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Journey into Troubled Iran

With 35 Illustrations and Map
26 in Natural Colors

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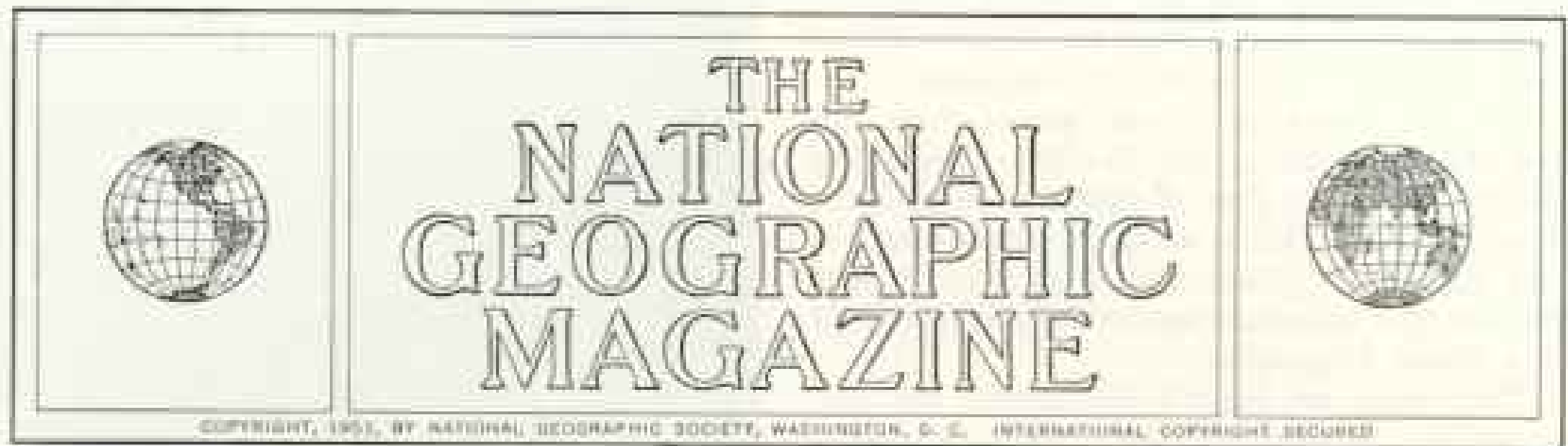
ALBERT W. ATWOOD

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Journey into Troubled Iran

BY GEORGE W. LONG

With Illustrations by National Geographic Photographer J. Baylor Roberts

"WE'RE terribly sorry," said the blond hostess as I entered the dining room of the Anglo-Iranian Oil Company's Riverside Guest House in Abadan, "but there's been a little trouble. Riots in the town, mob violence, perhaps a dozen people killed. Right now things are quiet. Persian soldiers, reinforced by sailors from the naval base in Khorramshahr, are patrolling the streets.

"There's a curfew on," she added, "and all of us are confined to the premises until further notice. Guards are on duty at the gate, and they've put up a barricade to protect us. Make yourself comfortable."

Eating dinner, National Geographic staff photographer Joe Roberts and I reviewed the afternoon, wondering how narrowly we'd missed the outbreak. That morning we had flown the length of Iran from Tehran, at the foot of the snow-mantled Elburz Mountains, to see this city that oil had built near the shores of the Persian Gulf (map, page 428). After lunch we had set out on a tour of Abadan in an oil company car, guided by a 30-year Iranian employee.

City Mushroomed on Barren Island

In three crowded hours we covered every section of this modern company-built town of 175,000 people (pages 426-7). On street after wide, palm-fringed street we passed workers' substantial brick houses—single, double, and row—each with well-tended lawn. Major avenues intersected in shrub-planted traffic circles. Oleander was in bloom everywhere.

Forty-odd years ago flat, sun-baked Abadan Island was a barren waste except for a fringe of date palms. At the century's turn William Knox D'Arcy, an Englishman who had made a fortune in Australian gold, became interested

in the prospects of finding petroleum in the Middle East. In 1901 the Persian Government granted him a concession.

After seven costly, disappointing years his agents struck oil in the hinterland. Overcoming countless obstacles, D'Arcy men sank more wells, built pipe lines down from the hills, and started Abadan's refinery. In 1913 the first petroleum products trickled from Abadan to world markets. Now some 20 million tons of crude a year normally pour through this largest refinery in the world.

"The company does a lot more than get and sell oil," our guide said. "It has built and equipped 17 public schools in Abadan and provides substantial allowances for their Persian teachers. It gives apprentices a five-year training course, conducts adult night classes, and provides higher technical training in its Technical Institute, the only such school in Iran. Specially promising students are sent to English universities.

"The company has built this city single-handed and provided its public services and utilities—roads, lights, water works, sewage system, and the like. Its model farms and hospitals are the Middle East's finest. Company doctors and health officers fight a continual battle against disease and treat school children free.

"For its 70,000 employees, the vast majority of whom are Persians, AIOC has a wide program that ranges from industrial insurance to free medical care and organized athletics. It publishes three newspapers and operates 10 social clubs with outdoor swimming pools. It runs hobby groups, lecture and concert series, libraries, and 23 cinemas."

Sprawled in the center of the city was the gigantic refinery, its tall stacks smoking or spasmodically belching sheets of flame. Huge

storage tanks covered acres of ground. Our guide pointed out the new catalytic cracking unit recently brought from the United States and installed by American engineers.

On the Shatt al 'Arab water front we saw the lifeblood of the Machine Age being pumped aboard a fleet of seagoing oil tankers. Before going dockside we had to leave matches and cigarette lighters with a guard. A sign the size of a billboard warned NO SMOKING in a dozen languages.

Returning, we passed the School for Apprentices. Our small British automobile edged through a crowd milling in the street. Around the building stood a grim cordon of helmeted Iranian soldiers with fixed bayonets. At a circle farther on traffic jammed while a truckload of youths waving a flag rumbled past.

"The apprentices are on strike," our guide said. "Last night there was a demonstration. It's nothing."

Reign of Terror

By our calculations, the trouble broke out a few minutes later. When it subsided, 11 Iranians and three British lay dead, and terror reigned in Abadan. No one could tell when or where another flare-up might occur.

After dinner we joined fellow "prisoners," men and women, in the Guest House lounge. Pent-up emotions found relief in conversation; no social introductions were necessary. Rumors flew, and experiences of the afternoon were exchanged. Old Empire hands told of similar adventures in their youth that sounded like episodes from a Kipling novel. Every hour, as if drawn by a magnet, we gathered around the radio to hear the latest BBC news report.

Two days later the situation in Abadan seemed under control. Roberts and I left our comfortable "prison" to board an Iranian Airways plane for Tehran. Stopping in Isfahan after a blind flight across the rugged Zagros Mountains in a crashing storm, we heard of outbreaks there among the textile workers. Our informant was a handsome young Bakhtiari prince, who was boarding our plane. A flyer himself, he took over the controls when we were aloft, on the invitation of our bearded French pilot.

Three weeks earlier we had flown into Tehran from Damascus on the wings of Air France. Our arrival in the city, which seems to be at the end of the world, was made pleasant by the American colony there.

Going through customs, we heard a voice behind us exclaim, "Welcome to Iran. You're Long and Roberts, I presume. I'm Ed Wells, of the Embassy."

That evening we dined with the hospitable Wellses and later swung partners in a square dance at the new American Center. Next day we cheered for old Penn State in its



Abadan: World's Largest Petroleum Refinery

Smoking stacks, acres of storage tanks, office buildings, and workers' homes sprawl on a flat, sun-baked island at the head of the Persian Gulf.



Heart of Oil Operations in Iran, It Can Process 500,000 Barrels of Crude a Day

In 40 years Abadan grew from barren wasteland to industrial colossus. Around the refinery Anglo-Iranian Oil Company, Ltd., built a modern city complete with hospitals, schools, theaters, and social clubs. Last spring its population reached 175,000. Seagoing tankers, berthing in the Shatt al 'Arab, normally swallow the refinery's output.



The Ancient Land of Iran—Hot Spot of the Middle East—Is Vast, Strategic, and Oil-rich

Great Britain, France, Italy, and Spain could fit inside Iran with room to spare. It is a bridge between Far Eastern Asia and the Mediterranean world, and is a neighbor of Soviet Russia. Beneath Iran's soil lies nearly an eighth of the world's proved petroleum reserves; central of this vast resource is the aim of Iran's struggle to nationalize its British-built oil industry. Oil fields lie on the flank of the Zagros Mountains.

soccer match with a team of Tehran All-Stars in the city's stadium (page 434).

Getting acquainted with Tehran took time. Most of our first two weeks were spent drinking countless glasses of tea with Iranian officials, filling out Government forms, and obtaining the numerous permits foreigners need.

Moreover, it was spring, and the Persian New Year. Slender poplar trees showed faint green along streets and in walled gardens, birds were singing, and the midday sun was waxing strong. And in a land where *jardak*

(tomorrow) is the watchword, spring fever is harder to combat.

"Tomorrow you must come with me and enjoy a real Persian holiday," invited a new acquaintance.

"What's the occasion?" I asked.

"It's the 13th day of the New Year," he replied. "Our year begins on March 21. Before the old year is out, families plant wheat or lentil seeds in a shallow bowl. Tomorrow they will go on picnics and cast the sprouts into running water. In this way they



Gaily Colored *Chadars*, Women's Concealing Wraps, Blossom Again on Tehran Streets

Banned in the 1920's, the old-style garment virtually disappeared; now it has made a comeback. Older women prefer black, while the younger choose bright prints. Many walk on Western-type wedgies. Tehran's buses sport handmade bodies built on American truck chassis. MP is armed with a machine pistol.

welcome spring and carry the coming year's bad luck into the country and leave it there. Come, and you'll see."

Next morning we set out toward the towering Elburz Mountains. Already crowds in holiday mood jammed the main road. Old and young, rich and poor—in Cadillacs, carts, jalopies, trucks, afoot, and on burros—poured out of the city. Buses did a landoffice business, heading north packed and returning empty for other loads. MP's directed traffic; vendors hawked soft drinks, water, and "eskimos" (ice cream). Picnickers on foot spread cloths and set up samovars in vacant city lots. The more fortunate reached green fields, shady orchards, or pleasant mountain retreats (page 440). Soon Tehran was deserted.

An English correspondent who flew into the capital that day told me later how unsettling this mass evacuation had looked from the air.

"As we circled for a landing," he said, "we noticed the roads jammed with people. Had no idea what had happened. Thought it must be war, or perhaps a revolution."

Actually, although political assassinations, threats of violence, and occasional demonstrations kept the Government on edge, the city itself seemed calm, especially after our visit to Abadan. Martial law and the midnight curfew were lifted. The vast majority

of Tehran's inhabitants were too busy earning a precarious living to be concerned with politics.

With members of the foreign press we visited the Majlis, Iran's House of Commons, where the life of Prime Minister Hussein Ala's Government hung in the balance. Deputies, gathering under the ornate chamber's crystal chandeliers, conferred in small groups or quietly took their seats. Citizens jam-packed a small gallery. Soldiers with bayoneted rifles stood by doorways.

Iran's House of Commons in Action

The Prime Minister and his cabinet arrived. The Speaker's gavel rapped. Half a dozen deputies spoke in turn, including emotional Mohammed Mossadegh, soon to be Prime Minister himself. Heckling from the floor interrupted them. A loud bell, rung by the Speaker, cut too-heated arguments short.

At length Ala, twice Iran's Ambassador to the United States, walked to the rostrum. Calm, dignified, he read his program in a low voice: cooperation with the United Nations . . . maintenance of security . . . negotiation of disputes . . . justice under law. No interruptions now; delegates listened attentively, thoughtfully fingering the beads that many Persian men carry. Later they gave the Prime Minister a thumping vote of confidence.



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Big Water Mains Bring a New Era to Iran's Booming Capital

For generations Tehran's chief water supply has flowed in open stone gutters. Last spring, while citizens stared, workers began tearing up main thoroughfares to lay a modern underground system for the fast-growing city.

Yet within two weeks he was out, Mossadegh was in, and oil nationalization was an accomplished fact in law.

Tehran has been Iran's capital since 1785, when the fierce Kajar chieftain, Agha Mohammed Khan, seized the city and made it the center of his government. Since then it has grown from a town of fewer than 15,000 to a metropolis of 1,000,000. But only since 1906,

Imposing Government buildings, combining native and Western architecture, sprang up. Palaces, a handsome museum, stadium, university, and magnificent Officers' Club were built. The city spread out, and its growth accelerated.

Tehran today offers many a curious contrast. Its often thick traffic is a mixture of streamlined American automobiles, fleets of

when the country was granted a constitution, has it witnessed parliamentary scenes.

Mr. Arthur L. Richards, Counselor of the American Embassy in Tehran, who began his career there in the '20's, gave us a description of the city 25 years ago.

Tehran in the Twenties

"In those days," he said, "it looked more like a large town than a city. A high wall surrounded it, with huge gates that were closed at night. Most streets were narrow and crooked, the houses of mud brick. Camels were everywhere, coming and going in long caravans. Perhaps there were a dozen automobiles, mostly Fords. Men dressed in styles unchanged for centuries; every woman wore the *chador*, with veil. There was no hint of the West about the place then.

"And it really seemed to be at the end of the world. Getting here meant a long sea voyage, followed by a tedious trip overland from the Black Sea or the Persian Gulf."

But Riza Shah Pahlavi, father of the present Shah, changed Tehran's face. Making the capital the symbol of his westernization policy, he radically re-planned and rebuilt it. Down came the wall. Broad avenues, intersecting at right angles, were cut through squalid, congested areas.



Iranian Bakers Create Their Own Styles. This One Specializes in "Breadbaskets"

Slapped against the roof of a dome-shaped oven, these "loaves" baked brittle over a charcoal fire. Most Iranian bread comes in wide, flat sheets. Restaurants serve it folded like napkins.

small British-built taxis, pushcarts, wagons, handmade buses, war-surplus trucks, and plodding burros (page 444). Carts and wagons are painted in bright geometric designs. Horses' legs and tails are dyed henna; blue beads on their harness ward off the evil eye.

Even in the city's main square a flock of sheep and goats, perhaps a string of camels in from the desert, may momentarily tie up traffic.*

Though the city boasts broad streets, traffic lights, dial phones, and pretentious buildings, it still lacks sanitary water and sewage systems. Water from the mountains flows in its square stone gutters, called *jubes*. Children wade in it, men wash in it, animals drink it. No foreigner touches jube water, nor do those who can afford a well or to patronize the swarm of water peddlers who fill their two-wheeled tank carts at city wells. But for the mass of people it's the only water available.

Before we left, we watched men laying huge water mains down the center of one of the city's chief thoroughfares, marking the

dawn of a new era for Tehran (page 430).

Iran's chief city, like the country as a whole, is still only in the shadow of the machine age. Local products are largely handmade, from the shiny samovar that graces every home to the handsome bodies of the nation's buses, built on U. S. truck chassis. (Many of the buses, copying Cadillac, sport tail fins). Parts of the city seem like surging beehives, their people banging and clattering away from dawn to dusk. If your automobile motor needs a new part and one isn't available, the chances are an exact copy can be handmade in short order.

Factories are few; modern plants produce textiles, cement, cigarettes, bricks, and carpets. South of the city a forest of tall chimneys marks the yards that turn out the buff-colored bricks from which the capital is built. There, too, stands one of the world's largest grain elevators, which Iranians call "silos."

Shops are small. Tehran has no department store, unless its vast covered bazaar can be called one, and no real grocery. The druggist, not the grocer, sells powdered milk, and only the cereal man sells rice. Everyone seems to be in business for himself; butcher, baker, vegetable man have their own tiny stalls.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Old and New in Persia," by the Baroness Ravensdale, September, 1939, and "Modern Persia and Its Capital," by F. L. Bird, April, 1921.

Sidewalks swarm with men and boys selling lottery tickets, sunflower seeds, chewing gum, candy, oranges, fruit drinks, neckties, socks, or beads. The corner snack bar is a charcoal brazier, over which broil skewered lamb bits and chicken livers.

A wide variety of foreign goods, from aspirin to zithers, fills shop windows. United States products predominate. Though few customers read English, window placards ask "Which twin has the Toni?" or extol the properties of an American dentifrice or deodorant. Nearly every window displays a background gallery of pin-up girls or Hollywood stars.

The "star" most often seen is Walt Disney's Mickey Mouse. A favorite Persian food is *mast* (pronounced "mahst"), which is something like yoghurt, and the leading brand is Mickey mast. It comes in small earthenware jars, with the inimitable Mickey prominently displayed on their paper caps.

Most shops have radios, which pour forth news reports and the wailing music of the East. Atop the two- and three-story buildings antennas are strung on slender poles, favorite perches for fat black-and-white crows.

Western dress predominates in Tehran, unlike any other city or town in Iran. Men wear tailored business suits, but a minority of the older women cling to the flowing chadar (page 429). In any crowd, only a *mullah*, an expounder of Islam, in turban and black gown, may serve to remind a visitor of where he is.

City of Rags and Riches

Tehran is a city of rags and riches. Expensive American automobiles are legion. Palaces and pretentious walled villas dot the city and its northern suburbs. On the sidewalks well-dressed men brush elbows with barefooted porters, well diggers, and other laborers in rags, while flanking the main road south to the shrine city of Rai (or Rhages) families live like animals in caves.

But, unlike other cities of the Middle East, Tehran has few beggars roaming its streets. Sponsored by a princess of the royal family, they are housed and fed in a rehabilitation center, where they learn useful trades.

With a local friend we wandered, gaping, through miles of narrow, covered streets and alleys in the bazaar. To this maze, the country's commercial heart, countless products from every part of Iran and many a foreign land find their way. Booths exhibit a bewildering array—jewelry, shoes, spices, dry-goods, hardware, brass goods, copperware, perfumes, and grain and other foods.

Everywhere were the sights, sounds, and smells of the East. Crowds jostled in the dim

passages; every human type was there. Women handled goods while shrewd dealers, puffing pipes, leigned indifference. Other housewives, in groups of twos and threes, haggled long to get a bargain. Barefoot urchins darted on errands for their masters. Shouting men leading heavily laden burros parted the crowd. Merchants bowed and beckoned to us or, guessing our nationality, shouted "Okay, okay" and waved toward their shops.

Tehran's Fabulous Rug Mart

In a covered square off the street of the shoemakers we found the rug mart. Piles of multihued rugs reached almost to the domed roof; every type of Persian rug was represented, from tribal primitives to silk-backed beauties that looked like paintings. From high balconies hung lustrous carpets fit for palaces, their rich colors glowing. While I browsed, I heard cameraman Roberts's Virginia accent bargaining with a dealer. But, inexplicably, the merchant wasn't in a bargaining mood, and we left empty-handed.

Time and again in Tehran we were told, "This isn't the real Iran. Take a long trip; see the unchanged countryside."

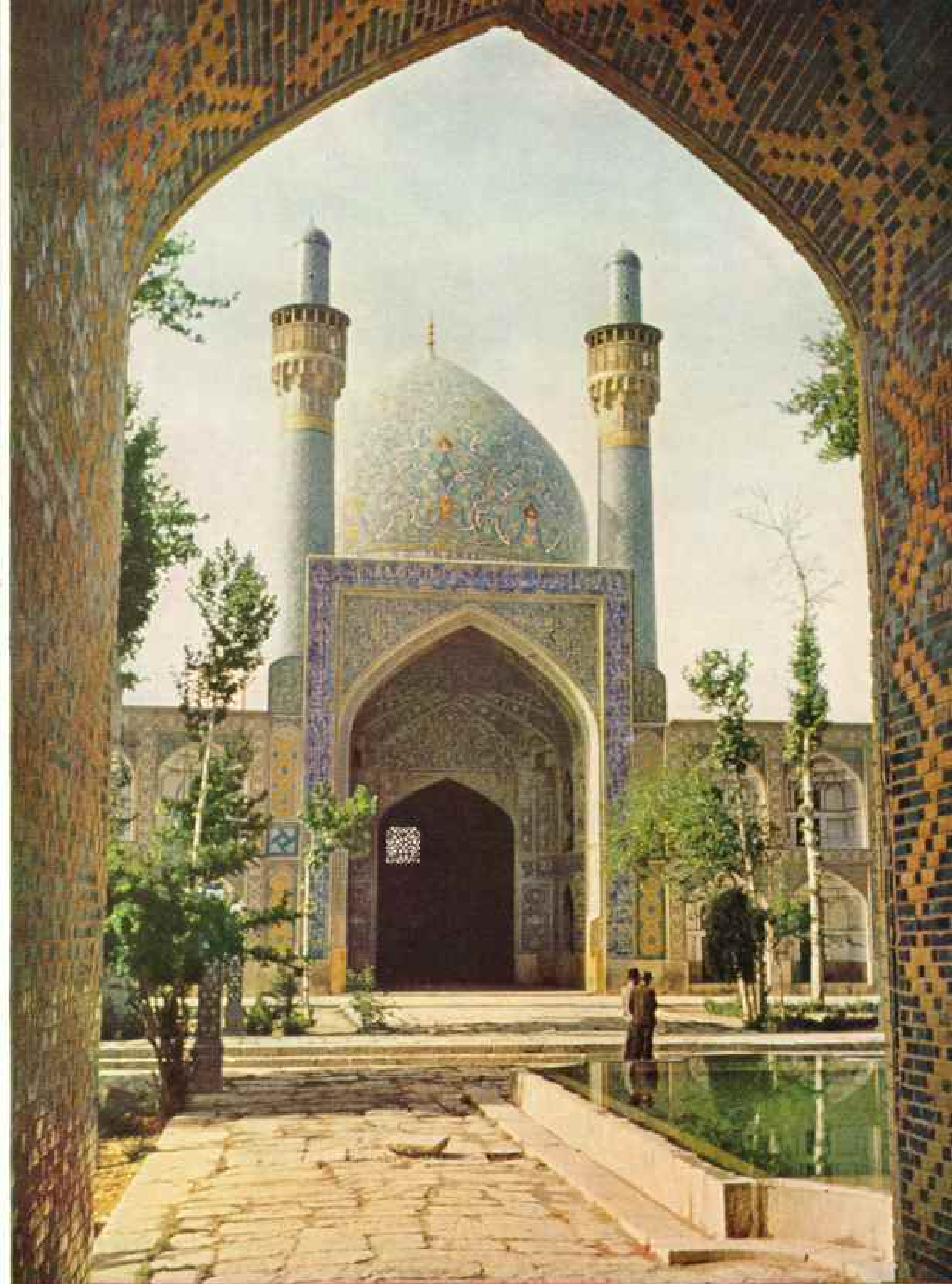
Eager to do just that, we arranged a trip south some 600 miles to Isfahan, home of James Morier's unforgettable character, Hajji Baba, to ancient Persepolis, and to storied Shiraz. But first, to get a briefing in Persian geography, we sought out an American who had spent most of a lifetime in Iran.

"This land is vast, strategic, and full of oil," were his first words after learning the purpose of our visit. Getting a map from his desk, he spread it on the table between us. An index finger swept across the country just south of the Caspian Sea.

"Here are the mighty Elburz Mountains, rising to more than 18,000 feet," he said. "You can see them from the window there.

"And here," he went on, "are the Zagros Mountains along Iran's western and southwestern boundaries. Together they form two sides of a rough triangle with its apex aimed at Turkey. Between them lies the heart of Iran, a vast plateau covering half the country and averaging 3,000 feet above the sea. Rocky hills, fantastically eroded, cut it into numerous valley basins. You'll see a good cross section of it on your trip."

Pausing to relight his pipe, our friend went on: "These mountain walls, Elburz and Zagros, shut off moisture-laden winds, and most of the plateau gets less than 10 inches of rainfall a year. So it's largely sand or stony desert, or steppe. All life there depends on irrigation. Towns and farm villages are green islands in a barren sea. Almost every



Old Persia Lingers in Iran's Gleaming Turquoise Domes and Minarets

Graceful twin towers and bulbous dome glow with intricate designs in tile. An archway frames a portico of the Chahar Bagh Theological School, an early 18th-century masterpiece in Isfahan.



East Meets West—at Soccer. Beneath Snow-capped Elburz Mountains, Tehran Booters Play Host to Pennsylvania State College

On a good-will trip to Iran, the American team won a game and lost two. Soccer is Iran's national sport; every stable city has a team. Figure on player's luck is Persian 2. Opposite page: In a scene recalling *The Arabian Nights*, Tehran actresses model costumes in vogue 150 years ago.









↑ Millions of Hand-tied Knots
Make This Persian Rug
a Masterpiece

Too fine to be walked on, this product of an Isfahan factory will adorn a wall, like an oil painting. When the author asked its value, the boss's son (above) replied, "Give me a new Cadillac and you can have it." The rug will take more than 18 months to complete.

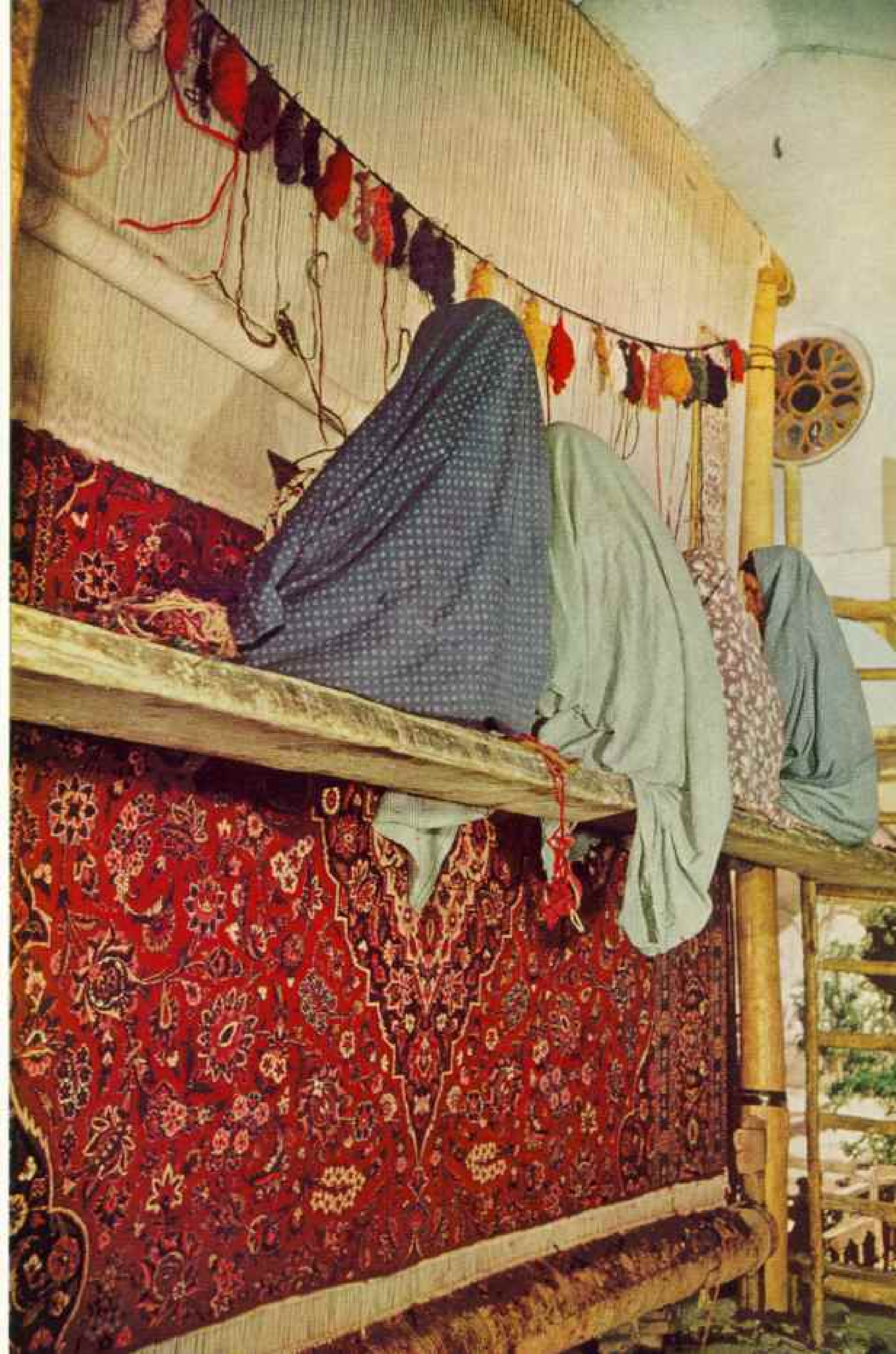
Full-scale color drawings guide the nimble fingers of girl workers who began tying knots before they were seven years old. The best can tie 3,000 a day.

← When camera-carrying visitors arrived, most of the girls pulled concealing *chadars* over their heads and worked even more furiously. But one stole a mischievous look at the photographer.

→ Hooded Girls Ply Busy
Fingers in a Home Shop

Most Persian rug "factories," like this one in Kashan, are small—one or two looms in a home. Rugs have a base of woven cotton threads, on which strands of wool are knotted to make the pile. Fine rugs may contain several hundred knots per square inch.







Iranians Rid Themselves of Bad Luck on the 13th Day of *No Ruz* (New Year) by Picnicking

By tradition, picnickers carry the coming year's misfortunes from their homes into the country and abandon them there on this day. In Iran the New Year arrives March 21, the first day of spring.

square foot of productive land has been won from the burning sun, the sand, and the wind; only constant toil keeps it won.

"Stretching some 650 miles southeast of Tehran are two of the world's most formidable deserts, the Dasht-i-Kavir and the Dasht-i-Lut. They're trackless wastes, with huge salt flats; parts have never been explored. They look like the second day of Creation, before life or vegetation appeared on earth.

"Only 10 percent of the land of Iran is cultivated, and a third of that depends on irrigation. Another 15 percent is grazing land, for most of the plateau has a stubble of coarse grass or sagebrush. Mountains, forests, and barren land cover the remaining three quarters. The best farm land is in the northwest and along the Caspian shore."

"Where does the water come from for all this irrigation?" I asked. "From what little I've seen, Iran has very few rivers."

"You're right," he answered, "and even fewer fresh-water lakes. Have you flown over much of Iran?"

"Only from Damascus here, and to Abadan and back."

"Did you often notice long lines of holes in the ground, sometimes running for miles? Look like anthills from the air."

"Certainly," I answered. "Can't miss them. They reminded me of gophers' holes."

"Those are *kanats*. About four-fifths of the water used in irrigation on the plateau is subsurface. Diggers hand-sink a well in the hills. If they make a strike, they tunnel an underground bed for the water to the nearest village. Every few hundred feet they dig another shaft to bring up dirt and to use later for repairs. Rather an ingenious system; been used for centuries. There's very little evaporation, and the water can't be stolen."

Journey into Southern Iran

Early next morning we drove through a city just awakening and headed south. Behind us cone-shaped Demavend, Iran's highest peak, wore a cap of white clouds. Ahead, the brilliance of the rising sun was reflected in the golden dome of the shrine of Abdul Azim at Rai (page 450).

At Tehran's doorstep began the parched plateau, over which we drove for two days to reach Shiraz. Some sections in their utter bleakness resembled landscapes on the moon. At wide intervals walled adobe villages, with green fields and slender poplar trees, or an upthrust range of jagged, rocky hills broke the monotony. Gendarmerie headquarters, looking like Hollywood's version of French Foreign Legion posts, were spaced along the road. We saw few inhabitants—an oc-

casional shepherd or a group of men, sun-burned black, working on the highway.

Tank trucks marked BP (British Petrol) lined both sides of the road for miles as we entered Qum, for the city is a major distribution center for gasoline. Better known is its revered position as a holy city. Second only to Meshed in Iran as a place of pilgrimage for the devout, its beautiful golden-domed mosque holds the shrine of Fatima, daughter of the Imam Musa al Kazim.

Qum is also the birthplace of the Old Man of the Mountains, Hasan-i-Sabbah, 11th-century founder of the dread Order of Assassins. His headquarters was the Rock of Alamut, a fastness deep in the Elburz Mountains, whence he sent his messengers of death to dispatch his enemies. Many of his fanatical followers were home-town boys from Qum.

Skirting the Great Salt Desert

Leaving the asphalt, we skirted a range of naked hills and took an alternate route to visit Kashan, noted for its fine rugs. Our only stop was made to watch *kanat* diggers ply the trade they hand down from father to son for generations. Men, working a crude windlass, lowered a small boy into a 180-foot hole. Every few minutes up came a leather bag filled with dirt. In this way thousands of miles of these underground water tunnels have been dug all over the Iranian plateau.

Gusts of wind blew swirls of dust across the road and dissipated the cloud that streamed behind our car. A haze wrapped the horizon in mystery. Eastward, seemingly limitless, stretched the great salt desert, shimmering in the heat. To the west, gaunt rock hills, pastel-shaded, made a grotesque skyline. A caravan of camels plodded by; carrion birds glided above a burro's carcass. I pointed out to Joe a placid lake with wooded islands. He couldn't see it. When I looked again, it had disappeared.

Green barley fields marked Kashan's outskirts; the town itself was sun-baked and almost treeless. Halting at a traffic circle to have our travel permits checked, we inquired through Petros, our driver-interpreter, for a "rug factory."

A small crowd gathered, launched into animated conversation, and chose one of its members to guide us. Through narrowing, wall-lined streets we drove until we had to abandon the car and proceed afoot. Threading a maze of alleys, we stopped before a weather-beaten door.

A wizened old woman answered our knock, bowed us in, and led us to her bedroom. Opening off a court, it was bare except for bedroll and a loom on which hung an un-



Iranians Scratch Hard to Win Food from Grudging Soil

In many sections of the country farmers use methods unchanged for centuries. Plodding oxen pull heavy frames lined with metal teeth over grain to thresh it. Iron-tipped wooden plows scratch the soil, or workers turn it with spades. Four out of five Iranians work on the land.

finished tapestry. On the wall was a picture of Christ. Exquisitely done, the tapestry showed a classical Greek scene—gods and goddesses, nymphs and fauns dancing to Panpipes. Admiring her work, we asked, by signs, whether she also made rugs. A toothless smile, a shake of her head, and an invitation to have tea were our answers.

