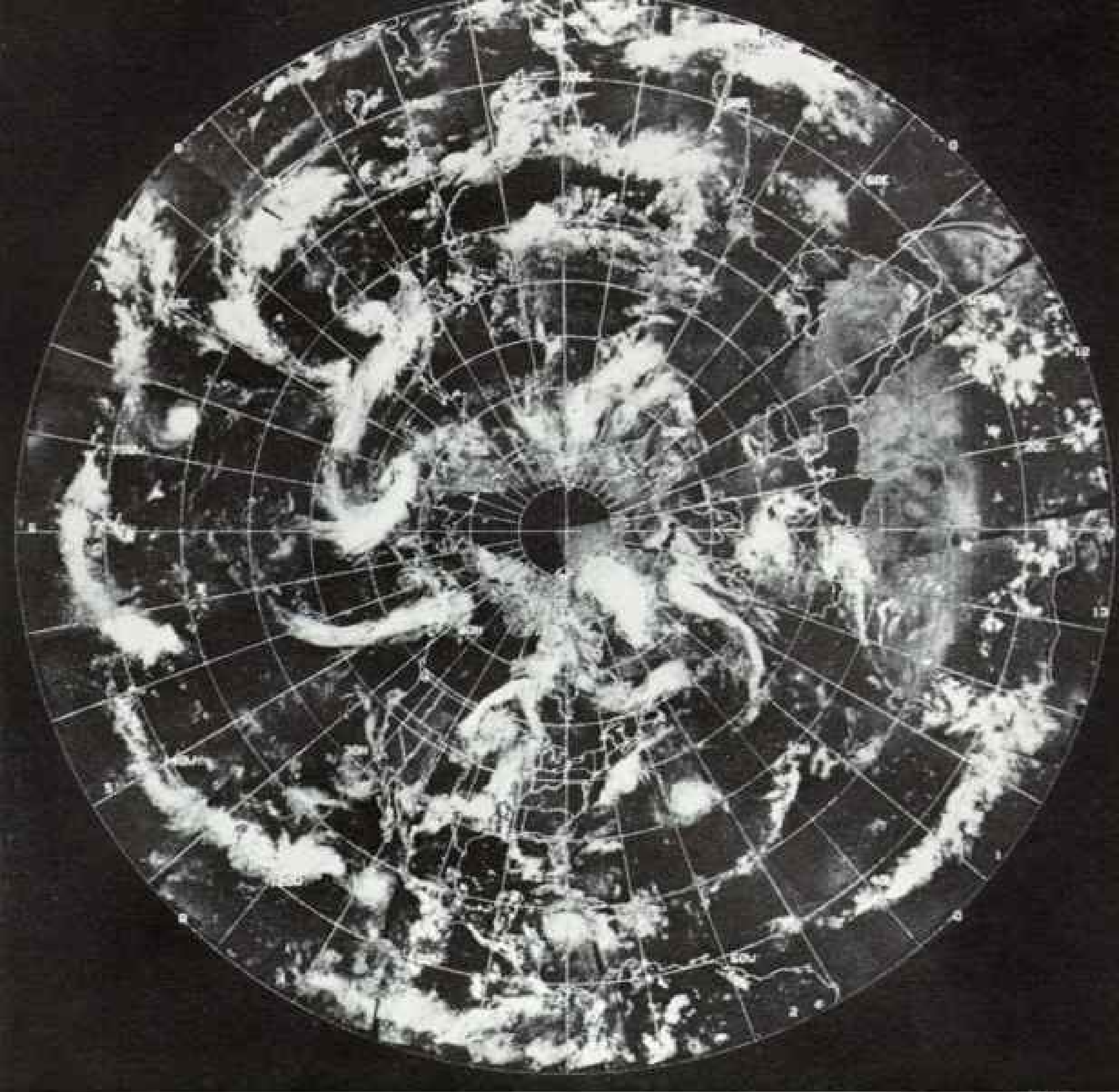
World weather

Innocent wisps on film, cloud masses thousands of miles long (right) swirl over the Northern Hemisphere. ESSA-V, a satellite sent aloft by the Environmental Science Services Administration, records the weather with a TV camera some 850 miles up. Here it reads atmospheric conditions for September 14, 1967: a cold front over the Midwest, bottom center, Hurricane Doria off New England, and Hurricane Beulah in the Caribbean. Digesting the satellite's output, a computer prints out a daily world-wide weather mosaic, a basic source for forecasting.



DETACHMENT BY DAVID F. LUFF © N.S.S.

Sure hands of a technician, seen through a magnifying glass, clean the delicate workings of IRIS, an Infrared Interferometer Spectrometer, at Texas Instruments Incorporated in Dallas. Designed for mounting in satellite or balloon, it will send back temperature soundings of earth's atmosphere to aid in weather analysis. Because the longer IRIS looks the more it sees, it is designed to stare at a single point for 10 seconds, then jump its eye ahead to the next target area.



Solar weather Fiery magnesium vapor incandescences as high as 100,000 miles above the sun's surface (left) in a map of solar turbulence compiled by OSO-IV, a NASA Orbiting Solar Observatory.

A spectrometer in the satellite measures ultraviolet radiation emitted by the gas, converts the information to numerical values, and transmits these to a computer, to be reconstructed as an ultraviolet map. Darkest areas indicate vapor clouds hotter than 2,700,000° F. Because our atmosphere absorbs most ultraviolet rays, earthbound instruments could not have detected the solar activity.

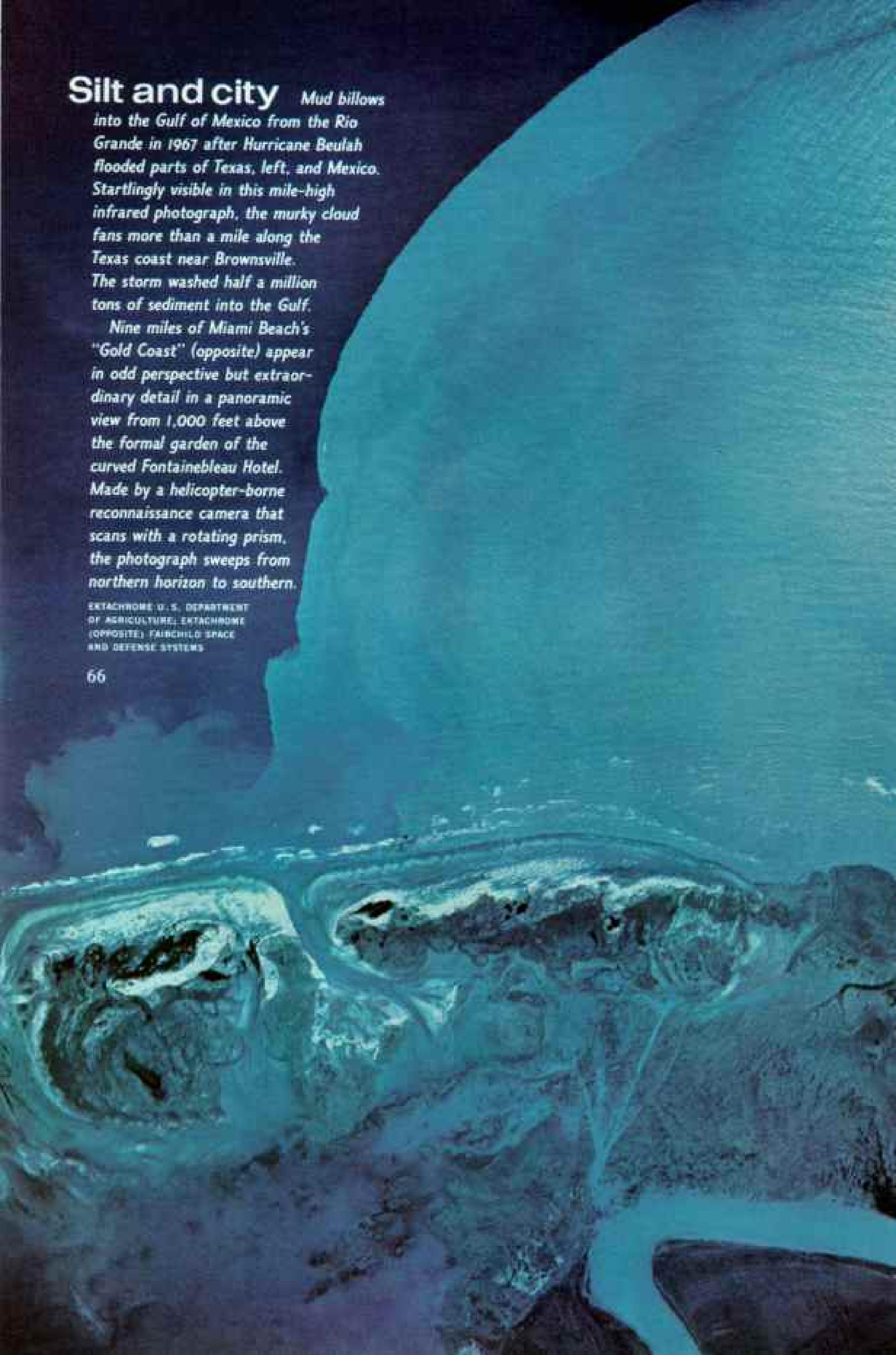
Silt and city

Mud billows into the Gulf of Mexico from the Rio Grande in 1967 after Hurricane Beulah flooded parts of Texas, left, and Mexico. Startlingly visible in this mile-high infrared photograph, the murky cloud fans more than a mile along the Texas coast near Brownsville.

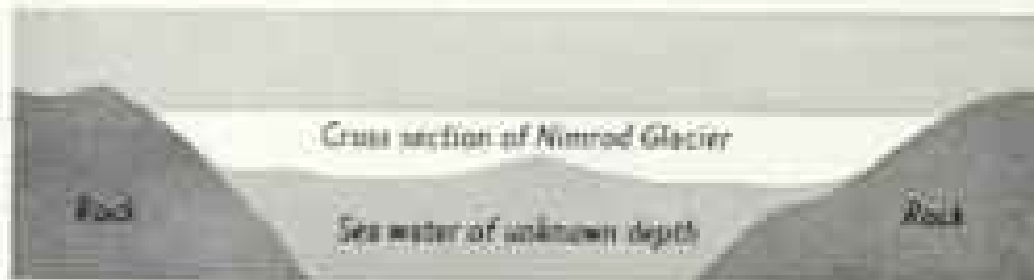
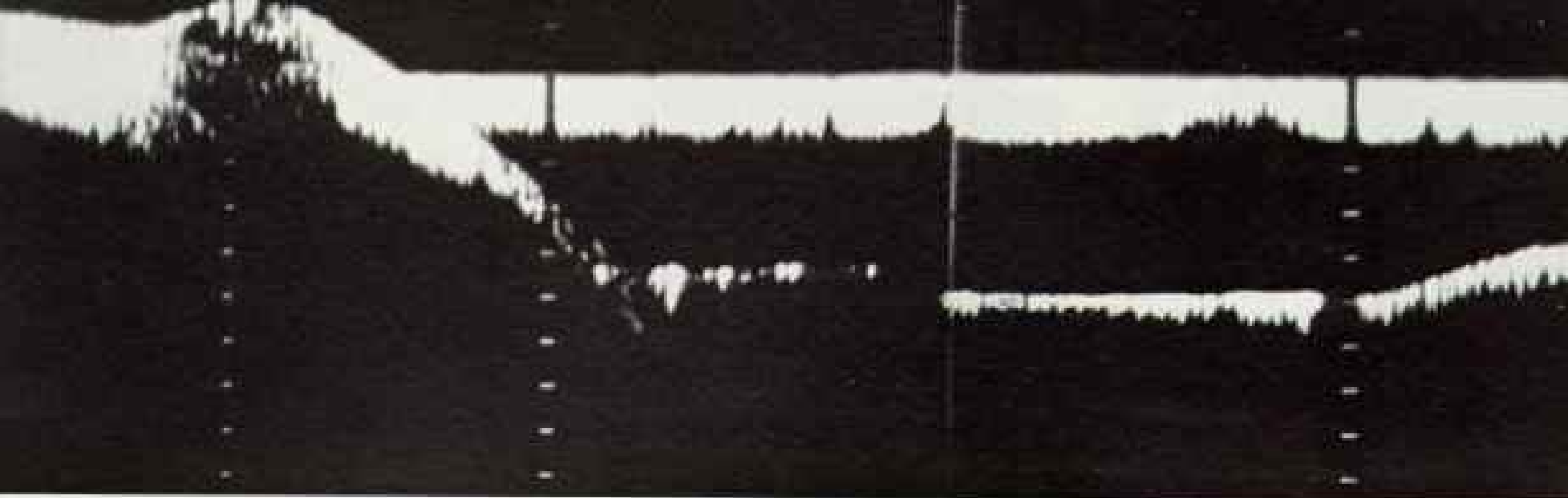
The storm washed half a million tons of sediment into the Gulf.

Nine miles of Miami Beach's "Gold Coast" (opposite) appear in odd perspective but extraordinary detail in a panoramic view from 1,000 feet above the formal garden of the curved Fontainebleau Hotel. Made by a helicopter-borne reconnaissance camera that scans with a rotating prism, the photograph sweeps from northern horizon to southern.

EXTACHROME U.S. DEPARTMENT OF AGRICULTURE; EXTACHROME (OPPOSITE) FAIRCHILD SPACE AND DEFENSE SYSTEMS







Ice... How deep are earth's great rivers of ice, the glaciers? To find out, glaciologists today sound by seismic echo or actually drill. Radio sounding from the air, still experimental, promises a far faster method. The oscillogram above

agricultural surveys. And by indicating atmospheric thermal inversions that lead to smog, they may become useful predictors of air-pollution emergencies.

GAMMA RAYS Radioactive varieties of uranium, potassium, and thorium in the earth's soil and rock characteristically give off these extremely high-frequency waves. Although the radiation levels are low—less than from a luminous watch dial—they can be measured by gamma-ray scintillometers, somewhat akin to ultra-sensitive Geiger counters. Such instruments, employed in planes flying several hundred feet above the ground, have become a major tool of the prospector in the current uranium boom in the western deserts of the United States.

A great deal of remote sensing can be done with techniques that do not involve electro-

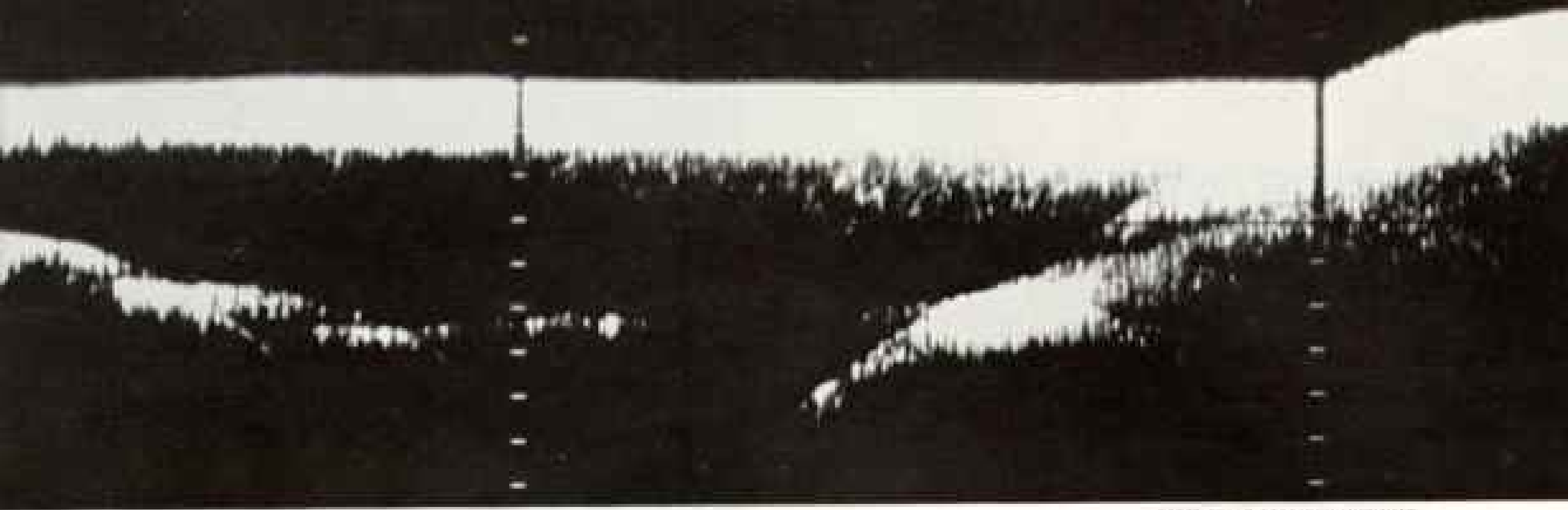
magnetic radiations at all. These include measurements of:

COSMIC RAYS Did an important Egyptian pharaoh, 4,500 years ago, build a secret chamber deep within his funeral pyramid to conceal treasure from grave robbers? Some students believe Chephren, son of famed Cheops, did just that in the Second Pyramid at Giza. Cosmic rays, those high-speed particles from space that constantly bombard earth's atmosphere, may provide the answer.

Dr. Luis W. Alvarez of the Lawrence Radiation Laboratory at Berkeley, California, who won the 1968 Nobel Prize in physics, has set up detectors in a chamber in the Second Pyramid to "X-ray" the massive 447-foot-high structure. His technique: to monitor the passage of muons, secondary particles created when cosmic rays collide with the atmosphere.

...and fire Like a brand searing earth's flank, a forest fire rages in a 25-mile swath across Sundance Mountain in Idaho. Defying an army of 2,260 fire fighters as it blackens 56,000 acres, the 1967 holocaust sweeps northeastward, right, driven by 60-mile-an-hour winds. Though hidden by blinding clouds of smoke, the conflagration revealed its advance to a mapper-plane equipped with Fire Scan, an





SCOTT POLAR RESEARCH INSTITUTE

traces a profile of Antarctica's Nimrod Glacier (diagram at left). British scientists from the Scott Polar Research Institute flew over the glacier in a U. S. Navy plane in late 1967, beaming down radio signals. The echoes, flashing on an oscilloscope and recorded by a slowly grinding camera, show both the flat surface and irregular bottom of the ice—the upper edges of the two white bands. Riding on sea and rock, the great glacier reaches a thickness of 3,000 feet.

If there is an unknown chamber, muons traversing it on their way through the pyramid will lose less energy than if they passed entirely through tons of limestone. The existence—or absence—of the secret room can thus be confirmed, Dr. Alvarez believes, by computer analysis of many months of muon counts.

This somewhat bizarre example of remote sensing, if it succeeds, may produce one of the great discoveries of archeology—an unrifled tomb of a major king of ancient Egypt, one far more important than Tutankhamun.

MAGNETISM Magnetometers have long been in use for hunting submarines and for ore and petroleum exploration.*

GRAVITY One gravity meter, used for finding salt domes where petroleum may be plentiful, is made entirely of quartz, including

its spring; it is so sensitive that its readings change when it is lifted from floor to table.

EARTH VIBRATIONS Seismometers, detecting some 10,000 earth tremors a day, help geologists improve prediction methods.

SOUND Mark Twain's riverboat captains used to blast their whistles in the dark and fog and listen for the echoes to locate bluffs. Sonar has for years employed essentially the same technique under water, sending out pulsed sound waves and recording echoes from the bottom or from objects in the water.

Sonar signals sent vertically can penetrate not only water but dozens of feet of mud before bouncing back. Thus they can even locate buried shipwrecks or submerged cities. Sonar was used in the search for both the

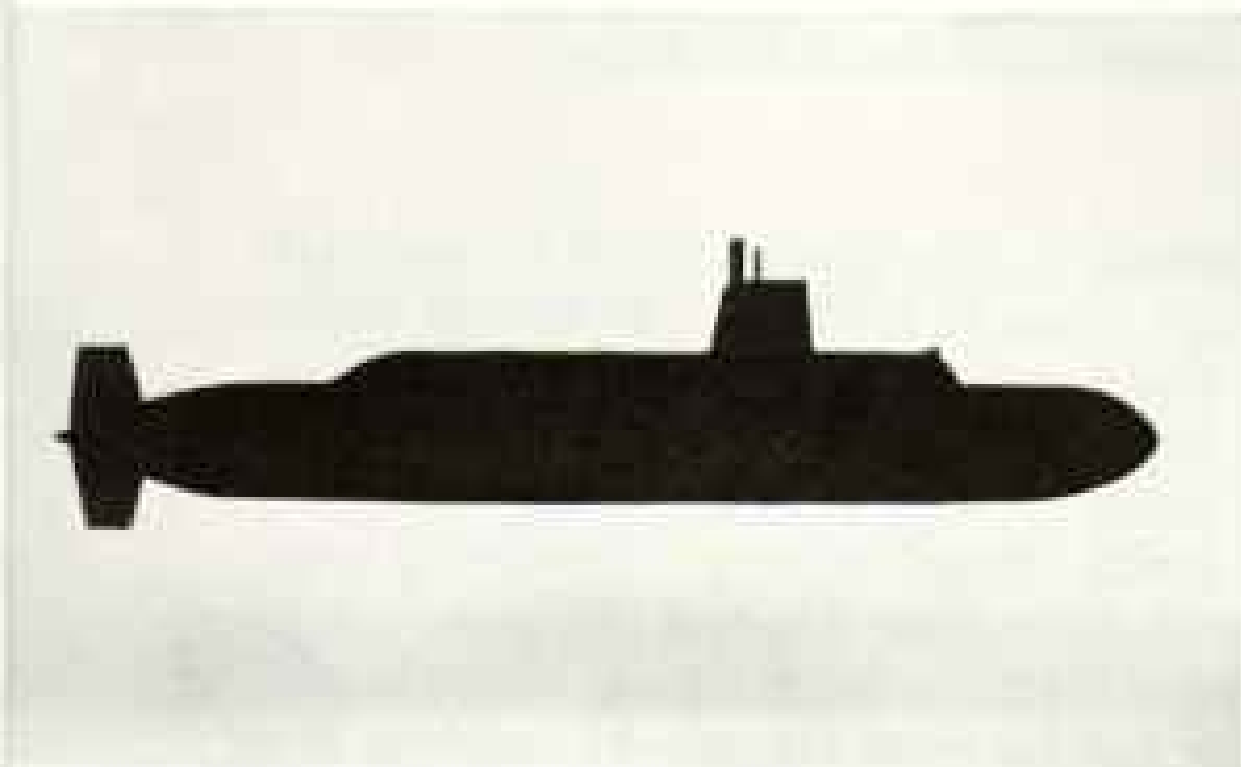
*See "The Canadian North, Emerging Giant," by David S. Boyer, NATIONAL GEOGRAPHIC, July 1968.

infrared sensor developed by U. S. Forest Service scientists. The device registers hot spots on a screen for instant recording on Polaroid film. On the mosaic second from left, a forest road is plotted for fire fighters. Use of IR for fire mapping and detection has saved an estimated \$13,000,000 in timber since 1965, and another \$1,300,000 in fire-fighting cost.



Seeing with sound

Sonar echoes from a target reveal distance and bearing, but not the object's features—a short-coming that may be solved by experiments at Douglas Advanced Research Laboratories in Huntington Beach, California. Using a six-foot submarine model as their target (top), scientists bombard it with sound waves. As the waves break around the sub, a scanning microphone sends the sound pattern to an oscilloscope to be recorded on Polaroid film (center). A laser's intense light, projected through the film negative called a sonoptogram, yields a remarkable three-dimensional view (bottom).

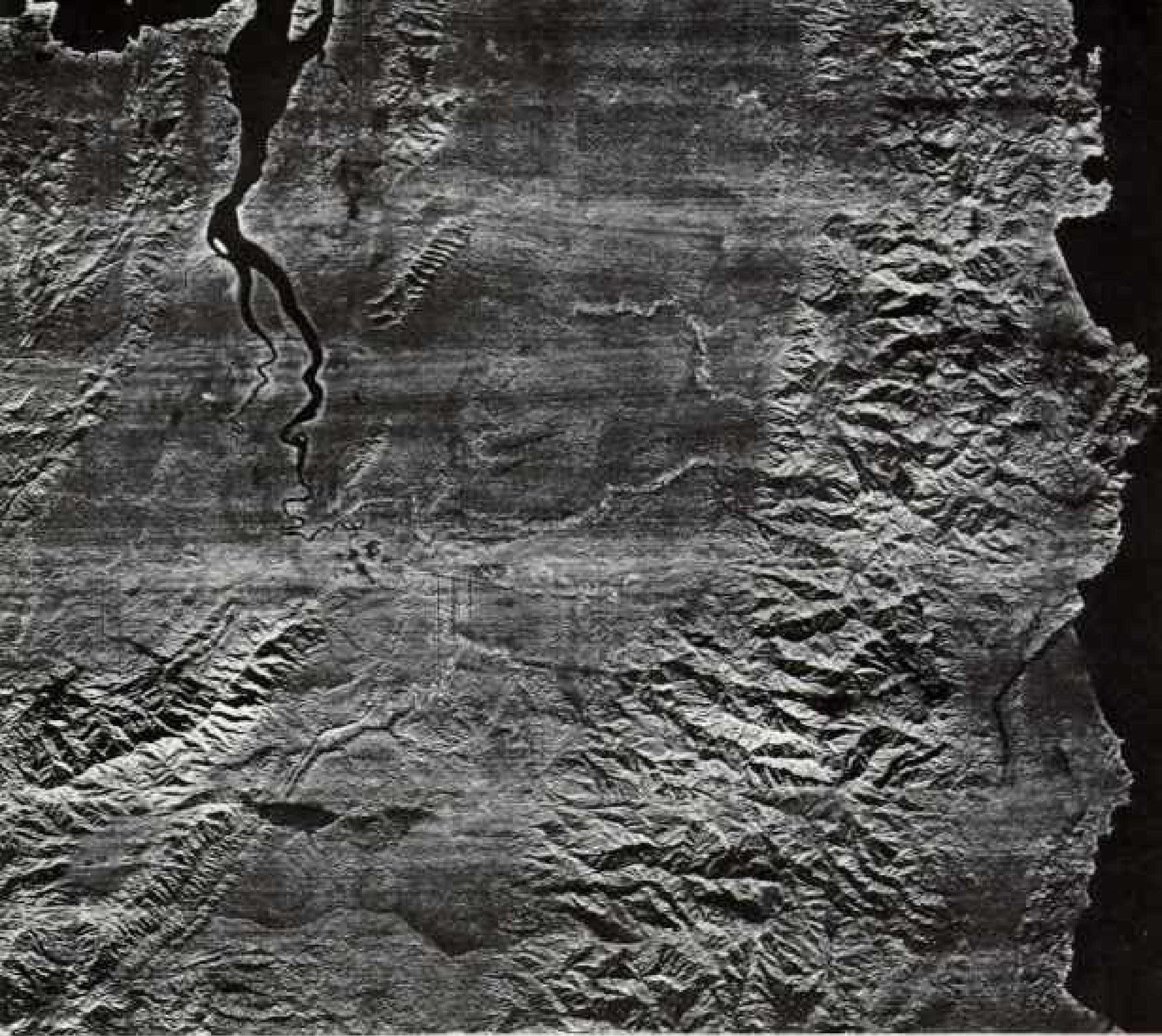


Side-looking radar

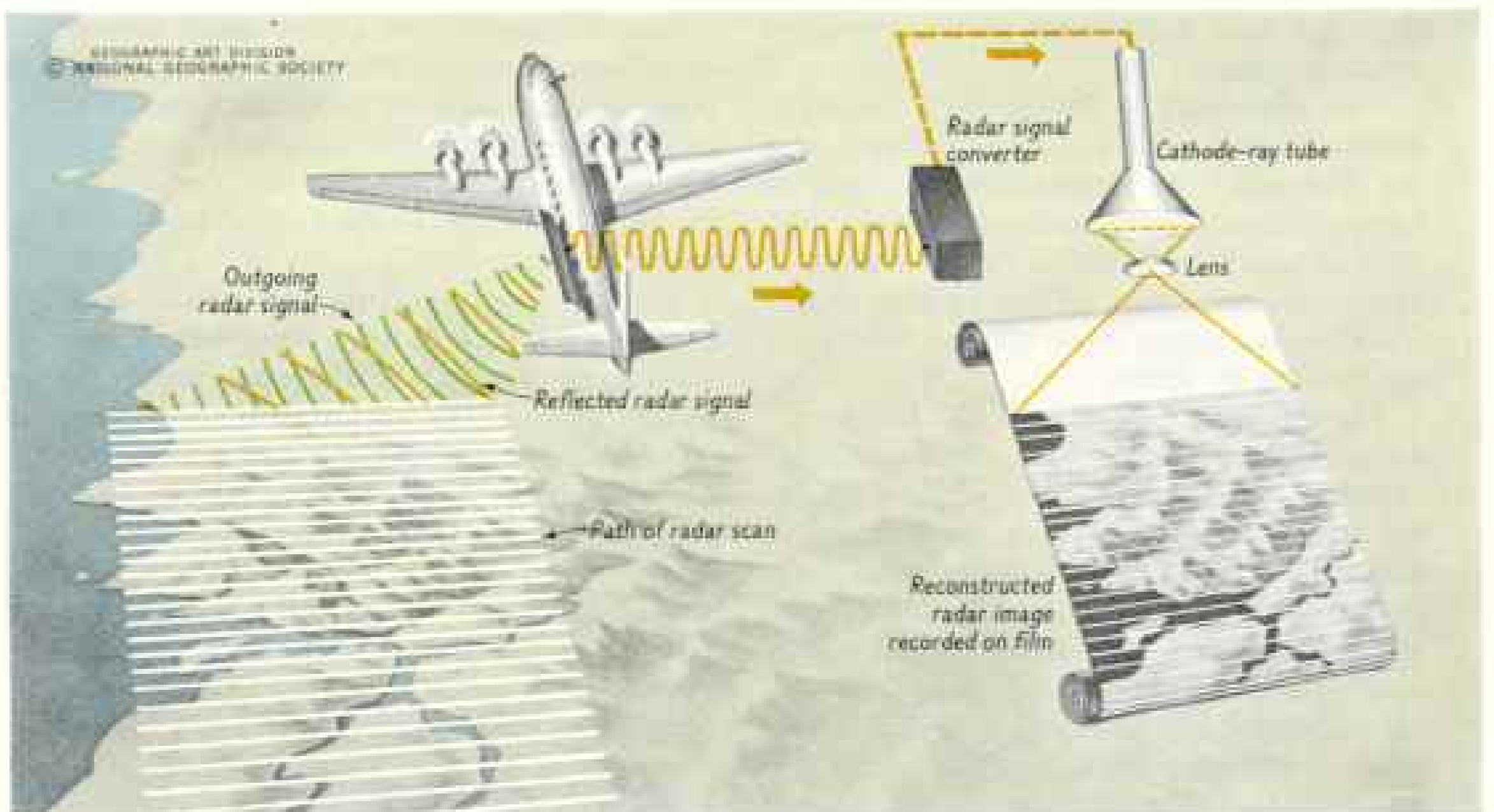
Veiled by clouds, southeastern Panama and northwestern Colombia defied aerial map makers for 20 years. Then U. S. Army Engineers and Westinghouse tried radar mapping by plane. In eight ocean-to-ocean passes at 20,000 feet, the side-looking radar created a mosaic (above) that changed earlier ground surveys. It revealed that the broad Rio Tuira, upper center, meanders in unsuspected turns, and that Isla Mangle, near its fork, lies farther upriver than formerly charted. Unmapped mountains rise northeast of the Tuira—vital data for future extension of the Pan American Highway.

To depict landscape in such detail, side-looking radar scans in overlapping strips (right). A converter changes returning echoes into electron beams, which flash a line at a time across a cathode-ray tube. A camera records each line on moving film to build up the final image.

With its capacity for all-weather mapping, side-looking radar looms as a likely technique for charting the seven million square miles of earth normally hidden under dense cloud cover.



U. S. ARMY CORPS OF ENGINEERS (ABOVE) AND DOUGLAS AIRCRAFT COMPANY





Parting the shadows All but invisible in a screen of maples and flowering goldenrod, two men stand in the shadows 75 feet away. But an infrared thermograph strips off their covering. In 30 seconds the instrument takes 10,000 heat measurements from the brush and converts them into a color picture that eerily exposes

sunken nuclear submarine *Thresher* and the lost hydrogen bomb off Palomares, Spain.

Two recent underwater archeological expeditions supported by the National Geographic Society, through its Committee for Research and Exploration, have employed sonar techniques.

One, organized by Dr. George F. Bass, Associate Professor of Classical Archeology at the University of Pennsylvania, sought to locate presumably Roman or Greek shipwrecks which had yielded bronze statues to sponge-draggers' nets off the Turkish coast.* Two sunken ships were spotted for future exploration by divers.

The other, led by Dr. Philip K. Lundeberg and Alan B. Albright of the Smithsonian Institution, searched in Lake Champlain off Schuyler Island, New York, for remains of Benedict Arnold's fleet. A penetration sonar device developed by Dr. Harold E. Edgerton at the Massachusetts Institute of Technology was towed behind the search boat. Its sound waves located two submerged objects which, when divers reach them, may prove to be two Revolutionary War gondolas, the *Providence*

and the *New York*, that helped frustrate the British advance in 1776.

Can sensing instruments that work such wonders on the ground or in aircraft do even better in orbit about the earth?

Not all scientists or Government officials agree, and some are critical of the rosier aspects of plans announced in the past two or three years for earth resources satellites. Moreover such plans have been forcibly delayed by sharp cuts in the Federal budget for space programs.

Yet the evidence is strong that at least some of the sensing techniques offer tremendous advantages at altitudes where one can see the forest instead of the trees. And the truth may be reflected in the comment of a Lockheed engineer, Louis A. Riedinger, that "we overestimate the near future and underestimate the far future." If that indeed be true, orbital sensing has a definite, and expanding, future.

There is little debate about weather observations from space. They can save builders, farmers, and property owners 2½ billion

*See "New Tools for Undersea Archeology," by George F. Bass, NATIONAL GEOGRAPHIC, September 1968.



THEODORE LARVEL AND LEXACORNE BY BARNES ENGINEERING COMPANY

the figures. Faces and sleeveless arms glow hottest, together with a strip of paved surface, foreground. Even clearer images come at night, when cooling foliage heightens temperature contrasts. Valuable for military reconnaissance, the thermograph also holds promise for industrial uses, such as detecting heat loss from blast furnaces and buildings.

dollars a year, the National Academy of Sciences estimates.

Similarly, few would doubt the advantages of space photography for small-scale mapping. Even the relatively coarse pictures taken by the astronauts using hand-held cameras showed how out-of-date and inaccurate most maps are. To make an aerial-photography map of the United States would require three years and 1,500,000 photographs. A satellite could do the same job in three weeks with only 400 photographs; the cost would be \$750,000, as against \$12,000,000 for aerial pictures.

Eyes in Space Expand Man's World

But in the long view of things, the value of observations from space will perhaps be most significant in monitoring earth's resources and environment.

"In our lifetimes, people will use more natural resources than man has used in all previous history," says William A. Fischer, research coordinator of the earth-orbiter program for the U. S. Geological Survey. This unprecedented demand from expanding populations will come at precisely the time when

resources are dwindling all over the world.

As Dr. Peter C. Badgley, who for several years headed NASA's remote-sensing program, says, "Photographs and other evidence from space will help us find fish; locate oil, minerals, and water; reduce disease in crops and forests; and predict crop yields on a world basis for better famine prevention."

And scrutiny of the earth day by day, from planes and ships and perhaps ultimately from spacecraft, with the advantages of great height and swift passage, will help detect the relentless spread of pollution; mark the silting of harbors, estuaries, and dams and the erosion of valuable land; measure the runoff from snow fields and glaciers for better flood control and water use; and monitor the mounting problems of traffic congestion and urban sprawl in the beehive megalopolises of the world.

Perhaps it is not too much to say, as did Dr. George J. Zissis of the University of Michigan at the Fifth Symposium on Remote Sensing of Environment at Ann Arbor last April:

"We have no planet to call home except the earth. At stake is the survival of mankind."

THE END

Oregon's Many Faces

By STUART E. JONES

Photographs by BATES LITTLEHALES

Both National Geographic Staff

BEFORE I WENT TO OREGON, I asked a native to describe his state. After a few moments of brow-wrinkling thought he asked, "Which Oregon?"

"I can tell you how it is to live in Portland," he went on, "or to weekend on the coast, or to ski in the Cascades, or to catch steelhead in the Rogue or the Deschutes, or to listen to coyotes howling in the desert. I could quote that newspaper columnist, writing about Oregon politics, who called the state a kind of suburb.

"But, really now, how do you put a label on an area of almost 100,000 square miles that embraces such a tremendous variety of climate, scenery, and vegetation? To say nothing of the people—an extremely mixed bag with a unifying love for independence of thought, people who would reject the very idea of wearing a label.

"Go and make your tour," he said, "and when you come back, see if you can give me that all-encompassing description."

State Offers a Kaleidoscope of Contrasts

Off I went. From Portland I covered some 4,000 miles, mostly by car, but also in airplanes and boats and on foot. At the end I was no closer than my friend to an accurate summing up of Oregon.

But I could see what he meant. Pleasant weeks of looking upon Oregon's many faces left me with memories of busy harbors, lively resorts, and scenic marvels along the cool, misty Pacific Coast, the rockbound edge of the continent. Driving among snow-capped mountains where the air tasted like a dry white wine, I passed through green forest corridors where whole families of deer created traffic hazards as they trotted across roads.

In the sun-scorched southeastern desert I traveled through lonely, rugged wastelands where the early settlers had faced their sternest tests, and where many met defeat.

In lush valleys and on high plateaus I saw the tidy farms, orchards, wheat fields, and beef and dairy ranches that make Oregon

Chasing the foaming Pacific surf, riders approach Haystack Rock on Cannon Beach. Along Oregon's 400-mile coast, hikers, rock hounds, clam diggers, surf-fishers, and an occasional hardy swimmer can pursue their pleasure. Inland, timbered mountains, swift rivers, fertile valleys, and deserts satisfy the varied tastes of Oregonians.







an important supplier of the country's larder.

Everywhere I encountered signs of Oregon's dominant industry—lumber. On the roads trucks thundered out of the forest with giant logs bound for sawmills, pulp-paper plants, and plywood factories. On the rivers more logs, chained together in vast rafts, were shepherded along by tugs (pages 92-3).

Astoria: City of Fur and Finns

At seaports like Portland, Astoria, and Coos Bay, still more logs were being loaded aboard ships to help ease the housing shortage in booming Japan. This trans-Pacific trade, I learned, helps some and hurts others. Japan is buying so much—at such inflated prices—that many of Oregon's smaller

sawmills are having trouble getting timber.

The Pacific washes what many regard as Oregon's most beguiling face—400 miles of shoreline from the Columbia River southward to California (map, page 87).

I began my tour of the coast at Astoria, Oregon's oldest city, founded in 1811 by John Jacob Astor's fur traders. Near the Columbia's mouth, where the Lewis and Clark Expedition crossed at the end of a transcontinental journey of discovery,* a high, curving toll bridge carries highway traffic to Washington State and the north.

Along Astoria's waterfront and business streets, frequent signs offered the services of sauna establishments, evidence of the city's large Finnish-American population. Finns—



Fair as the cherished blooms of Portland, Christine Bertrand strolls amid Queen Elizabeth roses and a sprinkling of gloriosa daisies in the city's International Rose Test Garden. Here at the famous garden in Washington Park, hundreds of varieties are tested, judged, and displayed. Each June the "City of Roses" honors its flowers with a festival and show.

Portland, proud of 7,200 acres of parkland, preserves landscaped city blocks as breathing spaces and protects Douglas fir trees that stood when explorers Lewis and Clark camped nearby in 1806.

Snow-capped companion of a city, Mount Hood—50 miles to the east—provides Portlanders with a cooling view on a clear day. Here a telephoto lens brings it closer. The dormant volcano, at 11,235 feet Oregon's highest peak, signaled journey's end for pioneers trekking west on the Oregon Trail.

From the first cluster of log cabins, Portland has sprawled into Oregon's largest city. Astride the Willamette River, foreground, near its confluence with the Columbia, the city serves as crossroads for farmers, wheat shippers, lumbermen, and merchants.

Most of the city's 386,000 residents live on the east side, here stretching beyond a new high-rise apartment building and double-decker freeway toward the majestic mountain.

together with Swedes, Danes, and Norwegians—settled here by the hundreds. They man the fishing vessels, work in the salmon, tuna, and crab canneries, and own many businesses.

To the south, along the shore, mountains of the Coast Range come right down to the sea.† Motorists follow U.S. 101 uphill, downhill, and around bold promontories, each commanding a spectacular seascape that often includes a pod of spouting whales.

This is the tourist's Oregon, and drivers on 101 might as well resign themselves, as I did, to creeping along in an endless file of trailers and camper-pickup rigs. I saw license plates from at least 20 states; California's outnumbered even Oregon's.

One Saturday night I arrived without a

reservation at a large beach-front motel near Newport and asked for a room. The clerk seemed amused. "Sorry," he said. "We're full."

"Why don't you light your 'No Vacancy' sign?" I asked.

"On weekends," he replied, "we take it for granted that everybody knows we're sold out."

This was the usual story along the coastal strip—a long, winding avenue of motels, pizza parlors, salt-water-taffy stands, and rock-bound shops that too often hid the seashore's natural beauties. But I found welcome oases at many tasteful and well-planned private

†See "Following the Trail of Lewis and Clark," by Ralph Gray, NATIONAL GEOGRAPHIC, June 1953.

†See "Oregon's Sidewalk on the Sea," by Paul A. Zahl, GEOGRAPHIC, November 1961.





developments and at frequent public parks.

Outstanding was the state's Short Sand Beach, near Seaside. I reached it by parking just off 101 and walking a trail through a cool, dark forest. It proved to be a surfers' haven. Some youths rode their boards in rubber wetsuits, while others braved the frigid water without protection. Their girl friends watched from beside driftwood fires.

"City of Roses," Oregon's Second Capital

There is a lot more to Oregon, though, than salmon, sand, surf, and sightseers. More than three-quarters of a million of the state's two million residents make their homes in and around bustling Portland. After days of wandering the coast, I paused for a closer acquaintance with the "City of Roses," also called the "Gray Lady of the Willamette" for its oftentimes lowering skies.

Many of its people live atop the beautiful

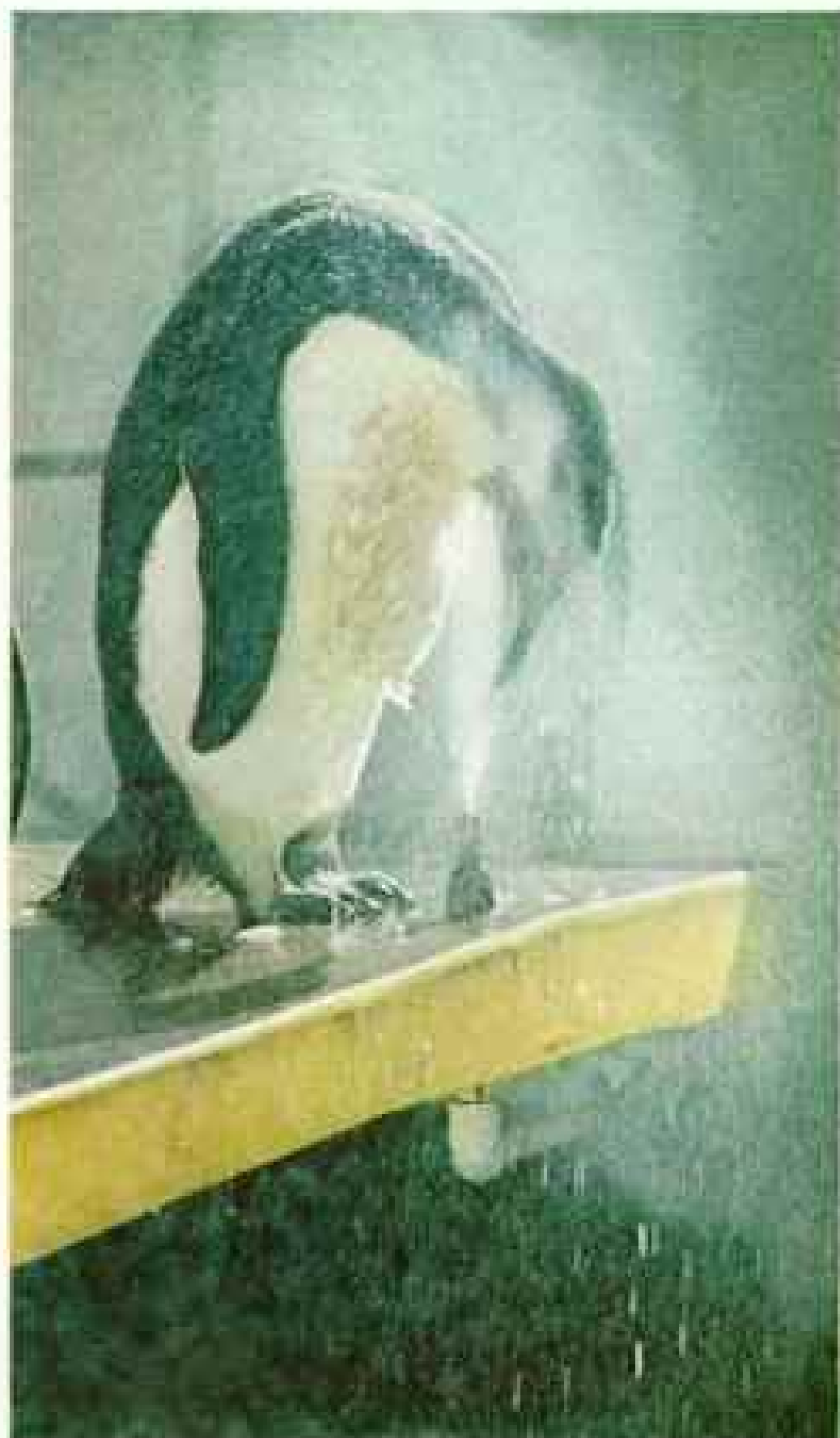
West Hills, with majestic views stretching to the Cascade Range to the east and the Coast Range to the west. Abundant rain (they don't call Oregonians "webfeet" for nothing) helps account for Portland's profusion of flowers.