We found the automobile surrounded by admiring housewives who had come to fill water jars at a near-by underground reservoir. Its elaborate tiled stairway resembled an entrance to a subway.

"The woman in the blue chadar says she makes rugs," Petros told us.

Smiling, she led us to her home, a pleasant villa that had seen better days. In its courtyard a dozen moppets made mud pies beside a pool. A three-sided room facing the court housed two big looms with unfinished rugs. A mural showed Persian hunters chasing fleet gazelles and ibex. Another depicted a carnival, complete with dancing girls, tightrope walker, magician, and strong man.

Several young girls, squatting cross-legged on an improvised scaffold, worked furiously on the larger rug. Chattering among themselves, they tied knots faster than the eye could follow. The visitors received only

darting sidelong glances; all of photographer Roberts's wiles failed to get even one of the workers to look around (page 439). But after each flash photo small hands reached back for burned-out bulbs.

Across bleak plains, past snow-flecked peaks we drove toward Isfahan. Shangri La farm villages, life-supporting oases, nestled in arid valleys. High on a ridge we stopped to get a sweeping view of one (pages 460-1). Fruit trees were in blossom, birds sang, and squads of bronzed, barefooted farmers turned over soil made fertile by water from the neighboring mountains.

Tall, cone-shaped structures of sun-dried brick, resembling Doré drawings of the Tower of Babel, piqued our curiosity as we reached Isfahan's outer fields.

"Pigeon houses," said Petros. "Isfahan farmers keep thousands of pigeons—good eating, good fertilizer."

After a welcome shower and dinner in the Irantour Hotel, we took a stroll on Chahar Bagh, the city's wide main avenue. It was Thursday evening, the Moslem equivalent of Saturday night. Crowds, almost exclusively male, sauntered along the sidewalks. Matched teams, pulling handsome open carriages, clip-clopped on the asphalt. Youths talked on

street corners or rode the latest style in English bicycles. Decorated sidewalk stands sold soft drinks. Several brightly lighted movie houses advertised old American films, including *The Sign of the Cross*. Public baths, their red towels drying on roof tops, did a rush business.

Older men wore beards, dyed henna, and usually the Eastern type of dress. Occasionally a green sash proclaimed its wearer a descendant of the Prophet. One old-timer, seated before a shop, covered his face as we passed so that his eyes might not behold the infidels.

A loud-speaker on the Chahar Bagh Theological School (page 433) harangued the crowds about conditions in the local textile mills. Newspapers carried a front-page cartoon in color showing Prime Minister Atlee shaking hands with Premier Stalin while Iran went up in flames. (Widely held in Iran is the belief that Britain and Russia have a secret agreement for dividing the country between them.)

Back at the hotel we met Consul John Ordway, who represents the United States in Isfahan. Far into the soft, star-studded Persian night we talked of this storied city.

"In the 17th century," he reminded us, "Persians called Isfahan 'half the world'—and not without reason. European travelers of those days left descriptions of it that sound like the *Arabian Nights*. Apparently it was a fairyland of magnificent palaces, beautiful mosques, and enchanted gardens.

"Shah Abbas the Great, a contemporary of Queen Elizabeth, was responsible. He made Isfahan his capital and adorned it with architectural jewels. Many still exist; you'll marvel when you see them.

"Isfahan is still a place of importance," he went on, "which is why we've just opened a consulate here. It's central Iran's main communications, textile, and agricultural center. This lovely oasis produces wheat, a useful substance called gum tragacanth, linseed oil, almonds, wonderful fruit, sausage casings, and half the textiles made in Iran."

A friend of John's, a Bakhtiari leader dressed in well-cut business suit, joined us. Temporarily talk switched to movie cameras and projectors, his hobby. When someone commented on his fluent English, he laughed and said, "It's rather limited, I'm afraid. I was educated in France and never studied English. Bought a stack of old comic books a couple of years ago and taught myself."

Early next morning we visited the Maidan-i-Shah, the majestic square that Shah Abbas made the hub of his new capital (pages 452-3). Already it hummed with activity. Merchants, running a curb market, displayed

miscellaneous wares from pins to old door hinges. Whenever trade slackened they lolled on bright rugs, sipped tea, and smoked water pipes. Local farmers sold mounds of fresh peas to retailers. Western music drifted across the square. Two taxi drivers argued the cause of a creased fender, while a recalcitrant donkey brayed loudly.

High above this hubbub soared the magnificent turquoise dome and minarets of Masjid-i-Shah (King's Mosque) and Masjid Sheik Lutf Ullah. In gaping wonder we walked around the square to see these masterpieces of old Persian architecture from every angle.

Later we visited the mosques and saw their wonders at close range. Atop the roof of Ali Kapu, a small palace the Shah used as a gatehouse for his other royal residences, we had an unforgettable view of Isfahan (page 454). From Ali Kapu's pillared veranda, a royal box, the Shah and his court watched polo matches and exhibitions of horsemanship and military prowess. Its top floor was a banquet hall; niches still covering the walls held the vessels, cups, and drinking glasses of the diners.

Anvil Chorus in Isfahan's Bazaar

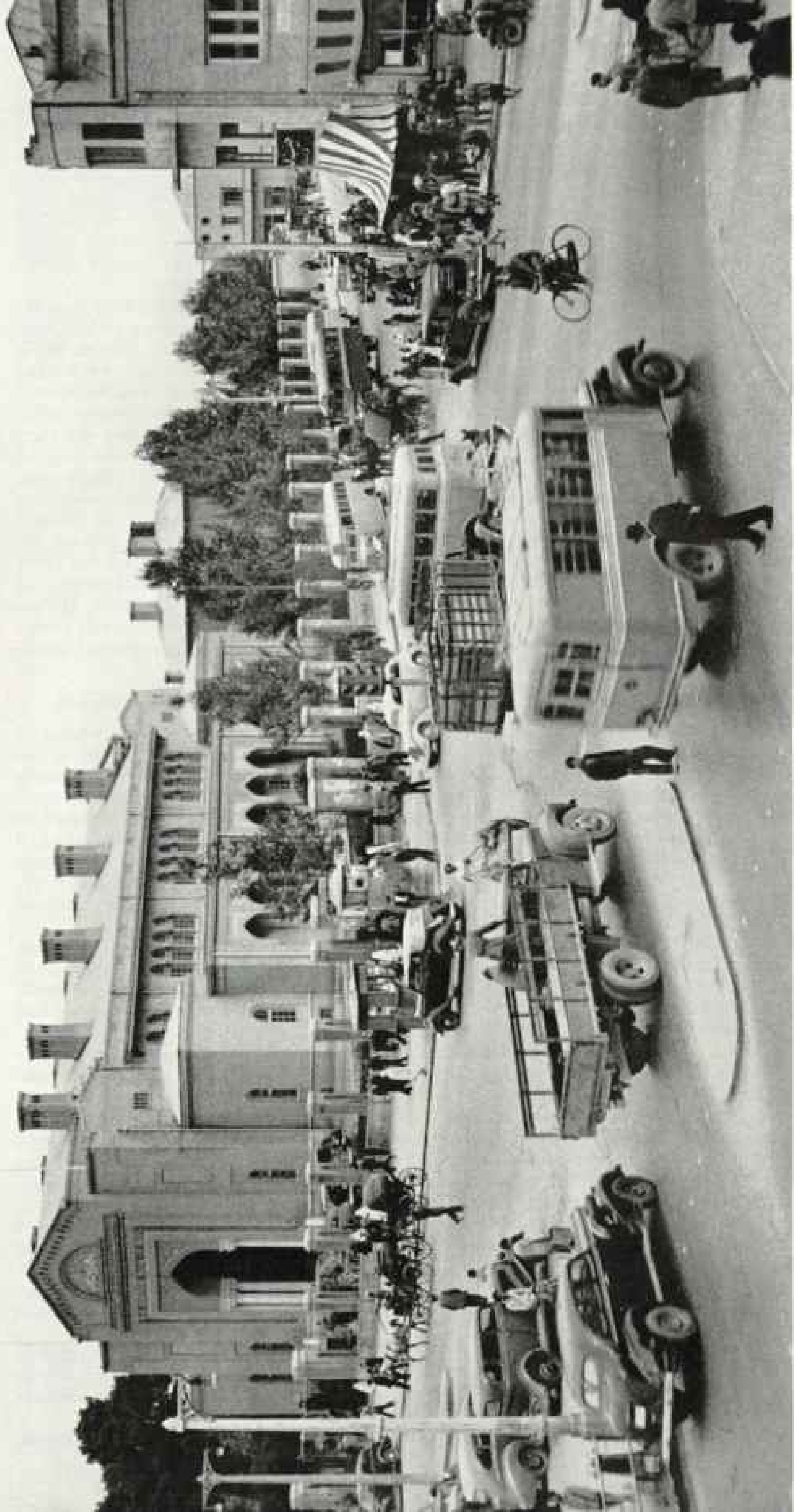
For hours we wandered in the twilight of Isfahan's big covered bazaar. Holes in the street's vaulted roofs admitted bright shafts of sunlight that resembled batteries of spotlights. On the street of the metalworkers a thousand hammers tapped a ceaseless anvil chorus. In hundreds of small workshops boys tended bellows and roughed out work, while craftsmen fashioned delicate pitchers, ornamental trays, and samovars.

Deep in the cellar we watched a patient blindfolded camel turn the giant stone of a primitive, centuries-old linseed oil mill. Climbing to the bazaar's adobe roof, we had another eye-filling view of city and square. Investigating the sound of a bell close by, we discovered a cow placidly chewing her cud in a penthouse enclosure.

With a local artist we visited the 17th-century Armenian Cathedral of St. Saviour's and its remarkable museum that mirrors three centuries of Christian life in Isfahan. To his capital, to stimulate its arts, crafts, and commerce, Shah Abbas transplanted thousands of Armenian families from Julfa (Dzhulfa), on the present Soviet border, in 1605. Their descendants form a sizable minority in Isfahan; many have relatives in the United States.

In Chihil Situn, Palace of the Forty Pillars, we traced Persian history in old murals and drank tea with the Chief of the Department of Antiquities.

"Where are the other pillars?" I asked.



Tehran Traffic Mixes American Automobiles and Trucks, Handmade Buses, Pushcarts, Bicycles, and Open Carriages.

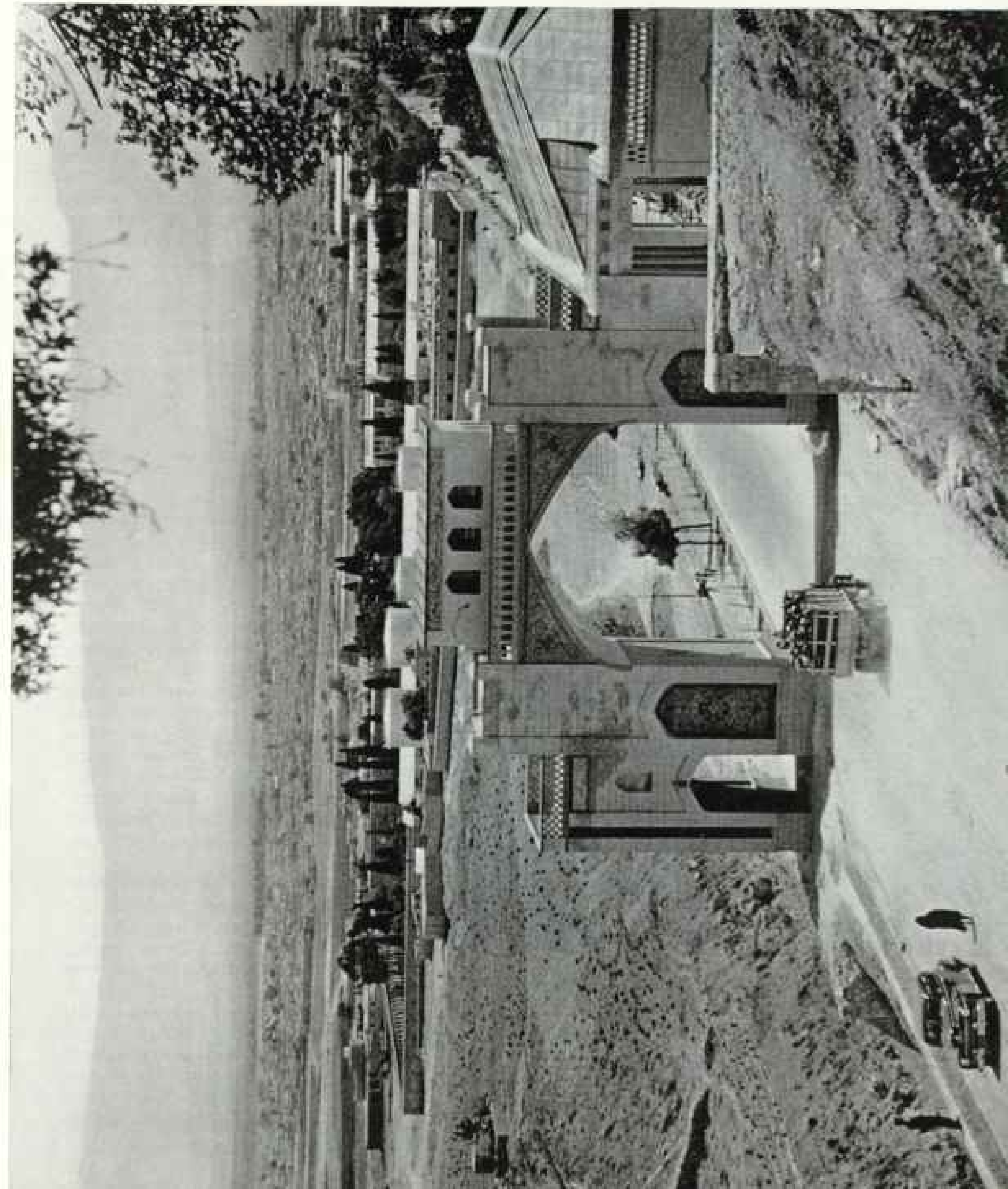
Vehicular confusion increases with the capital's growth as a Middle East metropolis. Taxes are replacing carriages. Most intersections have policemen or lights; at some it's every man for himself. The British Bank of Iran and the Middle East (left) stands on the Maidan-i-Sopah, the city's main square.

Storied Shiraz Carpets a Shangri La Valley in Southern Iran

This view of the oasis city bursts into sight as the traveler emerges from barren mountains on the road from ancient Persepolis. The arch, built a dozen years ago, replaced one that had stood on the site for centuries.

Famous for its dream-world gardens, beautiful women, and fine wines, Shiraz holds a special place among Iran's cities. Birthplace of the celebrated poets Hafiz and Saadi, it is the country's poetical capital. Almost a mile above sea level, it has a superb climate. In spring roses and orange blossoms perfume the air.

Paradoxically, Shiraz is perhaps Iran's most progressive city. It has giant reservoirs, water system, hospital, medical school, library, college of arts and crafts, athletic field, stadium, and swimming pool, all recently finished or being completed. Since the war, wide avenues have been cut, streets paved, and whole new sections laid out. Population, now 150,000, has jumped a third in 10 years (page 445).





Oil Pulses in Steel Veins from Mountainside Wells to Seacoast Refinery

Half a dozen rich fields in the Zagros Mountains of southwestern Iran pour black gold into giant stills and cracking plants at Abadan. Through the pipe lines flow about 650,000 barrels a day (map, page 428). Iran's first sizable oil strike was made in 1908. Five years later petroleum products began to trickle from Abadan to world markets. By January 1, 1951, the fields had produced well over two billion barrels.

"I counted only 20 on the palace veranda."

"Look in the reflecting pool," he answered, "and you'll see 20 more."

Introduced by a leading merchant, whose daughter is a member of the National Geographic Society, we made a tour of modern textile mills, antique shops, and workrooms where Isfahan's famous chased silverware is handmade. In the city's attractive School of Fine Arts we visited classes in old Persian arts and crafts—pottery, inlaid cabinetmaking, and miniature painting (page 455)—and others in Western sculpture and drawing.

South we headed again, hour after hour across barren wastes and over low mountain passes. The farther we went the less advanced was spring, for slowly our elevation increased. Slender trees waving above the mud walls of few-and-far-between oasis villages showed only a faint tinge of green. Wild flowers carpeted some areas; one looked like the ancestor of the hyacinth.

Occasional crumbling caravanserais bore witness to the triumph of truck over camel as Iran's chief means of transportation, though we saw many herds of the shaggy beasts grazing. A crumbling village perched on a promontory, resembling a stranded ocean liner, aroused our curiosity. Exploring, we found its modern adobe successor tucked in a narrow valley. Bullocks pulled wooden steel-tipped plows across narrow fields; close by, an attractive schoolhouse neared completion.

In the small town of Abadeh we stopped for lunch and tried a favorite Iranian dish, *tchelo-kabob*. On a heaping mound of fluffy Persian rice the diner drops the yolks of two raw eggs and mixes well. Across the now yellow mound he lays strips of charcoal-broiled lamb, making a dish fit for a shah. With mast, yards of flat, folded bread,



Kashgai Nomads, Visited During Their Spring Trek, Said They'd Never Seen a Camera

Skeptical at first, they found posing for pictures amusing and wanted to see the results at once. Long ago the Kashgais migrated from Turkey; they still speak a Turkish dialect. Some have taken up farming.

green salad, tea, and fruit, the modest snack we sought turned out to be a banquet.

A late-afternoon sun cast long shadows when the towering columns of Persepolis, capital of ancient Persia, loomed before us. Backed by a beetling rock wall, crowning a high man-made terrace, these impressive ruins overlook the wide, mountain-ringed Marvdasht plain. After 25 centuries the majesty, the power, and the grandeur that was the Achaemenian Empire still haunt this spectacular site (page 459).

Six Americans in Persepolis

Persepolis was not deserted. There we were welcomed by Dr. Ali Sami, Director of Excavations; Dr. and Mrs. Richard Ettinghausen, of the Freer Gallery of Art in Washington, D. C.; two lads from the University of Michigan; and a couple from the French Embassy in Tehran. We were wined, dined, and housed in comfortable rooms built into the former harem of Xerxes.

"This, you can bet, is the first night I've ever spent in a harem," was Joe's comment as we prepared for bed.

As if to impress us with the site, Nature put on a show. During our brief stay we saw Persepolis in a gorgeous sunset, by moonlight and dawn light, and in a resounding thunderstorm. The night was one to be re-

membered. Atomic-age visitors from a distant continent, we wandered by the ghostly brilliance of a full moon in the footsteps of kings long departed, through the heart of an empire long dead.*

Black goatskin tents dotted valleys and hillsides south of Persepolis. The annual migration of the Kashgais had begun. Wintering around Firuzabad, south of Shiraz, these hardy people gather their flocks, pack their few possessions, and start for distant highlands near Isfahan at spring's first sign. In autumn they retrace the long, slow trek. Such seminomadic peoples—Lurs, Kurds, Bakhtiari, Kashgais, and lesser tribes—make up an estimated one-sixth of Iran's 18,000,000 population.†

We encountered many Kashgai caravans where their centuries-old routes crossed our road. Mounted heads of families, bronzed and lean, wore big wool capes and round felt hats. Full-skirted women and young children perched on packs of household gear carried by horses, burros, and camels (pages 456 and 462). Often a woman held a woolly

* See "Exploring the Secrets of Persepolis," by Charles Breasted, NATIONAL GEOGRAPHIC MAGAZINE, October, 1933.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "I Become a Bakhtiari," by Paul Edward Case, March, 1947; and "Mountain Tribes of Iran and Iraq," by Harold Lamb, March, 1946.

newborn kid in her arms. Chickens, feet tied, were slung in pairs across packs. Youths carrying long staves kept the flocks moving.

In a wide green valley we visited a large Kashgai encampment (page 463). Dogs howled and children appeared as if by magic at our approach. Two men, capes held high about their faces, came toward us.

We greeted them, and Petros explained our business at length. Occasionally the older man spoke.

"What does he say?" I asked.

"I'm not sure," Petros answered with a shrug. "These people use many Turkish words. But I don't think he understands what 'taking pictures' means."

With passport photographs and wallet snapshots we tried to get the idea across. Joe took Petros's picture, showed his cameras, and let the men peer into the view finders. Finally they posed for us (page 447). Shyness disappearing, they took us on a tour.

Boys brought us brimming bowls of buttermilk. Gnarled grandmothers tended babies or worked at portable looms. Younger women, busy with chores, kept their faces turned from us. Men took predinner naps or gathered dung for fires. Every youngster in camp followed us about.

Part of Nature's pattern, this nomad life is almost changeless in its ebb and flow across the Iranian plateau. Modern times have passed it by; little we saw suggested the Machine Age. Largely self-sufficient, hardy, and self-reliant, the tribes follow an ageless way. Long before Persepolis governed most of the known world, similar tents dotted near-by hills and valleys.

Virginia license plates on a station wagon parked outside our hotel in Shiraz gave us an unexpected thrill. Inside we met Mr. Elgin Groseclose, author and expert on Iran, touring the country with his wife and three daughters.

"Shiraz," he told us, "is noted for its lovely gardens, beautiful women, and fine wines. Birthplace of Saadi and Hafiz, the celebrated poets, it's Iran's poetical capital. Besides, it's probably Iran's most up-to-date city" (pages 445, 457).

With Mohammed Ali Bahadur, Vice-mayor of Shiraz and a graduate of the American University in Beirut, we made a whirlwind 14-hour tour of this unusual city.

"Shiraz was Persia's capital 200 years ago," he said. "Karim Khan Zand, one of old Persia's best rulers, rebuilt it, as Shah Abbas did Isfahan. Now, partly through the generosity of one of our leading families, we're having another big building boom.

"Since the war, wide avenues have been cut and streets paved. Much of the city

has running water and other modern conveniences. Population has jumped a third in the last decade, and whole new sections are being laid out."

Atop a new 8,000,000-gallon reservoir we saw this delightful oasis in panorama. We inspected deep wells and big American pumps that will complete its water system. In rapid succession we visited hospital, medical college, library, college of arts and crafts, athletic field, stadium, and swimming pool, all recently finished or being completed.

We wandered in dream-world gardens scented with the perfume of roses and orange blossoms, drank tea in cypress-shaded villas, and paid our respects at the tombs of the poets. Dusk found us riding on a wide, circular boulevard being constructed on the city's old abandoned moat.

"Come see an old Persian institution," invited our guide.

To a former public bath, built by Karim Zand, we went. In the pit of its amphitheaterlike disrobing room a dozen men, loins girt in red towels, were doing rapid push-ups. A spare, grizzled veteran set the pace. Cross-legged on a dais, a drummer beat out a wild, throbbing rhythm and chanted in a singsong voice.

Athletics to Poetry

With scarcely a pause they switched to deep knee bends, in-position jumping, hopping, club swinging, weight lifting, mad whirling, and dances that would make an Apache jealous. As a climax, they paired off and started wrestling. Ceaselessly the pulsating drumbeats and the weird chant continued.

"It's what you'd call a physical culture society," Bahadur explained. "They're all over Iran. The practice goes back some seven centuries. These men do this from 6 until 8, morning and evenings, six days a week. Their leader is 70 years old; the drummer is chanting verses from Persian poets. Like to join?"

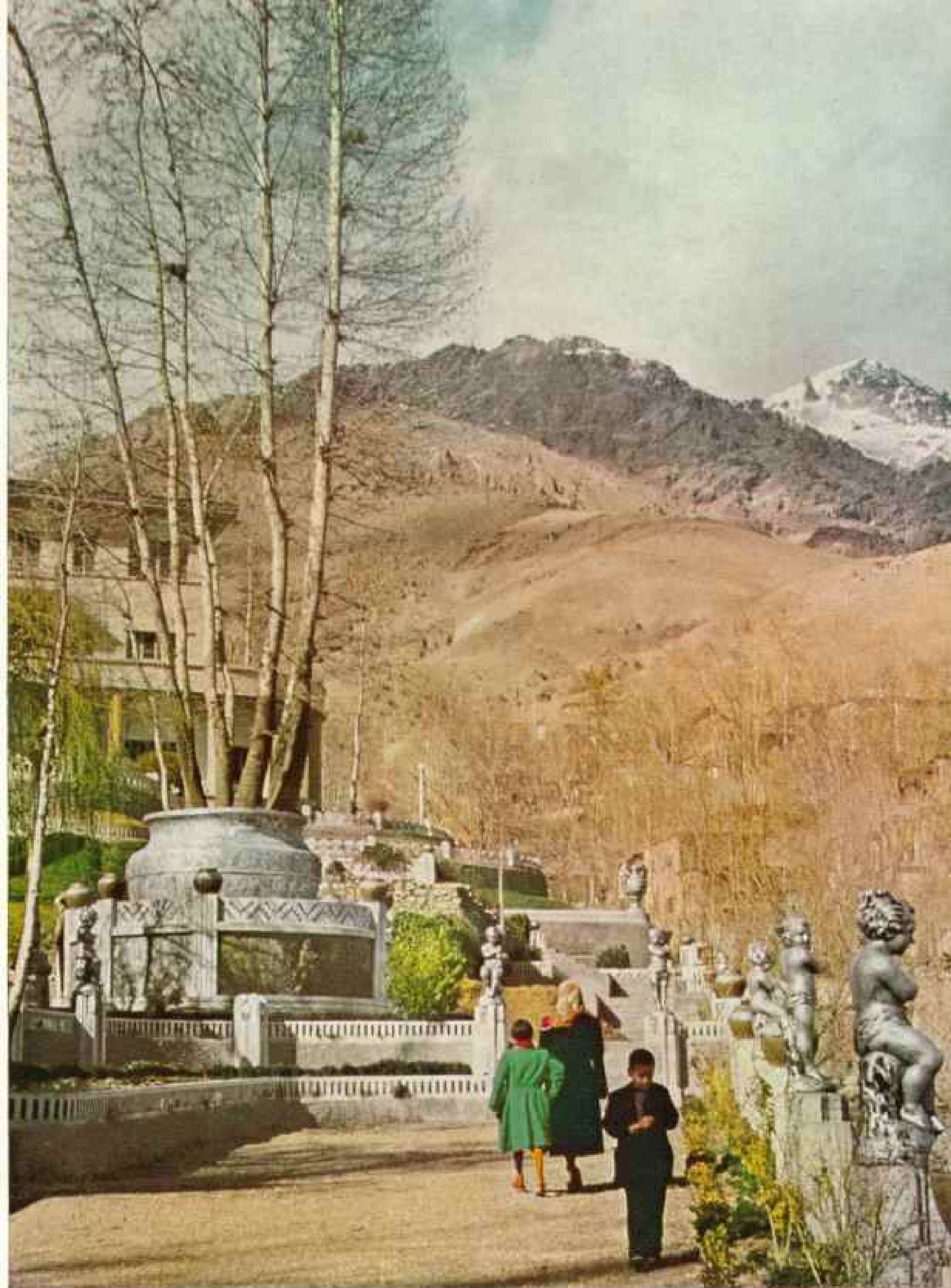
While admitting my waistline would benefit, I begged off.

Our time in Iran was growing short. Back in the capital, we made preparations to leave.

"Don't go before you see the Caspian coast," we were told. "It's another world."

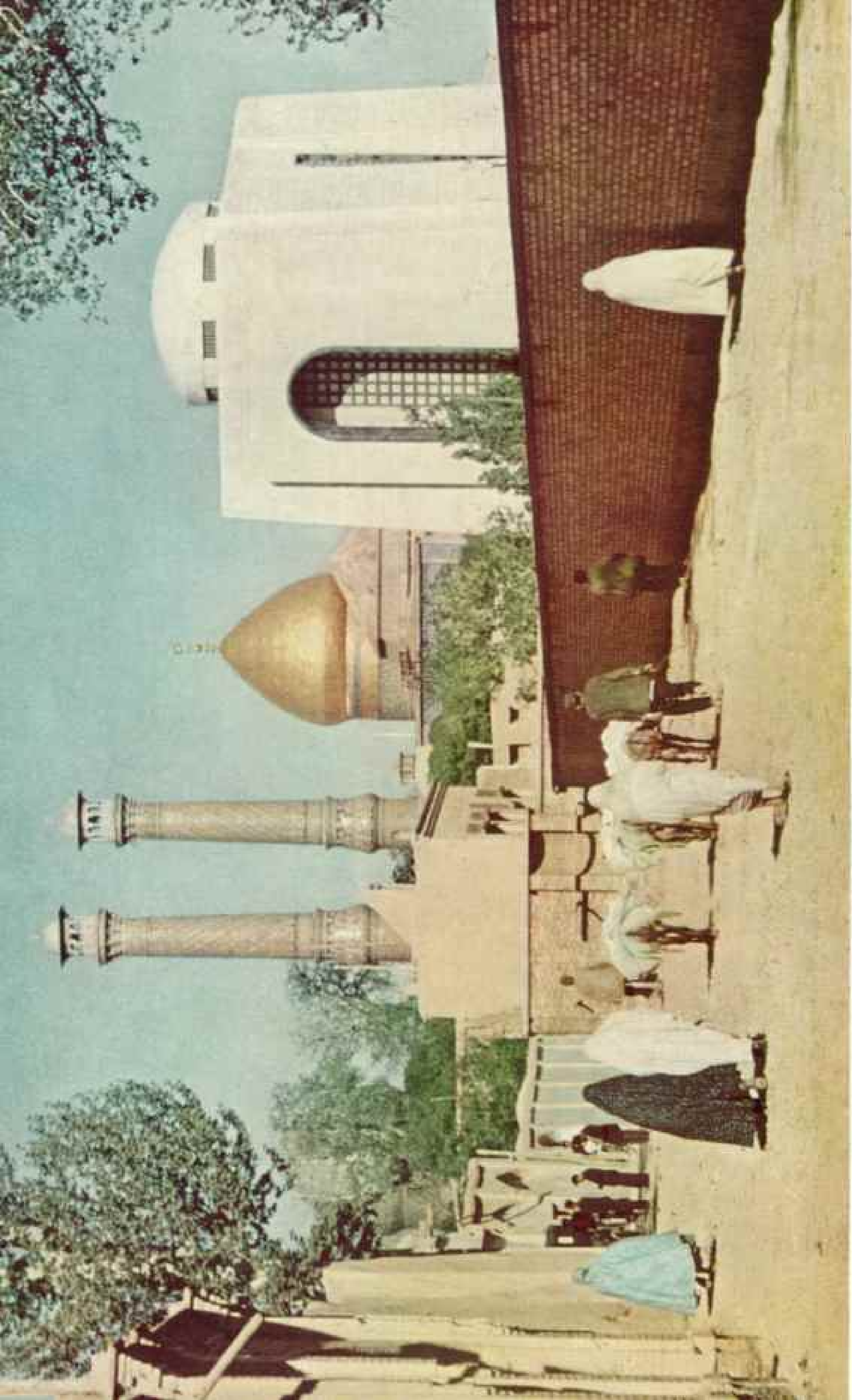
So we stole a few days, visited an amazing land of rice fields, tea plantations, lush semitropical vegetation—but that's for a later story. Soon we were winging west over now familiar Persian land patterns, over the ancient valleys of Tigris and Euphrates to Cairo on the first leg of our homeward journey.*

* For additional articles on Iran, see "NATIONAL GEOGRAPHIC MAGAZINE Cumulative Index, 1899-1950."



Darband's Palatial Hotel Turns Its Back on Rugged Elburz Mountain Giants

With an eye to tourist trade, the present Shah's father built a number of such hotels throughout Iran. Just outside Tehran, Darband is high and cool; summer villas dot the near-by slopes.



Beside the Golden-domed Shrine of Rai, near Tehran, Stands the Marble Tomb of Riza Shah Pahlavi, Iran's Late Ruler



← **Grizzled Constable, Walking His Beat, Doubles as Baby Sitter**

Author and photographer encountered this obliging policeman in a village on the outskirts of Tehran. He was making his rounds, greeting friends, and occasionally directing traffic with the swaddled infant under one arm.

He wears the regulation uniform of municipal police in Iran; outside the cities the gendarmerie, who dress like soldiers, patrol the roads and keep order.

♀ These young Tehran dressmakers enjoy a joke. Their employer, a Frenchwoman, designs and makes dresses for Iran's beautiful new queen.

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Illustration by J. Butler Roberts



Isfahan: Traffic Hums Where Courtiers Once Played Polo

In 1592 Shah Abbas the Great moved his court from Karvin to Isfahan. To embellish his new capital he built magnificent palaces, pleasure gardens, stately mosques, and wide thoroughfares. Heart of the city was its great square, Maidan-i-Shah, 560 by 174 yards.