In many ways Portland impressed me as the real capital of Oregon, although the legislature meets and the governor has his office in Salem, 45 miles to the south. The state has many administrative offices in Portland, and so does Uncle Sam, since more than half of Oregon is Federal property, mainly in national forests and grazing lands.

In Portland, the West Coast's second seaport after Los Angeles, one finds the big banks and law firms, the exporters and importers involved in heavy trade with the Far East. And such giant lumber firms as Weyerhaeuser, Crown Zellerbach, Georgia-Pacific, Boise Cascade, and many smaller ones.

Nobody expects to see lumber deposed as

Keeping his cool: Can a former resident of Antarctica find happiness in the temperate Pacific Northwest climate at the Portland Zoological Gardens? Yes, thanks to sprays of chilled water. This emperor penguin is one of three in the popular outdoor exhibit.



Lumberman's legacy: Timber magnate Simon Benson endowed Portland half a century ago with 20 bronze four-place fountains in hope of slaking the thirst of his hard-drinking loggers. Here a dapper doorman of the Hotel Benson stops for a sip.



Oregon's industrial king in the near future, but in Portland and elsewhere I heard Governor Tom McCall and other leaders speak of the need to get away from an all-eggs-in-one-basket economy.

"We've already diversified to a considerable extent," Governor McCall told me (page 89). "The list of new products is too long to recite, but I could mention light metals, freeze-dried foods, and women's sports clothes.

"Now the big push is in making electronic parts for the television, computer, space, and aviation industries. Plants are sprouting around Portland and in other parts of the state."

The Portland area's largest single-site employer is Tektronix, Inc., an electronics firm. Near suburban Beaverton, I watched some of its 6,400 employees assembling oscilloscopes, the delicate instruments that make electric impulses visible. One of the firm's customers is Boeing in Seattle, now hard at work building jumbo jets and designing the Nation's first supersonic transport.

As I toured the brightly lighted plant, I noticed that eight out of ten of these workers were women. Howard Vollum, head of Tektronix, commented: "We've found women have the patience and temperament—and the skill—to perform many complex tasks, and not just in assembly. You'll find women also in our technical and research areas."

Portlanders speak with pride of many other local products used throughout the world—among them Jantzen bathing suits (page 94).

As for the city's personality, it had been described to me as "very conservative—you might almost say prim." After observing it a



Sentinel to seafarers since 1894, Heceta Head Light flashes from the rocky, wave-washed coast near Florence. Its million-candlepower beam can be seen 26 miles at sea. Rugged point and lonely lighthouse bear the name of Spanish explorer Bruno Heceta, who in 1775 was the first white man to see the Columbia River mouth.

while, I decided that this special character springs from a strong New England heritage. Most early settlers came from the Midwest and the South, but many came from New England, too. And the sturdy, frugal Yankees seem to have left the deepest imprint.

Consider some Oregon place names: Portland, Salem, Medford, Newport—all of New England origin. In each of them I saw dozens of homes whose architecture would not be out

of place on Cape Cod or in a Boston suburb.

Portland, of course, was named for the Maine metropolis. It could just as easily have been called Boston. The question was decided by the toss of a coin in 1845, 14 years before Oregon became a state. The winner was Francis W. Pettygrove, a merchant from Calais, Maine, who had brought his wares around Cape Horn to Oregon country, and the loser was Asa L. Lovejoy, a Bostonian who had helped lay out the original 16-block townsite.

This strong tie with New England was made clear to me one day when I dropped into a Portland bookshop and noticed a small commotion centering about a stately gray-haired lady seated at a table. Dorothy Lawson McCall was busily signing copies of her book, *Ranch Under the Rimrock*.

Having heard much about Mrs. McCall, I looked forward to meeting her. Oregonians seemed to count her among the state's natural resources, like forests and rivers. Mention of her name would bring responses something like this: "Oh, the 'mothah of the govnah.'" Then, admiringly, "Did you hear about the time she called up President Johnson?"

From Beacon Hill to Crooked River

Dorothy McCall came to Oregon in 1911 as the bride of young Hal McCall, who left Harvard with an overpowering urge to live in the wide-open West. She was the daughter of Thomas W. Lawson, known in Wall Street as the "Copper King." Her husband's father, Samuel W. McCall, was a Congressman and later Governor of Massachusetts.

As Mrs. McCall says, it was a long jump from sedate teas on Beacon Hill, delicacies from S. S. Pierce, and Friday afternoons at Symphony Hall to 640 rattlesnake-infested acres near Prineville in central Oregon.

But it was good irrigable land, with the Crooked River winding through it. Here Hal McCall built a fine dairy herd, while his wife raised three sons and two daughters. Life centered around Westernwold, a magnificent mansion that was a wedding present from the Copper King. The house was modeled after Dreamwold, the Lawson summer place at Egypt, Massachusetts. At Westernwold the

McCall children had their own band, published their own newspaper, and staged plays in their own puppet theater.

For the birth of each of her five children, Mrs. McCall insisted upon returning to Dreamwold. That is how Oregon happens to have a Massachusetts-born governor—Thomas Lawson McCall, a six-foot-five-inch former newsman and television commentator.

Call to Cheer Up the President

I bought a copy of Mrs. McCall's book and asked her to autograph it. Then I asked about her telephone call to the President of the United States.

"Well," she said, "I was reading the newspapers one rainy day in my apartment in Portland, where I spend the winter months. I am a loyal Republican, of course, but it seemed to me that Lyndon Johnson was having more than a reasonable share of problems and that he was being unfairly abused. I decided he needed cheering up.

"So I picked up the telephone and asked long distance to put me through to President Johnson. I could detect some uncertainty at the White House end of the line as to whether I should be permitted to talk with the President. I kept telling people I was the mothah of the govnah.

"Finally, Mr. Johnson came on the line, and we had a nice talk. I told him I thought he was doing an excellent job. He thanked me and later wrote me a very gracious note."

A few days later I had a talk with Governor McCall, and he added an epilogue.

"I was taking a swim at the Y.M.C.A. in Salem when I was called to the telephone," he said. "Someone at the White House wanted to know if I had a mother who might want to talk to the President, and I said yes, I did.

"A week or so later the President had occasion to write me about another matter, and he added a postscript: 'I had a delightful talk with your mother the other day. Please ask her to call me again.'

"Knowing Mother," said the Governor, "I wouldn't be surprised if she did just that."

Fifty miles east of Portland rises Mount

(Continued on page 89)

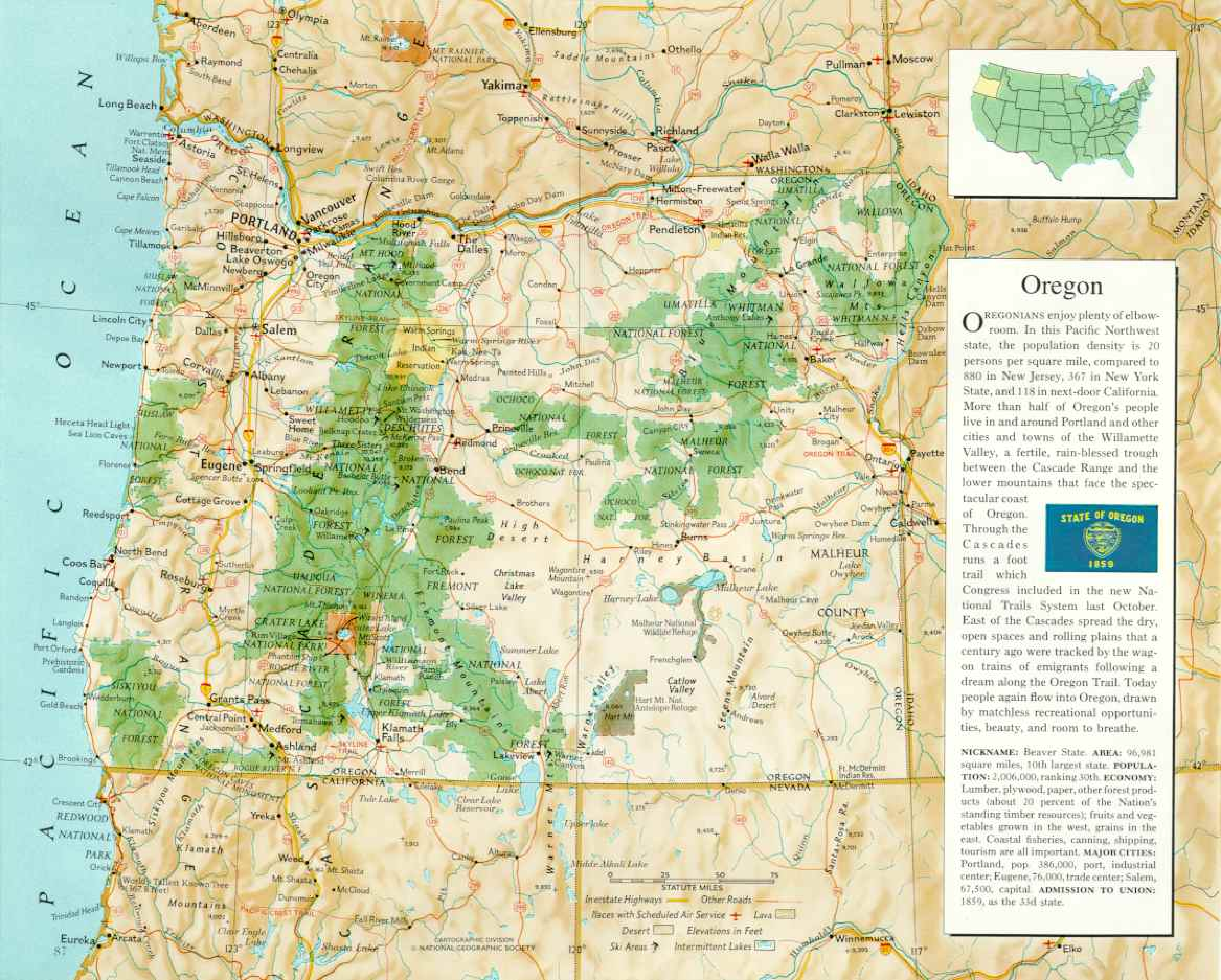
Bonanza of the Columbia River. 25-pound chinook salmon ride the "butchering line" at Oregon's largest fish cannery, the Bumble Bee Seafoods plant in Astoria. To help prevent overfishing, the state limits salmon netting to the lower 200 miles of the Columbia; last year commercial fishermen landed more than two million salmon. Astoria, the state's major fishing center, was Oregon's first settlement, established in 1811 by John Jacob Astor's fur company.







GRAND FINALE for novice mountaineers: an ascent of snow-mantled Mount Hood. Trained by Mazamas, members of a Portland climbing club, the class toils up a hogback on the southern route to the summit, some 700 feet above. To assure time for a safe return, the fully equipped climbers left their 6,000-foot-high starting point at Timberline Lodge at 1 a.m. Thus they could make the eight-hour ascent, rest briefly, and descend before the sun softened the snow near the top enough to make the footing dangerous.



Oregon

OREGONIANS enjoy plenty of elbow-room. In this Pacific Northwest state, the population density is 20 persons per square mile, compared to 880 in New Jersey, 367 in New York State, and 118 in next-door California. More than half of Oregon's people live in and around Portland and other cities and towns of the Willamette Valley, a fertile, rain-blessed trough between the Cascade Range and the lower mountains that face the spectacular coast of Oregon.



Through the Cascades runs a foot trail which Congress included in the new National Trails System last October. East of the Cascades spread the dry, open spaces and rolling plains that a century ago were tracked by the wagon trains of emigrants following a dream along the Oregon Trail. Today people again flow into Oregon, drawn by matchless recreational opportunities, beauty, and room to breathe.

NICKNAME: Beaver State. **AREA:** 96,981 square miles, 10th largest state. **POPULATION:** 2,006,000, ranking 30th. **ECONOMY:** Lumber, plywood, paper, other forest products (about 20 percent of the Nation's standing timber resources); fruits and vegetables grown in the west, grains in the east. Coastal fisheries, canning, shipping, tourism are all important. **MAJOR CITIES:** Portland, pop. 386,000, port, industrial center; Eugene, 76,000, trade center; Salem, 67,500, capital. **ADMISSION TO UNION:** 1859, as the 33d state.

0 25 50 75
STATUTE MILES

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 Races with Scheduled Air Service + Lava □
 Desert □ Elevations in Feet
 Ski Areas ↗ Intermittent Lakes □

CARTOGRAPHIC DIVISION
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(Continued from page 82)

Hood, the 11,235-foot king of Oregon peaks. Portlanders speak of it proudly as "our mountain," and as a daily ritual they look across the Willamette Valley in the hope of seeing it (pages 78-9 and foldout, pages 84-6).

Some days they're lucky, but often the mountain hides behind clouds that pile up against the Cascade Range. This barrier creates more than frustration for the would-be sightseer: it produces two distinct weather zones for Oregon: mild and moist west of the Cascades; to the east, warmer in summer, colder in winter, and drier in both.

Mountainside Hotel Owned by Uncle Sam

One day when the clouds were in and the view was out, I sat in the big-windowed dining room of Timberline Lodge, on Mount Hood's flank, looking out at swirling mists and listening to Richard L. Kohnstamm as he discussed the joys and problems of running a resort hotel halfway up the mountain.

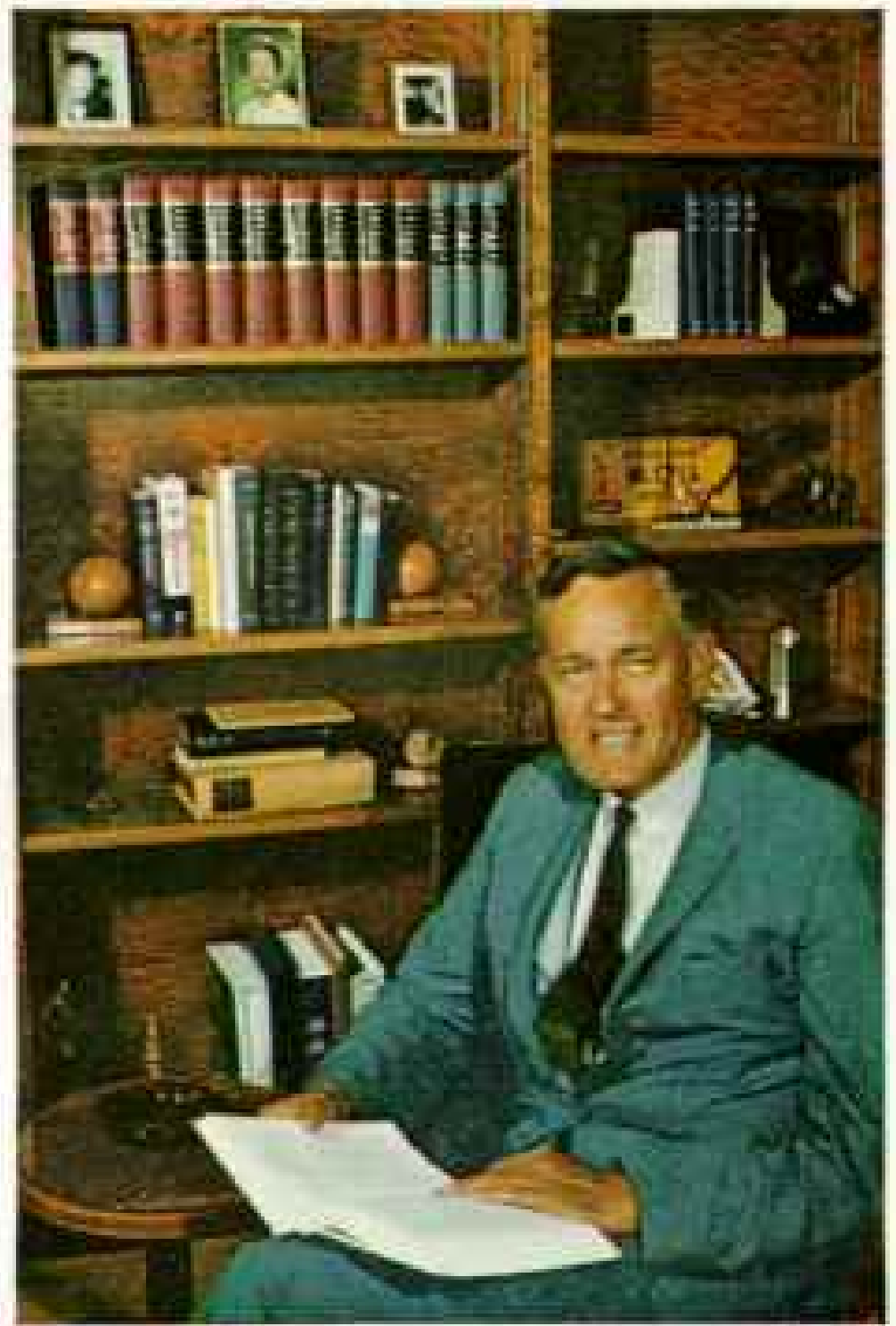
The great hotel, a classic of wooden construction, was built during the late 1930's as a project of the Works Progress Administration. Oregon ponderosa-pine logs were shaped into pillars and beams for the hexagonal main lobby. Stairway newel posts, made from old telephone poles, were carved with sleeping foxes, bears, and otters. Railroad tracks were turned into andirons for six immense fireplaces opening off the 92-foot-high stone chimney. Scraps from discarded Civilian Conservation Corps uniforms were made into hooked rugs.

"Running Timberline Lodge is like running an exclusive restaurant in the Lincoln Memorial in Washington, D. C.," Mr. Kohnstamm said.

Since the 63-room lodge lies in Mount Hood National Forest, it belongs to the United States Forest Service. A succession of early concessionaires tried in vain to operate it at a profit. Dick Kohnstamm, a New Yorker who had chosen social work over a job in his family's chemical company and moved to Portland in 1953, became interested in the lodge as a weekend skier there. He outbid 150 others to win the lease.

"I took the bull by the horns, and I'm still holding on," Dick told me. "The first year I would call possibly the most expensive hotel-management course in history. But we're in the black now, and we're going to make it."

"Skiers keep us going," Dick went on, "but we need more people to enjoy the nearby fishing and hiking and the swimming in our heated pool. One trouble is that we're so close to



PHOTOGRAPHS BY BATES LITTLEHALES © N.S.A.

At home with Western traditions, Massachusetts-born Governor McCall signs himself Tom rather than Thomas. He grew up in central Oregon, where his father cleared ranchland to raise crops and a large dairy herd. In 1966 the former news analyst, a Republican, won his four-year term with the largest vote ever given an Oregon governor. Warm-hued Oregon myrtle panels his office in the State Capitol in Salem (below). The marble building, topped by a statue of an ax-wielding pioneer, was completed in 1939.



Portland. Portlanders tend to bring visitors out here for a quick walk-through, a modest lunch in the cafeteria, the purchase of a few postcards; then away they go again.

"About a million people walk through this building each year, and they spend about 75 cents per person. That's not enough to keep the place clean.

"But," he repeated, "we're making it, thanks to the skiers and also to loyal regulars and the

organizations and corporations that find Timberline a good place to hold conventions and staff meetings."

Several trips south from Portland into the Willamette Valley took me to quiet, pleasant cities like Salem, Albany, Corvallis, and Eugene, all busy turning out forest products and marketing the produce of lush farms.

The enterprising city of Albany, now boasting a population of about 17,000 and growing



COLLETT/REX USA; AND FOTOFEST/REX USA

Bristly young braves wear porcupine headdresses and beaded buckskin to dance at the Warm Springs Indian Reservation near Bend. Here some 2,000 Indians of various Northwest tribes have developed flourishing Kah-Nee-Ta Vacation Resort, offering hot mineral baths, swimming, riding, and fishing in year-round sunshine. The tribesmen also operate ranches and a sawmill to finish logs felled on their 875-square-mile reserve.

Children like Elmo Johnson, left, and Wiggie Sooksoit attend public schools in Warm Springs and nearby Madras, in keeping with Oregon's policy of integrating Indian children into the state school system.

Hoofs pounding, dust churning, a stagecoach thunders around a turn during a race at the Pendleton Round-Up. Horsemen from throughout the West compete for cash in broncbusting, steer-wrestling, and bull-riding events at the four-day September jamboree. Some 40,000 spectators enjoy the rodeo, chuck-wagon dinners, and Indian pageant. The Round-Up revives early days of Pendleton, a roistering cow town in the 1870's. Now the city of 14,300 hums with lumber, woolen, and flour mills, and canning and freezing plants.