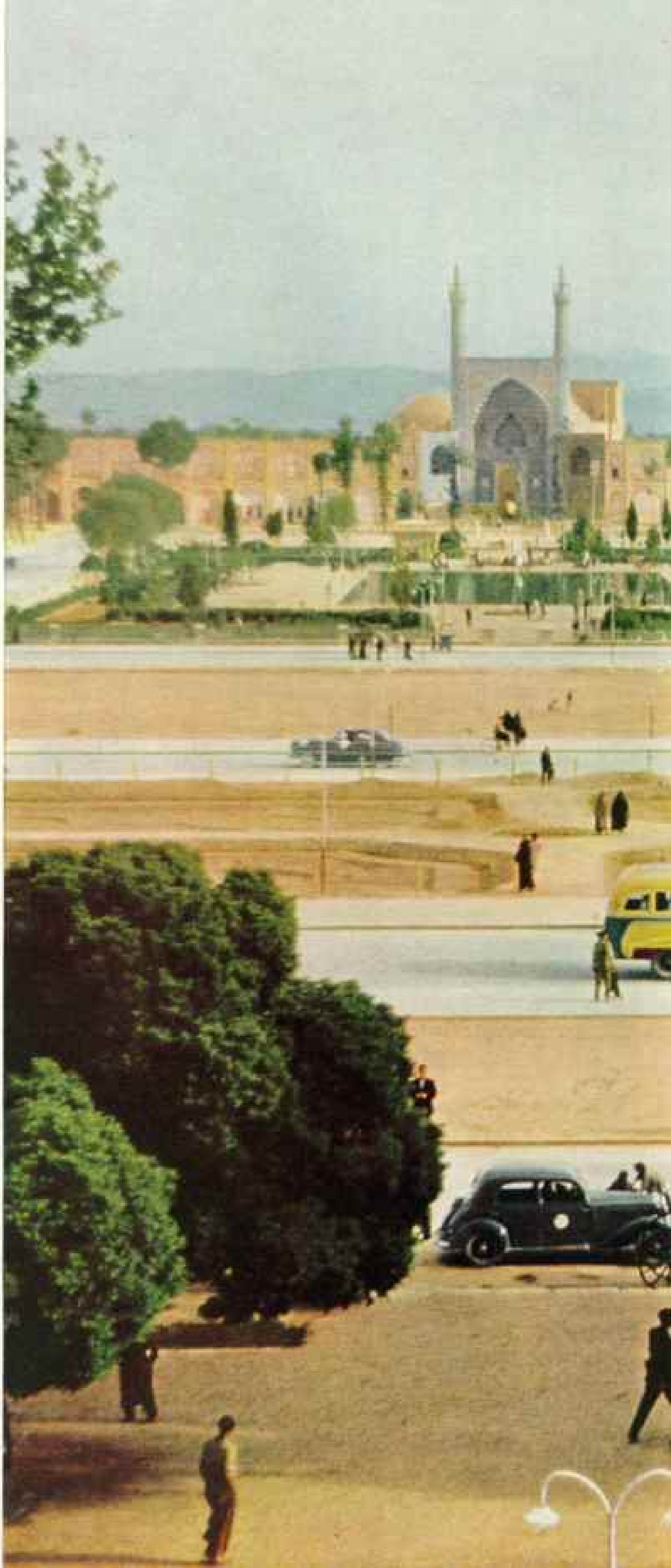
In the background rise the dream-world minarets and dome of majestic Masjid-i-Shah, or King's Mosque (page 454). From the colonnaded veranda of Ali Qapu, the Great Gate (right), the Shah and his court watched polo matches and military exhibitions in the square below. Stone goal posts still stand; one appears behind a taxicab (foreground).

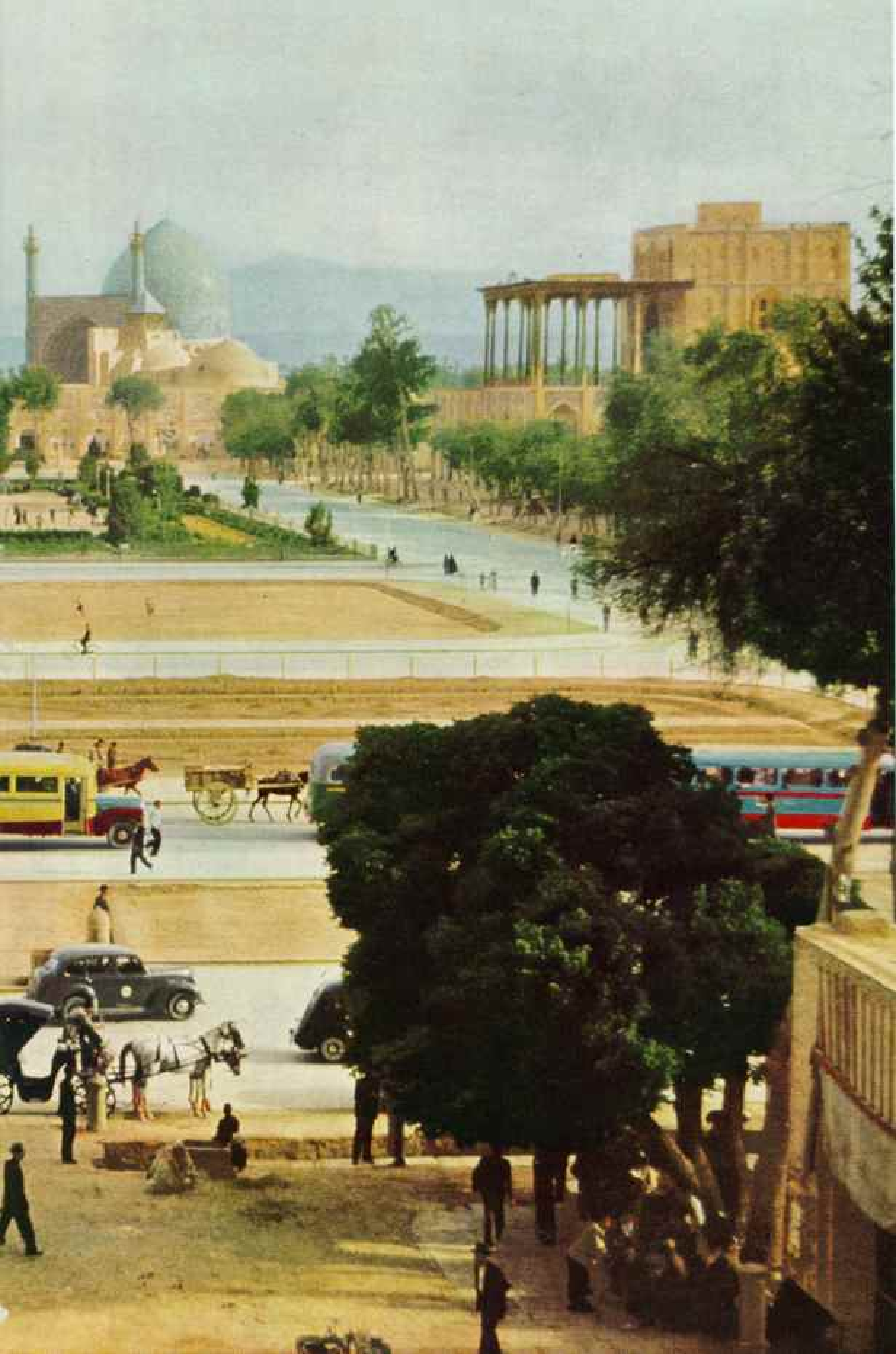
No longer is Isfahan "half the world," as it was known in the 17th century. But so many buildings—more than 80—remain from its glorious days that the city is a treasury of old Persian architecture.

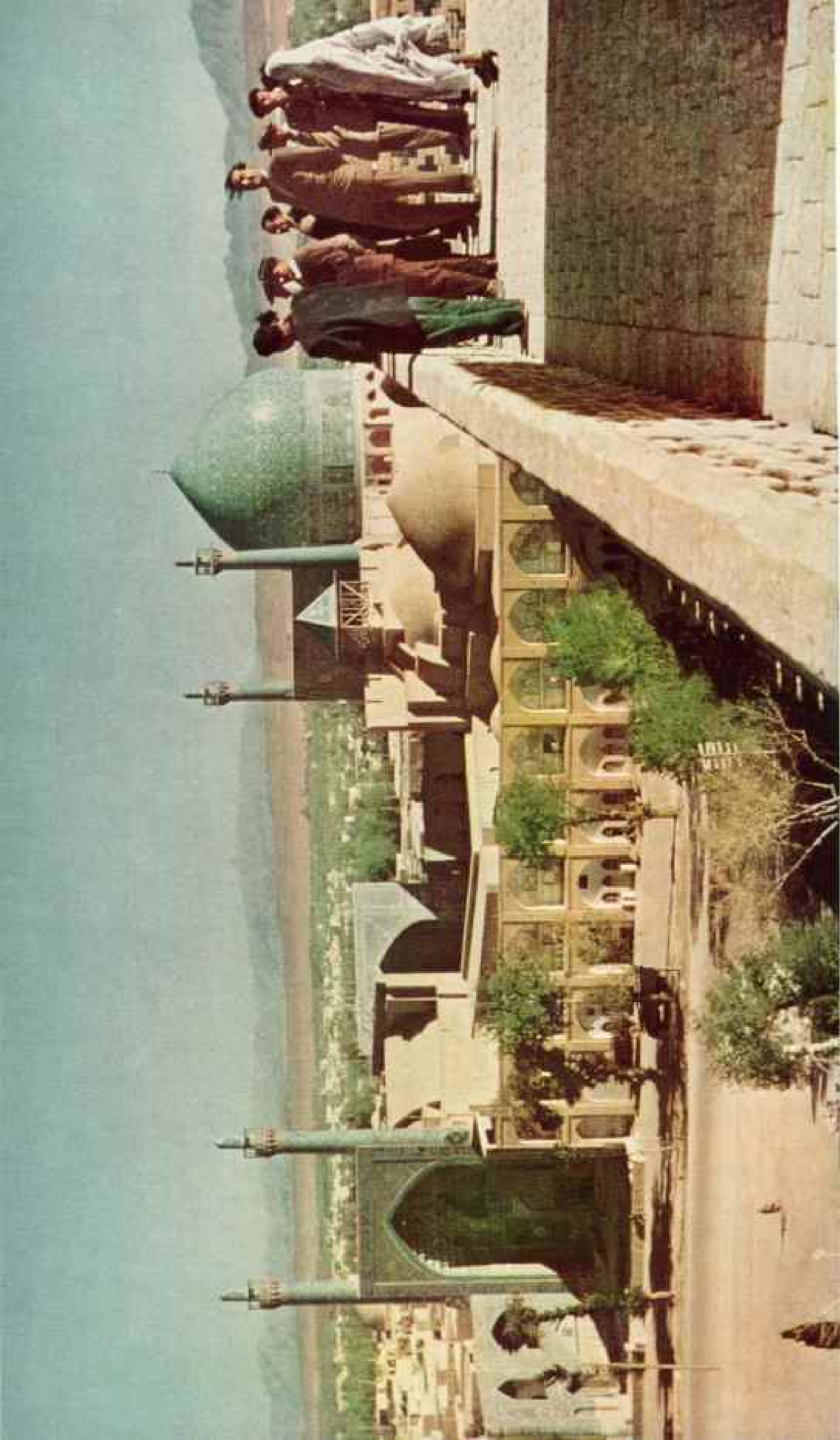
Modern Isfahan is also an important communications and textile manufacturing center, the market for much of central Iran, and a bustling city of 250,000. Its artisans keep a centuries-old reputation for fine metal work, pottery, and carpets.

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Illustration by J. Taylor Roberts







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Illustrations by J. Harlan Roberts

Masjid-i-Shah, the King's Mosque, Was Built at an Angle to Isfahan's Great Square So Its Prayer Niche Would Face Mecca

The square lies roughly north and south, Mecca to the southwest. The mosque is one of the finest examples of 17th-century Persian architecture. Graceful dome, viewed from the veranda roof of the gate palace, All Qapp (pages 452 and 453), soars 177 feet above the ground.



Modern Iran Keeps Alive the Ancient Persian Arts

← An instructor in Isfahan's School of Fine Arts paints pottery vases before they go into the kiln. The school, one of several such institutions maintained by the Iranian Government, not only preserves native skills but teaches Western painting and sculpture.

→ Hossein Hali Musavvir, one of Iran's leading painters of miniatures, works in his private studio in Isfahan. Sitting cross-legged on a bench, he uses water colors on ivory or mother-of-pearl. Self-taught, the 60-year-old artist has been painting since he was 10.

During World War II's Tehran Conference he sent Churchill, Roosevelt, and Stalin miniatures showing them as medieval Persian warriors routing Hitler, Tojo, and Mussolini. Torn swastika flag (top) is part of a wartime poster from which he took Hitler's likeness.

A miniature near the center of the table shows Isfahan's Maidan-i-Shah (pages 452 and 453).

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Kobachewicz for J. Bayliss Roberts





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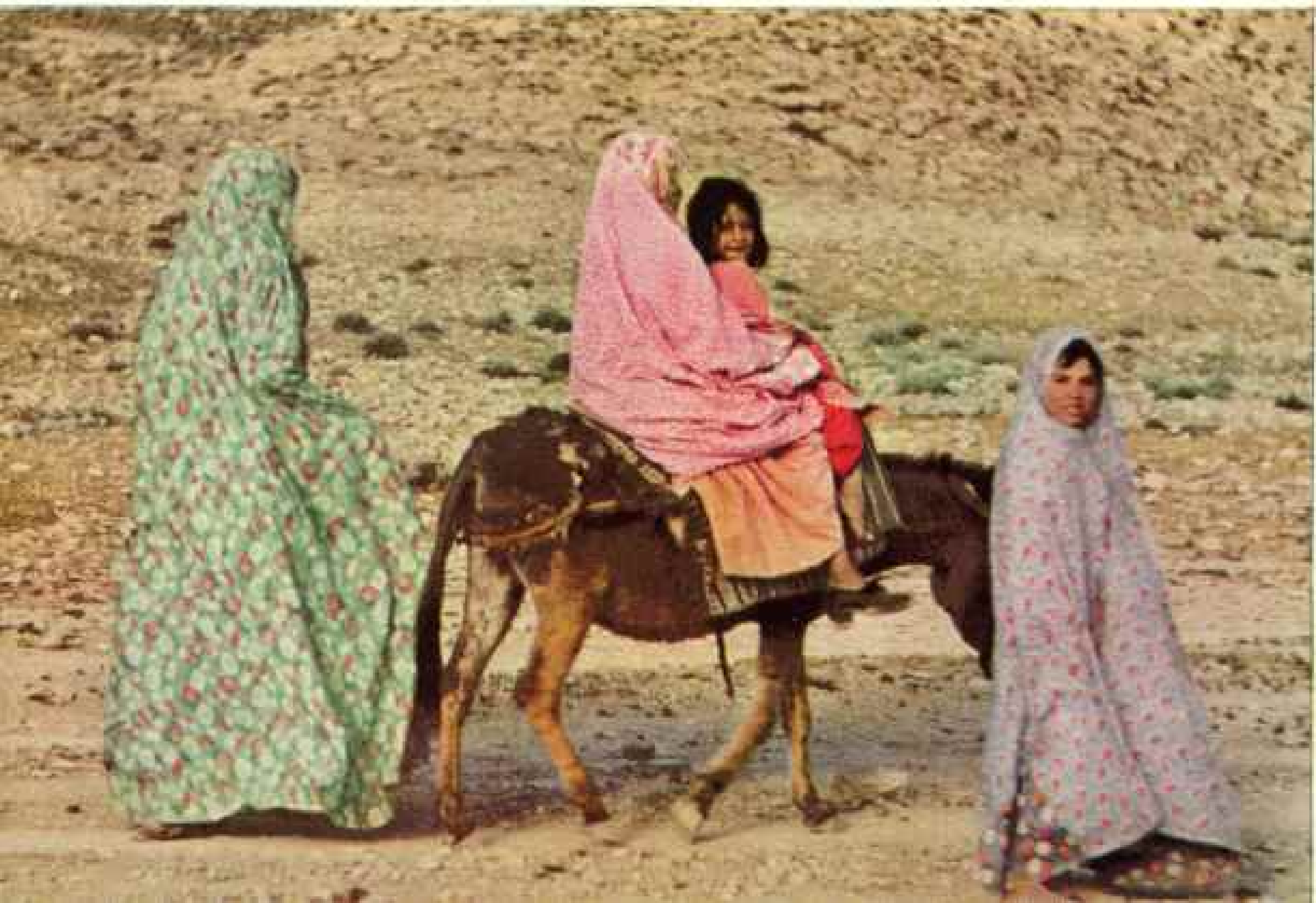
Kodachromes by J. Dasher Roberts

↑ **After a Day's Trek, a Kashgai Family Goes to Town to Shop**

While their men set up camp and tend flocks, these women and children steal away to the adobe village of Sivand, some 10 miles north of Persia's ancient capital, Persepolis. Almost self-sufficient, such tribespeople need to buy little, but it's fun to look.

↓ **Children Can't Resist a Look at the Camera; Veiled Women Stare Ahead**

Chadars envelop the women and girl. Abolished by the late Shah, these all-concealing and often colorful wraps have made a comeback. Only in Tehran are they in the minority. Kashgais live in southern Iran; most lead a semi-nomadic life (pages 462 and 463).





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Kolshirvan by J. Taylor Roberts

Shiraz's Madrasah-i-Khan Recalls Days When the City Was Persia's Resplendent Capital

The school is 200 years old; in its palm-fringed court *students* study Islamic law. Today Shiraz, with new water system, hospital, medical school, library, and swimming pool, is among Iran's most up-to-date cities.



Sassanian Monarchs Pictured Great Moments in Family History on the Rock Wall of Naksh-e Rostam, near Persepolis

With a flair for the dramatic, they cut the bas-reliefs below the rock tombs of Darius and Xerxes, their ancient Achaemenian predecessors. Here the oldest carving shows the god Ormazd investing Ardashir I (A. D. 226-241) with the *kyrbatis*, symbol of authority. Ardashir, at left, founded the dynasty; it lasted more than 400 years.

Bleaching Like Bones in a Desert, Ruins of Persepolis Reflect the Splendor of Ancient Persia's King of Kings

Achaemenian monarchs, chiefly Darius and Xerxes, built the magnificent capital 25 centuries ago. Alexander the Great destroyed it in 331 B. C. Tall columns, 11 out of 72 remaining upright, mark Xerxes' royal audience hall. Girl's dress rivals the flowers' brightness; she clutches a pair of photograph's flashbulbs.

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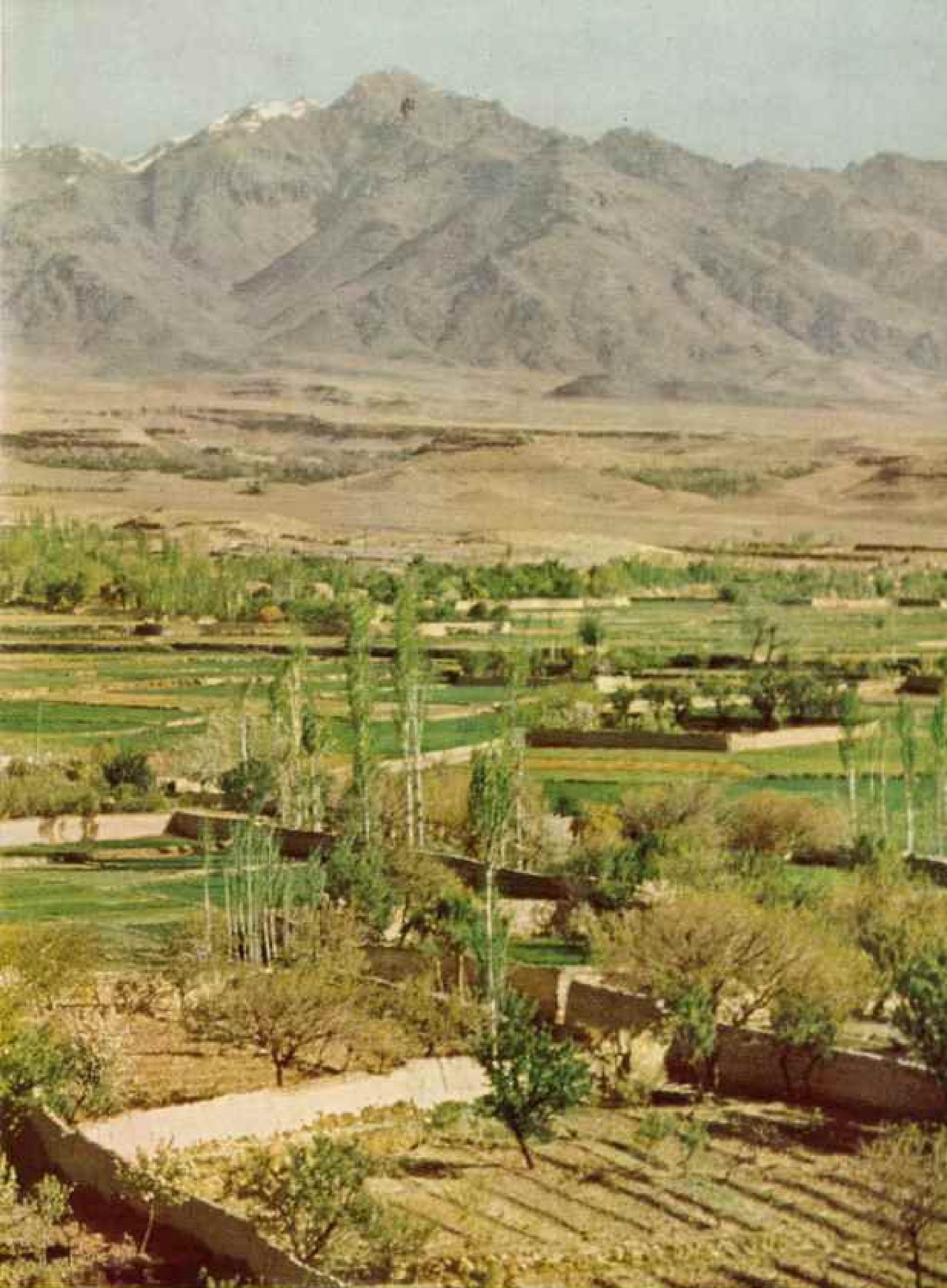
Illustration by 2. Paulin Roberts





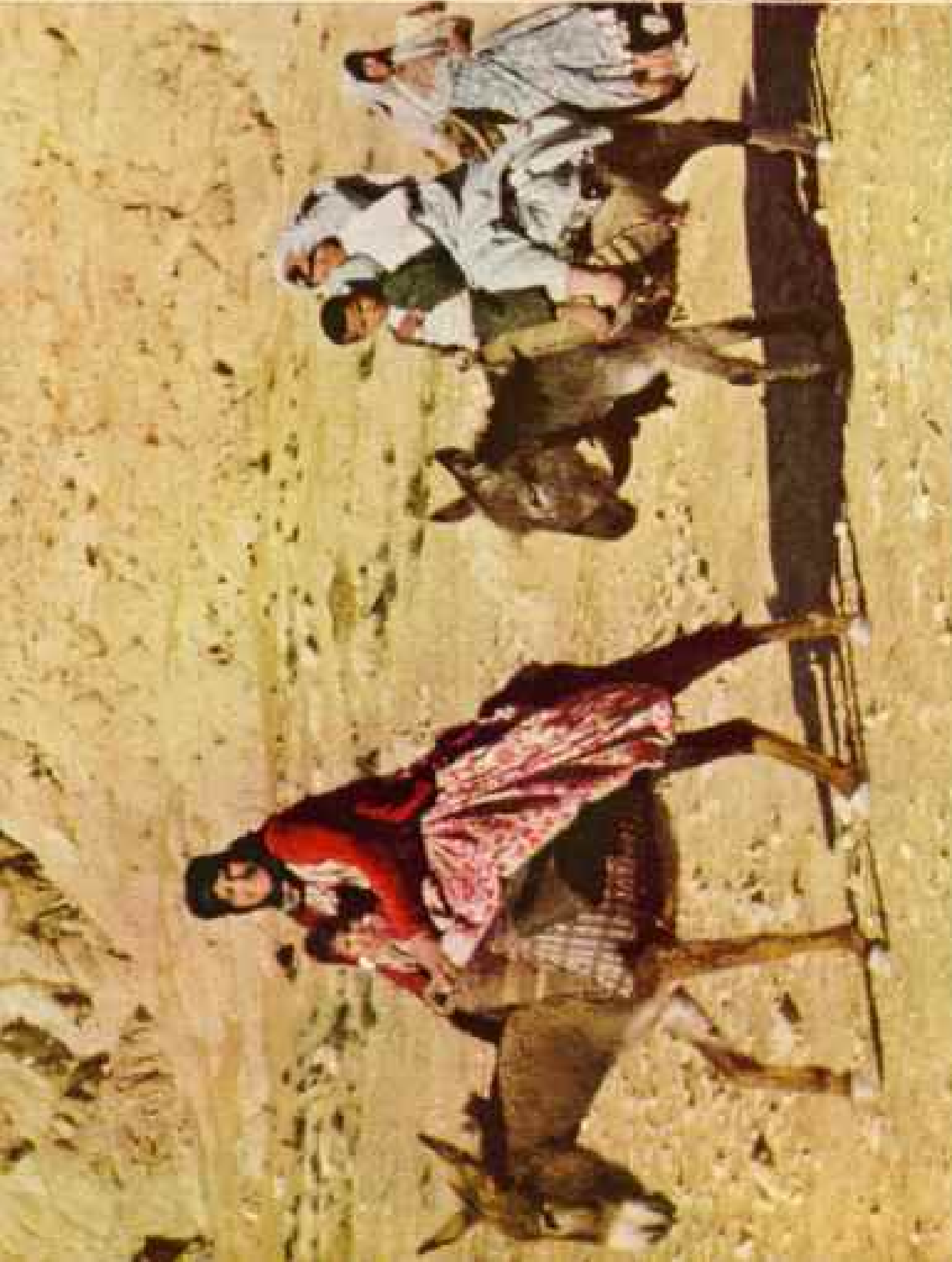
April on the Iranian Plateau: Spring Creates an Emerald Island in a Barren Sea

Burgeoning winter wheat and barley cover this valley, 50 miles north of Isfahan, with a rich green carpet. Fruit trees blossom; plowed fields await sowing. Parched land and barren mountains surround the oasis.



Snow, Melting on Mountains, Snatches the Valley from Desert's Hot Grasp

Over most of Iran's high, dry, and vast plateau rainfall is less than 10 inches a year. Wherever there is water for irrigation, as here, the land bears in abundance. Such farm oases are nearly self-sufficient.



© National Geographic Society

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Kashgarians by J. Harter Roberts

★ **Spring Sets: Iran's Nomads in Motion. Packing Humble Possessions, They Trek from Southern Plains to High Mountain Pastures**

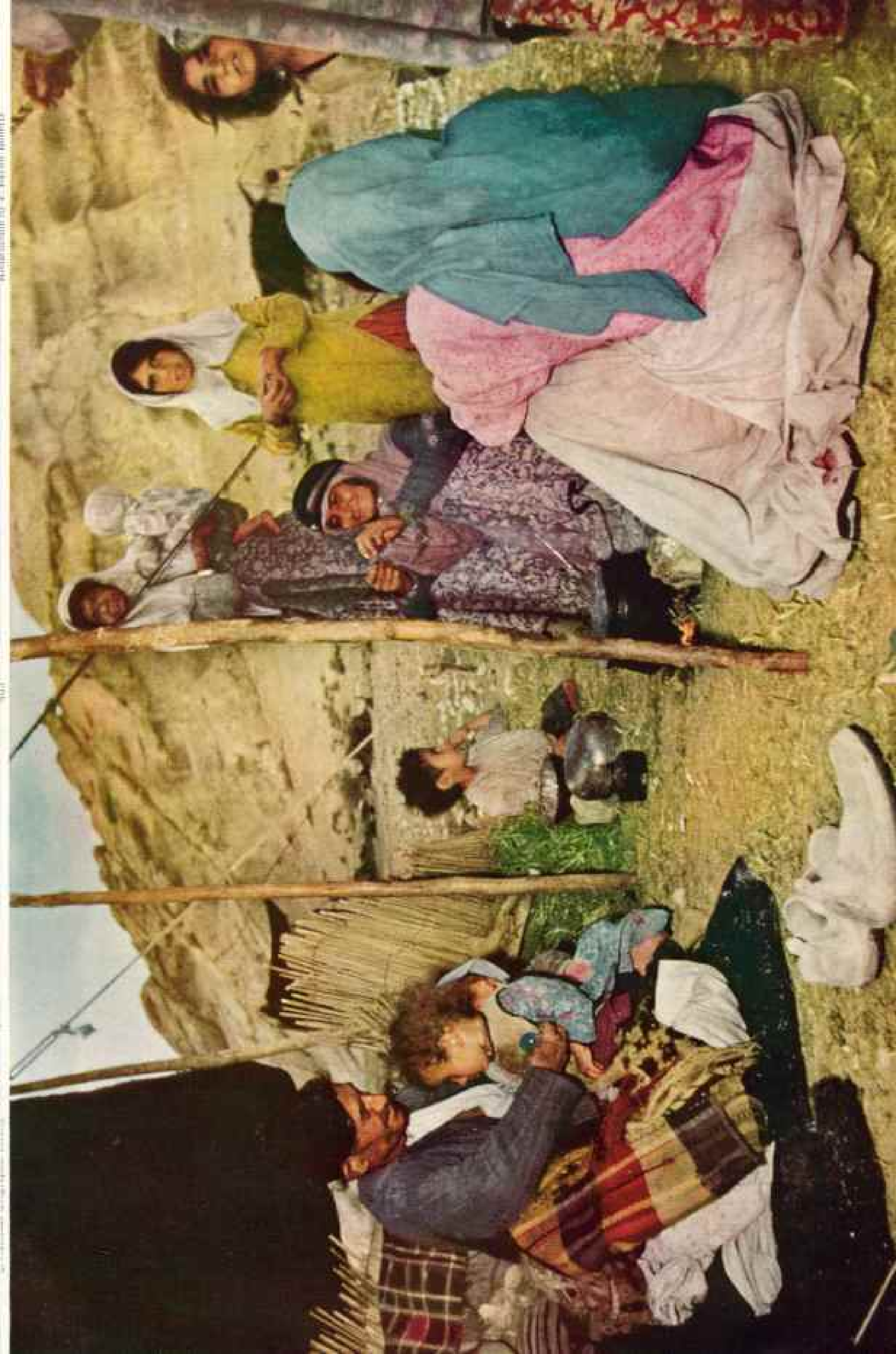
Wandering tribes make up about one-sixth of Iran's estimated 18,000,000 population. Typical are Kashgais, who winter south and west of Shiraz and summer in highlands near Isfahan. Seasonal migrations, covering hundreds of miles, take weeks. Flocks of grazing goats and fat-tailed sheep set the leisurely pace. Women and children perch on baggage-laden burros, horses, or camels. Men and youths, afoot or mounted, drive the flocks.

Kashgais move in small family groups. In April and September their black goat's-hair tents dot hillsides between Shiraz and Isfahan; flocks and caravans often slow traffic on the road.

→ Horse and bullock power a primitive roadside "pump" in southern Iran. The animals, pulling ropes down a ramp, lift large leather bags of water from the well. Through elephant-like trunks the bags spill the life-giving liquid into an irrigation ditch.

✓ Author and photographer visited several encampments of Kashgais, and were offered brimming bowls of buttermilk by the hospitable nomads.







In This Tomb Lay Cyrus, "Who Founded the Persian Empire, and Was King of Asia"

"Grudge me not, therefore, this monument," concluded its original inscription. Cyrus welded Medes and Persians into a nation, conquered Lydia and Babylon. He died in 529 B. C.; his tomb is at Pasargadae.

Far North with "Captain Mac"

BY MIRIAM MACMILLAN

"TAKE the wheel, Miriam," said Mac, quietly.

As I clutched the big mahogany wheel, "Hard aport!" he directed. Then, jumping on the deckhouse, he called out: "Cast off the lines! Half-speed astern!"

Slowly the *Bowdoin* backed away from the dock at Boothbay Harbor, Maine, away from cheering friends and relatives ashore and on small boats around us. The orders, "Steady on the wheel," then, "Ahead slow," made me tingle with the realization that once more we were headed back to the North—to clear waters filled with bluish-green ice and fantastic icebergs; to a land where the midnight sun casts a glow on snow-capped mountains; and straight-haired Eskimos dart about in seal-skin-covered kayaks.

Even our 88-foot Arctic schooner—name gold-leafed on her bow, white hull shining with fresh paint, spars newly varnished—even the *Bowdoin* seemed to glory at thought of being washed once more by icy waters, or tied to an iceberg while her crew refilled the water tanks, or "slowed down" while we photographed a polar bear, herd of walrus, a narwhal, or perhaps Eskimos.

Now, as she glided ahead, she seemed impatient to face once more the exciting uncertainty of poking her nose into those uncharted inlets along the icy, ledge-strewn coasts of Labrador, Baffin Island, Ellesmere Island, and Greenland (map, page 467).

Bombarded with Questions

It was June, 1950. This would be the 29th expedition to the Far North for my husband, Commander Donald B. MacMillan, U.S.N.R. (my own eighth), and the beginning of his 42d year of Arctic exploration.*

Weeks of hard work had prepared for the expedition. Then, in the last few days, there were endless questions: "How can this little boat stand the strain of that ice?" "Will you bring back polar bears and walrus—*alive*?" "How do you ever cook a walrus in that small oven?" "How do you keep warm?" "Why do you call that"—pointing to the crow's-nest at the top of the foremast—"the ice barrel?"

And, looking directly at me: "Where do you wash your hair or take a bath?" If I happened to be in the after cabin near my bunk, I'd point to the small basin in our four-by-four "head" and say, "In that basin—if we have enough water."

With all the questioning crowds, I sometimes wondered how we ever managed to stow on board under floors, in closets, in every cubbyhole enough food (four tons) for 14

men and one woman for four months. Not to mention 2,700 gallons of Diesel oil, 600 gallons of water, three tons of coal, and supplies for the MacMillan-Moravian School at Nain in Labrador (page 481). To forget a single necessary item—a spare part for the engine, a tool for repairs, even a light bulb—might prove disastrous.

But somehow we got everything aboard at last and with pounding hearts could thrill at what lay ahead—new experiences and discoveries, both geographical and scientific. Mac's answer to the question so often asked, "Why do you go?" is significant. "To learn something," he replies. And after 42 years he still "learns something" on every trip.

Commander Donald B. MacMillan's expeditions have been sponsored by geographical societies, including the National Geographic Society, and many museums. He has done work for the United States Government, for the Carnegie Institution of Washington, for many colleges—Bowdoin, Yale, Harvard, the University of Illinois, and others. These expeditions have ranged from a few months to one of four long years.

Not a Sailor in the Crew

The scientists, professors, college and preparatory school students who go along to do research in botany, geology, ornithology, zoology, and anthropology make up his crew. He never takes a professional sailor. He depends entirely upon training these men and boys, some of whom have never been at sea. Each one stands watch for'ard, takes his trick at the wheel, scrubs decks, shines brass, helps the cook. And I'm no exception; I do all these things. I take orders from the Captain and the mates and, when I'm scullion for the day, from our cook (page 473).

After two days' cruising along the Maine coast, our green crew were getting used to the routine of the ship; now they were ready for the start around Cape Sable, Nova Scotia. Each man had had a chance to steer by compass and knew what it meant to trim sheets and pull on a halyard.

The sun was setting when we anchored in the snug little harbor of Cutler, Maine. It painted the sky a brilliant red and deep yellow as it dipped below the horizon.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "MacMillan Arctic Expedition Returns," by Donald B. MacMillan, November, 1925; "Naturalist with MacMillan in the Arctic," by Walter N. Koelz, and "First Natural-Color Photographs from the Arctic," 22 ill., both March, 1926; "MacMillan in the Field," October, 1925; and "Scientific Aspects of the MacMillan Arctic Expedition," September, 1925.



Baffin Islanders Try to Follow *Bowdoin's* Course on Charts

Paddling frail kayaks, Eskimos seldom venture 10 miles from home and never out of sight of land. They return each night with the day's catch of fish or meat. This Pond Inlet party was astounded when Commander MacMillan (with pencil) showed how far his ship had sailed (map, opposite, and pages 490, 513).

Next morning we were up with the sun and ready for the day. The sailor's omen, "Red sky at night, sailor's delight," held true, and we set our course for the Bay of Fundy and Cape Sable under perfect weather conditions.

After a few hours, even our slight roll was enough to prejudice some of the new members against Clayton Hodgdon's delicious turkey dinner. "All hands watch for the Lurcher Lightship," said Mac, in an attempt to turn their minds from stomachs to navigation.

When that red-colored lightship finally came into view, we were ready to set our course for Seal Island. Keeping well to the "suthard" as we rounded that island, we soon picked up Blonde Rock Buoy, which seemed to moan out the disasters of long ago.

"Wrecks on the bottom all along here," observed Mac thoughtfully, yet cheerful about the present weather. "The *Staffordshire* sank right about there in 1853." He pointed to a spot very near the buoy. "One hundred and eighty men, women, and children, Irish immigrants, drowned. The *Anglo-Saxon* was lost here, too, in 1846. And also the—"

There was quite a list. We were thankful to pass by.

The *Bowdoin* rounded Cape Sable with ease, then Brazil Rock. As we approached the Halifax lightship with all sails set, it happened to be my trick at the wheel, 11 to midnight. And what a sight, the moonlight glittering on the water, gold flashes from electric lights pin-pricking the distant skyline on our port hand! As I looked aloft and pulled the wheel a bit to starboard to keep the mainsail full, every sparkling star seemed to twinkle and smile with me. How thankful I was that we were passing the city, leaving civilization behind; that we were heading north!

Fishing Boats Are Hazards After Dark

Clear weather continued all the way to Cape Canso. But a number of small boats here and there in our pathway made me shudder. I thought of that time in thick fog when we almost ran down one of those fishermen. Regardless of weather, these natives keep right on fishing without lights, foghorns, or the slightest signal of "Here I am—watch out!"

Three blasts from our air whistle on reaching the St. Peter's lock aroused the red-shirted workmen, who waved, then slowly hand-cranked the ponderous entrance gate to

let us through. Mac jumped ashore and greeted the customs officer, an old friend who had been there almost as long as the *Bowdoin* has been entering Nova Scotia by way of the Bras d'Or Lakes.* It was a personal as well as an official visit. Soon we were on our way again.

I always look forward to that run through the Bras d'Or Lakes, especially if we've taken a drubbing, as we often have, around Cape Sable. The pungent smell of spruce trees itself is worth a shaking up. And I love the peaceful green fields, dotted with grazing cows and sheep, which reach from the lake's edge back to neat farmhouses and white churches.

Ahead, off our port bow, loomed a high point known as Red Head, a landmark and once the summer home of one of the world's great men, Alexander Graham Bell. A clearing on Beinn Bhreagh ("Beautiful Mountain" in Gaelic) marks his burial place. His large house, with its high trees and green lawn sloping down to the water, has been occupied for many years by Gilbert and Elsie Bell Grosvenor. We swung in close, but three toots on our horn failed to break the quiet ashore. There was no flag flying. Clearly the family had not arrived for the summer.

A short distance beyond, at Big Harbour (Port Bevis), we stopped for the night. Here Mac had spent many happy summers with his grandparents as a boy.

Last Tub Bath for Three Months

When we landed in Sydney, Nova Scotia, next morning, I was the first ashore, hustling up the main street to order last-minute food supplies and presents for our many friends in the North. The *Bowdoin* had a refill of oil and water while the rest of us enjoyed hot baths at the hotel, our last good soak in real tubs until we returned to Sydney three months later.

Only 80 miles of Cabot Strait separate Nova Scotia from Cape Anguille, Newfoundland. Generally, however, it's a foggy stretch and a busy thoroughfare as well; so Mac watches the weather carefully. Late in the afternoon he decided: "Barometer's steady. Things look good for the crossing. We'll start."

Having crossed Cabot Strait before (shall I ever forget the rolling and tossing!), I was prepared to "hang on." But the going was so good I could think only of what all Arctic travelers know too well: good weather now means something coming later. Old Torngak, the evil spirit of the North, would catch up with us somewhere, somehow.

So far, Mac has always managed to get the better of Torngak, but there have been

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Salty Nova Scotia," by Andrew H. Brown, May, 1940; and "Charm of Cape Breton Island," by Catherine Dunlop Mackenzie, July, 1920.



467. DRAWN BY IRVIN E. ALLMOND

In These Waters *Bowdoin* Has Sailed a Quarter-million Miles

On this trip, latest of 29 "Captain Mac" has taken to the Arctic, his 60-ton schooner started from Boothbay Harbor, Maine, and sailed along the Labrador coast. Crossing from Cape Chidley to Greenland, she pushed on through increasingly ice-filled water until she passed Etah, northernmost permanent settlement in Greenland. In Kane Basin, about 79° N., the expedition was stopped by unbroken polar ice and forced to turn back. Return trip followed the Ellesmere and Baffin Island coastlines.



Donald MacMillan

Boulder and Plaque Mark the Site Where Heroes Died

★ In 1924 Captain Mac took this bronze memorial tablet, presented by the National Geographic Society, to Cape Sabine, Ellesmere Island. There he fastened it to a 100-ton boulder in the center of the camp-site where A. W. Greely and his men passed their tragic winter and 18 of the party of 25 died (pages 502, 509).

This picture was taken just after the tablet had been bolted in place, but members of the latest MacMillan expedition reported it still in perfect condition.

← At Wiscasset, Maine, Major General Greely says good-bye as Commander MacMillan gets ready to leave on his trip to Cape Sabine with the tablet. The picture was made in 1923. General Greely died in 1935.





In the Main Cabin, Donald and Miriam MacMillan Plot *Bowdoin's* Course

Guns in foreground will be used to bring back museum specimens—birds, seal, walrus, and polar bear. Books on shelf are part of the ship's Arctic library, studied by crew for background on the places they will see.

occasions when only miracles or "MacMillan luck" have done it.

We easily picked up Amour Point Light and kept on out the Strait of Belle Isle with no fog.

The deep bell tones of welcome from that lighthouse at the entrance to the Strait gave us a feeling of really getting north. Soon we saw our first icebergs, and this year there were many. The cheery little puffins with their black backs, white breasts, and large, peculiar, many-colored bills, popped up and down right under our bow and all around us.* Whales plunged through the calm waters, often killers in search of other whales.†

Twisted remains of wrecks reminded us that not always is there fair weather through the Strait. One rusty mass, all that's left of an English warship, H.M.S. *Raleigh*, has been on the beach at Amour Point since 1922.

As we neared the more dangerous stretch of the Strait several hours later, the wind came in dead ahead. Mac called a halt for the night: "We'll go into Chateau."

While most of us were admiring a weird-looking hill of black basalt, known as the Devil's Dining Table, which towers over the entrance, the man at the wheel was trying hard to keep up with Mac's curt orders—"Watch those salmon nets! Port, steady, starboard. Slow her down." To get fouled in that maze of nets crossing our pathway would be disastrous to the propeller. At least Jacques Cartier didn't have salmon nets to contend with, I thought, when he made his way into this same harbor over 400 years ago.

A Village Made of Stones

We went ashore eagerly. From the occupant of the first house came a genial, "Glad to see yah! Where yah bound? How's the weather to th' suthard?"

* See "Birds of the Northern Seas," by Alexander Wetmore, NATIONAL GEOGRAPHIC MAGAZINE, JANUARY, 1936.

† See "Whales, Giants of the Seas," by Remington Kellogg, NATIONAL GEOGRAPHIC MAGAZINE, JANUARY, 1940.

"My name's Stone," he explained. "Come in and meet the wife and kids."

After an hour's visit with Mr. and Mrs., a lot of little Stones shyly peeking out from every corner of the sparsely furnished wooden shack, we knew all the fishing and trapping news. We knew much more: for example, that in Chateau there are 13 families and 80 people and that "We're all named Stone."

In a village to the north, Cape St. Charles, it seemed that everybody's name was Pye. And almost all the families in Red Bay were named Pike.

I listened politely, but the handmade hooked rugs covering the wood floors were of far more interest to me. Tempting for a woman about to furnish a new home in Castine, Maine!

The weather was still good the next morning, and even with our stop at the St. Peter Islands to photograph herring gulls, eider ducks, and Arctic terns we were able to drop anchor in Antill Cove by noon. Here the crew refilled our water tanks from a clear stream at the head of the harbor.

"I came in here with Peary on the *Roosevelt* in 1908," said Mac, looking reminiscently at the remains of an old whaling station. "The very place where we loaded about eight tons of whale meat."

"Whale meat?" asked the cook.

"For our dogs," he explained. Then he added, "We can easily make Battle Harbour before dark. It's only six miles from here."

To my way of thinking, there's nothing easy in making port at this so-called capital of Labrador, with its salmon nets, trout nets, ledges, and islands barely hidden at high water.

There are few places where Mac takes the wheel, but Battle Harbour is one. Do you wonder I was nervous now when suddenly he said to me, "Do you want to take her in?" That much confidence in me I considered one of the high points of my eight trips into the Arctic.

Around the Iceberg and into the Dock

I stood straighter as I gripped the wheel, determined not to hit one thing on the way in.

First I steered for the side of a cliff until the bow practically touched the rocks. Then I slowly swung to port, just missing a ledge in the middle of the entrance. Back toward the cliff again, almost grazing the side, where wooden shacks and fishing stages projected into the water, natives stood waving, and mangy summer-coated dogs howled at us.

Battle Harbour furnishes a picture of what is to follow on the Labrador—dogs, barren rocks, and shacks perched as if they're ready to drop into the sea at one puff of wind.*

The *Bowdoin* lived up to her reputation.

"She could turn on a 10-cent piece," someone had said. We missed the small iceberg in the middle of the narrow harbor by a few feet and tied up at the dock without a scratch.

Our friend, Stanley Brazil, for years radio expert of the Labrador, was waiting to greet us.

"Don and Mariun back again! Looking younger than ever. How do you folks do it? Good work bringing her into dock, Mariun!"

It came in a single breath, and a little later Stanley was bringing us up to date on all the happenings along the Labrador: codfish were scarce—no price, only a cent a pound; salmon better, 15 cents a pound, 90 cents in the States; ice to the north of us; prepare for trouble—worst ice conditions in years!

Despite the low price and scarcity of fish, things looked busy at Battle Harbour.

A fisherman stood in his dory, knee-deep in fish, tossing the squirming bodies onto the rocks. Two schooners were tied up to the dock, loading boxes of iced salmon. On shore boys nailed shooks into shipping boxes.

But on the horizon one lone schooner, making its way north, showed the changing times. Once 1,400 schooners went north along that coast each year, returning in late September or October with holds full of fish. Now, we were told, only about 50 venture north.

Where Peary First Told His Story

We spent the first part of the evening exchanging stories, and no one can tell them quite like Stanley. Later we climbed to a dimly lit loft in the old Baine, Johnston & Co. building adjoining the dock (it bought out an English firm here in 1870) and there listened while my husband described, at first-hand, a dramatic scene of 41 years before.

As one of Robert E. Peary's assistants, Mac had been in this same loft when the tall, broad-shouldered explorer, dressed in rubber boots, old raincoat, faded blue cap and flannel shirt, gave his first interview to the press after discovering the North Pole. His audience consisted of reporters and photographers, some standing, some squatting on fish boxes and nets; behind them fishermen in oilskins peered over their heads; small curious boys sprawled on the floor.

All listened breathlessly, for this was one of history's milestones. After 300 years of struggle by many nations, ships crushed, crews lost, this man Robert E. Peary, who had reached the goal at last, sat here on the head of a barrel calmly telling his story. And suddenly the night air had crackled with wireless messages which encircled the world, one to

* See "Newfoundland, Canada's New Province," by Andrew H. Brown, NATIONAL GEOGRAPHIC MAGAZINE, June, 1949.

the *New York Times* stretching to 9,000 words. Battle Harbour was placed surely on the map that September day of 1909.*

Some believe the name Battle Harbour came from an encounter here between Indians and Eskimos, but since the word *Batal*, Portuguese for "boat," was found on maps 200 years before this happened, "Boat" Harbour seems more likely.

Dr. Wilfred Grenfell chose this Boat Harbour, really the fishing center of Labrador, for the site of his first hospital, which was built in 1893 and destroyed by fire in 1930. There is now a nursing station at Marys Harbour, 11 miles up the sound.†

His splendid work is now carried on by the Grenfell Association, the largest hospital being at St. Anthony, Newfoundland. During the summer Dr. Tony Paddon cruises north along the Labrador in the Association's medical ship, *Maraval*, attending the sick and bringing back severe cases for further treatment at one of the Grenfell hospitals.

We made our way out of harbor the next morning and laid our course due north for Spear Point. But the sky didn't look good ahead. From the way Mac was pacing the deck and humming—he always hums a tune when there's trouble brewing—I knew we wouldn't be at sea for long.

After eight trips with him, I've learned not to ask questions. I also try to answer questions of others before Mac hears them, in case someone in the crew insists on knowing exactly what time we'll arrive at Hopedale or Nain; or why, with the weather looking good, we can't continue. I explain that there is no schedule for travel in the North. We just push ahead whenever possible.

If the next run is treacherous and we have far to go before making harbor, we sit by, waiting patiently.

This time I knew what was ahead—Domino



William MacMillan

Who Cares if It's Sticky as Long as It's Sweet!

Eskimo children seem to like sweets even more than American children do, perhaps because they get them less often. These are pupils at the MacMillan-Moravian Mission School in Nain, Labrador. *Bowdoin* carries supplies, including molasses, to the school on each trip north (page 481).

Run. Not only is the entrance to this run so narrow that only an expert can hit it in fog, but the approach is literally peppered with ugly-looking ledges and projecting rocks. Many a fishing schooner has ended her life here.

Therefore, when Mac finally spoke, he said just what I expected—that we'd head in for Hawke Harbour. But we were a bit late.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Discovery of the North Pole," by Gilbert Grosvenor, January, 1910; "Peary's Explorations in the Far North," by Gilbert Grosvenor, and "Peary as a Leader," by Donald B. MacMillan, both April, 1910; and "Discovery of the Pole," by Robert E. Peary, October, 1909.

† See "Land of Eternal Warring (Labrador)," by Sir Wilfred T. Grenfell, NATIONAL GEOGRAPHIC MAGAZINE, August, 1910.

Before we reached the entrance, the fog had settled down, blotting out sea and land, compelling us to depend upon our noses to guide us to a safe anchorage. With a whale-odorous wind coming directly from the only active whaling station left on the Labrador, that was easy. The boys rushed ashore and came back with the news that three whales, killed in the morning, were being brought in that night to be cut up next day. The operation was to begin at 4 a.m., they said.

How Experts Carve a Whale

It wouldn't be the first time I'd gone ashore here before breakfast to photograph and watch the cutting up of whales. And I can testify that it is a far greater test of one's stomach than the roughest seas encountered anywhere in the Arctic. But I was ready to go again, for watching these expert Newfoundland and Norwegian cutters make quick work of a 50- or 60-ton whale is a dramatic sight.

In one hour, sometimes less, the huge animal is pulled onto the ramp, its skin peeled off as easily as you'd peel a banana, and each section cut and distributed to places of disposal.

At the top of high ramps, great steam saws whine as they cut into bone.

Meat and blubber are dumped into holes leading to separate steam boilers where all is cooked. Then the meat is ground into powder, dried, and shipped out as fertilizer. The oil itself is carefully separated, graded, and barreled, much of it for use in making soap.

At times some of this oil proves to be the precious, high-priced variety used in lipsticks.

We learned that the past few seasons here have been good, from 350 to 400 whales killed, cut, and shipped each season. Mostly they were the blue, or sulphur-bottom, and finback whales, each worth around \$5,000.

Hawke Harbour was interesting. Just the same, I was well content that noon to leave and head on along the coast. With clear weather, we easily hit the entrance to Domino Run and continued north, passing places familiar to me by now, harbors to remember in fog or bad weather—Entry Island, Indian Tickle, Mullins Cove, Gready, Curlew Harbour.

Each one is distinguished for some particular hazard or warning. Mullins Cove, for instance, is dangerous in an easterly. Twelve fishing schooners wrecked here in 1912! Curlew Harbour is bad in a northwest wind, but in an easterly or southerly it's a fine refuge. Comfort Bight suggests exactly that, comfort in any weather.

Other names along this southern Labrador coast are highly descriptive. Wild Bight, Mad Moll, The Wolves, Ironbound, Windy Tickle, Run by Guess, Mosquito Cove, Fillbelly Island are typical.

Before reaching Hamilton Inlet, Mac pointed to Gready. "Just off there is where the 19 men, women, and children of the *Polaris* party were picked up in 1873 by Capt. Isaac Bartlett. They had drifted 1,500 miles on an ice pan from October 15, 1872, to April 30, 1873."

Once across the inlet, 50 miles of open water strewn with ledges and islands, we began to look for Indian Harbour, then Cut Throat, and finally the wireless pole at Smoky Tickle. That was where Peary's terse message, "Stars and Stripes nailed to the Pole," was sent to the Associated Press on September 5, 1909.

Winding in and out through inside runs, we continued to Hopedale, the second Moravian village on the coast. When our anchor touched bottom here, we found ourselves surrounded by natives, some shouting "Aksuse! Illitarnamek!" (the Eskimo greeting to good friends), and others calling "Hello! Glad see!" Different natives, to be sure, from those Mac lived and traveled with some 40 years before; with civilization moving steadily along the coast, a full-blooded Eskimo on the Labrador is now a rarity.

Some Natives Now Curl Their Hair

It was Sunday in Hopedale. Finding church services about to begin, I went ashore "natively" dressed, which I thought would please our friends. To my chagrin, I was about the only one wearing a white dickey with hand-embroidered band and fur around the hood, and sealskin boots. The natives came in sweaters, skirts, blouses, dresses, coats, and even shoes and hats! How some of the girls had curled their straight black hair was a mystery.

As we stood there singing hymns in Eskimo, I couldn't help thinking about the changes since the Moravian missionaries from London first settled on these shores 179 years before: Eskimos murdering whites, whites killing Eskimos. But the Moravians built homes and churches, and gradually the natives gathered around. Counteracting the dubious influence of traders, fishermen, and other visitors, the Moravians have helped the Eskimos keep their own ways and customs, in habit, dress, food, and language.

Most important of all, they have used their medical training to help protect the Eskimos from diseases of civilization, seeing them through many an epidemic of smallpox, measles, and influenza.

We cleared Hopedale at 4 a.m. in order to reach Nain, the next Moravian village, 100 miles northwest, before dark. We took the inside run, another maze of islands and ledges. How Mac found the way, recognizing every



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Kodachrome by Donald MacMillan

▲ With Greenland's White Cap Behind Her, *Batavia* Sails into an Icy Sea

During the three-month 8,000-mile Arctic cruise, the author, like the rest of the crew, took her trick at the wheel and stood watch when her turn came. Here she heads for some ticklish steering through an ice field in Smith Sound.

▼ Reunion: These Four Helped Peary Reach the North Pole in 1909

Commander MacMillan, assistant to Peary, had to turn back short of the Pole with frozen feet. Forty-one years later, near Thule, north Greenland, he greets old Eskimo friends. Poo-ad-loonah drove dogs for Peary; the women made bearskin and caribou clothing.

Kodachrome by Ralph B. Hubbard, Jr.





Rust-colored Cliffs Overhang Bowdoin in a Fjord near Etah, Greenland. Sails and Diesels Are at Rest

The 88-foot schooner, veteran of more than 30 years of Arctic exploration, is one of the smallest ships to venture this far north, but also one of the toughest. Her oak-hull wears a girdle of ironwood; 22 tons of cement reinforce her bottom. Steel-armored bow smashes through heavy ice.

Like a Sluggish Ocean Breaker, a Glacier Winds Its Way Down a Rocky Valley; an Eskimo Girl Quenches a Sudden Thirst

In summer these Etah girls wear *anoraks*, shirts made of bright-colored cotton purchased at a Danish trading station, instead of the skin garments their ancestors wore. The little girl's pants are made of polar bear skin, her friend's of fox fur; boots are walrus. Inset: One of the girls drinks from a clear, glacier-fed brook.

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Illustration by Milton Macthuan





Time Out to Watch a Greenland Glacier Feeding Icebergs to the Sea

Many of *Botedain's* crew of scientists and students had never been to the Arctic before. On the trip north they often stopped to stare at glaciers, icebergs, and other frozen scenery. On the return trip, however, they were old hands.



Frozen Rivers Flow from the Vast Ice Sheet Which Covers Most of the Island

A scientist who measured one Greenland glacier found that it moved about 65 feet a day and calved about a cubic mile of icebergs a year. This one, some 30 miles south of the Arctic Circle, moves more slowly.



Seal, Caught Napping on an Ice Pan, Will Be Hoisted Aboard the Schooner and Mounted for a Museum

This is a squareflipper, biggest seal on the Atlantic side of the Arctic; some specimens weigh up to 700 pounds. This one was shot while sleeping; otherwise he might have dived and died beneath the surface. Taxidermist Novis Bertrand (right) mounted many animals for Bowdoin College's new Arctic museum.

← Colored beads, black dog fur, and white sealskin make a dress-up costume for the author's friend, a Lichtenfels teen-ager. Once all south Greenland women and girls had such outfits, each with a different collar design. Today there are fewer of them.

✓ Two boys at Pond Inlet, Baffin Island, inspect Mrs. MacMillan's book, *Etah, the Eskimo Hunter*. They can't read the story, but are engrossed by pictures showing adventures of a 14-year-old Eskimo boy. Jacket design was suggested by a fight Captain Mac once had with a walrus.

Recreation by Robert B. Hubbard, Jr.

Exhibitions by Donald MacMillan





↑ A Whole Village
Turns Out to Cut
Up a 50-ton
Blue Whale

A whaler near Nūgātsaq, Greenland, hauled its catch ashore for Eskimo women to carve with sharp *soleas*. The whaler takes the blubber; villagers keep the red meat.

Kodachrome by
Ralph H. Hubbard, Jr.

← Greenland Women
Pick a Bone

At teatime, these Thule housewives dropped in for a chat and stayed for a snack—two big beef bones given by *Bowdoin's* cook. Polar Eskimo diet consists chiefly of whale, seal, walrus, and fish; raw beef is a delicacy.

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Kodachrome by Mirjam MacMillan



hill, inlet, and harbor, I don't know. Although I'd sailed the course before with him, they all looked much the same to me.

I suppose the answer is that Mac has been navigating these waters for more than 40 years. He first tackled the inside runs in a trap boat in 1910, then alone in a canoe in 1911, which he rowed and sailed to the northern tip of Labrador.

Next, with one companion, he came in a motorboat, the first such craft to cruise the Labrador. Then year after year he picked his way through in the *Bowdoin*. From the air and by dog team also he has studied this coast, charting rocks and ledges. But I noticed that he remained on deck the entire 12 hours of our run, casually explaining, "We can easily hit a rock any time along here."

At Davis Inlet we slowed down, hoping to see some of the Nascopie Indians who come out from the interior and gather here to await the Catholic priest. He comes north on the mail boat to bless them and their implements of the hunt. But with no canoes or dirty tepees in sight, no smoke rising through the spruce and larch trees, we concluded they must have moved north to fish. We resumed speed and continued north.

The sun was dipping behind the hills by the time Mac finally called, "Around that point is Nain." Through our binoculars we could see white-hooded figures running back and forth. The *Bowdoin* had been sighted the instant her spoon bow rounded the hill. In a moment we saw the English flag at the mission house raised and lowered three times.

Welcome—with an Eskimo Brass Band

If there was less activity than usual on shore, we knew it was because some of the natives had gone off to the islands to fish, their only livelihood during the summer. Still, enough were left to load down every available boat and skiff. Packed into the lead boat, the *Seeko* (Eskimo for "ice"), a 40-foot motorboat which Mac had given the missionaries, we even made out members of the native brass band, cumbersome instruments and all.

Round and round they circled, singing hymns and calling to us in Eskimo. Then one bang after another as each boat hit the side of the *Bowdoin* and our enthusiastic visitors climbed aboard. Kate Hettasch, Doris and Bill Peacock, the missionaries at Nain, were first over the rail. Next came a line of sealskin-booted natives, more nearly full-blooded than those to the south.

The day was spent unloading supplies and visiting. The natives, living in wooden houses, gave us a warm welcome. Some of the homes were dirty; others were neat and clean, walls

gaily decorated with colorful pages from magazines, windows filled with flowers growing out of tin cans. There were even radios, phonographs, and sewing machines in evidence.

At the mission house in the center of the village, Doris and Kate served coffee and pastries and generous helpings of bakeapples. These reddish berries, looking something like raspberries, have an indescribable taste and mean as much to a native of Labrador as does a blueberry to a man from Maine (page 496).

The mission was typical of all Moravian buildings, with white sides and red roof, hard-scrubbed wood floors, long hallways, and windows and entryways aglow with flourishing potted plants, including roses in bloom.

A short walk through the Moravians' vegetable garden, already sprouting potatoes, radishes, lettuce, cauliflower, and rhubarb, led us over a white bridge to the MacMillan-Moravian Mission School. Three buildings, of which Mac gave two, stand here in a setting of larch and pine trees and well-trodden paths lined with fireweed.

In 1929 he brought north on the *Bowdoin* lumber, desks, blackboards, books, radio, blankets, dishes, food, clothing, sleeping bags—everything with which to start a school. He lighted the school building, the church, and the missionaries' homes with electric lights. He put an organ in the school and another in the church. One year we landed 20,000 false teeth and a dentist's chair.

While we always take additional supplies when we sail north on the *Bowdoin*, we feel that our part in the school's success is relatively small. The Moravians deserve the credit, particularly Kate Hettasch, the teacher since the day school first opened. Kate was born on the Labrador, her mother and father being outstanding missionaries there for nearly 50 years.

Reading, Writing, and Sleeping Bags

The school started with 20 pupils. Now some 70 black-eyed, red-cheeked children shuffle up the path in October, wildly excited to be back. They study English, reading and writing in Eskimo, spelling, drawing, Bible, needlecraft, carpentry, a smattering of geography and history. They're allowed plenty of physical exercise, and each one also helps with the work, cooking, mending, washing, gathering wood and water. At night they wriggle into their sleeping bags (page 471).

For dinner they may have *nipko* (dried seal or caribou) or *pipsit* (dried trout) with chunks of seal fat, hard bread and molasses, and raw *okauyak* (yellow willow leaves); or a piece of seal or caribou meat; or perhaps one



A Frozen Galleon, an Iceberg Heads Majestically Out to Sea

This comparatively small berg was sighted near the Labrador coast. Farther north, *Bowdoin* met one that measured more than a quarter-mile in diameter and loomed 100 feet above the water. Carried by ocean currents, a big iceberg may cruise for years before it melts in warmer southern waters.

ptarmigan stretched into a large stew. Whatever it is, there's none left at the end of a meal.

Saturday night is bath night for all. Sunday morning, dressed in clean Eskimo garb, they march two by two from school to church, where they sing, pray, and listen attentively with the rest of the village. A heart-warming occasion!

Their eager faces lined up at the long dining table make another touching sight. The blessing and joining of hands to form a chain around the table while they repeat the Eskimo greeting in unison, "Aksuse! Illitarnamek!" precedes the meal.

We were surprised to see so many Nascopic Indians here at Nain. They are a primitive race, generally looking half starved and only half clothed. Once deadly enemies of the Eskimos, they seemed friendly enough now. In fact, they looked in better condition than when we had seen them at Davis Inlet on other trips.

They were grouped around the government store, waiting for dole, each one being entitled to so much food. For many years, living deep in the interior of Labrador, they have been coming out once a year for trading.

In 1910 Mac, with three companions, suffered clouds of black flies and mosquitoes in traveling 100 miles across Labrador to their caribou-skin tepees to visit and study this branch of the Algonquians.

One of them, Sam Rich, with whom we talked, remembered Mac's visit well. And Napaho and others in the group hadn't forgotten that he fed and clothed them when they were starving the one winter he lived at his scientific station 20 miles from Nain. That station has since been moved to Nain and now constitutes one of the school's three buildings.

Back on board for a good sleep and early start, we couldn't help but think how pleasant it was here in summer, except for the hordes of mosquitoes and black flies and weird howling of dogs at night.

In the red glow of a rising sun we left the sleeping village and steered for more inside runs. I settled back on deck and watched the parade of deep fjords, thickly wooded on both sides with spruce trees, and now and then a tumbling waterfall. Mount Thoresby, noble-looking, rose a sheer 3,000 feet on our starboard hand.



Lung-powered Horn Sounds Once a Minute as *Bowdoin* Feels Her Way Through Fog

The hornblower is Arthur Boucot (quickly nicknamed "Buckets" by crew), a Harvard student; the location: off Newfoundland. So widespread is Captain Mac's fame as a pilot that during heavy fogs fishing boats sometimes follow *Bowdoin's* horn blindly, knowing she will lead them safely into harbor.

The Port Manvers Run is one of the most intricate of all, and Mac is about the only navigator who attempts it. But when we reached its long sand beach there was a low-lying bank of fog and scattered pans of ice; hoping for better weather, we anchored until morning. While we waited, we decided to catch some codfish for supper. Down went our jigs, no bait, just shiny bare hooks, and in no time we had yanked up a mess of beautiful fish out of the cold water.

Though the weather looked more favorable next morning, we could still feel that penetrating chill from the ice pack. And when we finally made our way outside, there it was, white ice stretching to the horizon. It was far enough from shore, however, not to bother us unless there was a sudden change of wind.

Okak Is a Ghost Town Now

As we rounded Thomas Island, Cape Mugford stood out bold and bleak, the objective of the Moravian ships from London for more than 100 years. From this cape they headed in for what was once the most prosperous Eskimo village on the coast, Okak. It lay now on our port hand, a ghost town. Okak was

practically wiped out by the influenza epidemic of 1919. Of the 263 Eskimos there at the time, 216 died within a week or so.

In a solitary place just north of Okak, one entire family was wiped out. All, that is, except a 6-year-old girl named Martha. She was left alone in a rock-sod igloo with the bodies of her dead parents, brothers, and sisters. Until she was found, two months later, she lived on a small amount of flour, berries, and melted snow. She's living today, the mother of healthy children.

Mugford Tickle, a narrow "ticklish" place, but our only exit to the ocean, we found filled with ice from shore to shore. While waiting for wind and tide to scatter the pans a bit, we headed west into a particularly obscure area to correct charts and make soundings for the Hydrographic Office in Washington, D. C.

We anchored that night under Mount Brave, 4,300 feet high, first climbed by members of the *Bowdoin* crew in 1937 and again on this trip.

Next morning we pushed through Mugford Tickle and on to Hebron, now the northernmost Moravian settlement. There we found the natives busy netting, splitting, salting, and

packing trout for shipment to Newfoundland.

North of Hebron are some of the highest mountains on the whole Atlantic coast, towering more than 5,000 feet, and so wild-looking that the Eskimos call them the Torngat Mountains, the abode of evil spirits. I could readily believe it. Abandoned by the natives, by the Hudson's Bay Company, even by the Moravian missionaries, the Torngat Mountains stand desolate, without a living inhabitant.

The fjords here would make a Norwegian feel at home, with deep water in narrow passages, flanked on both sides by high black hills, and winding endlessly on and on.

We were surprised to find a Newfoundland schooner north of Nachvak at Seaplane Cove. As soon as we anchored alongside, her captain and several of his men came on board.

"Couldn't mistake your vessel, sir. We all knows 'er," said the captain. "I been comin' 'ere 60 years, I 'as. Since I was eight. Forty years captain me own vessel. I knows me Labrador, yes, sir, but you can git around these parts better than me."

He spoke sadly of the good old fishing days. "I remember when white sails come north together thick as gulls, sir. Now we travels all day and never sees a one. Only a few of us left."

With codfish low in price, this captain was smart to come way north for delicious red-meated fresh-water trout which summer in and out of bays along the coast and winter under the ice of thousands of lakes among the hills. The year before, he had done well, salting away 700 barrels, and he was making a good start now.

We noticed a limp as he jumped from the side of our ship into his small dory. "Wooden leg," he explained cheerfully. "Caught in the engine 23 years ago. Not much bother!"

Mac gave him some charts, some cigars, and a pipe, and he went away in a happy mood. Next morning at 5, before we got under way, we heard a bump, felt the jar of a boat, and there alongside was the captain—with four good-sized trout fresh from the traps for our breakfast.

"There's McLelan Strait," said Mac as we headed north. He was pointing to a long passage of water which runs through to the western coast and turns the northern tip of Labrador into an island.

"That's the one you paddled through alone in a 16-foot canoe, isn't it?" asked one of the boys.

Mac nodded. "Thirty-nine years ago, I'd heard about it and wanted to see what





A Moment Later She Charged the 60-ton *Bowdoin* in Defense of Her Dripping Children

it was like. I didn't paddle through, though," he added. "I sailed. Fair wind, and I just let her go. No trouble until I reached the eastern end. Then it was blowing so hard I didn't dare go for'ard to take down my sail. Not a thing between me and Europe. And that was the one place I didn't want to go."