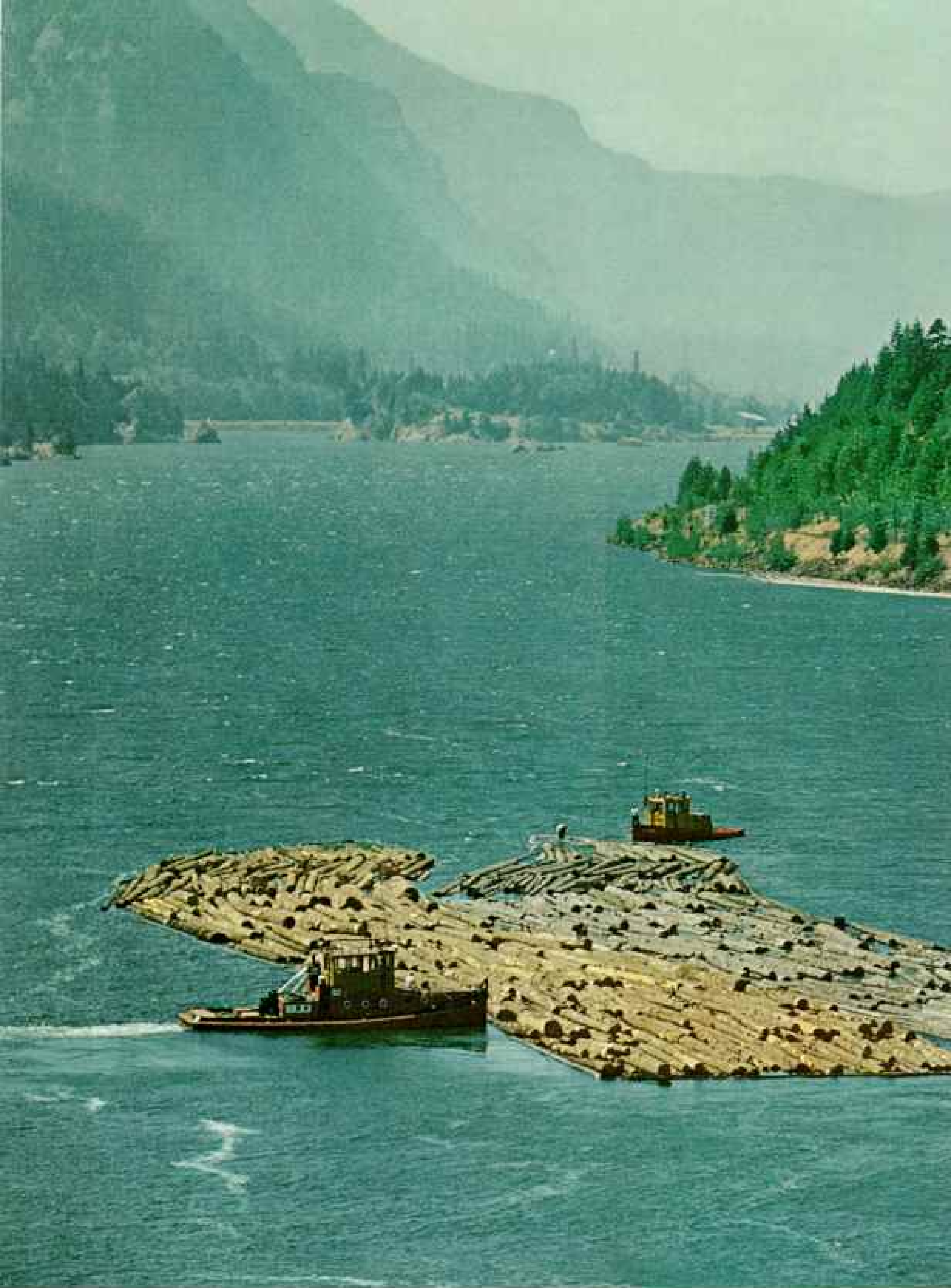
fast, became more than a farm and sawmill center by turning a setback into an opportunity. Back in 1939 little Albany College left town to become Lewis and Clark College in Portland. After much persuasion by local and state interests, the U. S. Bureau of Mines in World War II took over Albany's 42-acre campus for its Metallurgy Research Center.

The center specializes in the development of alloys and exotic metals such as zirconium,

hafnium, and titanium; the ores come from as far away as Australia. Private industry, quick to see the advantage of being near the research center, now has five big plants in Albany producing special metals for space vehicles and nuclear reactors. The city calls itself the "Exotic Metals Capital of the World" (page 95).

The thought of space vehicles reminded me of a phenomenon reported by a chance acquaintance in a motel on the coast.





Paul Bunyan plowed a furrow for the Columbia River to float his timber to the Pacific, or so runs one of the Northwest's taller tales. Today's sure-footed loggers ride log rafts herded by small tugs to lumber, paper, and plywood mills. The Columbia River Gorge slices between Oregon (left) and Washington. With 26 million acres of commercial



timber—enough to rebuild every house in the United States—Oregon leads the Nation in forest products. The state cuts nine billion board feet of fir and pine a year.



EXTENDING LADDER AND BOOCHROWE BY HEYER LITTLEHALLS © N.R.S.

Fragile cascade, Multnomah Falls leaps from cliff top to rock ledge to tree-fringed basin in a 620-foot drop. A parade of cataracts rewards sightseers on the Columbia River Highway that winds through the gorge.



STITCHING BY WILLIAM ALBERT HALL © N.E.L.

Bright and brief, today's Jantzen, Inc., swimwear stands a far cry from swim fashions of 1917 that scandalously bared the knee. Here a seamstress at Jantzen's design studio in Portland inspects a bikini destined for the beaches in 1969.

"I'm not a believer in flying saucers or anything like that," he said, "but it gave me a jolt to see this big silver thing floating above the trees in Siuslaw National Forest. It turned out to be a balloon. I haven't the slightest idea what it's doing there."

From Albany I drove southwest, following Route 38 along the Umpqua River. In a notch between the trees I glimpsed what looked like a large, gaudy ice-cream cone hanging in the sky—a silver sphere atop a conical white-and-red skirt (page 97).

I turned onto a rough logging road. It led to a ridge high above a canyon whose mouth opened upon the Umpqua. Here I found a collection of machinery, including a yarding donkey—a war-surplus M-6 tank chassis with three cable drums mounted on it.

Near the donkey I was welcomed by Faye H. Stewart, vice president of the Bohemia Lumber Company, Inc. He smiled at my question about that "big silver thing."

"There's no mystery about it," he said. "We use the balloon to lift logs out of the canyon."

He told me how it worked. The tethered helium-filled silver sphere, 86 feet in diameter, could lift 12,000 pounds. Its movements were controlled by the yarding donkey. The donkeyman communicated with loggers down in the canyon by short-wave radio.

With Mr. Stewart I walked to the lip of the canyon. Far below us the balloon began to rise, slowly and dreamily, with five big logs hanging by a cable beneath it. At the top of the ridge the donkeyman deftly lowered the logs to the ground, to be unhooked.

"We think this solves the problem of getting logs out of difficult places," said Mr. Stewart. "For one thing, it cuts down on the building of logging roads, which can cost as much as \$30,000 a mile. Equally important, we don't damage standing trees, or cause erosion problems by tearing up the earth.

"We've had some problems," he went on. "Every now and then traffic piles up on Route 38 when drivers stop to take a look, and there have been some flying-saucer scares. For a while, until they learned what it was, airplane pilots liked to buzz the balloon."

Nisei Build New Lives in Oregon

At Ontario, just across the Snake River from Idaho, I aimed to see what Max Taggart, a lawyer friend who lives there, had meant by his promise to show me "something unique in Oregon—or possibly anywhere."

What Max showed me was a group of citizens who had spent almost 25 years lifting themselves from humiliation and disgrace to positions of respect, prosperity, and equality. They were Nisei, sons and daughters of Japanese immigrants to the United States.

Twenty-seven years ago thousands of Japanese families, looked upon as potential spies and saboteurs, were rounded up on the West Coast and confined behind barbed wire. Some, with proper sponsorship, were allowed to settle in other parts of the country. Many joined the Armed Forces and served with distinction. But most of the 110,000 were interned all through World War II.

Released at war's end, the Japanese began picking up the pieces of their lives. Some returned to their old homes, while others scattered throughout the Nation. Many gravitated to inland Oregon, some becoming apple



EXHIBITION BY WOLFFER ALBERT BLANK © R.A.S.

Metal for the Atomic Age, a 1,500-pound ingot of zirconium glows at 1,800° F. in a forge at the Wah Chang Albany Corporation. Highly resistant to corrosion, zirconium sheathes uranium fuel rods in nuclear reactors. Flashbulb manufacturers use the metal for filaments, and jewelers polish bits of the natural mineral for diamondlike zircons. Albany, claiming the title of the Nation's exotic-metals capital, produces other rare elements, such as columbium, hafnium, tantalum, titanium, and vanadium, for nuclear and aerospace applications.

growers in the Hood River Valley, others moving to the eastern edge of the state.

"And that," said Max, "is how this part of Oregon happens to have, among its most valuable citizens, about 2,500 Japanese Americans. Most are row-crop farmers, but we also have Nisei doctors, dentists, produce brokers, merchants, mechanics—you name it.

"To me, this is not a colony. It is a classic example of integration. The Nisei themselves deserve great credit, of course, but I like to think that the special spirit of Oregon also played a part. Here a man is judged by what he is, not by his race, religion, or pigmentation."

On a ride around Ontario, Max showed me a number of homes that reflected Japanese influence in architecture and landscaping. We lunched in a popular Nisei-owned restaurant

—it served Chinese food. Then we went to see George Iseri, a onetime internment-camp inmate who now heads a firm dealing in real estate, insurance, travel bookings, and automobile rentals.

"The wartime scars healed long ago," Mr. Iseri told me. "Oregon has been good to us. We harbor no bitterness."

Water Does the Trick

"And now," said Max as we left Mr. Iseri, "I want to show you something at the other end of the scale from the Niseis' small farms. Ever seen 10,000 acres of potatoes?"

I said I hadn't, and soon we were bumping along dusty roads bordered by rows of potato vines laid out with geometric precision. Long sections of irrigation pipe sprinkled water on

the plants. It was sobering to think of all those unseen tubers quietly manufacturing carbohydrates and waiting for a drink.

Max explained that this gently rolling, treeless empire, Skyline Farms, was the brain child of G. A. Masterson, part owner of Ore-Ida Foods, Inc., a vegetable-processing concern. A few years ago Gib Masterson decided that only water was needed to turn his native corner of sagebrush-strewn eastern Oregon into good farmland. The water was close at hand, in the Snake and Malheur Rivers. All one had to do was get the water to the land.

Masterson, F. Nephi Grigg, and other Ore-Ida partners bought up 10,000 acres on a plateau 500 feet above the confluence of the rivers. Then they sold the package—Skyline Farms, Ore-Ida, and their own potato-growing expertise—to the H. J. Heinz Company, of “57 Varieties” renown, for \$50,000,000.

Heinz spent more millions on many pumps and miles of pipe to lift water to the fields at the rate of 75,000 gallons per minute. For the growing season, 120 Navajo Indians, who don't mind moving water lines in temperatures up to 112° F., fly in from New Mexico.

Ore-Ida's big plant, nine miles away, converts Skyline's product into frozen French fries, hash browns, shoestrings, and the like, and ships them to a potato-hungry world.

Land of Many a “Bad Hour”

From Ontario I headed southwestward on U. S. 20 into a region that conquered many a homesteader who came here in the latter half of the 19th century with dreams of building a great wheat empire. Here the land is so dry that, as one old-timer put it, “one juniper fence post will outlast three sets of post holes.” In winter, snows drift “high enough to hide a horse,” and the wind “blows so hard that once it held a sage hen up against a cliff so long that she laid eleven eggs.”

The name heard most often in this wasteland is Malheur—literally “bad hour” in French, but translated as “misfortune” or “hard luck.” In eastern Oregon it designates a county, a river, a lake, a village, a cave, a national forest, and a Federal wildlife refuge.

Some historians believe the name Malheur was born during the gold excitement of the 1860's, when a tunnel cave-in killed a French miner. But an earlier clue appears in the journal of Peter Skene Ogden, a Hudson's Bay Company trader who led French-Canadian hunters into the Snake River country in 1825.

Ogden wrote on February 14, 1826: “We encamped on River au Malheure (unfortunate River) so called on account of property and Furs having been hid here formerly, discovered and Stolen by the Natives.”

Ogden has been linked with another etymological curiosity—Owyhee, a name identifying a river, lake, dam, village, and 4,220-foot butte (map, page 88). Four days later, says the journal, Ogden reached “sandwich Island River so called owing to two of them having been murdered by the snake Indians in 1819.”

Presumably, “two of them” refers to Sandwich Islanders, or Hawaiians, often members of such expeditions, and the river was named for them. Hawaii was then called Owyhee.

Covered Wagon—1968 Style

My thoughts were with those hard-luck people and their *malheurs* as I passed through the pleasant town of Vale and moved into a vast nothingness, a beige monotony of parched earth relieved only by gray-green sagebrush, dark, scraggly juniper, and the brownish rounded shapes of distant buttes.

A few cattle drank from the Malheur River, only hoof-deep in late June. The region gets but 8 to 12 inches of precipitation in a year. Here and there a ranch house huddled against a hillside or under rimrock for shelter from wintry winds and snow.

Frequent breaks in the flatness of this high, wide plateau were created eons ago by geological faults, or cracks in the earth's crust, with one side tilted into rock cliffs. One such escarpment, stretching along the eastern edge of Lake Abert, rises 3,000 feet.

I thought of the old-timers who challenged this rugged country—the explorers, the trappers, and the emigrants who came later over the Oregon Trail. Venturing into a land full of terrifying unknowns, many perished of thirst and hunger. Some died violently at the hands of Indians. And here I was, in the drowsy quiet of a Sunday morning in 1968, tooling along an excellent highway in a swift, comfortable station wagon.

As I climbed effortlessly up steep grades and over high passes named Drinkwater and Stinkingwater, I switched on the air-conditioner—and wondered what a covered-wagon driver would have said. Or what he would have thought about the sermons, news of foreign and domestic crises, rock and roll, and commercials pouring from the radio speaker.

My imaginary companion surely would



Helium-filled skyhook hoists logs out of a mist-drenched valley in western Oregon. By steel cables attached to the balloon's dangling cargo line, a tractor-type yarding donkey controls the load and pulls it in to the landing point. Trucks take over from there.

Balloon-logging eliminates the need for gouging costly, land-defacing roads in precipitous timber country. Trees on this steep slope lost their tops in a violent storm seven years ago.



The land surrenders its bounty at harvest time in northwest Oregon's fertile Willamette Valley. The mild climate and rich soil that lured pioneers over the Oregon Trail more than a century ago fulfill their promise with bumper yields of berries, hops, orchard fruits, and vegetables. Sweet corn (right) climbs a corn-picker's conveyor on a farm near Salem.



Armies of Oregon youngsters earn pocket money each summer by harvesting beans, strawberries (above), blackberries, gooseberries, and other fruits in season. Schoolteachers organize platoons of 50 to 60, busing them to fields by 7 a.m. and back home by 3:30 p.m.—leaving the rest of the afternoon free for leisure.

Trucks rush most of the crops to Salem, Eugene, and Portland, where round-the-clock food-processing plants freeze or can the produce at the peak of perfection.

have been puzzled by the signs erected along the roadside by some desert humorist. The first said "No Loitering," and a few miles later came another warning, "Nude Bathing Prohibited." Still later came "Free Sagebrush—Help Yourself," and, beside a heap of rounded oblong stones, "Petrified Watermelons—Send One to Your Mother-in-law."

A problem unlike any faced by a pioneer or homesteader arose soon after I obeyed a whim and turned off U. S. 20 onto U. S. 395 at a crossroads called Riley (map, page 88). The fuel-gauge needle was quivering ominously at "E." I rebuked myself for having failed to buy gasoline farther back.



REARRANGED BY WILLIAM ALBERT ALLARD (ABOVE) AND BATES LITTLEHALDE © BILLY

Fortunately, after about 25 uneasy miles, a settlement hove into view and I pulled up at a tiny general store with two gasoline pumps. After the owner filled the tank, I followed him inside to get my change.

Here was another example of desert wit: an egg carton labeled "1 doz. Porcupine Eggs." Naturally, I lifted the lid. Each compartment held a prickly, egg-shaped thistle head. The storekeeper guffawed.

"Gets 'em every time," he said. He handed me my change and a receipt. "I put my stamp on it, so you'll know where you've been."

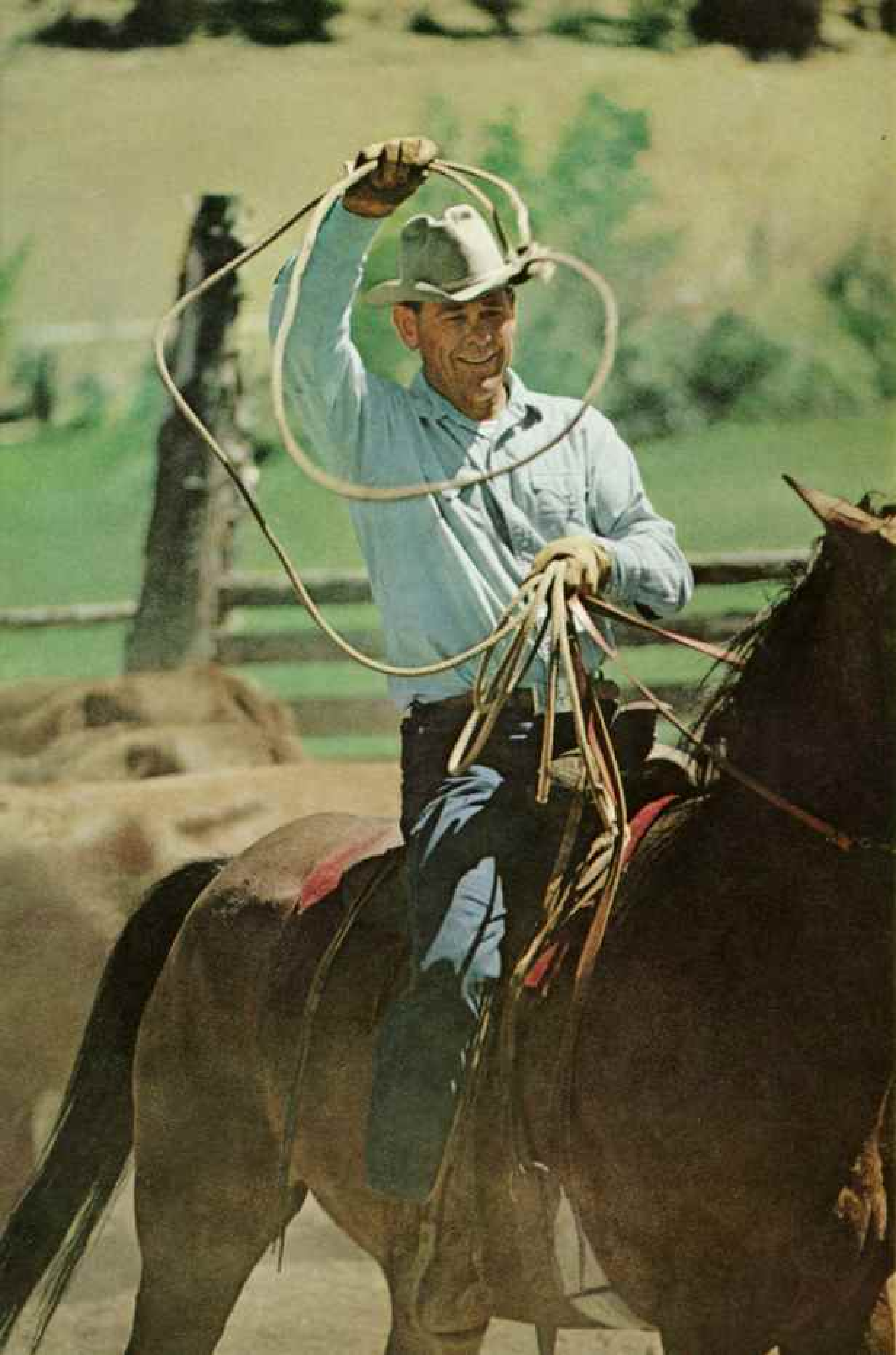
"Thanks. Incidentally, where am I?"

"My friend," he replied, "you're smack in

the heart of downtown Wagontire, Oregon. Population, one million. Gophers, that is."

Soon I left well-traveled 395 and struck off northwestward on dusty, bumpy back roads. Many more miles of the High Desert's sagebrush, dry lakes, lava beds, and buttes brought a reward—the sight of mountains.

These were real mountains, craggy and majestic, with snow streaking their upper slopes. First came Paulina Peak, thrusting a mile and a half into the sky and lording it over a cluster of lesser mountains and a sprinkling of emerald lakes. Beyond the Paulinas, to the west, rose the Cascades themselves, volcanic peaks crowning a mighty range that





ILLUSTRATIONS BY BATES LITTLEWALKER © N.A.S.

Saturday cowboy, Monday morning judge: With the Oregonian's yen for the outdoors, Alfred T. Goodwin, Associate Justice of the Oregon Supreme Court, easily slips from weekday robes in Salem to work shirt and blue jeans. Here building a loop to rope a calf for branding, he joins in the June roundup at the Aspen Valley Ranch near Prineville.

leaps across the Columbia River from Washington and divides Oregon into two unequal parts as it reaches southward into California.

On the eastern slope of the Cascades lies Bend, the city I would choose if I decided to move to Oregon. Once it had a more poetic name. Farewell Bend, it was called by pioneer travelers. Here they had their last view of the Deschutes River after they forded the stream and urged their wagon teams on toward the mountain passes leading to the promised land, the fertile, hospitable Willamette Valley.

The old river crossing, now a city of more than 13,000 and growing rapidly in its 3,600-foot-high setting of mountains, desert, and evergreen forests, ranks as the metropolis of central Oregon. Sawmills and wood-processing plants form the economic mainstay, but Bend has escaped the ugliness that afflicts some mill centers.

Welcoming hands reached out everywhere in Bend. One of the warmest belonged to Robert W. Chandler, a dynamic Californian who

bought the Bend *Bulletin* in 1953 and quickly made it an outstanding newspaper.

After showing me his new plant, fitted out with up-to-the-minute offset printing equipment, Bob invited me to join him next day for "two or three hours' worth of central Oregon from the air."

In the morning I helped him roll a twin-engine Piper Comanche out of a hangar at the Redmond-Bend airport. We took off, bucking a 20-knot headwind, with visibility unlimited.

"A lot more Californians have moved up here since I came in 1953," said Bob. "They're still coming, more all the time, looking for elbow room. California is getting crowded.

"There's plenty of room here, of course, but the trouble is, the Californians come with fat wallets and bid land prices up so that Oregonians are beginning to wonder how much longer they can afford to live here. The old-timers are sad about the way ranches are being broken up into subdivisions."

Northwest of Bend, over the Mount Washington Wilderness (map, page 87), we looked down upon Belknap Crater and vast expanses of black, tortured lava. This surface is so moonlike that astronauts have trained and tested their equipment here."

Heading south, we took a close look at deep snow on the crests of the Three Sisters, all rising above 10,000 feet, and on slightly lower Broken Top. Off to our left lay 9,065-foot Bachelor Butte, where businessmen from Bend have built a ski resort so challenging that United States Olympic skiers have used it for summer training since 1963.