"Well, sir, what . . .?"

"Oh, I watched for a lull, crept for'ard on hands and knees, grabbed the mast and sail and threw them both overboard. Then I got out my oars—rowlocks and oars in that canoe—and worked up under the lee of an island just south of here. There was a fishing vessel anchored there, so I spent the night on board."

Such was Mac's account of an early incident that nearly ended his life.

The *Bowdoin* has made several trips through McLelan Strait against the tide, but I remember one time when she didn't make it. With our engine going full speed, turning up 1,600 and our propeller at 400, we churned white water at the very center of the stream. Couldn't gain one inch!

We tried the starboard side within a few feet of the rocks, hoping to take advantage of an eddy. But no progress. We crossed to the port side and fought for several minutes. Still going backwards! Finally, giving it up, we whirled around and shot out like an arrow through the western end, then anchored under the lee of an island to await fair tide.

"Cape Horn of the North"

This time we passed by McLelan Strait and headed for the best harbor in northern Labrador, Bowdoin Harbour. Mac discovered it some years ago when, dodging a gale in the *Bowdoin*, he crept along the coast looking for shelter and came on this calm inland lake. It's the last good harbor before making the plunge to Cape Chidley, then across Hudson Strait and on to Baffin Island.

The Cape Chidley area, off Labrador's northern tip, is sometimes called the "Cape Horn of the North," and with reason. Tides rush out of Hudson Strait at seven and eight knots, often carrying with them great pans of ice from Foxe Channel and Hudson Bay. There are frequent heavy fogs.

And wind! It whistles around that point and down over the tops of mountains, bringing with it dark, threatening clouds. Only a few years ago the *Bay Chimo*, a Hudson Bay supply ship, was crushed and sunk here.

So far, crossing and recrossing Hudson Strait many times, we've been lucky.

Greenland, the most fascinating of all northern lands, lies on a northeasterly course from Cape Chidley. I'll take that course now in my narrative, as the *Bowdoin* has on so many

trips, and as we did in 1947, right across Davis Strait for Godthaab, capital of Greenland. Two days and three nights of heavy seas were forgotten when we looked ahead to a long line of ice and snow shining white between blue water and blue sky. The icecap of Greenland, a thrilling sight! *

I've never been far enough south on the coast to understand why Eric the Red called this land "green." Six-sevenths of the island's area is covered with ice, in some places 8,000 feet thick; a narrow fringe of rocky coastline is the only part habitable for its 21,000 people.

In such a land, who would expect to find a thriving modern settlement like Godthaab? A two-mile ride over good roads leads to the village. The well-built red-and-white wood houses, office buildings, church, hospital, and high school, the "University of Greenland," made it easy to understand why the natives call it Igdluarssuit—"Place of Many Big Igloos."

The Greenlanders, a mixture of European and Eskimo blood, dress much as we dress. Only occasionally did we see the colorful south Greenland costume: wide beaded collar, sealskin pants, and hip-length red, white, or blue boots (page 479).

On a hill overlooking the village stands a statue of the robed missionary, Hans Egede, who landed near here in 1721. Arms outstretched, he seems still to keep watch over this first Danish settlement, founded in 1728, and now the cultural, religious, and political center of Greenland. His house, still standing after more than 220 years, is the oldest on the island. Its walls of stone and turf, about a yard thick, are covered with yellow-painted clapboards and red roof; inside, it is a charming, up-to-date Danish home.

Where Glaciers and Buttercups Grow

We had clear sailing along the coast and could plainly see two well-known high mountains silhouetted against the sky ahead, marking the location of Sukkertoppen. A little farther north we blew whistles and foghorns and fired a few rounds of ammunition to celebrate crossing the Arctic Circle.

And right there I tossed overboard a well-sealed bottle containing a letter with location, date, and address—in case it was found. We drop many records in the current to determine its rate and direction. This particular one was returned to me the following May by a

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Milestones in My Arctic Journeys," by Willie Knutsen, October, 1949; "Americans Stand Guard in Greenland," by Andrew H. Brown, October, 1946; "Servicing Arctic Airbases," by Robert A. Bartlett, May, 1946; "Greenland Turns to America," by James K. Penfield, September, 1942; and "Greenland from 1898 to Now," by Robert A. Bartlett, July, 1940.



Do Eskimos Have High Blood Pressure? *Bowdoin's* Doctor Found None

Medical scientists have long been interested in the health of Polar Eskimos, particularly the effect of their meat-and-fish diet. This Thule, Greenland, woman was one of many whom Dr. Edward Morse, of Camden, Maine, examined on the trip north. Though he found no instance of high blood pressure, he learned that hardening of the arteries was fairly common. Despite the absence of fruit and green vegetables, he saw no signs of vitamin deficiency. Some white explorers have lived years on Eskimo food without ill effects.

Scot who had picked it up on the shores of the Orkney Islands.

All along this south Greenland coast are deep fjords, with water, sometimes a brilliant green, leading far into the interior. These are bordered by big, black hills, many with glaciers leading down through valleys (pages 476-7). You also see masses of purplish fireweed spread over rocks near tumbling streams, yellow Arctic poppies, buttercups, and dandelions nestled in sheltered nooks (pages 496, 505).

Off Sukkertoppen and for the next 40 miles we sailed over the Hellesfiske (Halibut) banks, fairly dotted with four-masted schooners and dories. In each dory was a man pulling a line, tending a sail, or rowing to his next trawl. To meet this maze of boats and halibut nets in fog is uncomfortable, but this day the sky was clear and the waters mirrored the blue and red of tiny sails in some of the dories. One fisherman, singing loudly in Portuguese as he worked, added a joyful touch to the setting.

From the rail of a big Portuguese four-master, the captain, mate, and a line of fisher-

men grinned at us. By their expressions I could tell that a woman on a ship beyond the Arctic Circle was a bewildering surprise.

Holsteinsborg slipped by, and Jakobshavn, where from a hill behind the village you can see an ice-jammed fjord leading to the Jakobshavn Glacier. In 1875 a Norwegian geologist, Amund Helland, determined that the average daily movement of this glacier was 65 feet, its annual output of icebergs between *three* and *six billion* cubic yards!

We continued on towards Disko, largest island on Greenland's west coast, and dropped anchor off Godhavn (Good Harbor), the principal town of central Greenland.

For over 200 years Godhavn was the gathering place of English and Scottish whalers. The whaler's lookout, its frame constructed of jawbones of a whale, still stands on a hill overlooking the sea. Only a few yards away is a rusty cannon used to signal men to boats when whales were sighted. But the many racks of drying yellow shark meat hung above reach of dogs suggest there are more sharks than whales hereabouts now.

The remains of the historic old ship, the

Fox, rest forlornly on the beach near by. Many years ago she was caught in the ice pack in Melville Bay and drifted south all through one winter. Later she discovered the fate of Sir John Franklin and his 128 men. Then she carried supplies up and down the coast, until she was left to rot, unhonored and uncared for, her fame forgotten.

As we sailed along the shores of Disko Island, we saw seams of coal, evidence that this land now topped with ice was once rich in vegetation. Many a Greenland home today is heated with coal from the mining center of Qutdligssat on Disko Island.

At Umanak and Karrats Fjords we met more icebergs. For here is the birthplace of most of the bergs that float south in the Arctic current, some drifting 2,000 miles before they melt away in the warm waters of the Gulf Stream. Here, in embryo state, a line of towering bergs led us past Igdlorssuit, then across to Nûgâtsiaq, a "Pretty Point," as the Eskimo name designates, and made even prettier by its red-and-blue-painted houses on a flat land.

Mountains Roar as Icebergs Are Born

But from the fjord, beyond this peaceful spot, comes a thundering, crackling roar as Nature produces one of her greatest dramas: the calving of icebergs weighing millions of tons.

From the *Bowdoin* we could see the icecap peering over tops of black mountains rising sheer out of the water; glaciers, rough-topped rivers of ice, wound their way down black valleys to the sea.

At the head of the Kangerdluk Fjord, about 30 miles away, is the Rink Glacier. That and the Upernavik, farther north, are two of the largest and fastest moving glaciers in the world. The Umiamako, another active glacier near the village, is also impressive.

All about are icebergs recently born, with only a small part of their beauty showing. Some are smooth and round, others rough and pinnacled, white as alabaster and dazzling in the sunlight. Occasionally, showing through the white, you see a block of pure blue ice, undoubtedly born of the very bottom of the glacier, or a streak of clear green.

Natives at Nûgâtsiaq looked at us with an expression which implied, "You'll never come back if you go up that fjord!" To them these glaciers and icebergs are not beautiful, but dangerous and destructive.

"Nobody ever enters that fjord," we were warned.

"That's why we're going," said Mac.

Actually, both Mac and I knew what was ahead, for this was our second trip to the Rink and Umiamako. The water was 2,000

and 3,000 feet deep, and our only anchorage was an iceberg. If the Rink calved while we were near, if even a small piece of a berg dropped onto our deck, it might crush the *Bowdoin* to the bottom.

But Mac has a slogan: "If we don't take chances in life, we'll never get anywhere." It has led us to many narrow escapes; now it led us into—and safely out of—this icy maternity ward.

And when we sailed back down the fjord past Nûgâtsiaq several days later, the natives, so worried when we left, didn't even notice our return. They were too excited over a blue whale which had been brought in by the whaling ship *Sonja* (page 480).

When a whale is killed off Greenland, it is taken to the nearest village to be cut up by the natives. The steamer takes the blubber to Denmark, and for their help the natives get the meat—tons and tons of rich red meat for next winter!

With their *ooloos* (sharp knives), women cut big chunks into strips, which men dragged away and hung on racks to dry. Now and then they stopped to eat a piece of *matak* (skin), a delicacy rich in vitamins. The dogs snarled and howled as they rushed in to get more than their share. While taking a movie during one of these fierce fights, I fully expected to be flipped over and eaten along with the meat. Fortunately, several small boys wielding long rawhide whips protected me.

"Dreaded" Bay of Sunken Ships

Reluctantly, we left this part of Greenland. And now, regardless of the icebergs, drift ice, and "growlers" in Melville Bay, we could run day and night. For a midnight sun was with us, spreading its subdued glow and tinting the world a golden yellow. Nothing bothered us, until all at once a fog bank settled down.

Nothing to do then but tie up to an iceberg and wait.

We waited, it seemed, for hours. But the setting was perfect for visualizing the tragedies which have taken place here in what the Dundee Scotch whaling fleet called the "dreaded" bay.

Between 1819 and 1853, 210 vessels were destroyed in Melville Bay: 14 in 1819 alone and 20 more in 1830. In 1857 a southerly wind howled for six weeks, herding all the whaling ships against the ice and crushing two of them. In the summer of 1857 the *Fox* was caught; in 1849 the *North Star*, about the time of year we were there, July 30. The *Bowdoin*, too, once was nipped and partly lifted out of water, while a second ship of Mac's 1925 expedition, the *Poary*, was damaged, her steel beams bent, her iron plates badly dented.



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Kodachrome by Miriam MacMillan

▲ **From the Rigging, a Botanist Scans
a Barren Coast for Plant Life**

Stanton Cook (Harvard '51) has been north with *Bowdoin* on three trips and brought back large collections of Arctic flowers for study. Here he inspects a 1,000-foot cliff walling a narrow Baffin Island fjord about 10 miles north of the Arctic Circle.

▼ **Sun's Warmth, Melting an Iceberg,
Creates a Clear Pool**

Such wells of clean, fresh water form under the Arctic's summer sun. Here a crewman from *Bowdoin* drinks his fill. When the schooner's tanks ran low, as they did about once a week, she tied up to bergs and refilled from icy reservoirs.

Kodachrome by Peter Rand





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Illustration by African-Bachmann

★ **Father's Gone to Catch a Whale; Wife and Children Stay at Home.**

When *Bowdoin* anchored at Pond Inlet, only 40 of the village's 350-odd people were present; the rest were off on long hunting or fishing trips. Left behind was this family, shown standing next to their summer home, a sealskin tent, and wearing *sillapaks*—cotton garments with large hoods used to carry babies pupoose-style. Each tent has its drying rack in front, usually hung with pelts. The dog-skin drying here will become part of a bed cover.

Pond Inlet, a whaler's harbor for more than a century, boasts a Hudson's Bay Company trading post, a Royal Canadian Mounted Police station, two Roman Catholic and two Church of England missionaries. Once a year, in September, a Hudson's Bay ship calls to unload a year's supplies and pick up a load of skins, oil, and ivory from walrus tusks and narwhal horns. The Union Jack flies from the English missionaries' home (left).

☆ **Eskimo Women at Thule Board *Bowdoin* to Visit Captain Mac, an Old Friend**

Three of these women knew *Bowdoin's* skipper when they were seamstresses with the Peary polar expedition. Five others were members of families he lived with on later Arctic trips.

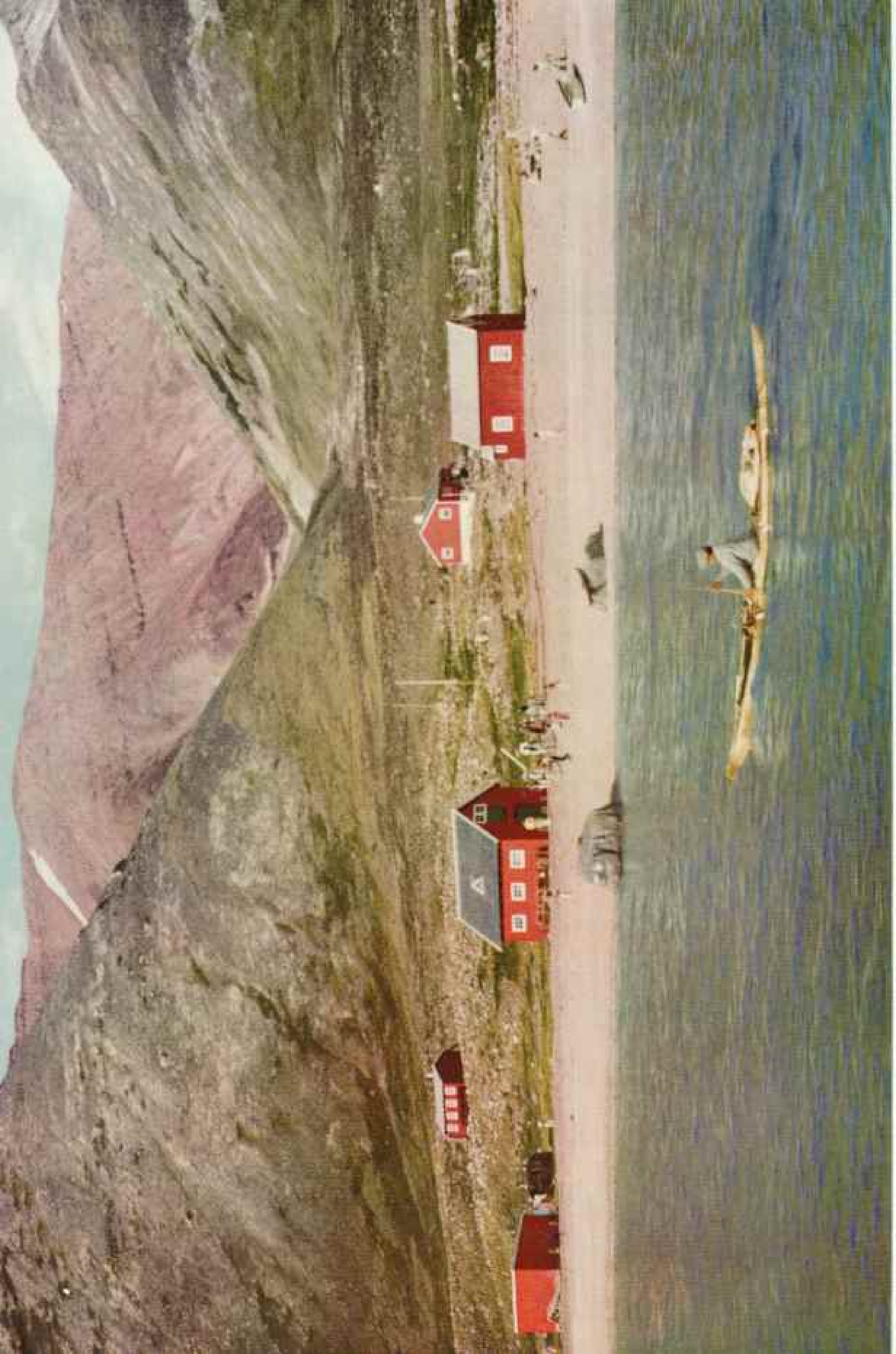




Midsummer Night's Dream at Refuge Harbor: Multiple Suns Light the Polar Sky

This is the midnight sun. To make the picture, the camera was placed on firm ground overlooking this north Greenland bay (about 78° 30' N.). The shutter was snapped every 20 minutes; the sun in the center was shot exactly at midnight. Opposite page: A shower of spray at *Bowdoin's* starboard bow sparkles in nocturnal sunlight.





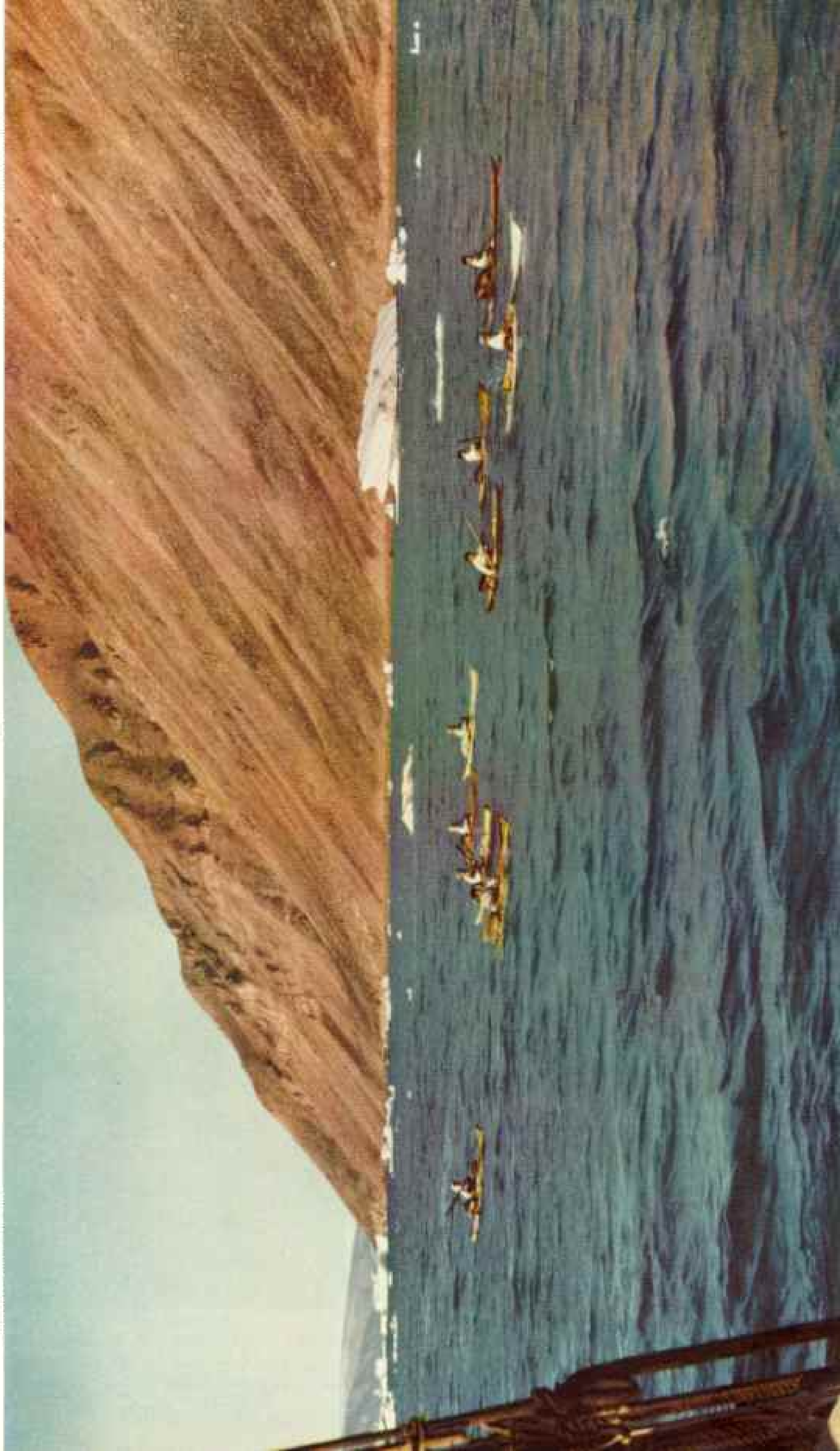
★ Sioropaluk, North Greenland; 40 Eskimos and a Handful of Houses on a Narrow Shelf Between Mountains and Sea

This village, 90 miles northwest of Thule, is typical of many in Greenland. It has no highways; communication is by sledge, kayak, or ship. Houses built of wood instead of rock and sod are signs of civilization's advance. Below: A fleet of kayaks skims out to meet *Bearded*.

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Illustration by Ralph H. Hutson, Jr.





In Summer the Frozen North Puts On a Coat of Many Colors

During June, July, and August vegetation covers low ground all the way to Cape Morris Jesup, northernmost land in the world. Shown are fireweed (top), Arctic poppies (right), and tuckermallow, a northern raspberry.

We were relieved when the fog lifted and we could move ahead.

The metal top of the Peary monument, placed at Cape York by Marie Peary Stafford in honor of her father, was a welcome sight to us, for it marks the beginning of the land of Polar Eskimos, who, when first seen by Capt. John Ross in 1818, thought themselves the only people in the world.

As usual, the waters around Cape York were filled with bergs and winter ice, now breaking up and drifting out of the bay. As we edged in closer, under half speed, we could see women and children scurrying from tent to tent and men wriggling into their kayaks. How eager they were to reach us, and how happy they seemed as they squirmed out of their kayaks and crawled over the rail!

These Eskimos had seen the *Bowdoin* many times. And they knew Mac well. He had lived with them in 1908-9, and again for four years in 1913-17. Later, in 1923-24, he had spent another year far north of here at Refuge Harbor. All are Mac's friends, and now mine, too.

Hand-to-Hand Fight with a Bull Walrus

Many remembered Mac as the only white man ever to harpoon walrus from his own kayak. They still talk of the hand-to-hand encounter when he actually stabbed a walrus to death, something unheard of before or since by these expert harpooners.

But his bold action had saved his life when a big bull popped up close beside his kayak. As they stood around, reminiscing with Mac about the good times they'd had on the long trail over the heights of Ellesmere Island, it was like old home week, except that all the talk was in Eskimo.

Once one of the most primitive people in the world, they lived in the rock-sod igloos of their ancestors in winter and spent their summers in sealskin tents. They ate meat, much of it raw, and roved from place to place, their one aim in life to get food. Now they are settling down, building permanent homes of wood. They are learning to bathe, shave, comb their hair, and brush their teeth.

When we called on Kalapaluk (page 499), one of the best hunters in the North and the owner of a motorboat, he entertained us in his newly built one-room house of wood at Thule, his wife serving coffee and bread and even offering us cigars and cigarettes.

There are approximately 300 of these Polar Eskimos today, about the same number as when Mac first met them in 1908. The largest number live in Thule, where there is a Danish trading station, a school, church, and a weather station (pages 480, 487, 491, 500, 501, 507). Of the 50 men, women, and children

who served as dog drivers and sewers on the North Pole trip, we found eight still living after 42 years (page 473).

All the way north from Cape York, Mac felt thoroughly acquainted with every hill, cliff, point, and indentation of the land. "There's where I fell off the glacier into freezing water one winter. . . We built a snow-house in the hole under those rocks while on a sledge trip."

Off Nerke, he pointed again: "I started from there for Etah in a 12-foot punt at 4 o'clock one day. Rowed all night. Only stopped once. Took me 18 hours to row the 40 miles. Wind, rough water, and walrus around Cape Alexander bothered me, but it meant saving my home at Etah," he explained, adding, "I was a little dizzy when I stepped out of the boat the next morning."

A few miles beyond Sonntag Bay we could see Cape Alexander, a noble headland almost exactly halfway between the Arctic Circle and the North Pole. Crystal Palace Cliffs followed, then Pandora Harbor, and at last Etah.

Once anchored at Etah, on Smith Sound some 140 miles northwest of Thule, Mac felt really at home (pages 474, 475, 503).

Hundreds of dovebies, or little auks, the essential bird of the Eskimo, welcomed us with their incessant chattering as they filled the sky and covered the reddish-brown cliffs on both sides of the fjord.

From there we could look toward Provision Point where Mac and provisions for two years had been landed in 1913 for his Crocker Land Expedition. But, because of ice conditions, no ship could reach him for four years. When his own food was gone, he and his men lived largely on an Eskimo diet. During this long period Mac learned much about these primitive Eskimos, their customs, habits, language.

He traveled with them 8,000 miles by dog team up and down the Greenland coast, explored and surveyed the east coast of Ellesmere Island from Cape Sabine to Clarence Head, and west to Axel Heiberg Island. From there he sledged 150 miles northwest into an unexplored area of the polar sea.

Knives and Forks Mark an Old Campsite

North of Etah about 15 miles, we worked our way through ice into Refuge Harbor (page 492) and dropped anchor at the very spot where the *Bowdoin* had wintered in 1923-24. On landing now, I was excited by what lay almost at my feet, the foundation of the scientific station where 10 months of research had been carried on for the Carnegie Institution of Washington. Knives, forks, dishes, tin cans—all were just as they had been left by that expedition so many years before.

On a hill overlooking Kane Basin I discovered a well-built rock cairn and in it the very record Mac had left there in 1924. It gave me as much of a thrill as Mac got when he found, at various times, 24 records of other explorers, many of them much farther north.

From this hill, too, I could look across to Cape Sabine, Ellesmere Island, where he had sledged that spring to place a bronze tablet for the National Geographic Society, to honor the dead of the tragic Greely Expedition of 1881-84.*

We poked the nose of the *Bowdoin* still farther north, for we hoped particularly to reach the Humboldt Glacier. Mac had been there in 1915. A glacier about 50 miles along its face! The looks of the ice, however, discouraged us. If we traveled much farther in that direction, chances were we'd have to remain there for the winter.

So we turned west, then north again, and out into the center of Kane Basin, the *Bowdoin* bucking ice pans until we were stopped completely by an almost solid pack at about 79° N. The ice seemed to extend right to the Pole itself. We were content to tie up to the pack and travel north another mile or so on foot (page 502).

As we huddled there together on a hump of ice in the middle of Kane Basin, the familiar hum of an airplane turned our eyes skyward. "On its way to the Pole," I mused. More than anything else, that plane typified to us the miracle of modern travel, tying people and places together as never before.†

I pictured Mac on his first trip north, sledging over just such an icefield, making the first surveys of Markham Inlet on the coast of Grant Land, and taking tidal observations at the most northerly point of Canada, Cape Columbia.

Here he had lived in a snowhouse during the dark period of November and December, farther north than any other white man. Frosted feet! Cheeks frozen! Half-starved! Throbbing, piercing pains of snow blindness! Lost in blizzards! Tormented by cutting, biting winds! Still, he had chosen Arctic exploration as his life's work.

Pushing West to Cape Sabine

In the past 42 years (with the exception of seven) he has journeyed northward; he has traveled thousands of miles over this Arctic land by dog team, by plane, and along its coasts by ship, every trip "to learn something" and pass it on to others.

He, too, might have been thinking of these past years, but he wasn't looking toward the North Pole, as I was at the moment. He was pointing west to Cape Sabine. "I'd like to get in there in the *Bowdoin*," he said.

He meant the old Greely Starvation Camp. Many times we had tried to reach it in the *Bowdoin*, but with no success. We pushed our way in that direction in 1947, but a field of ice blocked our schooner, solid ice stretching out into Smith Sound at least 20 miles from shore.

This past summer we attempted it again. I'll never forget that August day in 1950 when Mac came down from the ice barrel and announced, "I think we can make it."

"You mean Ellesmere Island, Cape Sabine, the Greely Starvation Camp?"

He nodded. "I've wanted to get there in summer for 25 years. This may be our last chance. We may never get this far north again."

I thought of the few ships which had gone as far north as the *Bowdoin* now was and of what had happened to them. The *Polaris*, nipped and squeezed in the ice, now on the bottom near by! The *Advance*, abandoned and left to her fate! Just north of Cape Sabine, clearly visible on the horizon, the staunch *Protens*, best of the Newfoundland sealing fleet, was crushed into a shapeless mass. Under the tremendous pressure she folded up like an accordion.

A call from Mac: "Let her go! Let's see what we can do!"

We headed northwest with clear going until we came within a few miles of a big black knob projecting above a heavy bank of fog.

"That's Wade Point," said Mac, recognizing the coast he had sledged along 34 years before. He had made the first map of this section. Here near Wade Point, where the Greely party first landed, he had found the remains of their boat and partially constructed stone house. But no soundings had ever been made of this coast. The fog didn't look good.

"Tie her up," came the order.

In my eight trips north there have been times when conditions seemed actually ghostly. This was one of them, and apparently for no good reason. True, we were at the moment some of the northernmost people in the world.

We were snuggling up against an iceberg in a strange harbor within a ring of dense fog—and perfectly blue sky was smiling at us from above. This last is quite unusual, but a sure sign of clearing weather.

* See "The *Bowdoin* in North Greenland," by Donald B. MacMillan, NATIONAL GEOGRAPHIC MAGAZINE, June, 1925.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Top of the World (the National Geographic Society's New Map of the Northlands)," October, 1949; "First Flight to the North Pole," September, 1926, and "Flying Over the Arctic," November, 1925, both by Lt. Comdr. Richard Evelyn Byrd; and "Arctic as an Air Route of the Future," by Vilhjalmur Stefansson, August, 1922.



Checkers Help Pass the Time While Waiting for a Fog to Lift

Besides checkers, chess, and cribbage, evening activities included reading books, writing notes, and listening to radio. Some nights Captain Mac gave lectures on the North. Cigar-smoking Eskimo intent on the next move is Kalapaluk, one of two hunters who joined the ship at Thule (page 497).

There was no sea, no lapping of waves against the base of bergs; the stillness was deathlike, broken at intervals only by the musical chirping of a little auk, a straggler from the flock. But perhaps the greatest weirdness came from our nearing a death camp, where men had suffered and died.

Finally the fog cleared and we slipped our ice anchor, heading for a black spot above the mist. Slowly it began to take shape. When we were certain it was Brevoort Island, I knew we were actually at the scene of one of the greatest tragedies of all Arctic history. I had read Greely's, David Brainard's, and Comdr. Winfield Schley's accounts.

What seemed like fiction years ago was now a reality. I myself had met Major General Greely in 1923, when he came to Wiscasset, Maine, to bid farewell to Mac (page 468). Later I had seen the crated bronze tablet sent north by the National Geographic Society to honor the dead.

Here on Brevoort Island, outlined against the sky, was the very cairn in which two sailors from the rescue ship had found a note assuring them that Greely and his men were all safe and just around the corner. There

were cheers and then, the date! That note had been written eight months before!

Rescue Ships That Never Came

Looking forth over that apparently limitless field of ice, I could visualize their well-built home at Lady Franklin Bay, some 235 miles northeast from where we were. There they had lived for two years, doing scientific work, taking meteorological observations, even breaking the world's record of "farthest north."

But a ship from home failed to reach them in 1882 as promised; failed again in 1883. These Army men of the Greely party obeyed their orders; they retreated south in open boats to try to meet a ship at the edge of the ice. Fifty-one days over a zigzag trail of 500 miles of difficult travel, their retreat was one of the most arduous trips ever undertaken in Arctic work. Imprisoned by ice which carried them north, east, south, and west, they finally made their way to Cape Sabine with every expectation that our Government had sent a ship to meet them there.

Instead, in a rock cairn, they found a letter. Its news was heartbreaking. The ship which



Men, Women, Children, Babies, and Dogs Go Down to the Beach to Say Good-bye as *Bowdoin* Sails from Thule

Standing far north in Greenland, near the gateway to Smith Sound, Thule is the largest of the Polar Eskimo settlements. It has a population of about 300, including whitts, a trading station, a school, a small hospital, and a weather station. The arrival of a ship is a big event (page 497).

Rapt Eskimos Listen to Recorded Concert of Their Own Music

Most Eskimos are musical; they sing excellently. However, their folk music, like primitive music in most lands, tends to fade away as radios and phonographs move in. Even now, few of the northern natives can sing the songs of their ancestors. To preserve what is left, the author took a wire recorder north and persuaded *Roald's* visitors to sing into it.

These Polar Eskimos listened attentively to music sung by their kinsmen. Later, when they heard their own voices played back to them, they laughed with delight.

In addition to music, the author has made wire recordings of the Eskimo language, one of the most complex in the world. It is so hard to learn that few travelers ever acquire more than a smattering. The average Eskimo has a vocabulary of more than 10,000 words.

Donald MacMillan





The Crew's Farthest North: 760 Miles of Ice Stretch Between Flag and Pole

In Kane Basin, *Bowdoin* was stopped by solid ice. Moving "ashore," the author and crew members walked a mile north over the frozen sea and planted the ship's ensign. At this point they felt they were the northernmost people in the world. A Pole-bound plane dispelled the illusion (page 498).

had come to their rescue had gone to the bottom within sight of their camp. The crew had taken to the boats and gone home.

Still, the concluding words in the message, "Everything within the power of man will be done to rescue the brave men at Fort Conger from their perilous position," gave them courage.

Confident that their country would never abandon them, but that another ship would pick them up, they erected four rock walls, turned a boat bottom up for a roof, crawled underneath, got into their sleeping bags, and tried to live for eight months on about two months' supply of food.

But the long winter night came. The sun disappeared behind the hills to the south. Darkness crept over the land and over ice-covered Smith Sound. They didn't have a chance.