Next to pass under our wing was a chain of sparkling, forest-ringed lakes—Sparks, Elk, Hosmer, Lava, and Little Lava. "All great fishing spots," said Bob. He pointed out another favorite, Irish Lake, which was appropriately bright green because of an unusually heavy growth of algae.

Oregon's Jewel—Crater Lake

"The *pièce de résistance* is coming up soon," said Bob as we skimmed along over dark-green forests laced with brown logging roads. Within minutes we sighted Crater Lake, the blue jewel of Oregon's only national park.

"To me, this is the most beautiful spectacle in the world," said Bob as we followed Rim Drive around the lake. "I never tire of flying over it. It looks as if about two hundred million gallons of bluing had been poured into that hole."

*See "The Making of an Astronaut," by Robert R. Gieruth, NATIONAL GEOGRAPHIC, January 1965.



RODOLPHUS © NATIONAL GEOGRAPHIC SOCIETY

Striped-vest dandy of the Western plains, a pronghorn grazes in Malheur National Wildlife Refuge, established by President Theodore Roosevelt in 1908. A nesting area on the Pacific flyway, the 180,850-acre preserve harbors ducks, geese, herons, egrets, and the rare greater sandhill crane.

Steep, barren banks of strange hues roll across Painted Hills State Park in north-central Oregon. Volcanic pumice and ash, spewed from earth during the birth of the Cascade Range, colored the formations. They contain fossilized remains of cinnamon, fig, alder, and other trees that reveal a warmer climate before the rise of the Cascades.







PHOTOGRAPH BY BETTE LITTLEHALL © N.S.P.

Model drugstore in a laboratory at Oregon State University helps pharmacy majors like Susan Hufford learn their profession. The Corvallis campus offers its 14,500 students 45 such professional specialties. One of nine state-supported institutions of higher learning, the State University excels in the fields of food science, forestry, marine research, and water- and air-pollution control.

Through rain and snow, wind and fog, health enthusiasts in Eugene jog on. Defined as slow running alternated with walking, jogging has swept the Nation as a means of keeping fit. Eugene residents attribute the vogue to University of Oregon track coach William J. Bowerman and Dr. W. E. Harris, co-authors of a book on jogging. Mr. Bowerman became a devotee after seeing its benefits in New Zealand.



Raw material for fine art, an oak log is transformed into free-form sculpture at the University of Oregon in Eugene. Carmen Bobzien takes tips from sculptor Jan Zach, who has taught here for 11 years. At present Mr. Zach creates suspended sculpture from stainless steel, but prefers Oregon's hardwood for teaching. "The chip-chip-chip of wood brings students close to nature," he says, "and helps them forget the dripping winter outside."

And so it did (pages 114-15). From 1,000 feet we had a matchless view of the water-filled caldera, created about 6,600 years ago when a 12,000-foot volcano blew up and then collapsed. The mountain had no identity until 1896, when it was dubbed Mazama, from an Aztec word for mountain goat, by Portland's climbing club of that name.*

On the way back to the airport, Bob talked of the many outdoor sports available in the Bend area. Horseback riding, he said, has become one of the most popular.

"If you want to know more about it, I suggest you get in touch with Larry Davis, a schoolteacher friend of mine. He moonlights—or rather sunlights—as a horseshoer. You might call him the modern equivalent of the village blacksmith—only he doesn't stand

under a spreading chestnut tree. He travels around in a truck."

Next day, I joined Larry on his rounds. In his mid-thirties, he said he was one of seven busy horseshoers in the Bend area.

"Mine is a familiar story," he said. "My regular job is teaching, but there just isn't enough money in it. Actually, I like horseshoeing, too. The pay is pretty good, it keeps me outdoors, and I meet nice people and horses. My grandfather was a blacksmith; he left me his anvil and other tools."

Our first stop was a few miles outside Bend, at a dentist's house with a spectacular view of

*See "When Mt. Mazama Lost Its Top: The Birth of Crater Lake," by Lyman J. Briggs, and "Crater Lake Summer," by Walter Meayers-Edwards, NATIONAL GEOGRAPHIC, July 1962.



LATACORNE © NATIONAL GEOGRAPHIC SOCIETY

the Cascade peaks. Larry donned a leather apron and hoisted his 40-pound anvil from the truck.

From the nearby corral Larry led a black Morgan gelding and tethered it to the truck. He went to work with a butteris, a tool used to pare hoofs. The horse stood quietly.

"Now," said Larry, "we're ready for the shoes. Here's something that would make my grandfather spin in his grave. These shoes were made in Japan—to an American design, however. They don't have to be heated in a forge, but can be shaped cold. These horse-shoe nails—they were made in Japan, too."

Within an hour Larry had fitted the gelding with four new shoes; they would last about two months. We moved on to other appointments, and by lunchtime Larry had shod

a Tennessee walking horse, an aged Shetland pony, two quarter horses, and an Arabian stallion that tried earnestly to kick Larry Davis, his anvil, and his tools into the next county. For each job he collected \$10.

Before I left Larry, I remarked that I wouldn't mind a day's trout fishing. Quickly he put me in touch with Ole Hansen, a former professional guide. Early on a Sunday morning we joined a parade of trailers and campers headed south from Bend.

"We'll try a place I know on the Deschutes, near a state campground," said Ole. "I haven't been there for a couple of years, but it used to be good."

At the campground Ole took one look and groaned at the acres of trailers, campers, and tents. Dozens of wading anglers competed for

space in the water. Others cast or dangled lines from the banks and a bridge.

"Things have changed," said Ole. "Let's try another spot."

We drove a few more miles, parked the car, and walked another mile or so to where the Deschutes coiled through a meadow. No other fishermen were in sight. We separated, each taking a section of the river. Three hours later, when we met again, my creel was empty. I had caught and released dozens of rainbow and eastern brook trout, none of legal six-inch size. Ole's story was much the same, but he had kept one 14-inch rainbow.

"Just too many people," he said as we headed back toward Bend. "With the good roads we have these days, it's too easy to get to the streams. The only answer, I guess, is to pack in to the really primitive spots."

Later that afternoon, in my motel on the edge of the city, I gazed out a window at the Deschutes, where it rushed past below a dam built to create a small lake for Bend's Pioneer Park. Fishing from a motel seemed a wild notion, but I jointed up a rod and began casting from the lawn outside my room.

Within an hour or so I caught and released six brown trout, all of legal size and one a handsome 18-incher. When I told a purist friend about my success at urban angling, he took a lofty attitude.

"The state stocks that stretch of river, you know," he said. "Not quite the same as catching native trout."

Camping in Modern Indian Style

Central Oregon people, and many others who prefer luxury to roughing it in the wilds, often spend a weekend or longer at Kah-Nee-Ta, one of this country's most unusual resorts (page 90). Kah-Nee-Ta—Gift of the Gods—lies in a deep canyon on the eastern edge of the 560,000-acre Warm Springs Indian Reservation, 50 miles north of Bend. It was created by seven bands of the Wasco and Tenino tribes that joined to form the Warm Springs Confederation.

Kah-Nee-Ta's guests—provided they have made reservations three months in advance—can stay in modern cottages, in genuine hand-sewn tepees, or in their own tents or vehicles at a campsite and trailer park.



A boy's first steelhead—scrappiest of the trouts—brings proud smiles to seven-year-old Mike Schneider and his dad. Mike caught his one-and-two-pounder on the Rogue River, one of Oregon's famed fishing streams. Rising from springs in Crater Lake National Park (pages 114-15), the sparkling torrent falls 5,300 feet in its 215-mile dash to the sea. The national Wild and Scenic Rivers Act of 1968 protects 85 miles of the Rogue.

Wilderness solitude envelops trout fishermen at twilight on the McKenzie River near Springfield. They drift downstream in a McKenzie River Boat, a modified dory specially designed for the rapids and riffles of the river.





Crisis-a-minute run on seething waters of the McKenzie River sends the nose of a makeshift raft plunging into the foam. Soaked and battered boatmen strive to keep their craft upright. The early-spring White Water Boat Parade—a test of skill and endurance, not a race—covers 20 miles



ENTOURAGE BY RAY ATKINSON © N.L.L.

from Blue River to Leaburg (map, page 87). The McKenzie River Guides, an association of experienced rivermen, patrol the river for safety; usually only half of some 500 starters finish. Spectators line both banks, heads swiveling as the rafts, canoes, kayaks, and other boats sweep past.



The resort offers riding, rock-hounding, trout fishing, and hiking on trails once followed by early explorers. To me, the chief attraction was the Olympic-size swimming pool, kept warm by mixing the 147° F. product of underground springs with river water.

Elsewhere on the reservation the enterprising Warm Springs tribesmen manage timberland, ranches, and shops. They lead busy lives under laws laid down by a tribal council and enforced by a ten-man police force. The confederation's profitable sawmill converts its own ponderosa pine and Douglas fir into lumber, chips for pulp-paper mills, and thin veneer sheets for plywood.

"In the Kah-Nee-Ta Vacation Resort alone," I was told by Vernon Jackson, a Wasco who serves as general manager of the confed-

eration, "we have an investment of about \$1,000,000. We have been offered a great deal more for it, but we're not about to sell."

On another excursion out of Bend, I drove through the wild, picturesque country of John Day, a Virginia backwoodsman who journeyed west in 1811 with an Astor fur-trading party. Washington Irving described John Day as "strong of hand, bold of heart, a prime woodman, and an almost unerring shot."

Names Honor a Pioneer Driven Mad

For all his skills and courage, Day was a loser. He and a companion were betrayed by "friendly" Indians, who first led them, then seized their rifles and left them naked. Found weeks later by a searching party, the men were taken to Astoria; Day shortly thereafter



PHOTOGRAPH BY DAN STREIBER © N.E.S.

went insane. His name has been perpetuated in "John Day Country," a small town, a river, and the newest dam on the Columbia River, northeast of The Dalles.

I reached Pendleton, center of northeastern Oregon's wheat and cattle country, a full two months before the famous September Round-Up (pages 90-91), but found its planners as busy as if the rodeo were to open the next day.

"It's like this all year long," said Leonard King, Round-Up president, as he went over advance box-office records with his staff at the stadium. "No sooner do we wind up one rodeo than we start working on the next. It's been going since 1910 and gets bigger every year. It celebrates the end of the harvest year, which in this part of the country means wheat and peas."

Smooth as tawny velvet pillows, fields of winter wheat fall to a harvester in the vast grain empire stretching from The Dalles to Pendleton. Oregon's principal crop since early days, wheat served as legal tender worth \$1 a bushel in the late 1840's. Until the coming of steam, Portland sent the grain to world markets in fleets of windjammers.

A big problem of recent years, said Mr. King, is arranging camera positions for television crews and taking care they are not maimed by bucking broncs and bulls.

"A few years ago," Mr. King went on, "some TV people talked us into digging a pit so they could photograph a wild horse from a low angle. We wound up with the horse, the cowboy, the camera, and the crew all piled up in the hole. Strangely, nobody was hurt."

The Sandhill Crane's Best Friend

I realized that my time in Oregon was running out and I still hadn't seen a man called Hawk Hyde. People all over Oregon had told me about Hawk. He was a rancher and naturalist formally named Dayton O. Hyde, who lived in southern Oregon and who had dedicated himself to protecting the greater sandhill crane. In doing so he had earned the thanks of the Fish and Wildlife Service, as well as awards from conservation organizations.

A Portland ornithologist had told me, "Sometimes I get the eerie feeling that this man has turned himself into a sandhill crane. At the very least, he is an honorary member of the species *Grus canadensis*."

Some 70 miles from Klamath Falls I turned in at the gate of Yamsi Ranch to be greeted by Hawk Hyde himself, tall, lean, denim-clad. Hawk explained that the name Yamsi was Klamath Indian for "home of the north wind."

Hawk said his interest in wild creatures was born during a lonely boyhood in northern Michigan. After graduating from the University of California, he went to work on an elder brother's ranch near Bly, Oregon.

"By that time," he said, "I had become an awfully soft touch for birds and animals, especially those in trouble. I used to lean on my shovel when I should have been working, and listen to the marsh birds calling. My favorite was the sandhill crane. Its cry is a delightful rolling sound; to me, it's as truly Western as the rumble of wagon wheels."

About 20 years ago Hawk realized he was hearing the cranes less frequently. Sloshing through the marshes, he counted the birds.



In an unregal pose, actress Ann Kinsolving awaits an entrance as Queen Gertrude in *Hamlet* at the Oregon Shakespearean Festival in Ashland, oldest in the U.S. The costume crew repairs and presses her gown, accidentally torn in the previous scene.

Elizabethan pageantry lives on as Ashland's Shakespeare festival presents *Pericles* in its open-air amphitheater to the usual standing-room-only audience. The actors perform on a stage patterned after London's 16th-century Fortune Theatre; costumed musicians accompany them from a balcony. More than 130 persons make up the company, most of them drama students from across the Nation.

He counted them again in the spring when they returned from their shrinking winter habitat in California. There had been more than a 50-percent loss.

"A few solitary cranes came back without mates and made no attempt to nest," he said. "I decided to try to help out.

"I swam out into an ice-choked stream in the spring and rescued a nest that was just about to go under. I put the eggs in an incubator, and one of them hatched—perhaps the first greater sandhill crane ever to be hatched artificially."

The baby grew up to be a female called Sandy.* The trouble with Sandy, Hawk said, was that she never realized she was a sandhill crane. "She preferred to hang around the ranch house, enjoying human company."

Eventually deciding that Sandy needed a mate, Hawk rescued another nest of eggs from flooding and raised a big male, Red King.

"I never believed that Sandy really liked Red King," said Hawk, "but she did lay four fertile eggs. And from them we raised four sandhill cranes. This was pretty exciting, because sandhills in the wild ordinarily lay only two eggs and raise one chick.

"These four, being hand-raised, were tame when migration time came. I taught them to fly by running with them, flapping my arms. They would take off and look around for me and find that I was still on the ground. They seemed to be worried about this odd-looking,



STAGEWORK BY BRUCE LITTLEDALE; GARDNER AND WILLIAM ALBERT HILLARD © R.S.G.

long-legged bird who was going to stay there and starve because he couldn't get airborne. They'd circle above the ranch and call to me, then fly back, tug at my clothes, flap their wings, and try to get me to go along. One day they just gave up on me and disappeared."

Eight months later came word that three cranes had turned up in a marsh near Bodega Bay; they had been taken to nearby San Francisco's Fleishhacker Zoo. Certain that these were his cranes, Hawk hurried south.

Lost Birds Recognize a Voice

At the zoo, he immediately recognized Eenie, Meenie, and Miney. Moe was missing. The birds, however, did not recognize Hawk—at first. Hawk then remembered a German

*Mr. Hyde's own book-length account of his battle to save the greater sandhill crane, *Sandy*, was published by Dial Press, Inc., New York, in 1968.



Ringed by snow-dappled hemlock and fir, Crater Lake highlights the 250-square-mile national park that bears its name. Its brilliant hue—a result of the water's purity and 1,932-foot depth—seldom dims, even on cloudy days. The six-mile-wide caldera formed 6,600 years ago, when the peak of Mount Mazama

youth who had worked at Yamsi when the cranes were young. At milking time he would call the cows by shouting "Coom, Jussey," which meant "Come, Jersey."

"So I yelled 'Coom, Jussey,'" said Hawk. "The birds immediately located me in a crowd of about sixty people and beat against the cage trying to get to me.

"That satisfied the zoo people, and soon the cranes and I were headed back toward Oregon. If you haven't driven 500 miles with a

back seat full of sandhill cranes—each standing four feet tall, flapping six feet of wing, and affectionately biting your ears—you haven't really lived."

About half a mile from Yamsi Ranch, Hawk stopped and opened the car door. The cranes rushed out and took wing. After circling above the ranch house, they glided down to join their feeding parents, Sandy and Red King. They were home again, after an absence of almost nine months.



BOOCHING BY BATES LITTLEHALES © N.Y.S.

collapsed following volcanic eruptions. Near the western shore Wizard Island, remnant of the volcano's last convulsion, rises 760 feet above the surface. About 50 feet of snow falls here annually, blanketing the park for eight months of the year, but plows keep the road open to Rim Village and its ski trail on the south shore, at right.

When Hawk finished his narrative, I closed my notebook and said I would be pushing on. I had planned to return east the next day.

"You can't do that," said Hawk. "Why, I'm just beginning to like you. After dinner we'll fish. You can bed down in the spare room."

On the way to the trout stream Hawk pointed out a pair of greater sandhill cranes, big gray birds with red patches on their heads, standing near their nest and probing the marsh grass for grasshoppers and frogs.

"Later on," said Hawk, "you might hear their call. Actually, it's two calls—one bird starts it and the other joins in at the end."

Three hours later, after we had cleaned a catch that included a four-and-a-half-pound rainbow trout taken by Hawk, I climbed into a big brass bed. It seemed fitting that the last sound I heard, on my last night in Oregon, should be that of a truly distinctive Oregonian—the wild, ululating *go-o-o-rah!* of the sandhill crane.

THE END





Article and photographs
by STEPHANIE DINKINS

Lanzarote

THE STRANGEST CANARY

BLEAK ISLE OF CINDERS, Lanzarote—easternmost of the Canary Islands—wears the burden of six consecutive years of volcanic eruptions in the 1730's. Undaunted by their lunar-like home, ingenious islanders coax surprising crops from the dead ashes. Here camels carry tourists over lava-crusted slopes that may sizzle at 700° F. only two feet beneath the surface.

KODACHROME © N.G.S.

WITH ITS WEIRD LANDSCAPE, its mysterious history, and its puzzling fauna, Lanzarote stirs speculation among scientists as well as romantics. Virtually treeless and punctuated by numerous volcanic cones and craters, the island, as seen from the air, resembles the surface of a boiling caldron suddenly turned to stone. Is this what the moon looks like? European movie-makers think so; when they want to shoot scenes of the moon, they come to Lanzarote.

The island's history is as eerie as its landscape. The original inhabitants, the Guanches, a tall, fair people with a Stone Age culture but an advanced social organization, were a startling anomaly— islanders who did not know the use of boats. To some, this poses provocative questions. Could Lanzarote, with its 10 sister Canary Islands, be the remains of the "lost Atlantis," which—Plato wrote—sank beneath the sea "in a single day and night"? If a continent sank, leaving only its highest points exposed, would not the survivors be pastoral people of the high mountains, ignorant of the sea?



REINCHRORE (AROVE) AND ESTALCHROME © N.C.C.

SINEWS STRAINING, Lanzarotean stalwarts stage a bout of lucha canaria—an ancient form of wrestling native to the Canaries. First man to touch the ground with any part of his body, other than his feet, loses the match.

GO, BURRO, GO! Crowd roars with delight as a rider urges his grudging steed to the finish line at the festival of San Antonio, patron saint of the village of Güime.

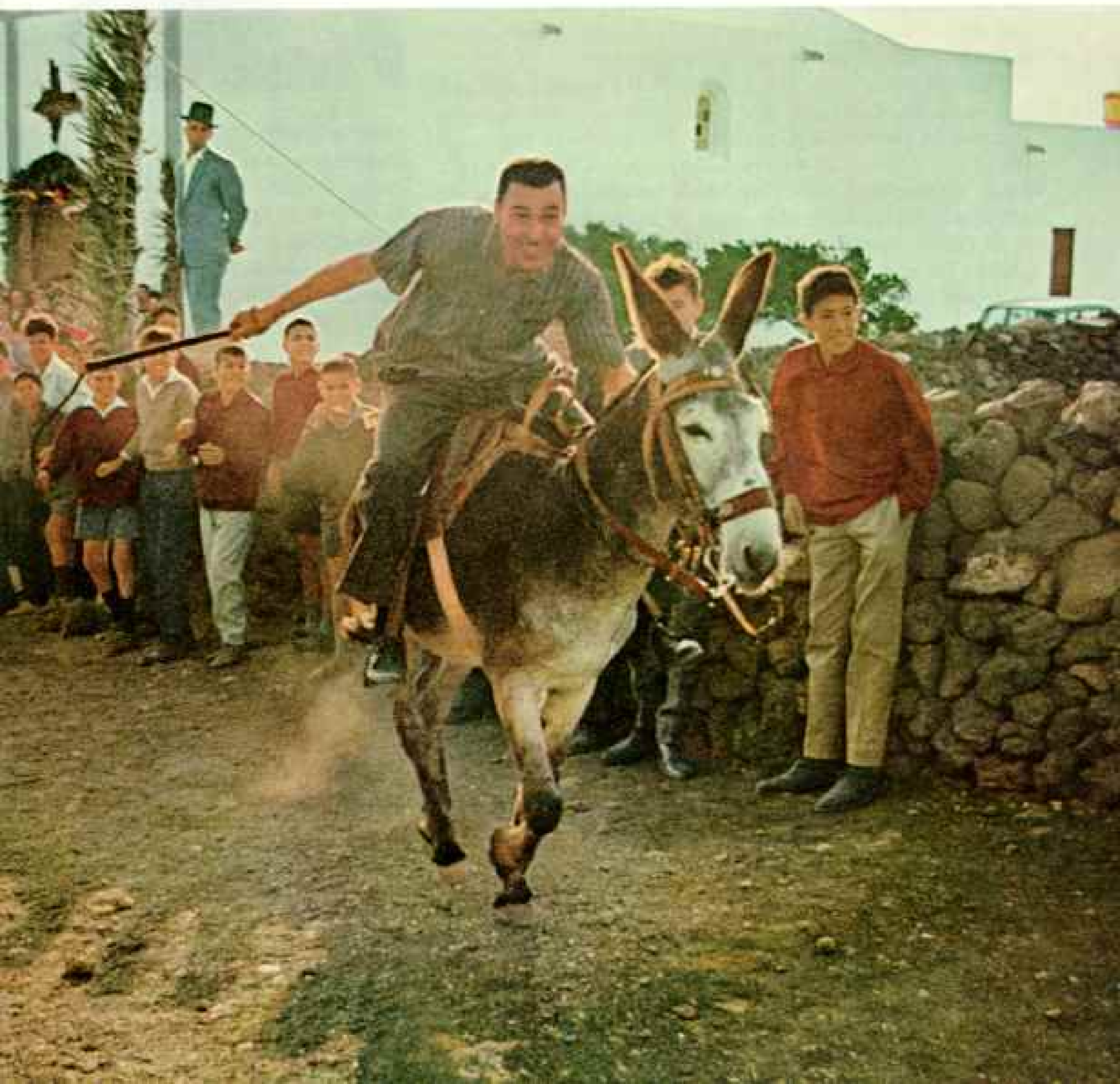


And the crustaceans, known nowhere else, living in the black pool called Jameo del Agua—pale, blind creatures—where did they come from, why and how do they uncannily appear, disappear, and reappear? Clearly, this is a strange land, an island like no other.