At last they wrapped up their little bundles, wrote letters home, told one another good-bye. One by one they died, until only seven were left. Six of the original 25 lived to reach home in August, 1884, after rescue by the *Bear* and the *Thetis* on June 22 of that year.

Then I thought of Mac, sledging south from

Peary's steamer, the *Roosevelt*, in 1909, arriving at Fort Conger to take tidal observations, and there finding the Greeley headquarters—clothing, notebooks, diaries, letters, scientific equipment, even tea, coffee, and cans of rhubarb (cans labeled "Potatoes").

In the winter of 1917, Mac had traveled to Cape Sabine by dog team. Again in 1924, he had sledged across Smith Sound to Cape Sabine from his winter quarters at Refuge Harbor. To a prominent boulder near the place where these heroic men lived and died, he had securely bolted the bronze tablet sent by the National Geographic Society.

When we rounded that same point which the men from the rescue ships had passed on that day in June, 1884, it happened to be my trick at the wheel, 11 to midnight.

Mac was in the ice barrel, searching for ledges and ice and carefully scanning every part of that desolate coast for a familiar-looking outline. He had been there when the land was buried under snow and ice. Now its appearance was quite different. The ice pans gave us little trouble; there were too few of them.

But ahead was the apparently unbroken

winter's ice of Buchanan Bay, while off to the north we made out a threatening white solid pack without a dot of blue water in sight.

"We'll anchor and row ashore for a look," Mac announced, grabbing the throat halyard, sliding down from the ice barrel to the foreboom, then hopping onto the deck.

For me to step so much as a foot on Ellesmere Island was a thrill. But a short way up the rocky valley Mac turned and said, "I'm looking for a small bight in the land, but they're all alike. No, I don't think this is it," he added hurriedly. He seemed uneasy and kept glancing off to sea, watching the ice.

For a time I almost forgot that we were looking for the Greely camp. Arctic poppies, purple saxifrage, buttercups, all nestled between the rocks alongside patches of snow (496). One field of cotton grass fascinated me. The large silky puffball heads of hundreds of plants carpeted a big area of reddish-brown rocks. Blue waterways wormed in and out through the white.

Mac's attention was on something white, too, but not cotton grass. Ice, slowly moving out of Buchanan Bay, worried him. "We must have passed the camp," he said. "Let's go back and try another spot."

Disaster's Debris

Next time we anchored he hit it just right. There before us were the remains of Greely's hut. After 67 years the ground was still covered with boots, shoes, rubbers, army clothing, pieces of canvas sail, tin cans, camping equipment (page 509). The little pond where they got their water was mirror-smooth, rimmed with cotton grass and colorful flowers.

Together, Mac and I walked up through the valley where some of Greely's men had crawled to the sand ridge to look toward home. Here the few remaining had pitched their tent. The rocks which held down the tent flaps were still in place. And within a few yards were eight shallow graves, those of the first men to die and to be partially buried in



Bowdoin Lists to Starboard as Her Keel Scrapes Bottom

Feeling her way through uncharted water, the schooner sometimes runs aground despite Captain Mac's careful piloting. Her cement-reinforced hull is strong enough to withstand the bumping. More dangerous than grounding is "nipping" by ice; once *Bowdoin* was flipped on her side like a fish out of water. Here, at Etah, the crew calmly tied up the ship and waited for tide to float her.

the frozen ground while the survivors had strength to dig. The last to die were merely pushed out the door.

The sight of this spot told the story. The rocky point where Francis Long had stood when at last rescue ships rounded the point, the cutter steaming on ahead, the small rescue boat coming toward shore. Long, feebly waving a flag, stumbling, falling as he made his way down the slope. In answer to the query, "Who all are there left?" he mumbled, "Seven left." A ghastly sight, cheeks hollow, eyes wild, hair and beard long and matted, ragged and dirty clothes.

And David Brainard in his sleeping bag on the ground outside the tent hearing strange voices, trying to stand, to salute.

Joseph Elison with hands gone at the wrist, feet gone at the ankles, still happy.

Henry Biederbick snatching a few drops of brandy and pouring it down the throat of Maurice Connell, whom they had thought dead hours before.

Greely temporarily dazed, not realizing that he had been saved. Then the warm fire, their piteous cries for food, the stretchers, gathering up the dead, the ships homeward bound. At last silence in the camp and along the shore.

We were silent ourselves as we walked to a huge boulder in the middle of the valley between the camp and the graves. The bronze tablet, securely bolted, was in perfect condition, just as Mac had placed it there in 1924 (page 468). Together we read:

To the Memory of the Dead Who Under Lieutenant A. W. Greely Here Gave Their Lives to Ensure the Final and Complete Success of the First Scientific Cooperation of the United States with Other Nations, 1881-1884. Erected by the National Geographic Society, 1933. [Ice conditions delayed erection of the tablet until 1924.]

As we stared at the tablet, reliving those heartbreaking days, a shrill whistle broke the silence. "A rescue ship!" flashed first through my mind, still obsessed by the old tragedy. Then another longer, louder whistle broke the spell. "They're in trouble—the *Bowdoin*," said Mac.

The Arctic Springs a Trap

As we rushed to the shore, our electric horn gave more blasts, and a clanking of the windlass became audible. I thought, "We may be marooned here ourselves."

The *Bowdoin* looked very small and helpless locked in the middle of an ice pack that extended as far as we could see (pages 508, 510). The tide and current had suddenly started huge blocks on the move, and within 20 minutes the pack from the polar sea had started south through Robeson Channel, Kennedy Channel, and Kane Basin. Even the

winter ice, packed so solid into Buchanan Bay on our west, had started to move fast!

Mac jumped for a piece of ice, landed in the middle of it, then kept on leaping from pan to pan until he finally reached the ship. I followed the leader, my horror of slipping mixed with an absurd feeling of Eliza crossing the ice. The boys who had come ashore with us lifted the dory and pulled it over the crunching, weaving blocks. There wasn't a crack wide enough to float its four-foot breadth.

A worried crew met us at the rail. The mate had started the engine, but the ship was making no headway. Caught in the ice pack, the *Bowdoin* was in grave danger of being crushed against the rocky shores of the island.

Mac scanned the ice in every direction, snapped out two quick orders: "Give her full speed! Cramp your wheel to port."

Full speed, and still we barely moved. But *we did move*. Inch by inch we forced our way through one narrow blue lead, then another, going as close to shore as we dared. Then we dropped anchor.

Mac had maneuvered the *Bowdoin* into an eddy in the lee of a small projecting point some 50 yards dead ahead and to the west. It was from this direction that the thick winter ice came pouring out of the bay.

A Respite—and More Trouble

We felt safe here for the time being. The current was such that we could swing the *Bowdoin's* bow to starboard or port even when at anchor. Thus we avoided the heaviest of the pans.

When the tide dropped, however, we found ourselves in more trouble. For now an ugly-looking ledge broke water just off our port quarter, and it became clear that the pack ice, sweeping along from the north, could easily lift us right on top of it. That ledge would not make a comfortable seat.

Our chances of escape seemed bad at the moment; our chances of being crushed to smithereens far better. We knew a north-easterly wind would mean certain disaster for the *Bowdoin*. No ship, no matter how strongly built, could withstand the sledgehammer blows of that ice from Kane Basin. Yet to push out into the pack without a definite line of escape meant disaster, for, once started, we'd have to continue.

The *Polaris*, the *Proteus*, the *Advance*. All smashed! Peary's ship, the *Windward*, locked in the ice near Victoria Head, forced to winter here! The *Fram*, under Sverdrup, wedged in the ice pack of a near-by island! And now the *Bowdoin*!

Mac paced our deck, watched the ice, the barometer, the wind, every rise and fall of



The Author Sits in a Patch of Golden Arnica 700 Miles North of the Arctic Circle

In a few weeks this flowering hillside will freeze white again. In wind-swept areas, however, patches of frozen vegetation will show through the snow to feed musk oxen and reindeer, which graze all winter.



From Every Eskimo Village and Town, Kayak Flotillas Streamed Out to Meet *Bowdoin* as She Hove into View

Every hunter has his own frail craft, made of sealskin over a wooden frame. All follow the same basic design—about 19 feet long, 19 inches wide, and 9 inches deep. The paddler laces himself tightly into his seat to keep water out.

The Girl Aims a Bone-tipped Harpoon "Just Like Daddy's"; a Walrus Rib and a Piece of Leather Turn a Primitive Bow Drill

In a treeless land, bones and tusks of animals must do the work of wood. As this Thule craftswoman saws back and forth, the rawhide thong turns the bit—a sharpened animal tooth—and it bores into a piece of ivory. Her wooden bench is an import.

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Ship in Trouble: Off Cape Sabine a Vast Field of Grinding Ice Threatened to Cave In *Bowdoin's* Sides

Only the grounded iceberg behind her saved the schooner from being crushed like a toy by the full weight of the main ice field astern. Not even the dory could find a safe path. Four men between ship and shore jump from pan to pan.

In This Desolate Spot Arctic Explorers Starved to Death

This is the site of Greely Camp on Cape Sabine, Ellesmere Island. Here, in 1883-84, Lt. A. W. Greely, of the U. S. Army, and 24 men passed the grimmest winter in the history of Arctic exploration. They had been stationed at Lady Franklin Bay, 335 miles northeast, to explore and to record weather data. When a relief ship failed to reach them after two years, they fled south, hoping to contact it.

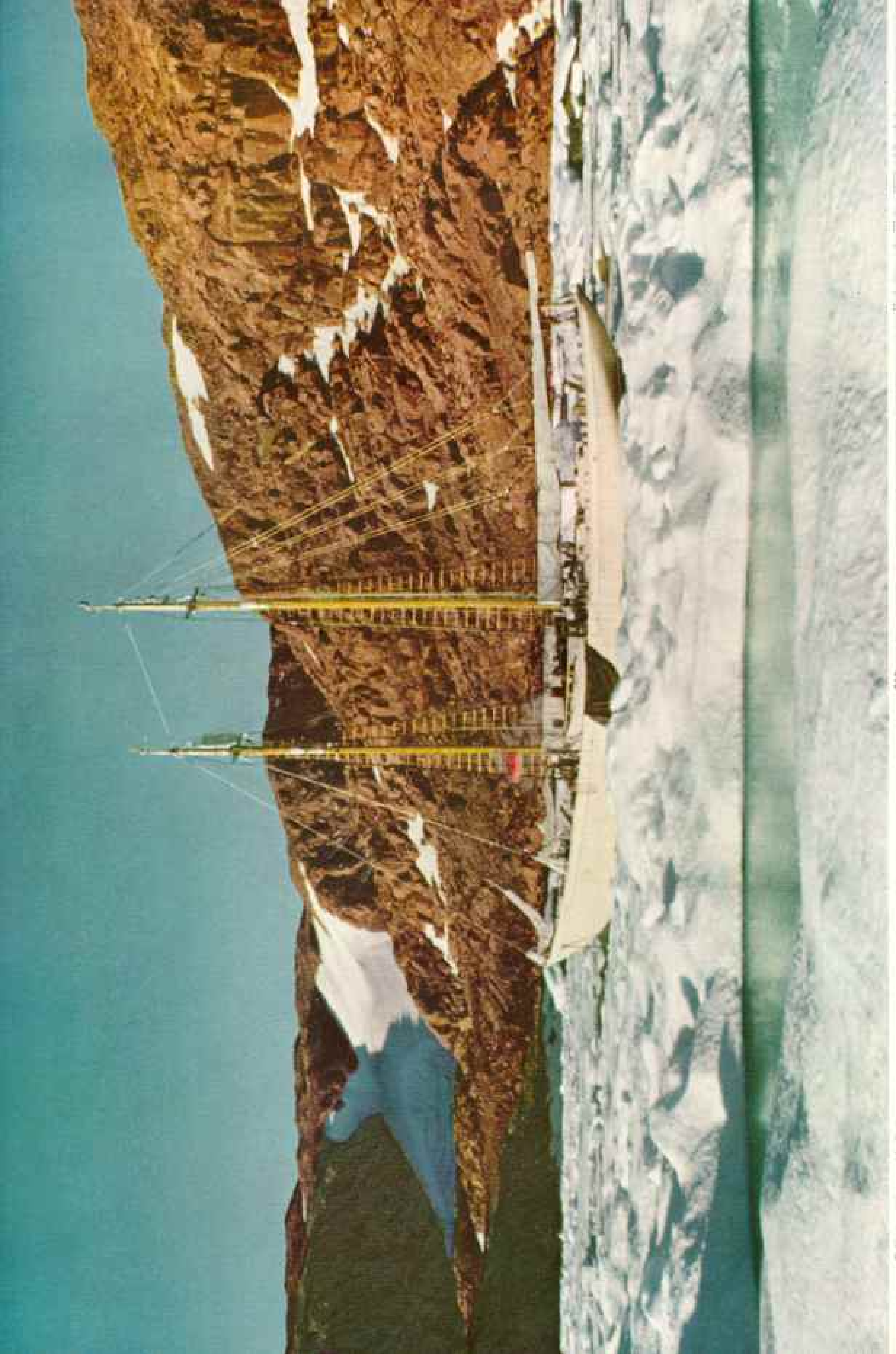
Bits of debris and a ragged stone wall (circling the spot where the author stands) are all that remain of their hut. The roof was a small upturned boat. Rations—enough for about two months—had to be stretched to last eight. As the supply dwindled, the men ate shoes, clothing, sleeping bags. To help pass the time, Lieutenant Greely lectured on geography.

Toward the end, supplies exhausted, the men died one by one. When a rescue ship finally arrived on June 22, 1884, only seven were left alive. One of them was Greely, too weak to stand, too dazed to realize that he had been saved.

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Robertson by Donald MacMillan





⚡ Locked in an Icy Grip, *Borofoin* Waits for a Break

When the ice finally opened up, the schooner plowed her way back to clear water. Many a ship, trapped in similar circumstances, has been sunk, or, at best, forced to spend the winter in the north.

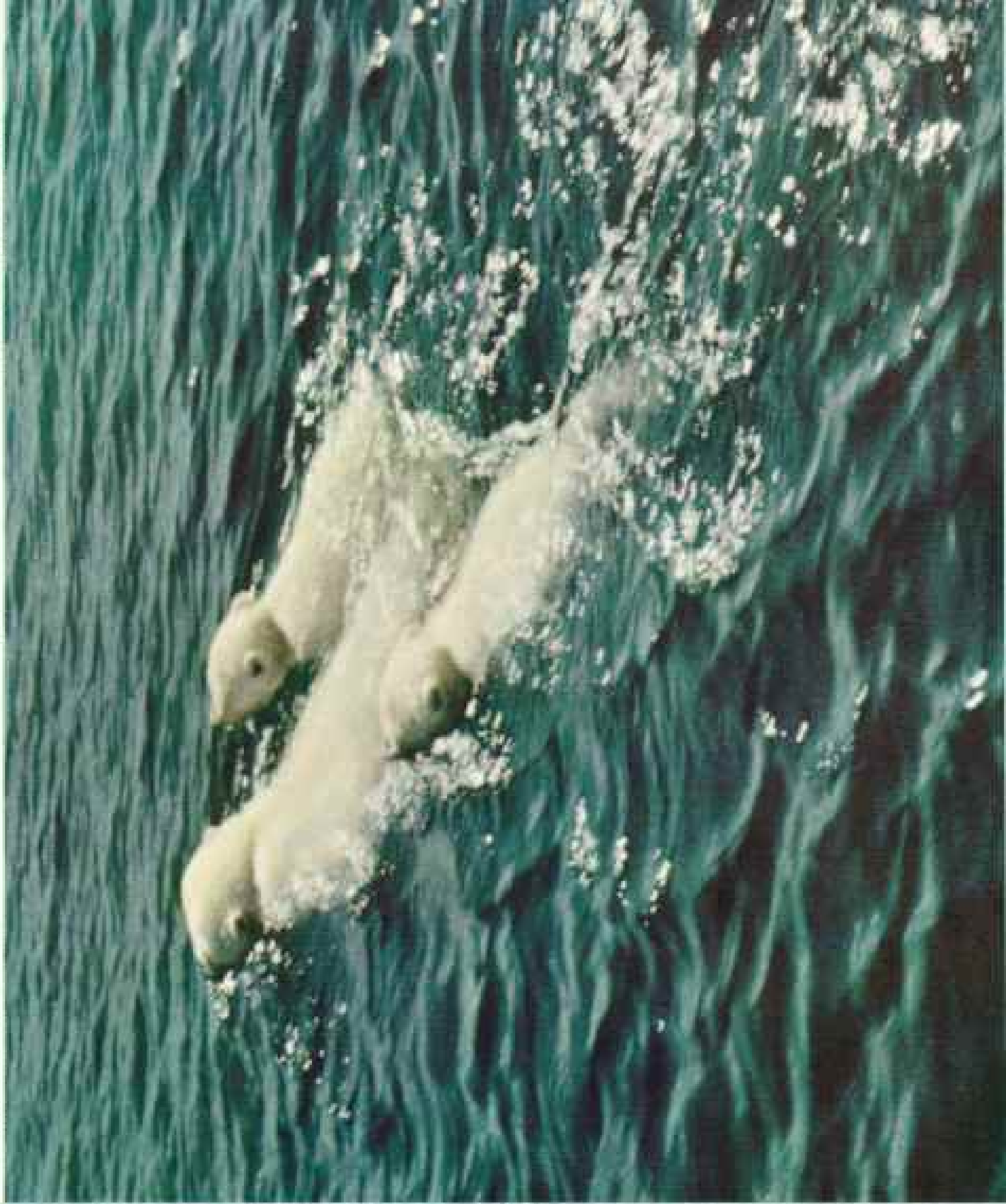
⚡ Bears Move Full Speed Ahead as a Long White Monster Pursues Them

On the homeward voyage, members of the crew spotted these polar bears on ice pans where they waited for a meal to show up—seal, walrus, or fish. As the ship followed them to take pictures, the bears were first curious, then nervous, then angry. The mother bear snarled at *Borofoin* and several times turned to attack it, biting fearlessly but futilely at the ship's wooden sides.

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Illustration by Milton Starbuck





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♣ **If It's Warm Enough for Polar Bears,
It's Warm Enough for Him**

While waiting for the ice field to open, some of *Bowdoin's* company decided to take a dip. Here Charles Hildreth, of Maine, braves Arctic elements in trunks and sneakers. Air is about 38° F., water 29.2°.

♣ **"Come On In, the Water's F-f-fine!"
Three Brave Shipmates Wait in Line**

Swimming lustily in the frigid salt water is Robert Marimon, of Chicago. Ian White (left), a Californian, has had enough and runs for warmth aboard ship. All took the plunge, but none stayed in long.



tide. I knew from the way he hummed quietly to himself that he was worried. Once in a while, though, he'd go below, pick up an Arctic book at random and read passages to me. The only member of our crew who took to his bunk for rest was our cook, Clayton. Nothing bothers Clayton except his haunting fear that he'll fail to give us enough to eat.

Five of the boys broke the tenseness a bit when they crawled out on deck in swimming trunks, jumped down to the ice at the *Bowdoin's* side, and one after the other plunged into a small patch of blue water between the pans of ice. As they came out gasping, they moved faster than anything else has ever moved—in the direction of our ship.

Saved by an Iceberg

Mac was watching from the ice barrel. Suddenly he came down fast. "See that, Miriam? The one out there?"

"Yes, but —"

"That may pull us through."

Call it miracle, fate, MacMillan luck, or the hand of the Lord. Something powerful was working for us that day.

An iceberg in the edge of the main driving pack at least a quarter of a mile away from us had been traveling broad off our beam. All at once it changed its course. Next we saw it coming directly toward us across the current, until it stopped on a ledge. As the tide was falling, it became locked tighter and tighter in place, serving as our barrier against the pack which might have finished the little *Bowdoin* in a few minutes. It was like a mighty hand holding off the ice to give us our chance.

"We'll make a try," said Mac.

At full speed, but making little headway, we pushed pans aside, making our desperate attempt. Once we came to an absolute standstill. No one spoke except Mac: "We'll wait for the tide a bit," he observed. "Let's have supper."

I can't tell you now, nor could I then, what we had for supper. I only remember hurrying back on deck. But Mac was there before me. Again it was "Full speed ahead," and once more we were on the slow move.

I've never seen the *Bowdoin* try harder. Her spoon bow, designed to rise up on pans and crush them underneath her 60-ton weight, hardly made a dent in this ice.

One whack she got on her side made quite a dent in her. A section of partition and closet door were driven half a foot out of place. This happened near the galley stove, where the cook was dishing out food. For once Clayton looked surprised.

"Who in hell's at that wheel?" he exclaimed. But he wasn't worried. He didn't even come on deck. He's been with Mac on four trips.

At our painful speed it was quite a pull out into the middle of Smith Sound.

From this point on everything went along smoothly, even the run along Ellesmere Island, a land dripping with glaciers, at times five and six merging into one at the sea. In every direction we could see seals and walrus peacefully dozing on ice pans. Fifty-four walrus on one pan! And on another, a bearded seal, or *ookjuk*, weighing about 600 pounds, a rare museum specimen (page 478). It is also known as a squareflipper.

Off Baffin Island, a land as unfriendly and desolate-looking as Ellesmere Island, we came across a mother polar bear leading her two cubs from pan to pan (pages 484-5, 511). How graceful they were in contrast with the clumsy 1,000-pound walrus!

At Pond Inlet, a Canadian Government station, we visited with the Mounties, Hudson's Bay Company officials, English missionaries, and Catholic priests. And not far from the village we found a number of friendly Baffin Island Eskimos (pages 466, 479, 490).

South of the Arctic Circle a southeast gale set the ice pack solid against the land and forced us out into the middle of Davis Strait. From then on we looked longingly at harbors where we had anchored the year before, but they were chock-full of ice.

High Seas Buffet the *Bowdoin*

As I look back on the weeks that followed, I think of the turmoil below and on deck. I think of dashing water, of banging books, boots, and boxes, of broken eggs and spilt Klim, of black and blue spots from being tossed around.

Ever since my early days of boating in Maine I've enjoyed plenty of spray coming over the bow of any ship. A few days of rough weather is good fun, but this time the high seas continued as we traveled along the Baffin Island coast, past Resolution Island, the Button Islands, Labrador.

But we reached home ahead of schedule. Shortly after our arrival a gale ripped along the coast of Newfoundland, Nova Scotia, and Maine. Several vessels and a score of small boats were wrecked. The *Bowdoin*, tied securely to the dock at Boothbay Harbor, Maine, was resting at her winter quarters. Mac and I, sitting in our after cabin, were listening to the whistling of the wind through the rigging and to radio reports of the raging storm off the coast.

Once again, the *Bowdoin* was safely home.*

* For more of Miriam MacMillan's adventures in the Far North, see her entertaining book, *Green Seas and White Ice* (Dodd, Mead and Company, New York, 1948), also published in England under the title *I Married an Explorer* (Hurst & Blackett, Ltd., London).

Duck Hunting with a Color Camera

BY ARTHUR A. ALLEN

Professor of Ornithology, Cornell University

With Illustrations from Photographs by the Author

DUCK hunting is a sport so contagious that millions of people the world over have become infected and plan their lives so that they can be in a certain place at a certain time when they expect a flock of ducks to fly by.

Duck hunting is big business that employs thousands of workers, directs millions of dollars into unusual channels, and has caused both State and Federal Governments to step in and offset the threat of "duck trusts" to control all duck hunting for the enjoyment of relatively few.

Thousands of legislative hours and much acrid debate have been devoted to setting up regulations designed to provide good hunting without extermination. Millions of dollars are being spent annually by the Federal Government, State, and Canadian conservation departments and by private agencies to provide better habitat for the ducks and make our wet lands more productive.

The new science of wildlife management, which has swept over the country and given rise to training courses for students in many of our State universities, had its beginning in the waterfowl shortage that threatened the country. Some of the most spectacular discoveries in the cause and prevention of wildlife catastrophes have been made with the waterfowl.

The literature on waterfowl is enormous, and every year sees some new and beautifully illustrated volume devoted to ducks and geese to delight the web-footed nimrods. It seems that everything that can be said about ducks has already been printed and every approach to the subject thoroughly documented.

But talk to a group of dyed-in-the-wool duck hunters and the subject becomes as fresh as if it had just been discovered. Ideas for killing more ducks or for preventing their extinction are as numerous as the duck hunters themselves.

This little essay, therefore, will not enter the controversy of killing or saving ducks. It will mention only incidentally the 196 Federal refuges designed to save them and other migratory waterfowl and the multiplicity of regulations controlling their hunting.

Taking Trophies That Never Die

The man with a camera knows neither season nor bag limit. He is restrained only by the limitations of his equipment, the

weather, the thickness of his skin, and his ingenuity in getting close enough to his quarry to make his trophies worth while.

Those of us who have shifted from gun to camera now get greater satisfaction from the string of Kodachromes we can show to our friends than we ever did from the string of ducks hung up in the woodshed or concealed in the home freezer.

The trophies are much more durable and have more points to be judged in competition with those of others; and they leave us with the satisfaction of knowing there are just as many ducks when we are through with our hunting as when we started—ducks in better physical condition because of having been filled with corn instead of lead pellets.

Lest someone think there is no uncertainty to the sport of hunting with a camera, however, I mention the fact that one spring I used up two tons of cracked corn in front of three blinds to secure only seven of the color illustrations which accompany this article. The "trophies" offered here are selected from more than 2,000 camera shots, the results of five seasons' expeditions from Florida to Quebec Province and from Mexico to Alaska.

Bad Shots Cripple Only the Wallet

Most of the misses in Kodachrome duck photography come from the slowness of the film, with resulting motion of the subject, or from imperfect lighting, owing to clouds or improper angle of the sun when the ducks are before the camera.

When ducks are feeding, there is a great deal of activity, and even when the lighting conditions are ideal, one has to use the lens wide open and speed up the shutter.

This results in little depth of focus; therefore, if there are several ducks in the picture, at least one is sure to be fuzzy (page 535). It is much more simple to take motion pictures than satisfactory stills.

When ducks are not feeding, they seldom come close to blinds; they are, moreover, very allergic to having lenses pointed at them. Even in parks or refuges, where they have become accustomed to people, they resent cameras and turn their backs on photographers. A flash gun has nearly as frightening an effect as a shotgun.

Many of the brighter colors on waterfowl are not due to pigment but to iridescence, and even the slightest turn of the head may



"Step Lively, Please!" Mrs. Mallard Takes 13 Bits of Fluff for a Stroll

This family, found in the garden of a home in London's East Dulwich, was transferred to pleasanter surroundings in St. James's Park. Here, while a bobby stops traffic and onlookers beam, mother and ducklings march briskly across a walk.

change a brilliant green or purple to dead black.

One can frequently make a dozen exposures of a pintail or a mallard or a wood duck (pages 527, 528, 538) standing in the same spot and have no two of them turn out the same. If the sun is a little too low, there will be an unnatural redness to all of the pictures; if it is too high, the black shadows under the head and breast will ruin their perfection.

So the hunter with a lens comes to expect a very low average from his camera shooting, though he has the satisfaction of knowing that his misses cripple nothing but his wallet.

On some of the refuges, and especially on private sanctuaries where an effort is made to maintain a breeding stock of hand-reared birds, some of the waterfowl lose their fear of man and become pets.

In June, 1950, I visited the Severn Wildfowl Trust, in England, where Peter Scott, the illustrious waterfowl artist, has built up a collection of more than 100 species of ducks and geese from all over the world.

Many of these, including the Ross's goose, for which he endured the hardships of an expedition to the Perry River country of northern Canada in 1949, and the nene, the nearly extinct goose of the Hawaiian Islands, are as tame as barnyard fowls and cluster about anyone with a feed bucket.

If one desires merely photographs of the various species, such a spot is an answer to the photographer's prayer. It is, likewise, yielding facts and observations of much scientific interest. Most of the hand-reared species perform their courtships and other behavior patterns in a normal manner, and since they are more easily and more continuously observed than is possible with their wild brethren, new facts in their behavior or life histories are often discovered.

The difference between wild-trapped and hand-reared birds in this particular is very marked, since it is unusual for wild-trapped birds to breed in captivity, even after they have lost their fear of man and seem contented on the ponds with others of their kind.



← **Docile Female
Mallard Accepts a
Ring for Her Leg**

Each year United States and Canadian authorities place numbered aluminum anklets on thousands of birds. Many thus identified are reported from other localities, enabling conservationists to determine migratory routes, distribution, and other facts.

To carry out this program, the U. S. Fish and Wildlife Service and the Canadian Wildlife Service have organized 1,000 banding stations. There the birds are trapped and banded before release. Volunteers operating under Government permit assist in the work.

Since 1920, when the program began, agents have banded about 6,000,000 birds. In Washington, a master file of recovery reports includes some half-million entries.

Here officers attach a band before freeing a female mallard rescued from an illegal trap on Virginia's Chesconessex marsh.

✧ On a New England farm the photographer chanced upon this "boy meets duckling" scene.

Hutcher and Bussett

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BIRDS COSTS





Here, Resting, May Be the Entire Population of Atlantic Snow Geese

Southward bound, this flock settled on Delaware Bay in March, 1946. Using an enlargement of the photograph, Charles L. Slaughter of the Bombay Hook National Wildlife Refuge, near Smyrna, Delaware, gratified a lifelong ambition by taking a census. His count: 13,494. Experts say the figure represented the vast majority of the Atlantic snow goose population, if not its entirety.

When armed with a camera a duck hunter prays for quiet weather and sunshine, so that there will be minimum motion and the ducks will be looking their best. Winds and low temperatures freeze up his shutter and make photography impossible, even if the sun continues to shine.

Best Plumage in Worst Weather

The camera hunter naturally hopes to photograph his birds in their best plumage. He is restricted, therefore, largely to the winter and early spring, when the weather is normally at its worst and sunny skies are at a premium. One cannot wait for summer,

for by that time the brightly colored males will be assuming dull feathers, like those of the females.

It is a curious fact that most waterfowl are different from other bright-colored birds in that during the summer they acquire what corresponds to the dull winter plumage of other birds (pages 521, 526). Indeed, oldsquaws get their "winter plumage" in April, while they are still migrating and a long way from their nesting ground. By early June many mallards, wood ducks, and gadwalls (page 529) have dark-brown feathers scattered throughout their bright plumage.

Waterfowl are also different from most



Startled Geese Rocket Upward from Their Island Feeding Ground

These birds made a migratory stop on Horseshoe Lake island in Illinois. They are Canada geese, en route to northern breeding grounds. Their honking V-shaped columns etch the sky in spring and fall.

birds in that they lose all their flight feathers at once and for several weeks are unable to fly (page 526). This happens as soon as they have acquired all their dull winter plumage in July or August. As soon as they have replaced these flight feathers, they start coming back into their bright breeding plumage again.

By late September wood ducks and mallards are once again in full regalia, when most birds have just donned their dull winter attire. Some species, like the blue-winged teal (page 523), which frequently winters as far south as Colombia and Venezuela, delay getting their breeding plumage until January or February, and the ruddy duck waits until March or April; but they are exceptional.

Differences in the feeding habits of the various species add to the photographer's troubles. Baldpates, shovellers, and ruddy ducks (pages 529, 531) are difficult to bait up, because they do not care for grain; and I have yet to find a suitable bait for fish-eating mergansers. Shovellers and cinnamon teal,

when feeding, put their heads beneath the water and steam along as if they had plankton nets attached to their bills. They must strain a great deal of water to get any food.

Canvasbacks, redheads, and scaups (pages 530, 535) are members of the subfamily of diving ducks, which feed in deep water by diving. Frequently, after they have discovered the bait in front of a blind, if they are at all suspicious they will dive far out and swim under water to the grain, so that the photographer never gets a chance for a close-up.

Real diving ducks, like canvasbacks and redheads, use only their large feet under water and seldom splash when diving. A good push from their great webbed feet throws the body clear of the water, but at the same instant the bill enters and the body follows with little disturbance to the water, save for the "boiling" set up by the broad-webbed toes.

When mallards, black ducks, or other dabbling ducks find that their ordinary tipping fails to reach the food and start diving, they use their wings under the water like flippers,

and the splashing, as they start down, is in great contrast (page 523).

In either case, the motion is difficult to stop with a camera loaded with Kodachrome.

Then there are a thousand and one little interruptions from well-intentioned but curious people who approach the blind at inopportune moments. They frighten the ducks away or prevent them from coming within camera range. Often the cause of the interruption is not evident to the photographer until he leaves the blind and finds some near-by cottager hanging up the week's washing, or some young lady taking a sun bath, in plain view of the ducks.

Sometimes the best-laid plans are foiled by the weather, when the sun does not shine for a week and the ducks just will not delay their migrations.

Dust Bowl Refuge Full of Ducks

In 1949 Dr. Paul Kellogg, associate professor of ornithology at Cornell University, and I drove our sound truck to the Lower Souris National Wildlife Refuge in North Dakota, hoping to add to our album of duck portraits as well as to our library of bird songs.*

The refuge area was part of the Great Plains Dust Bowl from 1927 to 1935, but in the wet and muddy spring of 1949 the bowl was full of soup—duck soup, in more ways than one.

There were ducks everywhere, even sitting in the middle of the road like sparrows. The air was full of them: flocks bound for the low spots in the grainfields, which were still full of water and grain scattered from last fall's harvest; trios whizzing by in their nuptial flights; and singles flushed by passing cars from trysting posts in the roadside ditches, where they had been awaiting the coming of their sweethearts from their nests so well concealed in the prairie sedges.

The males were still resplendent in their breeding plumage, but the females were demure in their various shades of brown and looked much alike.

Blue-winged teal were most abundant, gadwalls next; but mallards, pintails, shovellers, and redheads were nearly as common, and there was a good scattering of other species.

Here we had hoped to complete our survey of the waterfowl, which had started in the Finger Lakes of New York State and had taken us to the wintering grounds on Currituck Sound and Mattamuskeet Lake in North Carolina; Bull Island, South Carolina; Florida, Louisiana, Texas, Mexico, California; the Bear River marshes of Utah; Alaska, Hudson Bay, and Quebec Province.

At the North Dakota refuge there were certainly enough ducks to fill the eyes of

the most ardent ornithologist or to tantalize the most devoted duck hunter. There was little indication of the ravages of drought, disease, and overshooting that had brought the duck population, especially that of the eastern United States, to such a low ebb.

But it is one thing to see ducks or to shoot ducks, and quite another to get close enough to photograph them; it is still another to get them to sit still long enough for portraits in color. One can pass in a car within 20 feet and take motion pictures of them as they jump the moment the car stops. One can set up blinds by their nests and get pictures of the plain-colored females sitting on their eggs. But to catch the brightly plumaged males napping is quite another matter.

We were faced with the problem of getting these shy birds accustomed to some sort of blind, where we could hide with our cameras without arousing their suspicions. We decided on two procedures:

First, for those like the ruddies and shovellers which do not care for grain but return to trysting places not far from their nests, we set up blinds of grass cloth or burlap on the shore, hoping that sooner or later they would come back.

For others, like the canvasbacks, redheads, and baldpates, which sun themselves on the mud flats, we found an island in the lake. There we sank an inconspicuous blind into the gumbo at the base of a point—at least, it was inconspicuous until a big storm carried away most of the dead weeds that blended it into the general contour of the island.

That storm, incidentally, carried away all our other blinds and flattened the cattails and sweet clover as if they had been cut by a mower.

Hailstorm Kills Birds, Breaks Eggs

In North Dakota the radio talks about the weather almost continuously and makes hourly predictions of what is likely to happen during the following 60 minutes. I had not been listening to the radio when I changed my mind about paddling out to my island duck blind a half mile offshore. But a dark line of clouds along the horizon told me it would probably be cloudy before the ducks would come back; so it might be better to spend the time locating another likely spot for a "trysting blind."

Fifteen minutes later a cloud of black dust enveloped us as Merrill C. Hammond, the refuge biologist, and I drove north along the gravel highway. We could not see the edges of the road, and a moment later came the

* See "Hunting with a Microphone the Voices of Vanishing Birds," by Arthur A. Allen, NATIONAL GEOGRAPHIC MAGAZINE, June, 1937.

rain on a 70-mile-an-hour wind. We turned about and headed for home, but before we got there the rain had changed to hail, which pelted us like shrapnel.

Some of the hailstones were the size of pigeons' eggs, and they smashed windows and killed birds. Roofs were torn from houses, barns were flattened, trees were uprooted, and outhouses rolled across the prairie.

It was all over in 30 minutes, but about an inch of rain had fallen and there were scenes of devastation all about. What chance had my frail blinds? I shouldn't be surprised if they landed in Minnesota or even Michigan.

The next day we visited a colony of Franklin's gulls and found many of the eggs broken and small young killed. Tough duck eggs were dented by the hail, and the floating nest of a Holboell's grebe, near which I had placed a blind, had disappeared entirely, along with the tent.

Curiously enough, a colony of some 500 common terns, on a low, unprotected island in one of the lakes, in some miraculous fashion escaped entirely the force of the storm and was completely unscathed. Also unharmed were several fragile mourning dove nests near the headquarters, where 26 windows were broken in one building.

This storm set us back about a week in our operations. It was followed by a couple of bright days, but four cloudy days in a row brought us to the verge of discouragement.

Sticky Gumbo Impedes Work

It was not only the cloudy weather that impeded us. When the rain ceased, we attempted to drive down the south side of the refuge. A thin coating of gravel covered the black gumbo beneath, and the weight of our car was sufficient to press the slippery black ooze to the surface. We skidded on the slightest grade and almost slid into the ditch at every turn.

The black soil of this region has a curious consistency, for it seems almost impervious to water except for a thin, slippery film.

When Hammond and I dug a pit on the island, we found it easy to sink the shovel its full depth into the gumbo. It was not too difficult to lift out, but to get the sticky mass off the shovel was a different matter. Thereafter it was part and parcel of the shovel and would not shake off.

The first shovelful I scraped off with my boot, to which it remained attached with the same grim force, so that I could not walk and certainly could not scrape off the second shovelful. We were finally forced to break the black clay into lumps with a pickax and lift it out of the depression with our hands.

Quickly I changed my plan. Instead of a

comfortable 2-foot pit, I settled for a mere scrape, with a higher superstructure. After the storm the deeper portion of the blind, designed for my feet, resembled a hog wallow.

To the average person a duck is a duck, and even informed duck hunters may speak of ducks as if they were all alike except for size, color, and taste. As a matter of fact, the different species of ducks are just as different as the various species of sparrows or thrushes or blackbirds.

All ducks belong to the same family, but no two species have exactly the same distribution, migration, breeding habits, calls, food and feeding habits, and environmental requirements. Conservation practices that are highly beneficial to some species might even be detrimental to others; and, similarly, hunting practices which are successful for some bring no results with others.

World's Most Widely Distributed Duck

The most widely distributed duck the world over is the mallard (pages 516, 521). It is the ancestor of all our domestic breeds except the Muscovy.* The curly upper tail coverts of the males of the white Pekins and pied Indian runners give evidence of their mallard ancestry, even though they have changed so drastically in size, shape, and color.

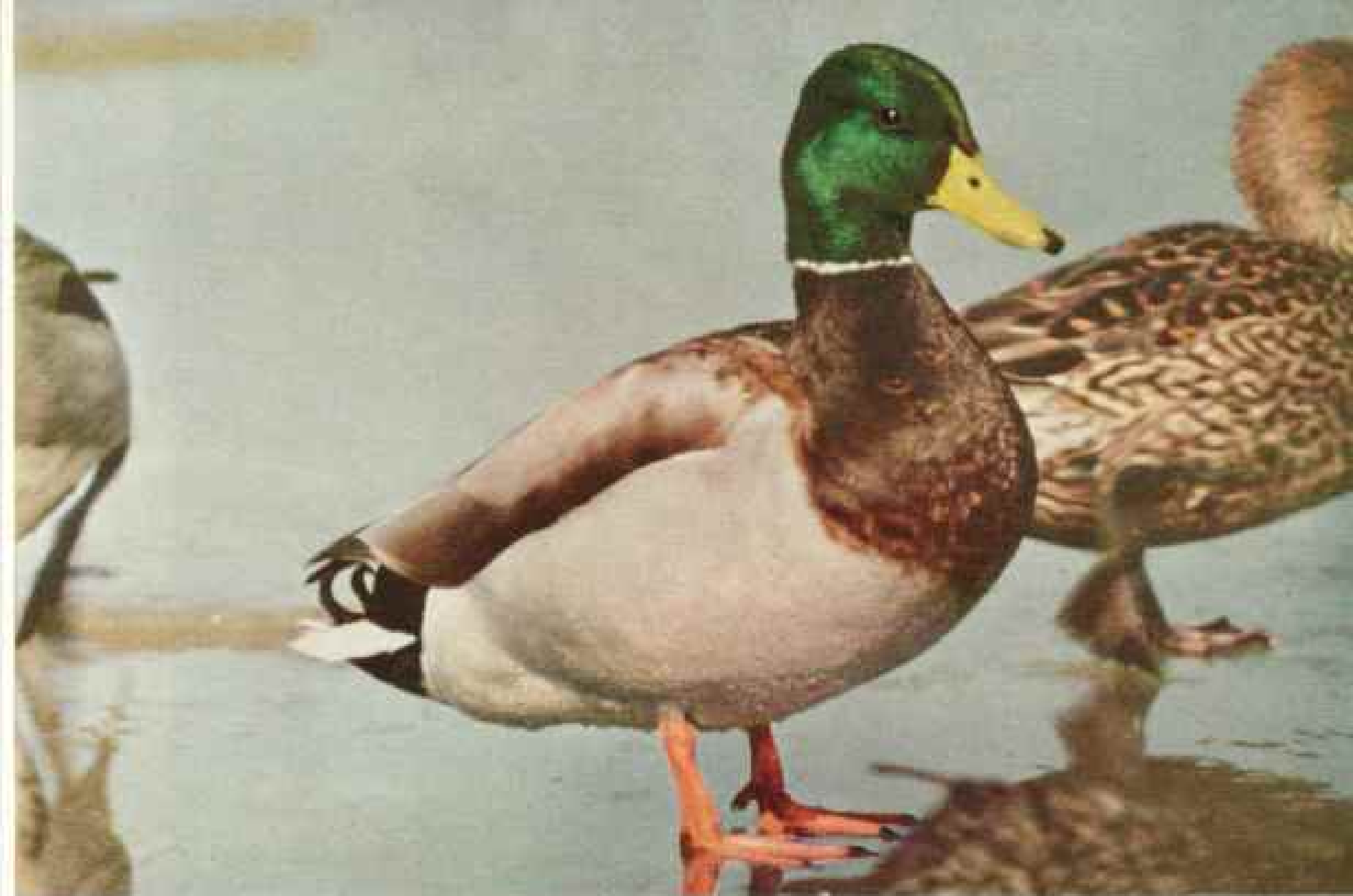
Mallards are found throughout the Northern Hemisphere, but are by no means evenly distributed. In North America the main breeding ground is in the prairie Provinces of Canada, and the principal migratory highway is the Mississippi Valley. But there is scarcely any place in the United States or Canada where a few mallards never drop in at the proper season.

In eastern North America the mallard is largely replaced by the black duck (page 523), a closely related but somewhat less adaptable species that is scarce west of the Mississippi.

From September to June the male mallard wears the bright-green head feathers and reddish breast of the breeding plumage and is very different from his streaked brown mate. But in July he assumes his "eclipse plumage" and for two months is scarcely distinguishable from her or from the juvenile birds, except by the trained eye.

The courtship antics of mallards may start in the fall, shortly after the males have come back into their breeding plumage, though active love-making does not start until the winter or early spring. At this time the female urges him on by swimming close, turning her head to one side, and giving little cackling notes.

* See "Fowls of Forest and Stream Tamed by Man," by Morley A. Jull, NATIONAL GEOGRAPHIC MAGAZINE, March, 1930.



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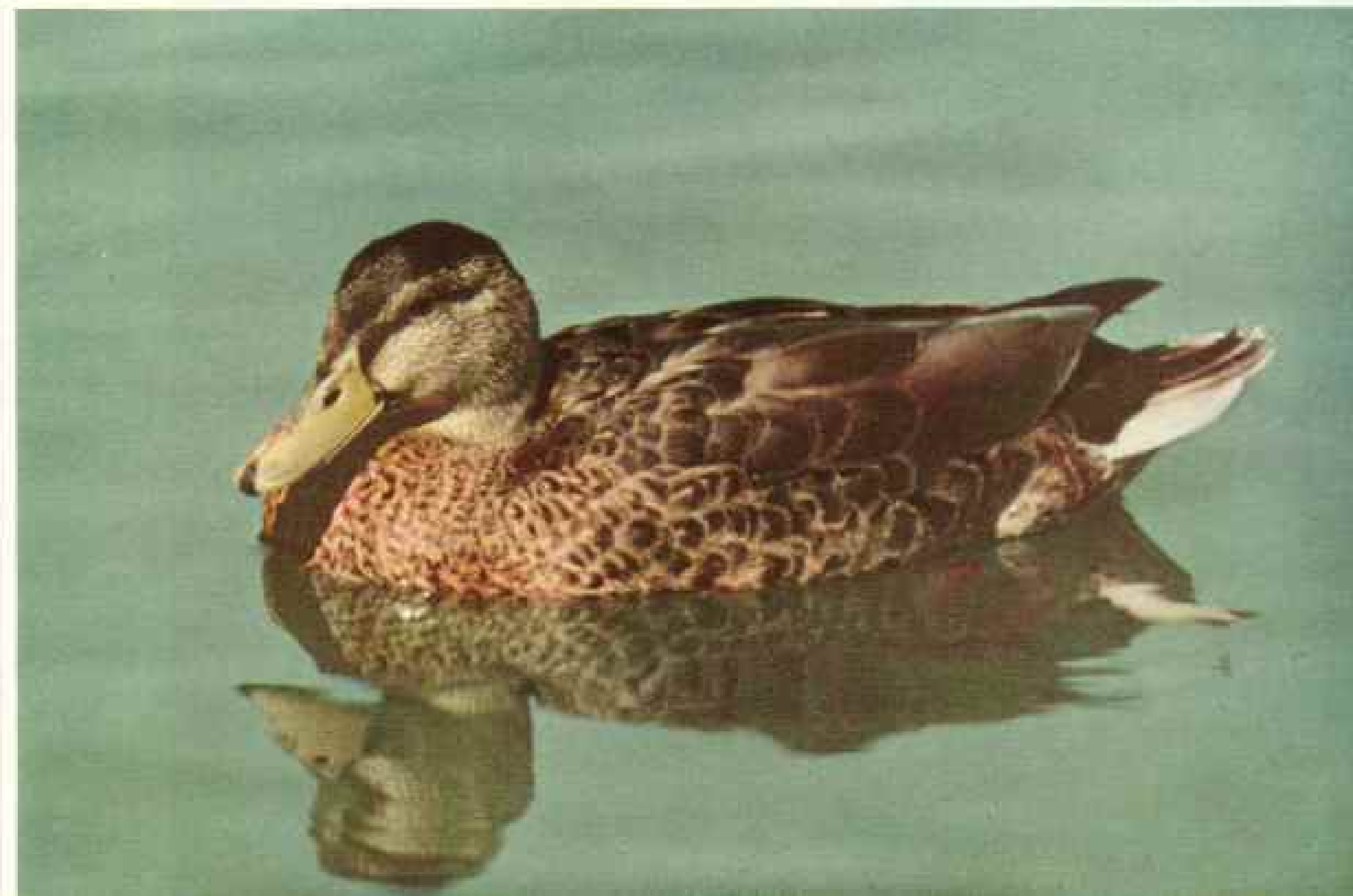
Illustrations by Arthur A. Allen

♠ **Mallard Drake in Breeding Plumage
Stands on the Ice**

All breeds of domestic ducks, except the Muscovy, are descendants of the wild **Mallard**, found throughout the Northern Hemisphere. This drake wears gay dress from September to June. In summer molting season he resembles his drab mate.

♣ **Molting Male, Brilliant Colors Gone,
Gazes at His Dull Reflection**

Flight feathers are lost during the July "eclipse," or molt season; for a month the drake **Mallard** cannot fly. He hides in marshes until again airworthy. Inexplicably, Southern Hemisphere ducks have no eclipse, even in climate similar to that in the far north.





Proud Mother Mallard Convoys Her Downy Flotilla on a Shakedown Cruise Across the Author's Pond at Ithaca, New York

Devoted and courageous, the Mallard drives away small enemies; big ones she lures off while her ducklings hide. This mother returned to the pond each spring for 12 years, always nesting beneath the same tree. When the young were a few days old, she would disappear with them toward Cayuga Lake.

Splashes Betray Black and Mallard Ducks as Amateur Divers

♣ **Blacks and Mallards**, surface feeders, usually tip to reach their food. Occasionally they dive, raising a shower of spray. A bag of corn, tossed into Cayuga Lake, led this group to forage in deep water. True diving ducks submerge with scarcely a splash. They are aided by their much larger feet and legs set farther to the rear.

♣ **Blues-winged Teal**, a surface feeder, acquires its bright plumage after December, later than most ducks.

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Emperor Goose, Dweller in Alaska's Yukon Delta, Plucks Down from Her Breast for Nest Lining

Unlike most waterfowl, the **Emperor Goose** is not an inveterate traveler, generally limiting its range to Bering Sea regions. A few flocks sometimes migrate as far as California. The down, helpful in retaining heat, is also used to hide eggs from marauders when mother "empress" leaves the nest.

A Nesting White-fronted Goose Raises Her Periscope Neck to Scan Alaska's Tundra for Signs of Danger

Geese, models of fidelity like swans, retain the same mates year after year. Though the male never sits on the eggs, he stands guard near the female and helps raise the young. Ducks usually take different mates each nesting season, the male abandoning the female soon after incubation begins.

✓ **White-fronted Goose** enjoys a wide distribution. It breeds in northern climes, in both Old and New Worlds, and migrates far to the south. At times this alert mother was partially hidden from the camera by swarms of midges.

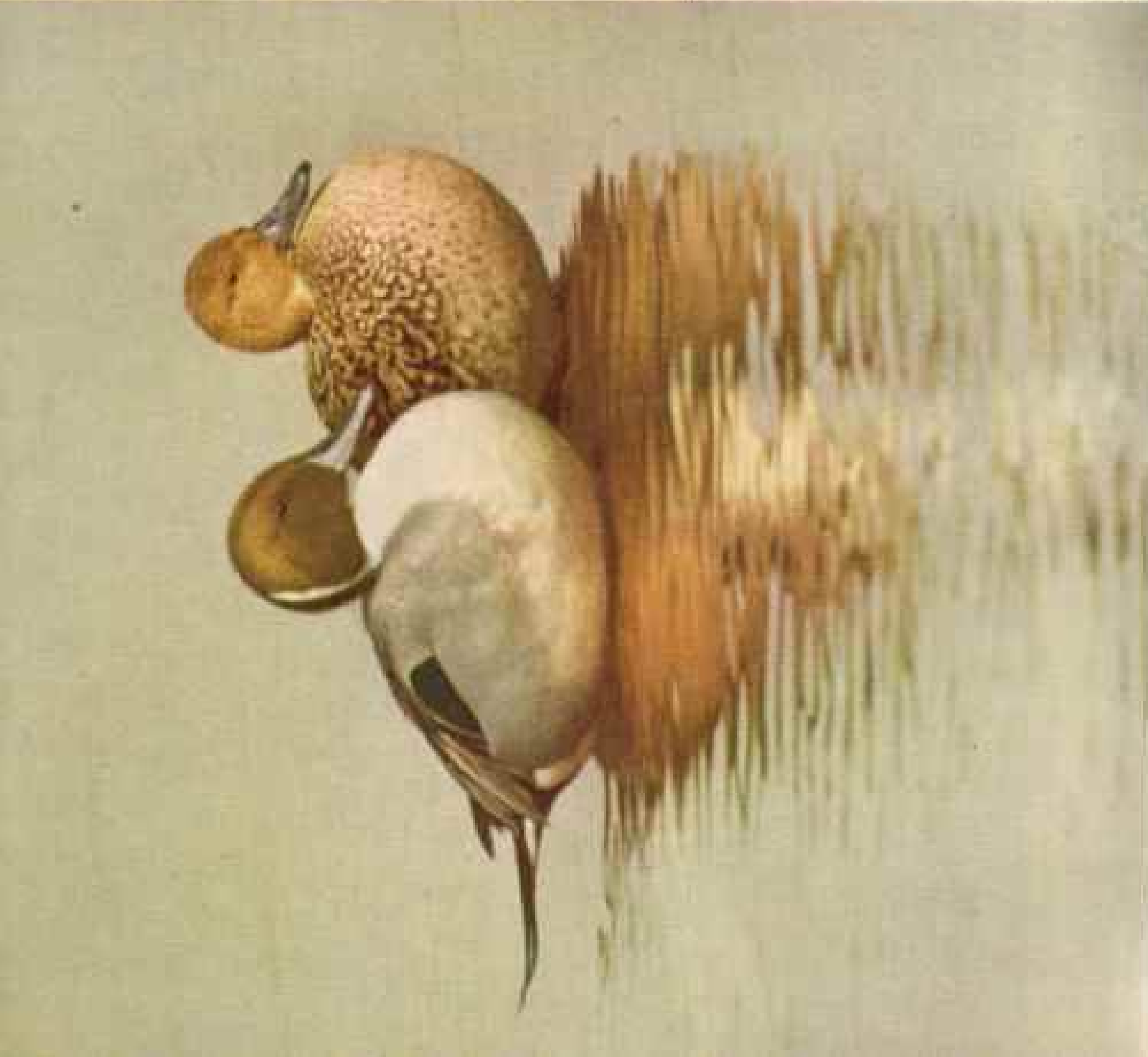
→ The young **Cackling Goose** (upper) will develop into a shrill-voiced chatterbox. Far less noisy is the **Emperor Goose** (lower), whose adult cry is an infrequent "Kla-ha, kla-ha."

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Pintails, Like Robins, Are Sure Heralds of Spring

A Farmer in northwestern States, hearing the musical whistle of the **Pintail**, know winter's end is near. Flocks arrive when open water appears on pond and lake → **European Widgeon**, a frequent east coast visitor, displays his breeding plumage (lower) and eclipse plumage (upper). While molting primary feathers the male cannot fly.

Nature Paints the Male Wood Duck with Bold Lines and Rich Hues. His Mate's Subdued Plumage Is Drab in Contrast

Wood Ducks once were classed as a vanishing species; hunting them was forbidden until flocks increased. Now one may be included in a day's bag. Fishermen prize the male's delicately penciled flank feathers for tying trout and salmon flies. These birds, lured in front of the author's blind by a food handout, were suspicious and ready for instant flight. They nest in hollow trees. Acorns, a favorite food, they swallow whole.

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Kulichovites by Arthur A. Allen

♣ **Pintails, Arrow-swift in Flight, Are the "Greyhounds of Waterfowl"**

Hunters need steady nerves and accurate judgment when a **Pintail** rockets overhead. The species, though widely dispersed, is more common in the West, nesting from Nebraska and California to the Arctic. This male made a migratory stop near Washington, D. C.

♣ **While Father Goes His Carefree Way, Mother Pintail Tends the Nest**

Drakes soon lose interest in their nesting mates. Forming huge flocks, they revert to bachelor habits. Offspring never see their fathers unless by chance at the fall migratory assembly. This **Pintail** chose Utah's Bear River marshland for a homesite.





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♣ **Male Baldpate, Inviting Battle, Hurls
Raucous Insults at a Rival**

Stealing wild celery from other ducks is a favorite pastime of the **Baldpate**, or American widgeon. It is extremely wary and often acts as flock sentinel, whistling an alarm when danger looms. Baldpates seem equally at home in sunbaked climes or Arctic chill.

♣ **Gadwalls Will Never Win the Title
of "Best-dressed Duck"**

Dark-colored, with few distinctive markings, the **Gadwall** is often difficult to identify when feeding with other species. Mid-June finds the male (left) losing his breeding plumage. His egg-heavy mate, grubbing for food, resembles the female mallard.





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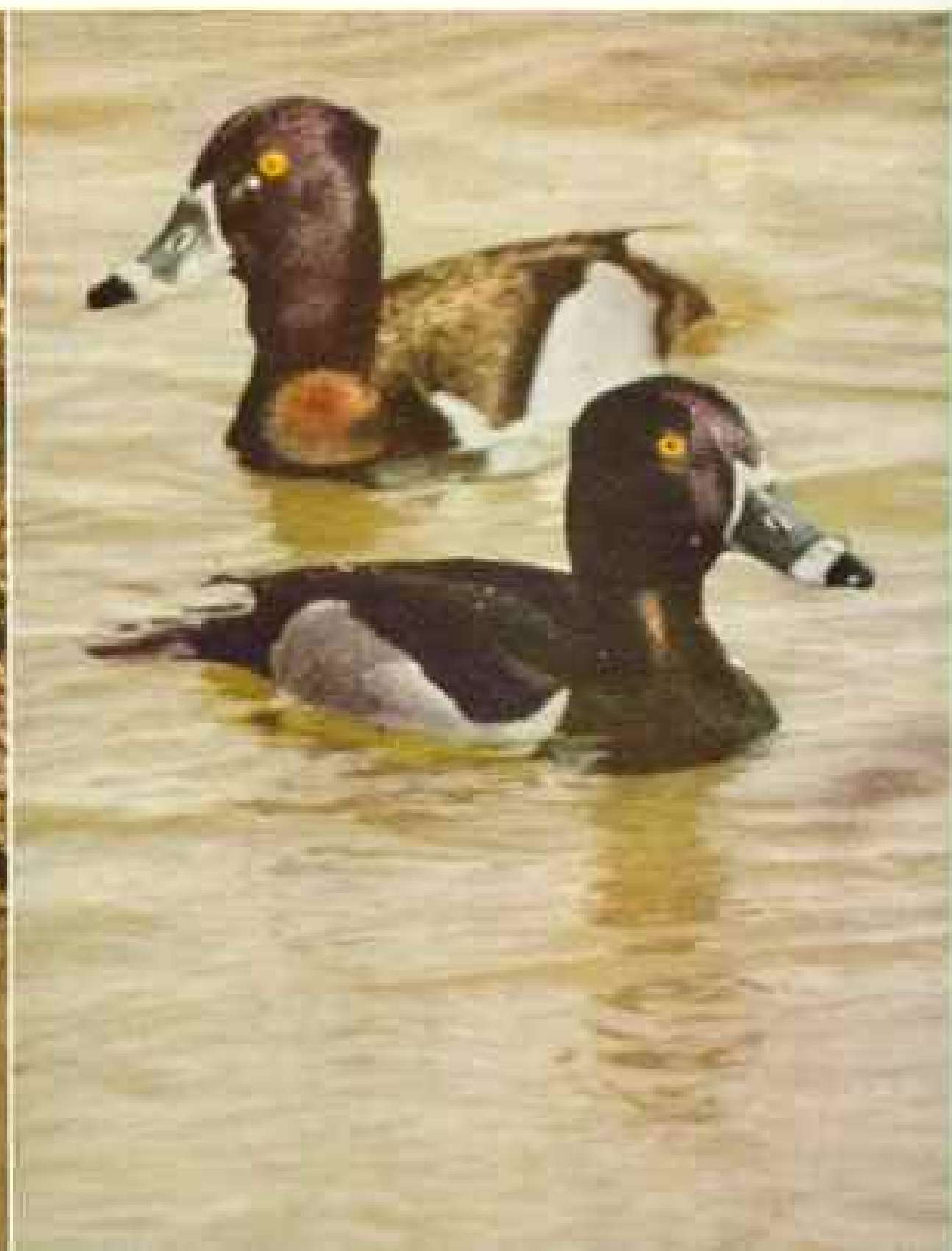
Illustrations by Arthur A. Allen

▲ **Lesser Scaups, Enjoying Florida's Sun,
Paddle Lazily in Crystal Waters**

Commonly known as blackheads and little bluebills, **Lesser Scaups** closely resemble their larger relatives, the greater scaups. Identification anklets, visible on two of the birds (left), help game authorities in studying duck migratory habits and age expectancy.

▼ **A Cinnamon Teal Looks for a Spouse;
Ringnecks Prospect for Corn**

Mating season finds the male **Cinnamon Teal** (left), a western bird, at his favorite trysting place in a Utah swamp. The **Ringnecks**, feeding near a baited blind, have just bobbed to the surface of Cayuga Lake. Their common name, ringbill, is more appropriate.





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♣ **It's Easy to See Why This Handsome Bird Is Named Spectacled Eider**

Velvety white feathers surround each eye of the male. Females wear darker, less pronounced eye patches. The **Spectacled Eider**, very limited in range, breeds only in Bering Sea coastal areas of Alaska and Siberia. Eskimos make caps of its skin.

♣ **Tail Erect, Air Sacs Inflated, a Ruddy Duck Courts His Ladylove**

A persistent wooer, the **Ruddy** may continue such antics throughout the nesting season. Though other male ducks are poor parents (page 528), this little bird escorts and protects his young. Both male and female are pugnacious and fearless.





Cayuga Lake's Expert Divers Chart an Underwater Bonanza

These ducks have been attracted by beds of wild celery and musk grass. Such group feeding, or "rafting," made many waterfowl easy prey in the days of market hunting and no bag limits.



Redheads, Canvasbacks, and Greater Scaups Share in the Strike

Feeding beds here are 8 or 10 feet below the surface. Much greater depths are easily reached by the diving ducks; **Redheads**, for instance, may submerge 40 feet or more.



Mallards Louf in a Sheltered Cove, Avoiding Cayuga Lake's Rough Water. A Sleepy Redhead (Left) Shares Their Company

To photograph ducks in their best plumage, the color cameraman must brave winter's icy winds. Hours of patient waiting may be spoiled by foul weather, inadequate light, or the birds' quick movements. A slight turn of the head may dim iridescent plumage.

Seeking Dinner, a Female Mallard (Right) Stands on Her Head. Better Divers in the Group Disdain Such Antics

The Mallard, a dabbling duck, feeds by "tipping" (page 523). Contrasting technique is demonstrated by a Redhead (foreground) as it clears the water in a splashless dive. Other diving ducks, completely submerged, cause the water's surface to "boil."

Left: Lordly bearing and big white body distinguish the Canvasback. His companion, a Redhead (foreground), is a near relative.

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↑ June Finds a Whistling Swan Incubating Eggs on an Alaskan Hillside

Unlike the vanishing trumpeter, the **Whistling Swan** is a hardy, prolific species. When migrating, its call is often heard from aloft on moonlit nights. Whistlers nest in Arctic areas and winter chiefly on the east and west coasts of the United States.

✚ A Noisy, Gabbling Call Won This Duck Its Name: Old-squaw

Northern portions of both hemispheres know the garrulous **Old-squaw**. New Englanders believe the male's cry sounds like "South-south-southerly." This female, whose nest contains seven eggs, was photographed not far from the whistling swan above.



To this coquetry he responds by standing straight up on the water and throwing his head down on his breast, at the same time giving a single curious peeping note. As he settles back into a horizontal position, he raises his tail, displaying his shiny black under-tail coverts, which are bordered by white. At the same time he may throw up a little jet of water with his bright-orange feet for the entertainment of the girl friend.

Each species of dabbling duck has a somewhat similar performance and a characteristic call, which in no way resembles a "quack."

The diving ducks, on the other hand, have a different courtship.

Canvasbacks, for example, indulge in a sort of communal love-making. The females huddle together, breasts touching, necks stiff and straight. The males then circle about them, each one in turn throwing his head backward until it strikes his back, at the same time emitting his love call—a very unducklike "Ick-ick-cooo."

Under similar circumstances redheads call "Caar" and golden-eyes, "Beard."

A courting group can be heard for half a mile on a quiet day.

Nor is this the end of the love-making, for a courtship flight seems essential to the course of true love. The female mallard leaves the pond, pursued by several males, but the competition soon settles down to two chief competitors for her favor. Round and round they go, the males trying to interfere with each other's flying and even with hers, so as to force her down to the water; but she leads them a merry chase.

On the water again, the competing males may go at each other with bills and wings and thrash it out in a shower of spray.

Canvasbacks Try to Outpush Each Other

Not so with the dignified canvasbacks. The competing males approach each other, breast to breast, turning their heads so that their long bills will not interfere, and then each swims just as hard as he can push with his great webbed feet. When one feels himself going backward, he is licked and must turn and dive before his opponent gets him by the back of the neck.

In some such manner with each species of wild duck the annual competition for mates is settled. Then the females search out satisfactory places for their nests.

Some, like the wood ducks, golden-eyes, and buffle-heads, search out hollow trees and have been known to lose their lives on lake shores when investigating the chimneys of cabins from which they could not escape. Most species, however, nest on the ground under some sort of cover from the eyes of maraud-

ing crows, magpies, skunks, and other egg-loving enemies.

The actual number of eggs varies from the 4 or 5 of the eiders to 15 or 20 with mallards, but incubation does not start until all are laid, because it is important that all should hatch at about the same time.

At first, the eggs themselves are not covered. As their numbers increase, however, one being laid each day, and as the time for incubation approaches, the mother duck starts pulling the down from her breast to cover them.

Plucking the down serves a double purpose, because ducks do not have the bare area, or brood spot, in the middle of the breast, so familiar in most birds, and the eggs must touch the bare skin to receive the heat from the mother's body.

The length of time required for the eggs to hatch varies with the different species, from only 21 days for the pintail to 30 days for the wood duck; the mallard normally requires 27 days.

At the time of hatching, the soft bill of the duckling develops, near the tip of the upper mandible, a sharp, hard, calcareous tubercle called the egg tooth. With this the duckling cuts through the shell and rolls out, all wet and stringy.

Within an hour, however, the down has dried and fluffed out; and as soon as all the eggs have hatched, the youngsters are ready to follow their mother to water. This may be nearly a mile away, although it is usually much closer and, in the case of diving ducks, often within one jump.

Wood ducks and others that nest in holes in trees have been reported to carry their ducklings to the water on their backs, but plenty of observers have seen the little ducks jump from the hole, even when it is 30 feet up and over hard ground, and then follow their mother to the water.

When the eggs are being laid and for a short time after incubation starts, the male usually dozes at some trysting place on near-by water.