Lanzarote belongs to Spain and lies 80 miles off the west coast of Africa, opposite southern Morocco (map, page 121). Although only a small island—13 by 36 miles—it has more than 200 volcanoes. Here is an open textbook of geology, where students can see everything from one of the largest volcanic tubes in the world—four miles long—to a spatter cone that you can put your arms around.

Most of the time Lanzarote's volcanoes are sleeping, but in 1730 a fourth of the island blew up and kept on blowing up for six years. With the courage and adaptability that mark them to this day, the islanders settled down to everyday living while the landscape exploded around them. Eventually, tradition has it, they even danced at fiestas by the light of fountains of volcanic fire.

When the eruptions were over, lava covered more than 70 square



miles. This might not have been such a disaster on an island like Hawaii, where rain and tropical vegetation quickly break lava down into rich soil. But most of Lanzarote gets only five inches of rain a year and qualifies as a desert. You can drive through stretches of lava where in 233 years not even lichens have been able to get a foothold.

There is no water for irrigation, and, as a last straw, the island is battered by the trade winds, the same that blew Columbus from the Canaries to the New World—and no wonder, since they range up to 40 miles an hour.

Lanzarote would appear to be one of the most unpromising pieces of land on which a seed could fall. In fact, though, it has an amazing agriculture. Farmers spread volcanic cinders over their land to hold moisture, plant grapevines in deep pits to defeat the wind, and even cultivate the sand that blows into their fields.

THE MAIN GOAL of visitors to Lanzarote is the *Montaña del Fuego*—Mountain of Fire—largest of the 30 volcanoes which, in the 1730-36 eruptions, laid waste the western quarter of the island. I went there with my guide and driver, Antonio Brito, and Hans-Ulrich Schmincke, a geologist from the university at Heidelberg.

The road runs west from Arrecife, the capital, through Uga and Yaiza, which, like most Lanzarote villages, are reminiscent of Morocco, with low white houses and occasional palm trees. As we reached the ocean, we came to a green lagoon with glittering black beaches, protected by red-and-ocher cliffs in the shape of breaking waves. This is *El Golfo*—a crater that was breached by the sea—the island's favorite picnic and swimming spot.

Nearby, surrounded by fields of jagged lava, the Mountain of Fire rises like a blood boil, dark, angry red at the tip, with yellow points—sulphur deposits—showing through



ARTWORK BY ESTHARDE JENKINS © N.C.C.

"LIKE A HUNDRED CANARIES singing in unison"—so the author describes the sound of the pito de agua. The fluttery notes of this rare and ancient water flute haunt the air during Lanzarote festivals.





Bahía Bay
 Casa House
 Castillo Castle
 Cueva Cave
 Playa Beach
 Punta Point

Vineyards and orchards
 Mixed cultivation
 Limited or no cultivation
 Lava fields
 Elevations in feet.

LANZAROTE SMOLDERS in the Atlantic near the Sahara coast like a burnt chip shrugged off the feverish shoulder of Africa. To some, Lanzarote and its 10 sister isles seem possible remnants of the "lost continent" of Atlantis, which—according to Plato—sank into the sea nearly 12,000 years ago. Geologists point out, however, that the Canaries have existed, much as they are today, for at least 15 million years. Since Plato, men have speculated on the location of Atlantis—the latest theory centering on the island of Thira in the Aegean Sea.



EMPTY CITADEL commands the entrance to the harbor of Arrecife, Lanzarote's capital. The Spaniards built the 16th-century Castillo de San Gabriel and other island fortresses to guard against European and Moorish pirates, who plied these waters for centuries. Fishermen's boats rest on the harbor bottom at low tide.

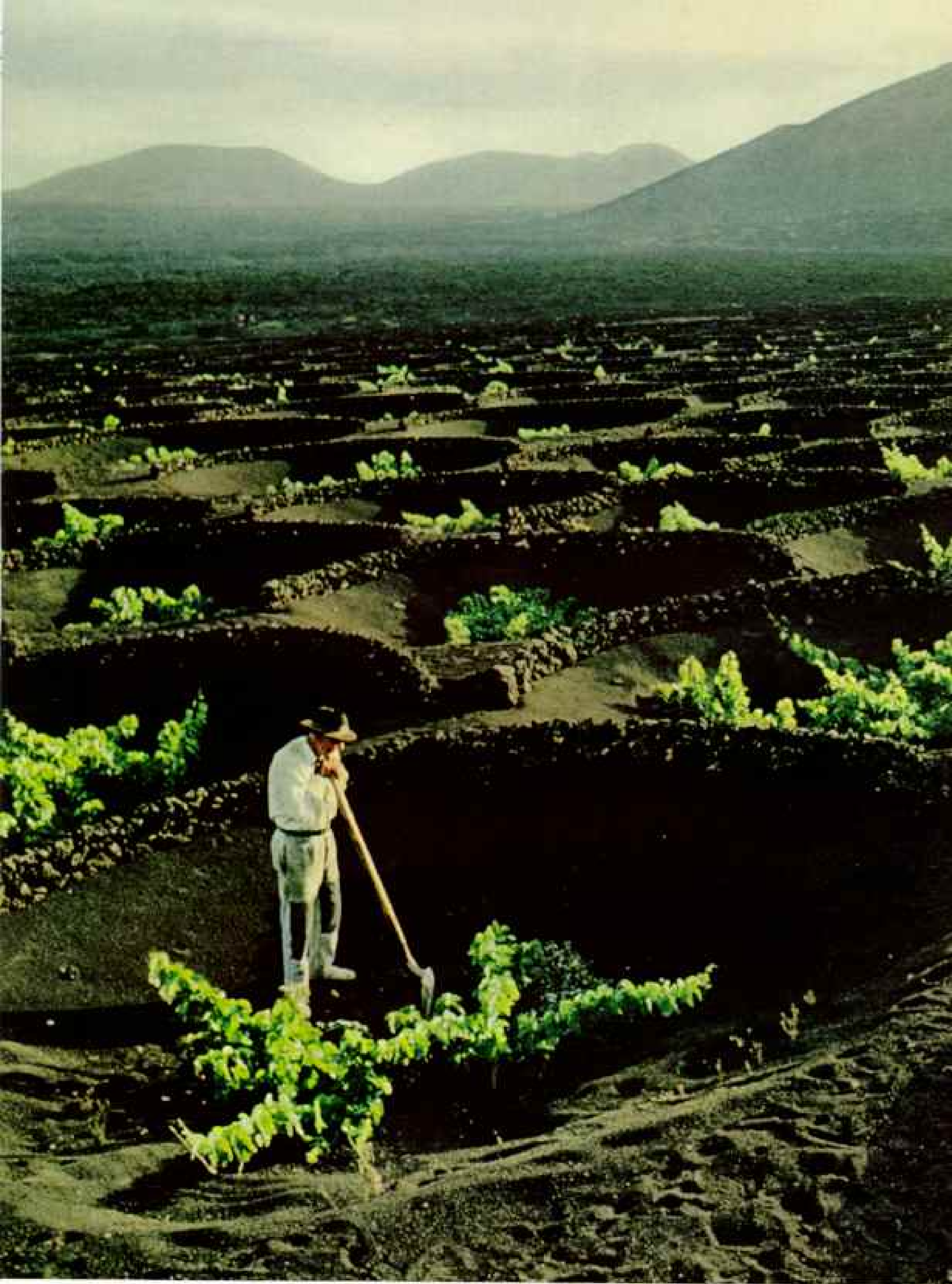
Spain occupied the island in the early 1400's and subdued the original inhabitants, the Guanches. Today Lanzarote and the other Canary isles still fly the Spanish flag—not as colonies but as politically integral provinces of the mother country. Air and ship lines link the Canaries with Europe and Africa.

the cinders that blanket its slopes (pages 116-17). Visitors make the ascent on camels rented from nearby farms, where they are the common beasts of burden.

Hans and I arranged to join a caravan, and Antonio drove us to the foot of a steep, featureless slope of black cinders where 13 camels knelt in a row, glowering. The camel's reputation for being surly and contemptuous is only partly attributable to his facial expression, and he is customarily muzzled. As the tourists descended from their bus and approached to climb aboard, the beasts began to roar like a pride of lions.

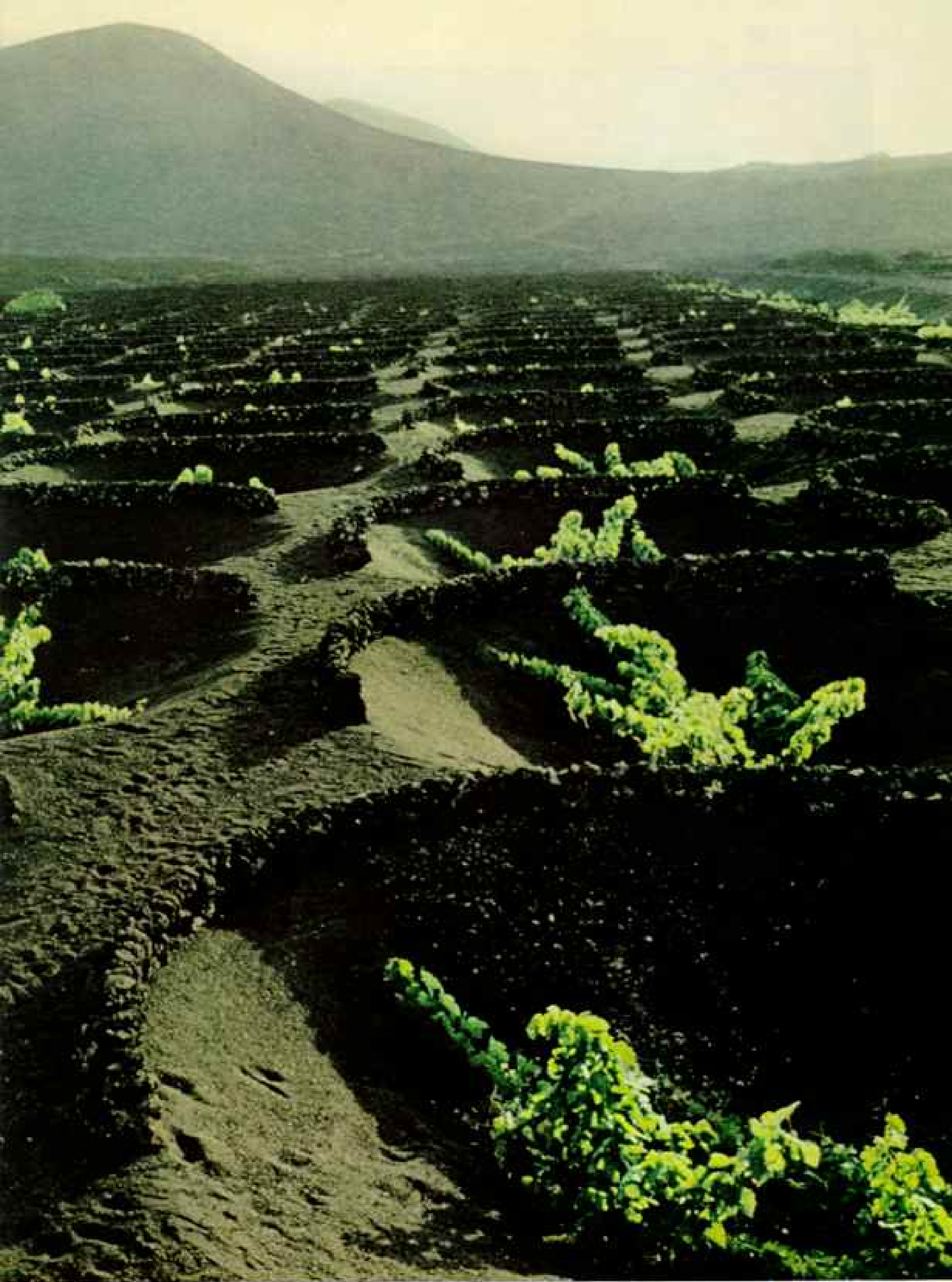
Each camel was equipped as a two-seater, with a little chair dangling on either side of the hump (pages 136-7). Camels arise in three mighty jerks, calculated to send passengers flying unless they have been told how to hold on. The driver usually instructs his passengers while standing with a foot pressing on one of the camel's knees to keep him from getting up too soon—an indignity which any respectable camel considers grounds for roaring.

The beasts are not without finer sensibilities. A female tourist, awaiting the signal to mount, was wearing with the customary slacks and sweater a cloud of French perfume that even the 30-mile-an-hour wind could not take away. When her camel got his first whiff of Paris, he opened his mouth, the better to inhale. Suddenly he swooped out with his great neck, farther than anyone would have thought



MAN-MADE CRATERS, scooped out of granular lava cinders, shelter grapevines from the constant trade winds that whip Lanzarote's tortured

landscape. Semicircular stone walls add protection to windward. After volcanic eruptions of the 1730's spilled a black mantle over much of the island, farmers



ROBERTSON BY FLIP SCHULZE, BLACK STAR © N.S.S.

found that many plants thrive when grown in the loose cinders. This material sponges up scanty winter rainfall and nightly dew and preserves the moisture

during the rainless months. A single vine thus nurtured may yield a hundred pounds or more of grapes for the noted tawny wines of the island.



possible, and fetched up face-to-face with his client, wearing an expression of rapture which the lady did not recognize as such.

"What's the matter!" she cried, jumping back. "Is he trying to bite me?"

"No, no, señora," said the driver, hurrying to her. "Camels just like good smells. I'll show you." He lit a cigarette and held it toward the camel, who turned and opened his mouth to inhale this as well.

Threading along blank precipices of cinders, the caravan provides spectacular views of Lanzarote's congealed rivers of lava, pocked by craters and crevasses. The camels' goal is a shelter near the summit, where they kneel down for passengers to disembark, and as this is an even more jarring experience than their getting up, a certain proportion of visitors normally make the return trip on their own feet.

The Mountain of Fire shows no fire, but in some areas the earth is so hot that twigs tucked into a hole will break into flames, and sulphurous fumes escape from cracks. At Islote de Hilario (map, page 121), for example, the temperature two feet down reaches 700° F. Chunks of lava strew the ground, in brick-red, pink, lavender, yellow, charred white, or iridescent blue.

"What causes all these colors?" I asked Hans.

"This is basaltic lava, more than 10 percent iron. The oxidation of iron and other elements at very high temperatures makes the colors. Even a razor blade when heated will turn iridescent."

SINCE Hans was collecting rock samples, we set out upon the plain of lunar desolation that stretches from the Mountain of Fire to the sea, Hans loping across lava piled up in folds like hardened rope.

"¡Peligroso!" shouted Antonio, "dangerous!" and Hans returned to find out why.

"This lava is treacherous," Antonio explained. "Once on a farm I was picking figs from a tree planted in a hole in the lava and it gave way." He showed a deep scar on the calf of his leg. "It got infected and I was in bed for six months."

We examined a few small neighboring craters and spatter cones, dark red inside like dried blood. But Hans was soon off again across the lava, with me cravenly trying to follow exactly in his footsteps.

"Ah, here is a sight!" he called out delightedly, and I picked my way to the spot. We had encountered desolation before, but here an element of disaster touched the scene. A canyon had been opened in the lava, more than 30 feet wide and equally deep, strewn with huge chunks of debris.

"The most beautiful example of a collapsed lava tube I've ever seen," declared Hans. "When a stream of lava comes out at, say, 2,000° F., the air cools and hardens the outside, but lava is such a poor conductor of heat that the inside remains hot and liquid. Eventually all the hot liquid flows out, and you have a hollow tube left. But if the tube is more than a couple of feet in diameter, it's very likely to collapse. One of the most remarkable in the world, undoubtedly, is the four-mile-long tube that includes the Cueva de los Verdes in the northern part of the island."

BLOOD OF THE PELICAN, symbolic of Christ the Redeemer, provides the theme for a salt painting (opposite) at Arrecife's celebration of Corpus Christi day. Other Canary isles use flowers for such elaborate displays, but Lanzarote—lacking abundant blooms—substitutes brightly colored salt. The pelican, according to ancient folklore, pierces its own breast to give its lifeblood to its offspring. Hence its symbolic relationship to Christ's sacrifice on the Cross.



RETAILED BY STEPHANIE BUNNIE © B.L.T.

INFLATED SHABK'S STOMACH, puffed into a misshapen balloon, whacks merrymakers at carnival time. Lanzarote fishermen began this odd custom long ago, and it survives today—thanks to a local club devoted to preserving colorful vestiges of the past.

On the very fringes of the Mountain of Fire one can see how man has turned a natural catastrophe to advantage.

"Nobody knows how it began," said Antonio. "Maybe a farmer just noticed that where the cinders were three or four inches deep, wild plants had begun to grow and were bigger than those growing in soil alone."

In time the farmers learned that different plants prefer various depths of the gravel-size cinders, or lapilli, as geologists call them. The general run of crops like a depth of three to five inches. But fig trees, grapevines, and—although no one was interested—wild geraniums do best in deeper cinders. These grow on the very slopes of the volcanoes.

As the porous little lapilli cool off at night, they act as condensers, extracting moisture from the air. Even more important, they prevent evaporation of the scanty winter rains, which will stay in the soil

VOLCANIC JEWEL, the islet of Graciosa glows in roughhewn splendor below cliffs on Lanzarote's northern coast. A lone goatherd guides his tinkling flock along the heights. Across the azure strip of ocean called El Rio, a fishing village clings to the smaller island's sandy hem.

When European explorers touched shore at Graciosa and Lanzarote in 1402, they encountered the proud Guanches, tall and fair Canary Islanders, whose origin still puzzles anthropologists. These isolated people knew the use neither of metal nor of boats. Yet, despite their Stone Age technology, they developed an advanced social structure and, like the Egyptians, mummified their dead.

Bitterly resisting Spanish conquest, the Guanches fell to overwhelmingly superior forces—the last of them four years after Columbus sailed from these island outposts to the New World.



beneath the cinders for months, until every drop has gone into onions, tomatoes, chick-peas, lentils, grapes, or—the ultimate challenge—watermelons.

Thus farmers who owned lapilli fields solved the water problem. It took several generations (farmers here are conservative) before those who had no lapilli decided they might transport them from some of the volcanoes to spread over their own land. Now one hardly ever sees a Lanzarote field with soil showing.

The island's farmers have also solved the problem of the buffeting wind in various ingenious ways, as we saw on driving through places like La Geria and near the mountain called El Peñón, around which loom Lanzarote's most exotic black landscapes. The farmers plant grapevines in cinder beds at the bottom of holes six or seven feet deep. Most of the pits also have a low, semicircular wall of lava chunks on the northeast rim (pages 122-3).



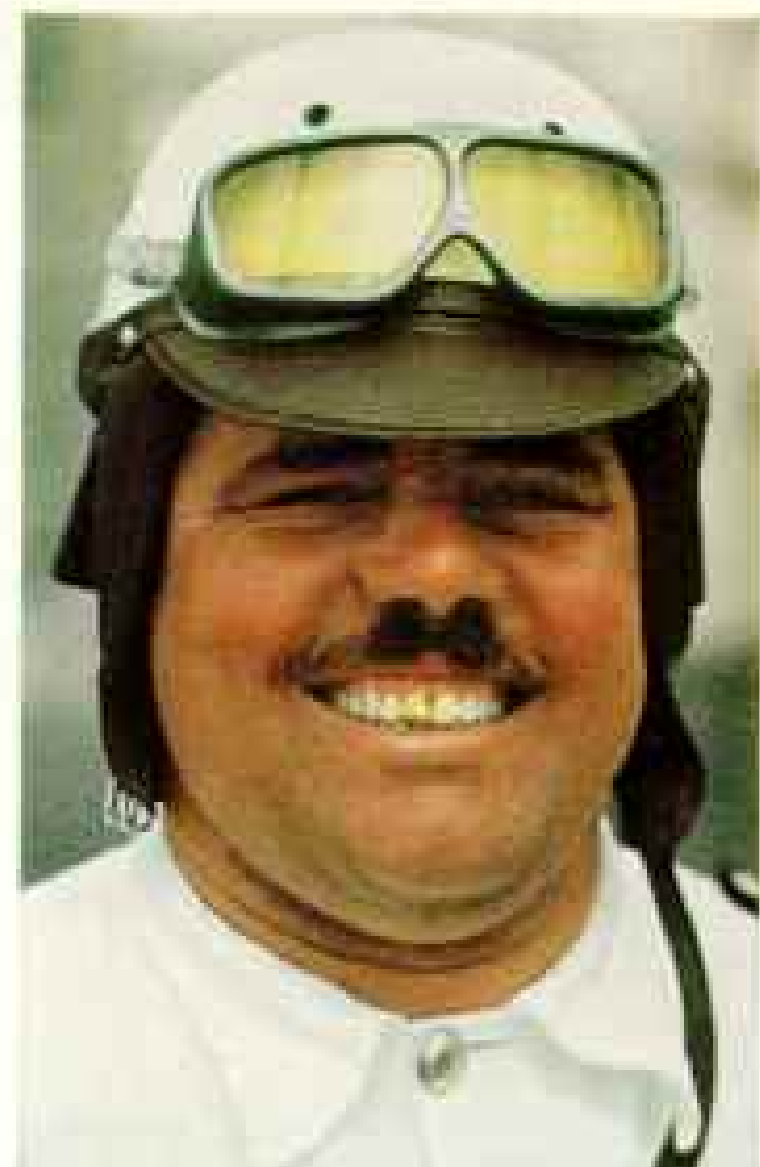
"Vines with walls produce about 10 percent more than those without," said Antonio, "because the wind makes whirlwinds in the pits if there is no wall. A good vine can yield more than a hundred pounds of grapes."

The islanders plant treasured fig trees in deep holes, too, sometimes chipped out of solid lava. And they encircle orange trees with one or even two stone walls.

Stiff little fences of wheat straw protect watermelons and sweet potatoes. Even a two-inch pepper plant will have its own personal rock to stand between it and the wind. Every plant on a farm receives painstaking individual care.

Approaching Arrecife, we came upon a stretch of wind-blown sands that rise from the Beach of Famara in the north and are carried southward by the trade winds. Anywhere else this would be considered a blight to agriculture, but Lanzaroteans have converted it into another unique system of cultivation.

"These fields are best for sweet potatoes and watermelons," said Antonio. "The sand keeps the moisture in, like lapilli. After harvesting a crop, the farmer lets the field lie fallow for a year to collect new moisture. Then it is ready for another crop."



BACK IN ARRECIFE, I shook off the ashes of the lava fields in an evening walk around the pleasant park along the harbor. The park is the social center of the town, where families stroll in the late afternoon, children romp, old men doze on the comfortable stone benches, and courting couples sit close, though always generously allowed a bench to themselves.

In traditionally water-short Lanzarote, the capital's 19,500 residents set great store by the park's flourishing trees. In one bad year, when people were rationed to a single gallon of water a day, they offered to sacrifice part of this for the sake of the trees. (It wasn't necessary; the trees had already been allotted their share.)

Arrecife is fringed by acres of salt-drying beds where sea water, drawn up by windmills, lies in small pools until it has evaporated (pages 130-31). A new silhouette has risen among the windmills: a collection of steel tanks and tubes, the key to Lanzarote's future—one of the world's first privately owned plants for the conversion of sea water into fresh water. Built and financed by an American firm, the oil-fueled steam plant produces 480,000 gallons a day and 1,500 kilowatts of electricity as well.

In the past, people sometimes stood in line and slept in line for the privilege of filling a jar at one of the few springs, and the government had to import fresh water to supplement the scanty supply. But that is over. Although Lanzarote will have little water to irrigate farms, it will have plenty for people, including the thousands of tourists, new residents, and new industries that may come to the island. More fish-processing plants will join the present sardine and octopus canneries. Hotels are going up, the airport is expanding; a new era lies ahead.

When the town was switching from the old water, brackish and polluted, to the new distilled water, I asked a resident how he liked the change.



"AT YOUR SERVICE!" Heraclio Niz Mesa, policeman and past wrestling champion, flashes a smile of 24-carat hospitality for visitors to Arrecife. The Spanish Government presented Heraclio with a special medal for his helpfulness to tourists.

BEATING HOMEWARD, a pleasure craft sails perkily past dozing seiners in Arrecife's harbor. Rich offshore fishing grounds yield a profitable bounty for Lanzarote's fish-canning and dried-fish industries. Burgeoning tourism also buoys the island's economy.

"It's wonderful for the plants," he replied, pointing proudly to his tiny garden. "It used to be that if you brought a plant from another island, as soon as it got sprinkled with our bad water, it began to die. Now look at them."

"And did you and your family notice any effects of the new, pure water?" I asked.

"Yes, it made us sick," he said, "but it made everybody sick. That's natural. Our systems weren't used to pure water. After about six weeks we got adjusted, and now we like it fine."

I passed on this consumer's report to an American engineer at the water plant, who provided the explanation.

"Actually, the town has been putting down new pipes to carry the water," he said, "and new pipes have dirt in them till they get well washed out."

Religion occupies a dominant place in the lives of Canarians, so I was fortunate to be in Arrecife for Corpus Christi day, the most colorful of the islands' religious festivals. Father Ramón Falcón explained the festival's significance:

"We will be commemorating the Communion service, 129

PHOTOGRAPHS © NATIONAL GEOGRAPHIC SOCIETY





PYRAMIDS OF SALT sparkle in drying beds at Playa de Janubio, where lava (top) has tumbled to the very edge of this oasis of industry. Windmills pump sea water into the beds.

which was performed for the first time at the Last Supper. Since the Church is in mourning during Holy Week, we wait until 60 days after Easter to hold this thanksgiving for the legacy of Communion.

"You know, the other Canary Islands are famous for the carpets of flowers they put down in their streets on Corpus Christi day.* Lanzarote has very few flowers, so we make our carpets of colored salt. People start the day before and work all night."

I watched the carpetmakers draw designs with chalk on the streets. Then they mixed damp salt with powdered colorings and filled in the outlines to create giant paintings (page 124).

Next morning the whole town turned out to admire its handiwork until the procession came along to walk across it—Father Ramón

*Jean and Franc Shor pictured and described this colorful custom in "Spain's 'Fortunate Isles,' the Canaries," NATIONAL GEOGRAPHIC, April 1955.



BOBCHROME © NATIONAL GEOGRAPHIC SOCIETY

and evaporation produces the salt deposits. Windbreaks of lava rock prevent gusts from

scattering the piles. The local fishing industry uses the salt as a preservative for exports.

holding aloft the sacred Host, accompanied by church and town dignitaries and children who had just made their First Communion, dressed all in white.

Besides Father Ramón, Arrecife's outstanding personalities include a burly policeman and former wrestling champion named, fittingly, Heraclio (Hercules) Niz Mesa.

Everyone knows Heraclio as "El Pollo," literally "the chicken" but slang for "young man"—especially a sports figure. El Pollo loves his job. He patrols the streets on his motorcycle, pausing to direct traffic, mediate quarrels, take coffee with friends, greet tourists in five languages, hand out photos of himself as wrestling champion, provide information, and end every conversation with "At your service," which is to be taken seriously (page 128).

Word of El Pollo's outstanding kindness to visitors has even





reached the government in Madrid, and he has been awarded the Medal of Tourism. The incident that precipitated this occurred when five students from California, reluctant to pay for a hotel room, inquired whether they could sleep on one of the fishing boats in the harbor. El Pollo took them all home to his wife.

ANOTHER OF ARRECIFE'S helpful citizens, Don Mariano López Socas, introduced me to some of the mysteries of the island's northern part. Don Mariano, who died last year, used to be mayor of the largest community in that area, Haría (population 4,100). While we discussed what I should see, we sipped the tawny malvasia wine for which the island is noted. With it we chewed on a Lanzarotean hors d'oeuvre—dried strips of shark meat. My impression of this *spécialité* was confirmed later when, in a restaurant, I saw a small boy behind the counter peeling the skin off the fish strips with a pair of pliers.

"Be sure to go to the Cueva de los Verdes, now open to the public," Don Mariano urged. "Then, half a mile away, you must see a black pond with creatures in it that exist nowhere else—small blind crustaceans called *Munidopsis polymorpha*. A white veil covers their eyes. At night they come out by the thousands, and at high tide there are many, but at low tide they disappear."

"Tides in a pond?"

"Yes, that is part of the mystery. This salt-water pond, which we call Jameo del Agua, is one section of the same great volcanic tube that includes the Cueva de los Verdes. Evidently it has a subterranean link with the sea; in any case, there must be other pools at lower levels that the crustaceans retire to. It all remains to be explored. A curious thing is that a closely related species—*Munidopsis tridentata*—lives nearby, a third of a mile below the surface of the Atlantic."

On the way north, with my guide Antonio, I encountered other strange fauna. Near Guatiza and Mala, we saw farmers putting the

CAVERN OF ILLUSION,
Cueva de los Verdes
seems to double its vastness in a mirror-smooth lake only four inches deep. The cave's walls, with their stone drapery, actually form the thin outer crust of a section of a river of lava whose surface cooled and hardened while its molten interior continued to flow, leaving behind a hollow basaltic tube 4 miles long and, in places, 80 feet high.

THERE SHE BLOWS! *Water poured into a hole at Islote de Hilario spews back as steam, vaporized by perpetual heat below.*



KODACHROME (ABOVE) AND EKTACHROME © N.S.L.



ETCHED IN SUNLIGHT,
a woman of Lanzarote
appears to have stepped
out of a painting by
an old Dutch master.

The deep-brimmed
straw hat, of a kind worn
only by married women,
shields her face from
sunlight and the island's
cutting winds. Her basket
sprouts stiff strips of dried
shark—a leather-tough
local specialty.

Behind her, shelves
of the century-old
Matallana Pharmacy
in Arrecife hold antique
apothecary jars.
Though fondly pre-
serving an atmosphere
of days gone by, the
pharmacy dispenses
modern drugs.

ETCHINGS (LEFT) AND PHOTOGRAPHY BY
STEPHANIE WARRING © N.O.S.

cochineal insect (*Dactylopius coccus*) to “graze” on cactus, like minuscule cattle.

The farmers plant the prickly-pear cactus in rows, and when it is grown, they drape small muslin bags of insects on the plants. The young are minute enough to crawl right through the cloth. When they grow to full size, the farmers scrape them off the cactus, dry them in the sun, and ship them abroad to make the famous dye that ranges from carmine to orange. Only the females yield dye, and 70,000 will produce about a pound of it.

The invention of aniline dyes eclipsed the cochineal industry, but the dye is still used as a coloring agent in cosmetics, pharmaceuticals, biological stains, and even in some oriental rugs. Lanzarote exports 15 tons of dried insects a year, chiefly to France, but also to England, the United States, and Iran.

Arriving at Jameo del Agua, Antonio and I descended 40 feet of steps to the floor of the tube. Part of the roof has collapsed at this point, but a section still in place shelters the pool like a natural bridge. Hundreds of *Munidopsis polymorpha* were scattered in the water like little white stars, clinging to rocks. They are very hard to catch, but Antonio finally got one.

The creature is a crustacean about half an inch long and built like a lobster. His two antennae, longer than he is, are so fine they are almost invisible. Since he dies in a few minutes when removed from water, I had brought along a soup plate and a black cloth for the bottom of it, to give him something resembling his natural habitat for photographic purposes. Antonio put his thumbs in the plate to give scale, and we were set (right).



MUNIDOPSIS POLYMORPHA
LANZAROTE'S SHARPEST CRUSTACEAN

Munidopsis polymorpha presumably gets his information about the outside world through his antennae. When he had made a tour of his new surroundings and got the message that he was in a soup plate, he evidently concluded that his antennae were out of order, for he took time out to clean them. Reaching up with his left front claw, he pulled down the left antenna and ran the right claw the full length of it five or six times. The right antenna then got the same treatment. When they still said he was in a soup plate, he retired under Antonio's thumb as the nearest thing to a rock he could find.

Scientists still don't know how *Munidopsis polymorpha* got into the Jameo. They believe, however, the crustaceans were trapped there several millenniums ago, and, living in utter darkness, gradually lost the power of sight.

From the Jameo a road leads through broken lava fields to the Cueva de los Verdes. Though this cave has been created by processes dramatically different from those that form limestone caves, there are resemblances. But its stalactites are pointed hangings of gray and red, where lava melted from the shell and solidified while dripping. It has extraordinary double galleries, created when a later eruption laid down a huge basaltic tube on top of the first, without completely collapsing the earlier tube.

A guide led us and several other visitors through a maze of narrow passages, through chambers 50 feet wide, up and down stairs and ladders. Then, with a word of warning, he brought us to the climax of the tour—a ledge from which we could look into an abyss, beautifully lit like the rest of the cave (pages 132-3).

"Would someone like to toss in a stone to see how deep it is?" the guide suggested.

Someone did—and we gasped as the abyss disappeared. It was just the vaults of the chamber where we stood, reflected in a pond.

"The water is only four inches deep," the guide said.

BYOND THE LAKE, in a part of the cave not open to visitors, lies another of Lanzarote's mysteries—a secret chamber used as a refuge from invaders even before the Spanish arrived. It is accessible only by wriggling through a small tunnel, at the end of which a clout on the head would readily dispose of any invader. Siege didn't work either, for at the chamber's other end the islanders could let themselves down a 27-foot drop with ropes and leave the cave by another exit to collect food and water at night.

Although beads, a jet cameo, and some pottery have been found in the refuge, archeologists have never really investigated it. When they do, they may find answers to some of the conundrums of Lanzarote's early history.

Writers of ancient Greece and Rome referred to the Canary





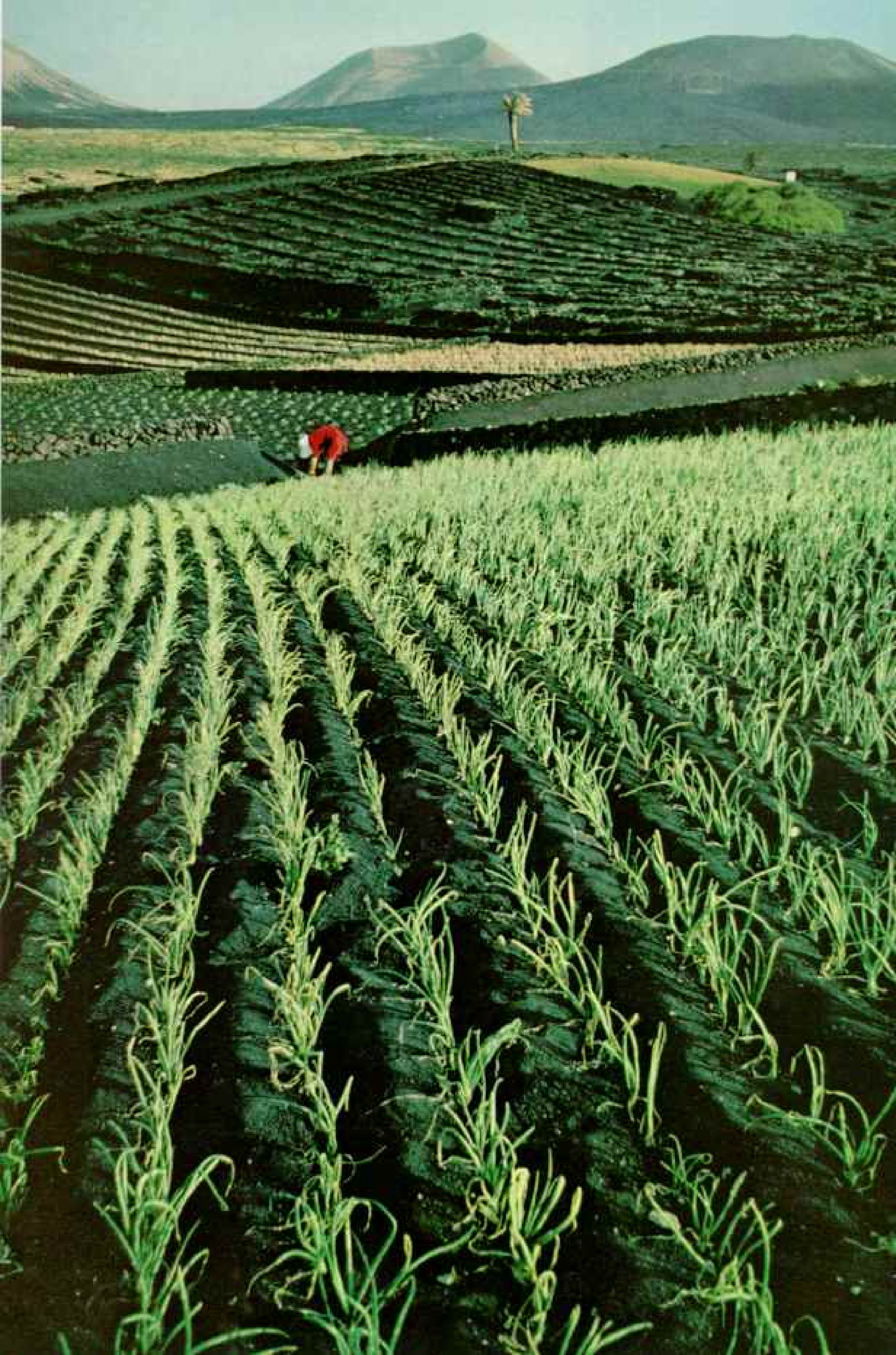
DOOR-TO-DOOR MILKMAID
in Arrecife makes her daily rounds. Green, blue, and pink house trimmings seem to cry out defiance of the island's monochrome landscape.

CRATERSIDE CAFE *affords cool shade and frosty drinks for tourists seeking refuge from sun and cinders. Behind them gapes one of more than 200 craters that pock Lanzarote.*



FOODCROWD (LEFT) AND ENRIQUETA © NELLE

TWO BY TWO, *chair-borne sightseers ride camels plodding along charred slopes to the spectacular Mountain of Fire, where Lanzarote's fierce heart throbs just beneath the surface.*



Islands by such names as Garden of the Hesperides, Fortunate Isles, or Elysian fields. But concrete evidence that the Canary Islands had had visitors from the ancient world did not appear till 1964, when a skin diver brought up a Roman amphora of the second century A.D. from the waters of Graciosa, Lanzarote's satellite island to the north (pages 126-7).

The first foreigner to make a lasting impression on Lanzarote was Jean de Béthencourt, who arrived in 1402, a Norman knight exploring for King Henry of Castile. Eventually he presented the king with four Canary Islands.

It was Béthencourt who discovered the Guanches, those Stone Age islanders who knew no boats. And it was he and his successors who conquered and eventually assimilated them. Few traces of the Guanches survive among Canarians. Who were these mysterious people that first populated the Canaries? The Guanches mummified

their dead, which suggests a link with Egypt. And they have left one living clue—a unique sport called Canary wrestling, still practiced in the islands (page 118). The opening stance and basic positions of attack and defense closely resemble those depicted in the ancient bas-reliefs at Beni Hassan, in Middle Egypt. El Pollo staged a demonstration for me in the vacant lot where he trains the Lanzarote team.

What does this suspicion of Egyptian origin do to the theory that the Guanches were the people of Atlantis? To find an answer I traveled to Tenerife to consult Dr. Telesforo Bravo,



LYNCHWOODS LABEL BY FLOR SCHOLZE, BLACK STAG, KILMACOMORE BY STEPHEN DICKINS © N.S.A.

LIFE-GIVING CINDERS, with their ability to condense moisture from the air and retain it, make agriculture possible in Lanzarote's unpromising geography and climate. Onions (left) grow to juicy perfection, as do grapes, figs, and even watermelons—despite an average rainfall of barely five inches a year.

SURLY BUT USEFUL, the camel serves grudgingly as a draft animal and beast of burden on rain-starved Lanzarote. Europeans introduced the creature from North Africa in the 15th century.

leading expert on the Canaries, a geologist also trained in zoology, botany, and archeology.

"I don't believe in the Atlantis theory," he said. "These islands have been more or less as they are now for 15 million years. You can tell by the way the sea has eroded the coasts, and by marine fossils."

"Then where did the Guanches come from?"

He paused. "You know, the Sahara was green with vegetation 25,000 years ago. Gradually it turned into a desert. Perhaps the Guanches lived there and eventually migrated to the coast with their flocks because of lack of water. The seamen of the coast could have transported them to the Canary Islands. Being people of the Sahara's interior, they would know nothing of boats. I should guess they came about 5,000 years ago. It is difficult to say, but I believe this is a reasonable theory."

So Atlantis buffs will probably have to look elsewhere. But should they find their lost Atlantis, I rather doubt it will prove any more mysterious and strange than Lanzarote.

THE END



The Quetzal

FABULOUS BIRD OF MAYA LAND



By ANNE LABASTILLE BOWES

Photographs by DAVID G. ALLEN

Resplendent princeeling of the lofty Guatemalan forest, a male quetzal alights at the door of his nest, his bright-red breast concealed from view. Three-foot-long tail coverts wave in the April breeze, resembling at a distance the air plants, right, growing high on the trunk of a dead tree. The author called this courtly fellow "the Caballero."

For centuries Indians of Middle America revered the elegant quetzal—pronounced ket-ZAL—member of the colorful trogon family. The Aztecs portrayed their god Quetzalcóatl, the Feathered Serpent, with a headdress of quetzal plumes (above).

Today poachers sell skins as curios; farmers clearing forests destroy the bird's home. The jewel-like beauty has become a rare sight, except in remote wilderness.

ILLUSTRATION © R.A.L.

MOSQUITO-BITTEN, breathless, and soaked with mist and perspiration, we labored over a tortuous trail high in the mountain cloud forest of Guatemala. We stopped often, both to rest and to scan the leafy overarching canopy for a feathered flash of green and red.

Quetzal, the Indians have called it for centuries—a fabulous bird as beautiful as Mayan jade or Aztec gold and nowadays increasingly rare. By cutting and burning the forests, and by killing the birds and selling their feathers, man has driven this iridescent, streamer-trailing beauty from many areas where it once was numerous. To observe and photograph the quetzal before it is too late, the National Geographic Society had sent wildlife photographer David Allen and me to this remote corner of tropical America. With luck and persistence we hoped to find a nesting pair.

Winged Jewel in a Green Setting

A green and grandiose world—the cloud-forest home of the quetzal. Massive oaks tower 150 feet, while figs laced with lianas reach almost as high. A bed of leaves, some as large as turkey platters, covers a layer of topsoil seven feet thick. Treacherous canyons slash the volcanic slopes.

Awesome rains drench the forest, encouraging decay of all that is dead, and nourishing living foliage to greater fecundity. Mists appear, mantling and muffling this regal garden. And through it all, an arc of green fire in sun, an emerald meteor in mist, a cold viridian flame in rain, moves the quetzal.

As Guatemala's heraldic emblem and unit of currency, the quetzal appears on the country's flag, coat of arms, stamps, and money (page 148). One of the most beautiful birds in the world, it takes its name from *quetzalli*, Aztec for tail feather, which came to mean "precious" or "beautiful."

The first part of the quetzal's scientific name, *Pharomachrus mocinno*, derives from the Greek words for "long mantle"—an apt description of the lustrous plumage that ends in a regal sweep of yard-long feathers. The second part perpetuates the name of a now-obscure 19th-century naturalist, who aided in bringing the first scientific specimens of the quetzal to Europe.

To reach our search area on the upland *fincá* (farm) of a helpful landowner, David and I squeezed into a supply-laden jeep driven by veteran guide Manuel Crespo. The jeep and a trailer carried a ton of food and equipment—cameras, climbing spurs, altimeter, slickers, rope ladder, and dehumidifier (to protect David's film). We bounced around the flank of 11,604-foot Volcán Atitlán in mist-wreathed forest that grew denser with every mile. At last we came to quetzal country and set up camp in a solemn woodland clearing.

At dawn next day we followed two local guides on foot through the mile-high forest. A contest of bird calls greeted us. So riotous was the music that it reminded me of a tape recording played at double speed. But our huffing and puffing left little silence for listening. Diego Tzam and Rojelio de León, accustomed to the rugged terrain, paused often to smile at the panting gringos.

Diego's coarse black hair hung over a pair of lively dark eyes. Barefooted and bronzed, he could slip through the jungle unheard and unseen. Rojelio, a teacher, wore a mustache and carried a .22-caliber rifle. His knowledge of quetzals proved invaluable.

Spectacular Bird Blends With Foliage

So long had we hoped and planned for a sight of one of these magnificent birds that I half expected it to be a moment of high drama. Perhaps that moment would come after a long, painstaking stalk. Or perhaps the bird suddenly would flash overhead, vivid against the somber foliage.

But it wasn't like that; the long-anticipated moment came quietly and undramatically. Rojelio and Diego stopped on the path ahead, pointed to a tree, and directed us to hiding places nearby. In the dim cathedral light, we could just make out bunches of bromeliads growing about the top of the tree. The blade-like leaves swung in a gentle breeze. Yet two of those leaves seemed greener, more fragile: Diego winked, Rojelio nodded. Feathery plumes—our first glimpse of a live quetzal!

The bird, a male, was snuggled down half hidden inside his nest hole, facing outward.



The quetzal's highland haunts span Central America. The species divides into two subspecies, or races (pages 144-5). This article describes the northern bird.

Cloud-climbing in the misty land of the quetzal, Diego Tzam, Guatemalan assistant to the photographer, sways toward a nest in a frail trunk. He tries to see newborn chicks of a pair of quetzals which the author named "Organ Grinders," because of the male's harsh call. Nylon cable supports rope ladder.

Wildlife biologist Anne LaBastille Bowes is a candidate for a doctorate at Cornell University. Seeking the quetzal in Guatemala, she worked familiar territory—for four years she has been studying the giant pied-billed grebe of Lake Atitlán and aiding international efforts to protect the rare flightless bird.



EXTREMES (ARIEL) AND FOGACHONE © R.A.S.







Flashing a crimson vest, a Guatemalan male, *Pharomachrus mocinno mocinno*, departs for lunch, his yard-long train rippling gaily. Usually a short-distance flier, he spirals high above the treetops during spring-flight displays. The red breast results from pigment. Other feathers, however, glow with iridescence because of their specialized structure: Microscopic granules break white light down into green, blue, and sometimes gold—hues that shift like colors in a soap bubble.

Equally dapper but slightly smaller, a Costa Rican male, *P. m. costaricensis*, sports plumes well over two feet long. All quetzals possess a short bill, suited to digging in soft, dead wood. A courting pair may enlarge a woodpecker's abandoned hole to accommodate their pigeon-size bodies. They take turns at nest carving, brooding, and feeding young.



ACQUAINTANCES BY JAMES A. KERR (MIDW.) AND DAVID L. ALLEN (R.S.S.)

His two longest tail coverts, bent up over his head, curved outward from the hole.

Work began in earnest. We moved silently, with deliberation, making every effort not to startle or, worse, frighten away the nesting pair. David had to set his cameras about ten yards from the hole and on a level with it—his lights even closer. This meant building a photographic tower 25 feet high. Atop the platform David secured his canvas blind, full of tripods, batteries, lights, and camera cases.

To blend with the forest setting, we spray-painted every exposed piece of equipment green. In this process Manuel earned the name "Señor Green Ears." To ward off the voracious mosquitoes, he applied a generous burst from a pressurized can of "insect repellent." On closer examination, he found that the label read "Emerald Green."

Finally, we draped vines near the nesting tree to offer tempting perches to quetzals. After days of work the stage was ready. David climbed into his lofty blind. The rest of us retired to the camp we had set up nearby—mountain tents, a palm-thatched *champa* (hut) for cooking, and a great stack of firewood.

To give me a close view of our quarry, David offered me his blind for a day. Next morning I huddled inside, binoculars ready.

Two hours passed without a sign of the quetzals. Normally the female incubates her eggs all night and much of the day. The male relieves her in early morning, allowing her time to feed until midmorning. Again in mid-afternoon he reports for brooding duty to give his mate a break until dusk.

Medley of Color Flashes Into View

I was developing deep respect for the patience and alertness of wildlife photographers. David had already calculated that, during the incubation time, the birds would offer themselves to his cameras for as little as 90 seconds in an eight-to-ten-hour day!

"Thump!" It was the sound of a quetzal swooping in to alight on the nesting tree.

I peered through my field glasses. In what had been an empty black hole perched a shimmering male bird. I gasped.

The quetzal heard me and turned his head suspiciously. For half a minute his chocolate-brown eye fastened upon the blind, giving me ample time to admire him. His bright-yellow beak, slightly curved at the tip, was adorned with short bristles at its base. His head and body merged, as though he lacked a neck. He had yoked toes—two forward, two to the rear.

The head, back, and wing coverts were an incredible luminous green, with the black primaries and secondaries just touching across his rump. Below hung four elongate plumes of iridescent splendor. The longer pair must have measured nearly three feet.

Satisfied that no danger threatened, the bird slipped into the nest hole. During this fluid motion, I glimpsed the male's curling shoulder cape of gilded green feathers, carmine-red breast and belly, and red undertail coverts. He seemed so dashing that I named him "the Caballero."

On April 7 David reported that the male had brought an insect to the nest. The eggs had hatched! David's photographic opportunities improved as the parent birds made frequent visits to feed the young.

While David stuck to his blind, Diego and I roamed the rugged forest, searching for new trees, observing quetzal behavior and feeding habits, and identifying animals and plants. Ranging over 250 acres, I located nine possible nesting sites, mostly in the soft, rotted trunks of the *masico*, a member of the mul-

berry family. The days passed magically.

I concluded that the quetzal, when not at the nest, spends much of its time high in the upper third of the trees and seldom, if ever, descends to the ground. He obtains water from dew and rain, and from the fruits and insects that make up his diet. The fruits he often snatches with a twist of his bill while in flight.

Early one afternoon, David reported that the Caballeros had abandoned their nest.

Stunned, we quickly examined the empty nest tree. We combed the ground for clues and found two breast feathers of the adult female. We remembered hearing the shrill chatter of gray squirrels, and I recalled seeing owls ghost past the previous night. David had heard a "swoosh" and glimpsed a passing *Spizaetus ornatus*—ornate hawk-eagle.

Later we learned that the unknown predator had killed only the chicks. Both adults survived, the mother bird minus some feathers.

New Nest Occupies Precarious Perch

Meanwhile, Diego and I had sighted another nest. It was in a mossy snag, fifty feet tall, standing lone and wobbly within a deep canyon. On the other side lay a rare level spot about twenty feet square, just big enough to accommodate the tower for David's blind. To cross over, we straddled and slid along an eighty-foot fallen tree trunk.

Here we added an innovation—a "perching tree." No vines or branches grew near the nest. With no intervening perch, the quetzals would swoop straight to the hole and duck inside before a picture could be snapped.

David chose a 52-foot *Cecropia*. It took six hours and several extra men from the finca to drag it down, dig a hole, insert the tree trunk, and lop off all but a few branches.

Within five minutes after we had set up the perching tree, the gorgeous male alighted on its lowest branch and voiced his territorial call. Clearly, it was his tree now. We nicknamed him the "Organ Grinder" because his call, in contrast to the quetzal's usual melodious whistle, was harsh, almost nasal.

Our new subjects taught me more about quetzal behavior. They seldom sit with their ruby-red areas exposed to an observer. On the wing, they fly like woodpeckers, in short, undulating dips and rises, plumes rippling saucily behind (preceding pages). Once I glimpsed the male quetzal's frivolous flight display: He spiraled skyward, singing exuberantly, hovered above the forest, then sped

Plain Jane compared to her mate, a female wears barred tail feathers and only a touch of red. Crest and train never develop like the male's. This mother carries a morsel for her chicks, which subsist on insects, grubs, and snails. Adult birds also eat small fruits, snapping them on the wing. Ever wary of predators—squirrels, owls, kinkajous—they seldom leave the nest for long.

Quetzals hardly ever descend from their towering trees, and to make this rare photographic record in color David Allen needed the agility of an acrobat as well as the ability to think like a bird. Besides nylon cable and rope ladder (page 143), he used a 25-foot portable blind. He had learned wildlife photography from a master—his father, the late Dr. Arthur A. Allen, noted Cornell University ornithologist, a pioneer color photographer of birds, and author of the National Geographic Society's book *Stalking Birds with Color Camera*. On a National Geographic Alaskan expedition in 1948, father and son discovered the nesting place of the bristle-thighed curlew, one of the last of North America's more than 800 bird species to reveal its home to man. David found the first nest.



QUETZALS: ILLUSTRATIONS AND PHOTOGRAPHY BY DAVID G. ALLEN © N.G.S.

Bruised and helpless, eyes not open, 12-day-old chicks tumbled 60 feet when their tree home collapsed after heavy rains. The author placed them in an artificial nest, but their parents would not approach it. Although Anne Bowes kept the chicks alive for three days with careful feeding, their injuries proved fatal. Later, she observed the parents preparing to raise a second brood. The pale-blue eggs of the quetzal, usually two, are laid directly on the sawdustlike debris that forms the floor of a nest hole hollowed out in a half-rotted tree.



Blowgun with clay pellets, weapon of forest hunters, sometimes fells quetzals despite Guatemala's protective laws. A poacher offered the author a quetzal skin for \$2.



Symbol of liberty, the graceful quetzal won its honored place as Guatemala's national bird because of the early—and erroneous— notion that it could not live in captivity. The bird also gave its name to the country's currency; one quetzal equals one U.S. dollar. Collectors value this rare silver coin at \$400.

To protect the species, author Bowes preaches conservation to rural schoolchildren, illustrating her talk with a stuffed quetzal held by teacher Rojelio de León. "We can help preserve the quetzal," she tells them, "by not cutting down his forest home or hurting him in any way." On a National Geographic map, she points out the bird's range.



back to the treetops and his bemused female.

One evening, just as we finished a meal of leathery beefsteak, tortillas, and beans, the earth began swaying violently. Earthquakes are common in this volcanic belt, and this one lasted for a minute and a half. Then a heavy thunderstorm began. We spent a gloomy night pondering what these elemental forces could do to a fragile, rotted nesting tree.

At dawn we bounced apprehensively up to the canyon in the jeep—and sighed with relief. There sat the Organ Grinder, safe in his snag, plumes waving in the breeze.

Chicks' Secure World Ends Abruptly

The rainy season soon arrived, bringing daily deluges. The Organ Grinders had chicks now, and the adults provided a two-bird shuttle service bringing food—grubs, spiders, termites, caterpillars, and moths.

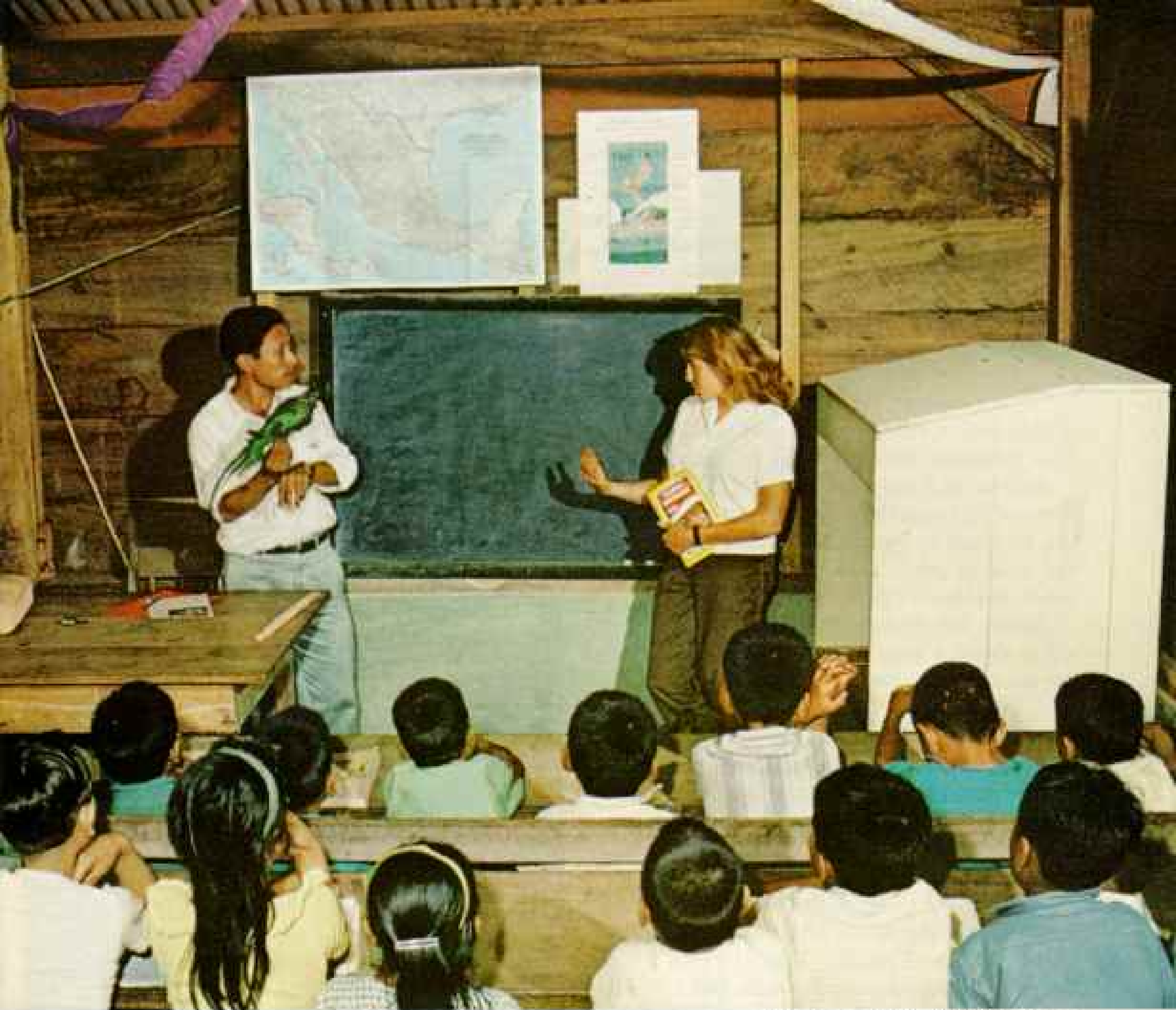
On one of our infrequent sunny mornings, we sat munching sandwiches and watching the spectacular Organ Grinders. Suddenly,

astonished and horrified, we saw the top half of the nest tree topple! There had been no recent rain, wind, lightning, or quake. Earlier soaking rains had apparently made the rotted tree top-heavy.

Nest and chicks dropped into the canyon. Manuel pawed through debris, found first one nestling, then the other. They were alive. He cradled them in his strong hands, breathing warmth over them (preceding page). The larger had a cut across its backbone; the smaller showed signs of hemorrhage behind its eye.

In a desperate effort, we hollowed out a section of trunk, grafted the new home atop the stub of the nesting tree, and installed the chicks. But the Organ Grinders merely called plaintively from the forest's edge. The adults would not enter the strange new abode.

So I had to assume the maternal functions, feeding the baby birds with forceps. Little boys from a nearby village came running with worms and insects. Women brought corn meal and avocados.



SETALAHUIME (FAR LEFT) AND KOTACHIHIMEL © R.S.S.

The chicks were heavy-legged, with enormously wide beaks and protuberant bellies. Fuzzy rows of black and brown feathers alternated with strips of naked, almost transparent skin. Never, it seemed, did such beautiful parents produce offspring so grotesque.

The chick with the cut back died first. After three days of care, the second passed away. We felt dismal. We had lost a priceless opportunity to document wild quetzal growth, but beyond that we had all grown fond of the rasping rascals.

Happily, we soon discovered that both the Caballeros and Organ Grinders were busy with second nestings.

Survival Hope Hinges on Conservation

Before breaking camp and departing, we built an experimental quetzal nesting box and nailed it to a tree. We wrapped metal flashing around the trunk below to protect possible tenants against climbing predators.

We never knew whether or not a quetzal

couple moved in, and perhaps it was a futile gesture. Saving the quetzal from gradual extinction will require a broad conservation and education campaign throughout southern Mexico and Central America.

Traveling in rural Guatemala, we learned of strange customs, fitting perhaps for the year 968, certainly not for 1968. Old men, to assure another year's good health, kill quetzals and parade them through the streets. Villagers of one hamlet annually wrap their statue of St. Joseph in quetzal plumes and carry it through the village in solemn procession.

Tradition thus continues what started many centuries ago, when Quetzalcóatl, the Feathered Serpent, a god revered by Mayas and Aztecs alike, was depicted wearing a head-dress adorned with quetzal plumes (page 141). Indians of those times live-trapped quetzals, plucked the prized plumes, and released the birds. The tail coverts grew back after the next molt. Any commoner who killed a quetzal faced the death penalty himself.

Ends meet as a quetzal does a U-turn in a nest hole too small for his beautiful train. This male, the Organ Grinder, peers from his home with his yard-long finery protruding from the nest-riddled tree. Some Guatemalans believe the birds enter by one opening and leave by another to save their feathers. Actually, the holes do not connect. Plumes may fall off during nesting, but others will grow by next mating season. SIMONNE © N.S.A.

"The mountain people still regard this bird with awe," a village priest told us, "but they also recognize its cash value in illicit trade."

Arrival in Europe of the first commercial skins of this unbelievable bird started a booming business in the mid-19th century. During the next 25 years, quetzal skins by the thousands reached Old World markets.

Today, despite protective laws, tourists and curio dealers keep alive an illicit trade that encourages poaching.

Smoke on Horizon Signals Trouble

Once our road took us above 9,000 feet into a fragrant woodland of pines, firs, and oaks, their branches weighted with masses of tropical air plants, fragile orchids, and golden mosses. This looked like ideal quetzal country.

"Just another kilometer to Pig's Foot and Lemon Crossing trails," said our jeep-driving friend Manuel Crespo. "That's where I saw two male quetzals, one juvenile and..." His voice faded away. From the crest of the rise we could see a smear of smoke and fire ahead. Worse, our vantage point revealed nine other forest fires blazing upon the hills around us.

Here, as in many parts of highland Middle America, man's unthinking misuse was destroying the forest habitat of the quetzal.

We halted the jeep near two soot-stained, ax-wielding Indians. All about us smoke billowed, trees crashed, and birds shrieked.

"Why are you cutting and burning the forest?" I asked with concern.

"To plant corn," said one of the Indians wearily. "We have to eat."

"But why don't you leave some trees to renew the forest?"

"It is the custom *this way*."

There was nothing more I could say. We climbed into our jeep and drove sadly off. The future of what many regard as the most beautiful bird in the world was at stake. But I took a measure of satisfaction in one thing: We had captured the storied quetzal on film for generations that might never know the living bird.



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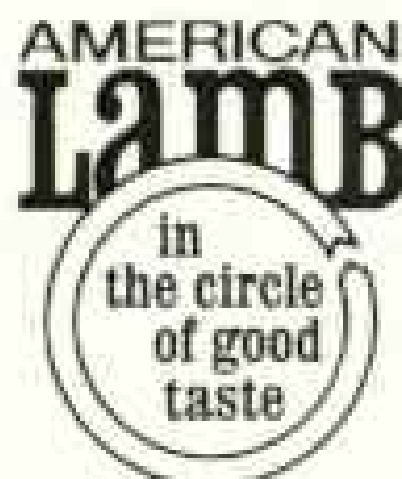
$\frac{3}{4}$ leg of lamb	2 tablespoons
$\frac{1}{2}$ cup chopped onion	prepared mustard
$\frac{1}{2}$ cup orange juice	$\frac{1}{4}$ teaspoon rosemary
Salt and pepper to taste	

Place lamb on rack in shallow roasting pan. Roast in 325° (slow) oven 30 to 35 minutes per pound, or until meat thermometer registers 175° for medium doneness. Combine onion, juice, mustard, rosemary and seasoning and spoon over the lamb during the last hour of roasting time.

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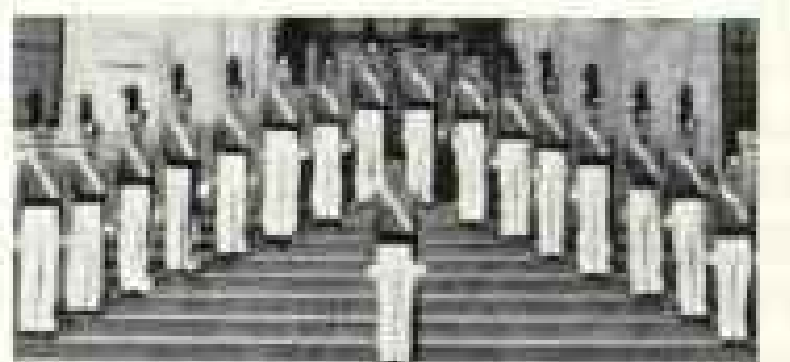
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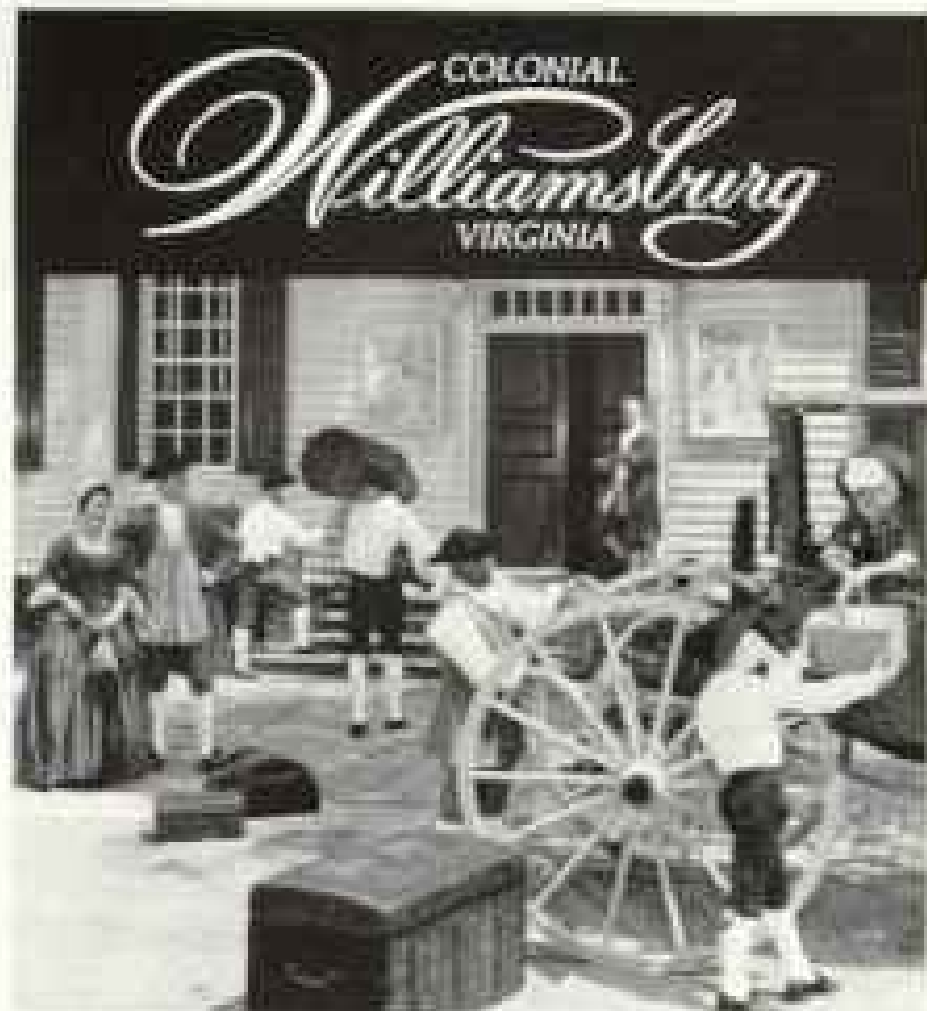
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