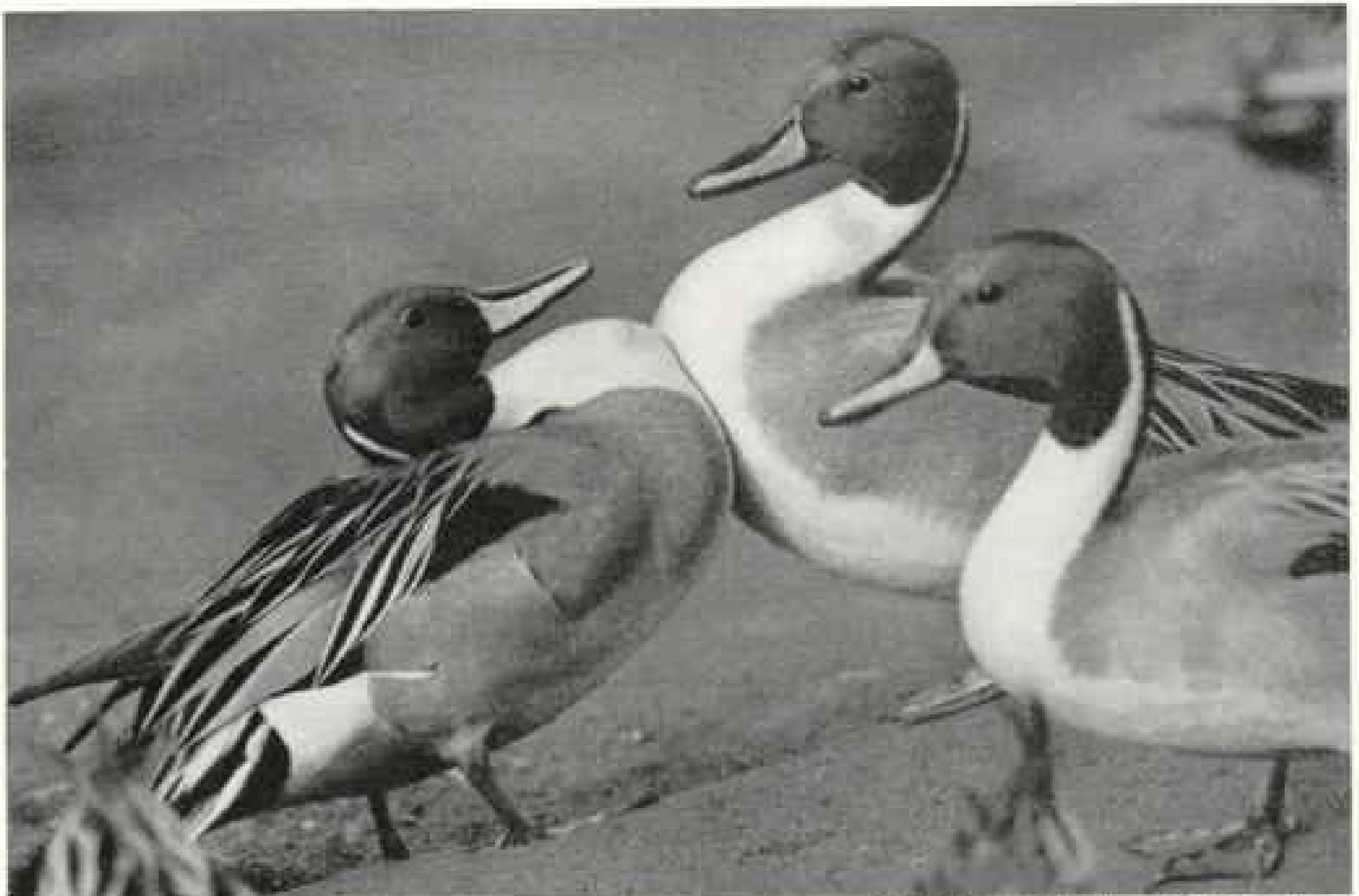
There he is joined by the female whenever she gets hungry or bored, but the male himself never sits on the eggs.

Gander Stays Close to Mother Goose

Even among the geese, which enjoy a model family life, the male merely accompanies the female to the nest and stands guard near by; he never takes over the egg-sitting job.

The gander remains with the goose throughout the incubation period and helps raise the young. Often I have seen an old gander leading a flock of five or six goslings, followed by mother goose, the parents keeping the little flock always between them.

Even on migration and during the winter



National Geographic Photographer Robert E. Rosen

Pintails Bump Chests, as if to Say, "Wanta Start Something?"

These handsome males measure one another in a 62-acre waterfowl sanctuary at Roaches Run, Virginia, across the Potomac from Washington, D. C. Here as many as 5,200 birds at a time, permanent residents and migrants, enjoy food handouts, undisturbed by the noise of near-by National Airport, cars whizzing along Mount Vernon Memorial Highway, and trains crossing a railroad bridge.

the family unit stays together, though many families may join to form flocks of a thousand or more. Indeed, it is an interesting sight to flush from a cornfield a large flock of these birds that have been feeding together with no apparent organization, and to watch them break up into family V's as they head for the lake.

Male ducks, on the other hand, lose all interest in the females before incubation has been completed. They gather in huge flocks and perhaps never see their offspring until the youngsters are fully grown and are assembling for the fall migration.

Mallards reach maturity and full breeding dress the same year they are hatched. Indeed, in most species it is difficult to distinguish first-year birds from older ones by plumage alone, although some, like the scaups, carry over quite a few juvenile feathers until the following spring and may not breed the first year. This is uniformly true with swans and geese, and flocks of immature nonbreeding birds are not at all uncommon on or near the nesting ground.

Swans, Geese Are Models of Fidelity

Swans and geese retain the same mates from year to year, but if ducks do, it is mere chance, for they may be widely separated during the

winter. However, the same duck tends to return to the same spot to nest year after year, and, if her mate does the same, they may well remate. This often happens with semi-domesticated mallards that do not migrate.

One mallard returned to nest on the identical spot at the base of a hemlock above my pond for 12 years, even though there was no water in the pond for much of that time. For many years she had the same mate, a friendly drake we called Jack. He disappeared long before Mary, the female, met some untimely end and failed to return in the spring.

It is sometimes reported that if one of a pair of swans or geese is killed, the survivor will not remate. I know from experience that this is not true, although if a mated pair in captivity is separated, neither one will take a new mate so long as it can hear its former mate calling.

During the nesting season the various species of waterfowl in North America are widely scattered through suitable habitats from Florida to Alaska. A few species, like the eiders or even the gadwalls, may seem almost colonial when nesting on small islands. Usually, however, nests are placed far apart, and broods of young are so scattered that their paths do not cross.

Occasionally with geese and regularly with eiders, broods may be pooled, and some of the less domestic females may desert the nursery for the company of the males. Normally only one brood is raised each season, but if a nest is broken up during the early stages of incubation, the female will usually nest again, laying somewhat fewer eggs the second time.

As soon as the ducklings are able to fly, or even before, they sometimes assemble in large flocks and get ready for the fall migration. Long before this, however, and even as early as mid-June, the males have assembled in huge flocks to complete their molting. The dabbling ducks head for the large marshes, so that, by July first, flocks of a thousand or more male pintails are frequently seen on the extensive Bear River marshes in Utah.

The male diving ducks, on the other hand, like the canvasbacks and the redheads, head for the deep water of lakes, where they raft out over submerged weed beds that supply their food. Out there they are not inconvenienced by their lack of flight, either in feeding or in escaping enemies.

Then comes the completion of the molt and the fall migration to the winter quarters.

Thousands Die When Botulism Strikes

Unfortunately, in the warm days of early fall waterfowl sometimes concentrate on some of the shallow alkaline lakes and marshes of the West. Here decaying aquatic vegetation has set up a culture of *Clostridium botulinum*, which makes conditions ideal for the death-dealing disease called botulism. Thousands of ducks are overcome by its paralysis; their heads fall into the water and they drown.

As many as 50,000 have died in a single week at some of the concentration points before help could be brought to them.

Nowadays an effort is made to deepen and freshen the water in these areas or to drive the ducks from them. If the ducks do become infected and can be rescued in time, they still can be saved by an abundance of fresh water.

But it is not botulism alone that has caused the great duck shortages in recent years.

When northern nesting grounds freeze over, waterfowl funnel southward into an ever-decreasing area suitable to their feeding habits and concentrate by thousands in the coastal marshes of the southern United States. As these areas have decreased in recent years through drainage and contamination, the unfortunate ducks have had to undergo still greater concentration; consequently, the toll taken by hunters and commercial interests has been out of proportion to their real number.

At times careless ship captains pump out

their oily bilges within a few miles of the coast, and these oil slicks seem to have a fascination for the waterfowl wintering or migrating near by. The oil glues together the feathers and down, destroying the insulating effect and permitting the water to penetrate to the skin. If the water is cold, it soon chills and stiffens the birds, so that they can neither fly nor dive. If they do not drown, they frequently die of pneumonia.

Lead poisoning is another hazard for which man is responsible. Ducks and other waterfowl feeding in shot-over areas swallow lead pellets from shotgun shells and quickly sicken and die. Chief offenders are "sky-busting" hunters with more shells than good aim.

Occasionally numbers of waterfowl are reported to have frozen into ponds after sleet storms and sudden drops in temperature. Usually, however, waterfowl in good physical condition develop sufficient body heat to melt any ice that forms about them, and those that actually freeze to the ice are ones already in poor physical condition.

Some species, like the buffle-heads and ruddies, unable to adapt themselves to changing conditions, have suffered more than others, but Canada geese and mallards, leaving the marshes to feed on winter wheat and cornfields, have more nearly maintained their numbers. Indeed, the mallards have learned to feed on the waste grains largely by night and thus escape the gunners.

If drainage projects continue, however, we may be faced with the near extinction of many of our interesting species. This danger is double, threatening the birds both on the wintering grounds and on the breeding grounds of the prairie Provinces, where periodic summer droughts prevent the rearing of young.

When nothing but the breeding stock returns in the fall to face the 2,000,000 gunners who take out Federal licenses entitling them to hunt migratory waterfowl, the result is as might be expected; and two or three dry summers in succession periodically bring the birds to the verge of extinction.

Fortunately, today, the United States Fish and Wildlife Service has been given the power to set the regulations controlling the annual harvest of waterfowl. Its trained observers make every effort in late winter to census the breeding stock left after the hunting season and, in summer, to judge the size of the broods reared, before formulating regulations for the following hunting season.

With the full cooperation of the sportsmen and all the commercial interests involved, such measures should go far toward perpetuating the sport of wildfowling and preserving for Nature lovers plenty of these most interesting subjects for their color cameras.

The Eternal Flame

Millions of Years Old, Natural Gas Now Is a New Servant of Man

BY ALBERT W. ATWOOD

A MAJOR revolution in the habits of the American people is now under way as the use of natural gas spreads swiftly from one section of the country to another.

From the seven great producing States of the South and Southwest—Texas, Louisiana, New Mexico, Arkansas, Kansas, Oklahoma, and Mississippi—natural gas pipe lines are fanning out like a giant's fingers, a thousand, even two thousand miles north, west, east, and northeast.

For a long time publicity has been focused on highways and airways. But underground there is a phenomenal and even newer development of transportation lines, whose silent, almost invisible, spiderlike spread is fast covering the country with a mileage that already exceeds that of the railways.

These pipe lines are steel tubes through which the gas is pushed by means of pumping stations all the way from the wells in the South and Southwest to distant cities.

A recent map of the Federal Power Commission shows approximately 120 "major natural gas pipe lines," many of which are moving with the utmost urgency to extend into new territory and to expand the volume of gas delivered.

Primitive Man Knew Natural Gas

There is nothing new about natural gas itself. Primitive peoples worshiped or left it severely alone, regarding it as a "wild spirit."

Since ancient times holy altar fires have figured in the folkways of many races. Some so-called "eternal fires" were merely burning jets of gas escaping from earth fissures. Such may have been the Oracle of Delphi and the fire temples on the Caspian Sea, and even the "burning fiery furnace" of the Old Testament (page 542).

Natural gas, like coal and oil, is found in vast quantities in the earth, and was formed millions of years ago by the decay of plant and animal life. It is "trapped" several thousand feet below the surface, under great pressure, in porous rock, usually limestone or sandstone, until man bores through the overlying strata to release it.

I have seen a piece of gas-bearing rock which appeared absolutely solid; but when it was crushed by heavy machinery, one could see the almost microscopic holes or hollows in which the gas had been stored.

Natural gas consists chiefly of a light, colorless, practically odorless, highly inflammable

substance known as methane, which is also found in certain other inflammable gases, such as fire damp in coal mines, marsh gas, and even sewer gas.

For more than a century, practical modern man has used manufactured gas and taken it very much for granted. A few years ago, however, the industry seemed to be on the downgrade. Then as the use of natural gas suddenly spread throughout the land, the gas industry as a whole blossomed forth, vigorous, rejuvenated, dynamic.

Naturally the destinations of the great new pipe-line systems are the populous cities of New England, the mid-Atlantic States, the Middle West, and the west coast, and more especially the industrial areas where steel, automobiles, and electrical equipment are made.

The lines go over and under many thousands of rivers, railroads, and highways. They penetrate thick forests, deserts, treacherous swamps, rugged mountains, wilderness areas, and thickly populated cities.

The 1,840-mile line of the Transcontinental Gas Pipe Line Corporation follows a substantially straight course from the Gulf coast of Texas to 134th Street, New York City. All the resources of modern technology are thrown into the construction of these giant steel lines, and nothing except shortage of steel seems to stop their relentless march to predetermined goals.

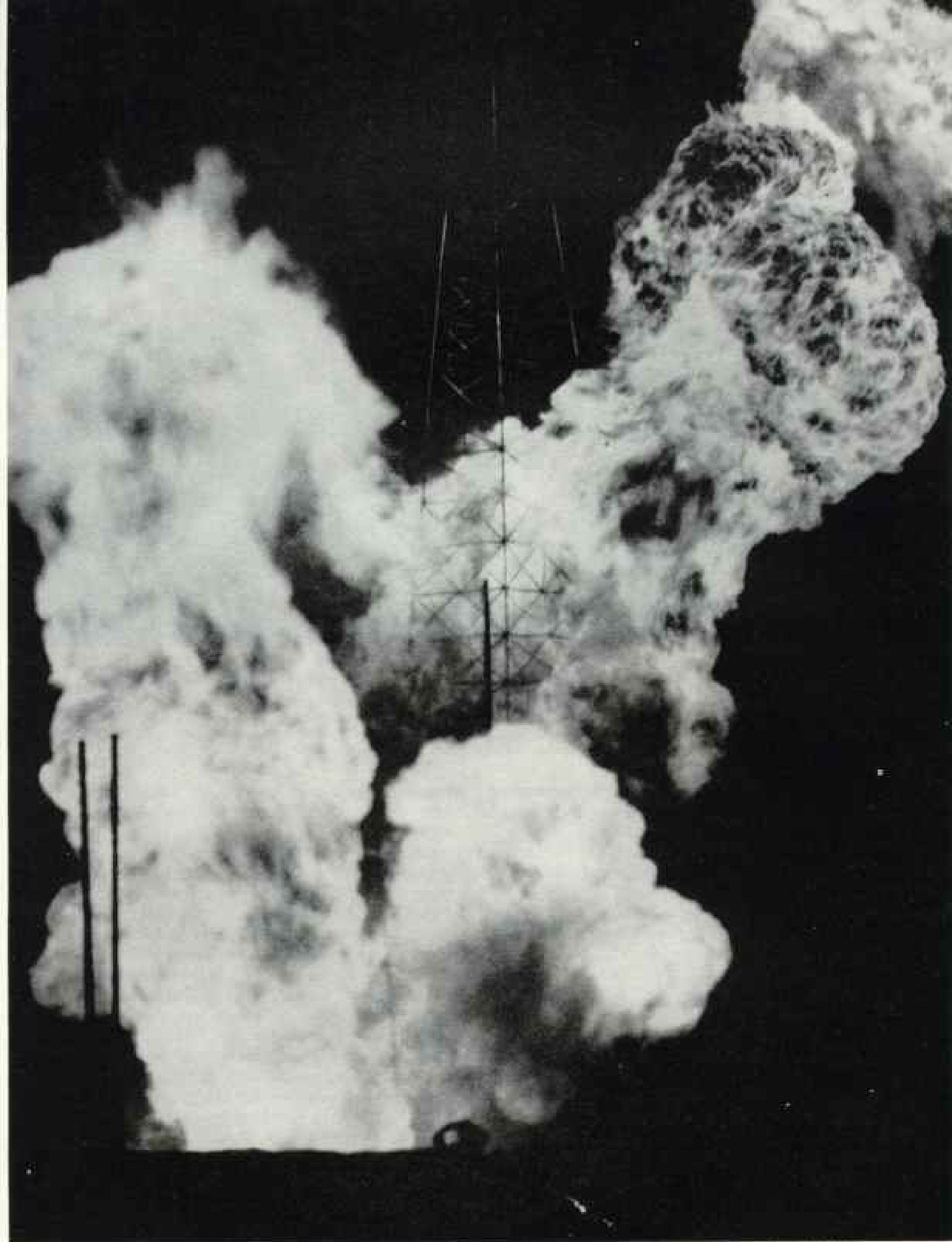
Driving them through the obstacles of Nature for a thousand miles or more calls for tough, hard work. Engineers, ditchers, bulldozer operators, cranemen, welders, and truckers alike must be rugged individuals.

Building the "Toughest Inch"

Building one of these lines is a dramatic affair. On a cold, snowy afternoon in a remote mountainous region of West Virginia I watched final construction of one part of the "Toughest Inch," a new 262-mile line of the Columbia Gas System from Cobb Station, northeast of Charleston, West Virginia, to Rockville, Maryland.

Earlier in the season it had taken a crew of brush cutters four hours to cut a narrow trail only 200 feet long through laurel and rhododendron thicket, and in two working days 104 poisonous snakes had been killed.

Because of the lack of highways, in order to get two miles ahead, equipment frequently had to be moved 40 miles, much of it on ac-



Fiery Streamers Leap from an Oklahoma City Well as from a Blazing Sun

A spark touched off the inferno one night in 1929. The steel rig melted in 15 minutes. Fire fighters, using nitroglycerin, snuffed out the blaze three and a half days later. Some 322,000,000 cubic feet of gas daily gushed from the well until it was capped eight days after the explosion. Drillers miraculously escaped injury. Others, encamped near by, fled for their lives.



Bible's "Fiery Furnace" of Natural Gas Emblazons an Arid Foothill in Iraq

Here, says the modern interpretation of Daniel (Chapter 3), Shadrach, Meshach, and Abednego walked unscathed because the Lord was with them. Today the near-by Kirkuk field exploits the oil which Biblical man neglected. Pipe lines snake oil from Kirkuk to Tripoli and Haifa on the Mediterranean. Pilots flying over the field sometimes mistake these flames for the lights of Baghdad.

cess, or "shoofly" roads, built by contractors for the purpose. In some cases it had to be trucked 60 miles from a railhead.

To a lay observer like myself, the striking thing was the way the line was built straight up to the peak of each mountain.

In rugged mountainous country pipe cannot be laid around the base or side of the hills for fear a landslide will break it. If the line goes right up to and over the top, a landslide merely glides along the surface of the pipe.

Evidently there are still frontiers to be conquered in this country, and not far from the Atlantic seaboard at that!

During the war two pipe lines, parallel for a large part of the way, were built from Texas to the eastern seaboard, near New York City, to carry oil for military purposes; later they were turned over to a natural gas pipe line company. At the time of their construction they became known as the "Big Inch" and "Little Big Inch" because of their respective diameters—24 inches and 20 inches, the two largest built up to that time.

Since then it has been fashionable to give large pipe lines unofficial nicknames. The Cobb-Rockville line is not one of the longest or one of the largest in diameter (26 inches),

but it crosses such excessively rough mountain terrain that "Toughest Inch" is a suitable name.

Securing right of way for a pipe line is a problem in itself. One company had to contact 20,000 persons here and abroad to secure approximately 5,000 separate tracts. Near large cities the farmers are especially hard to deal with because each one expects his land to be the site of a future subdivision.

Rivers, of course, are a problem. If a river is quiet and well behaved, pipe can be laid under or even on the bed; but if the river is very broad, turbulent, and with a changing, treacherous bed, it may be necessary to build a suspension bridge. Transcontinental's far-flung line had to cross or go under 40 major rivers and streams, 110 railroad tracks, and 619 State and Federal roads.

This same line traverses such widely separated rivers as the Atchafalaya, Coosa, Pearl, Tombigbee, Mississippi, Potomac, Delaware, Passaic, Hackensack, and Hudson (page 555).

Mammoth Machines Build Pipe Lines

The modern pipe line can be built only because of mammoth mechanical equipment. There are huge rooting machines, power shovels, bulldozers, and side-boom tractors. There



How Much Gas Heats the Oven, Chills the Refrigerator? The Meter Keeps Tab

As gas flows through the meter, pressure expands and contracts a bellows made of sheepskin or synthetic rubber. A cam attached to the breathing diaphragm moves the recording pointers. The average gas inspector reads 240 meters a day. One veteran checked more than a million without an error. Gas was sold for a flat charge per burner until the invention of the meter in 1833 (page 562).

are machines for digging and filling the ditches, and for bending a section of pipe in a few minutes' time without changing the thickness of its walls (bending being necessary where there is a curve in the line; page 551). There are others for applying protective coatings against corrosion, including paint, enamel, glass-fiber mats, and asbestos felt (page 545); still others for welding the pipe sections together and for laying them into place. Most lines are laid three feet or more underground.

The contractors on one recent line used 60,000 gallons of primer and 17,000 tons of enamel. It took 20,000 freight cars to deliver the pipe.

An unusually vast array of outsize mobile apparatus was required to build Pacific Gas and Electric Company's "Super Inch," a 506-mile link in a 1,600-mile line from Texas and New Mexico to California, both because of the size of the pipe and the desert conditions under which it had to be laid (pages 548, 550, 551). The contracting concern in this case, the Bechtel Corporation, is one of the six groups that built the Hoover Dam and, through an associate organization, International Bechtel, Inc., constructed the "Tapline," the Trans-Arabian Pipe Line which was completed last year.

Super Inch pipe is 34 inches in diameter, largest ever built for such purposes, and reaches to the waist of an average-size man.

Before the various protective coatings are applied to the pipe or wrapped about it, all by machinery, it must, naturally, be cleaned. Even in the case of the Super Inch, with all its super machinery, after being cleaned by mechanical apparatus an old-fashioned feather duster was applied by hand to remove any last-minute dust which might have settled on the pipe's exterior.

Nowhere has greater progress been made than in welding together the separate lengths, or sections, of pipe, thus speeding up construction and doing away with the likelihood of leaks from the older type of mechanical joints, or couplings.

One contractor in working across the Missouri and Mississippi Rivers welded his sections on an LSM and dropped the line in the water as the boat moved along.

In a recently completed job, after the sections had been put in place in the ground, an inspector was drawn through the pipe in a scooter, to locate defects (page 544). But the ends had to be closed to prevent foxes, rabbits, skunks, rattlesnakes, and copperheads from entering.



Pipe Inspector Rides a Dolly Through a Tunnel of Steel

Welds must be perfect, for gas seeps through the tiniest pinhole. In the field, X-ray equipment tests welded joints. Here at a south San Francisco plant inspector Everett Almond checks a seam in a 34-inch pipe for Consolidated Western Steel Corporation.

The pipe was then cleaned by a so-called "pig," or "go-devil," a rotating device to get rid of mill scale and construction dirt.

"Jeeping" the Line

An electrical device is used to detect "holidays," or defects, in the protective coating, and the process is known as "jeeping" the line, because the presence of holidays is detected by a buzzing sound from the apparatus.

It is standard practice not only to survey a pipe-line route in advance from the air, but to patrol it on a regular aerial schedule after it is built and in operation. Even a buried pipe line can be followed from the air.

A leak is easily spotted from a few hundred feet because of the discoloration of nearby vegetation, or because cows huddle as far away from the line as possible. A repair

crew starts out immediately.

Every line has its conventional linewalkers, and there has been a rapid increase in the use of radio communication, which obviates trouble that comes when severe winter storms knock down telephone wires. Whereas there were only 200 mobile radio stations in the gas industry in 1944, it is expected that 4,000 will be in operation by the end of 1951.

On one important transmission system there is a round-the-clock maintenance crew every 90 miles, constantly at work protecting the right of way against moving soil, stream washing, and other trouble factors, so that there is a crew of trained men not more than 45 miles from any point on the line.

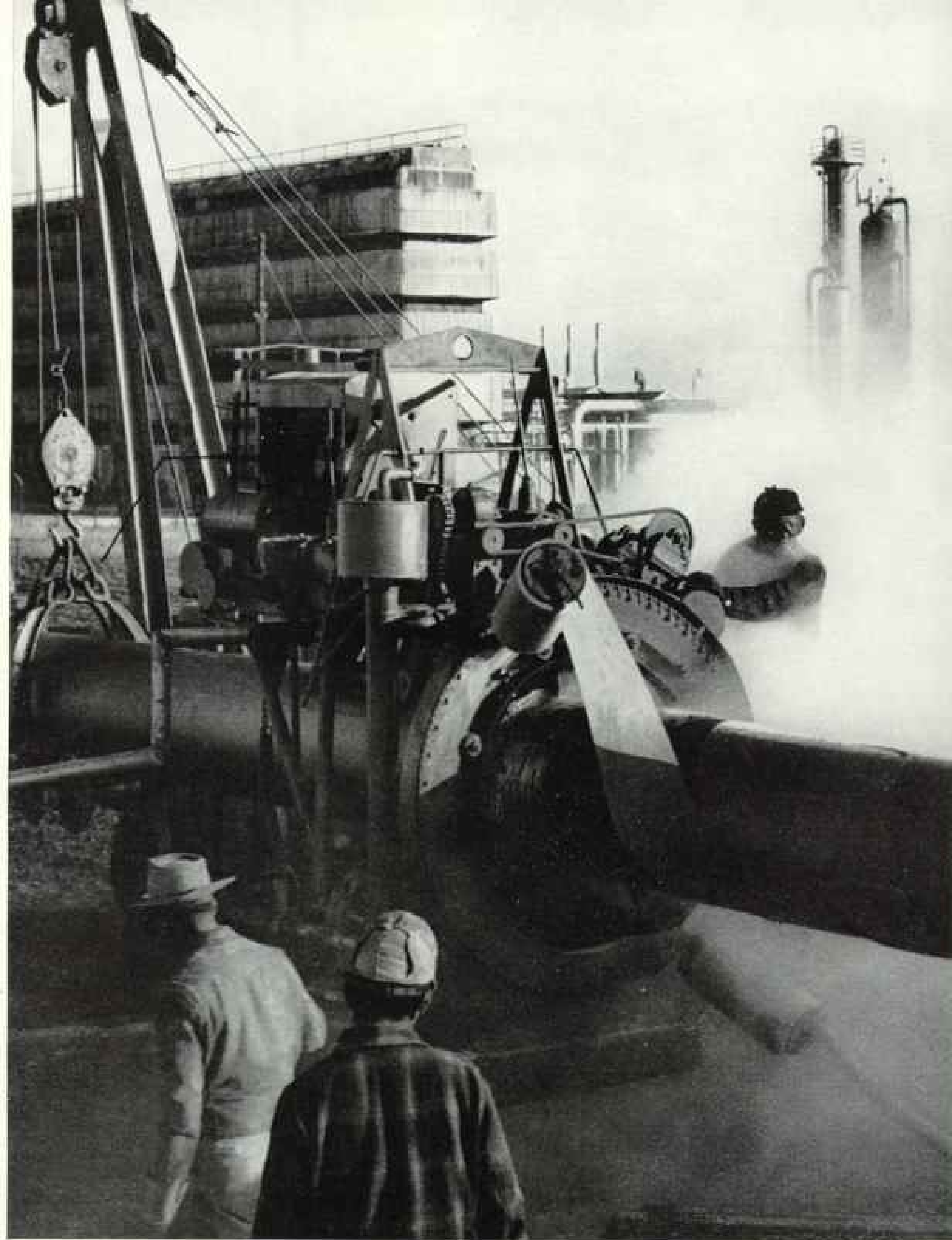
During heavy snow or intense cold it takes crews longer to reach the scene of trouble than in summer, spring, and fall. Both men and machinery are stiff in cold weather, and manpower is also less efficient in extreme heat than in the spring and fall.

One line superintendent would not admit to me that there is any place his trouble crews cannot go or that there is any problem which they cannot solve.

When a high-pressure gas line breaks, valves are immediately closed at each side of the break, and service continues outside the affected area. These valves are put in approximately every 10 miles.

In addition, the larger systems are constantly "looping" their lines—that is, building a second or even a third or fourth line alongside the first one, much as a railroad builds a double track, or perhaps a third or fourth one. In the case of looping, the lines are interconnected with tie-overs every 10 miles.

In certain types of soil, corrosion from various causes tends to create small holes in the pipe. In some cases an electric current is



A "Dope Gang," Masked Against Tarry Fumes, Spins Protective Wrapping Around a Big Incher

A hot coat of Bitumastic enamel and glass-fiber mat is applied to this natural-gas pipe beside the Hansford plant of the Phillips Petroleum Company near Guyton, Oklahoma. Some lines wear rag felt and asphalt-impregnated paper. Both techniques require that dust be removed from the pipe to ensure a strong bond. In addition to mechanical apparatus, old-fashioned leather dusters were used to clean California's Super Inch (page 543).



Drillers Blow In a Well. Gas Gushes from the Earth near Shreveport, Louisiana, with a Rocketlike Blast

Pressures of 6,000 pounds a square inch in some deep wells hurl rocks and mud skyward. Other wells are shot with explosives to release trapped gas. Pressure is generated in some formations by hundreds of gallons of hydrochloric acid dumped down drill shafts (page 558).

Clouds of Swamp Muck Erupt as Pipe Layers Dynamite a Ditch 1,880 Feet Long

Pipeliners, laying a 197-mile section between Green Bay and Milwaukee, here blast a channel through swampy Lake Butte des Morts, Wisconsin. Working on balsa-wood rafts, demolition men buried seven tons of dynamite. The explosion ripped a long, clean ditch.

Began in 1947, the Michigan-Wisconsin Pipe Line now taps the Hugoton Field in Texas, Oklahoma, and Kansas. Aerial surveys determined its route.

Some 140 contractors, employing nearly 65,000 men, compete for projects in the pipe-line industry. They provide no pipe but do supply machinery and such things as dynamite and welding rods. One company built a Coca-Cola bottling plant supplying all Lebanon just to keep its workers happy on the Trans-Arabian job.

Profits depend on the speed of field crews. Slowed by weather or rock, contractors must bear the loss. Heavy snow on a 200-mile Panhandle line cost one combine \$450,000. A rugged mountain crossing, the 26.7-mile "Toughest Inch" between West Virginia and Maryland, required more than a million pounds of dynamite and cost \$79,000 a mile (page 540).

The Explosives Engineer



Super Inch Worms Across California's Desert and Mountains

Helping to serve more than a million customers in northern and central California, Pacific Gas and Electric Company's 34-inch main is a 506-mile link in a 1,600-mile system tapping fields in Texas and New Mexico. More than 200,000 tons of pipe and fittings went into its construction (pages 343, 350, 351).

Pipelayers blasted off hilltops where steep grades required sharp pipe angles. They winched heavy machinery up steep hills; they hauled soil earth from lowlands to protect wrappings on hard ground. Every mile, on the average, they spanned a gully with steel and concrete.

Trucks carted 60-foot pipe sections over specially constructed "shoody" roads. Welders joined them into these larger links.

Here the line climbs from the Mojave Desert to its highest elevation, 4,600 feet, in the Tehachapi Mountains. The pipe hangs in a tractor's side-boom sling. A bulldozer anchors its lower end. If the operators follow custom, they will lower the sections into the ditch before dawn to avoid tube-expanding heat.

Richard Froude, Bechtel Corporation

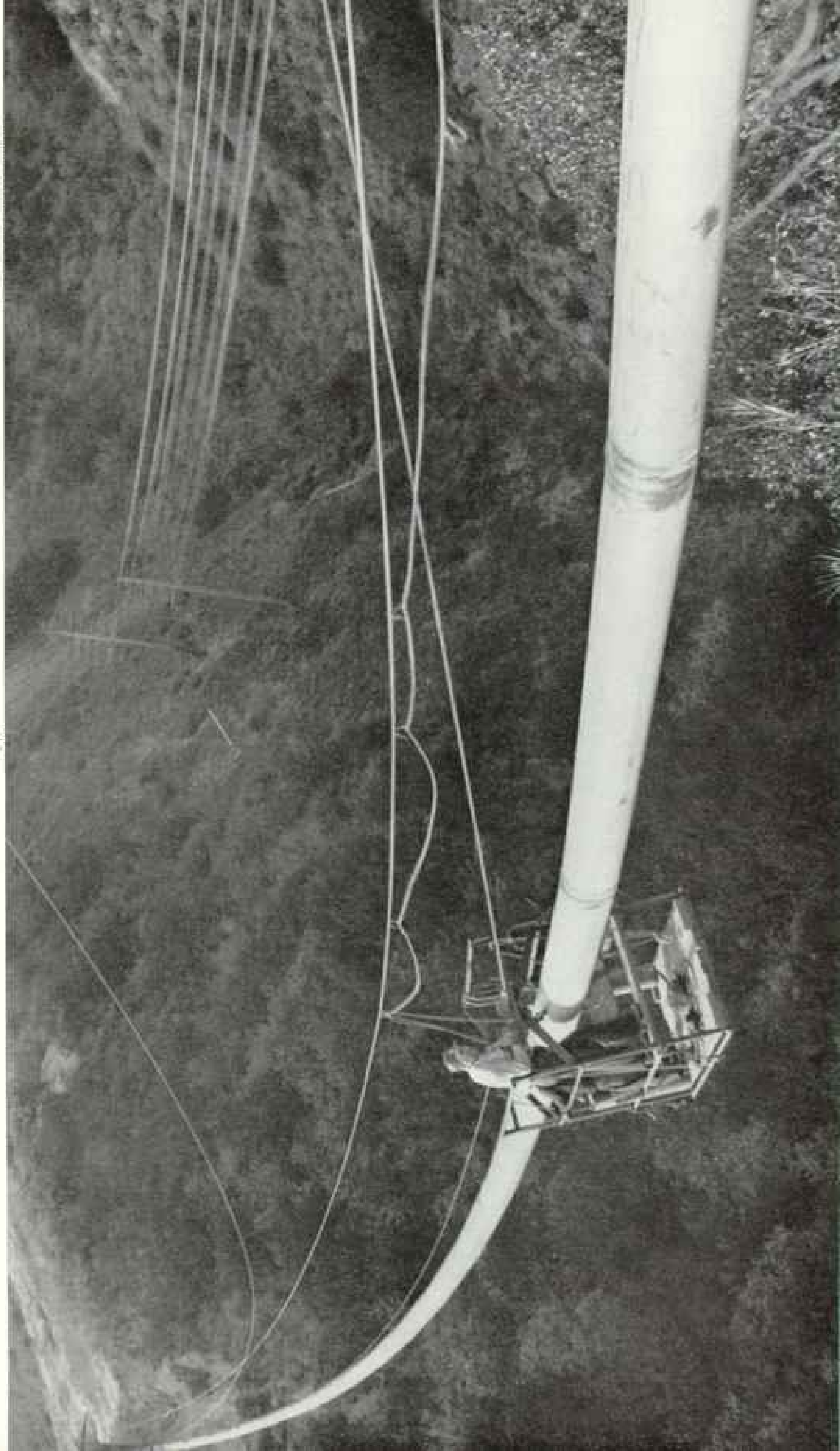


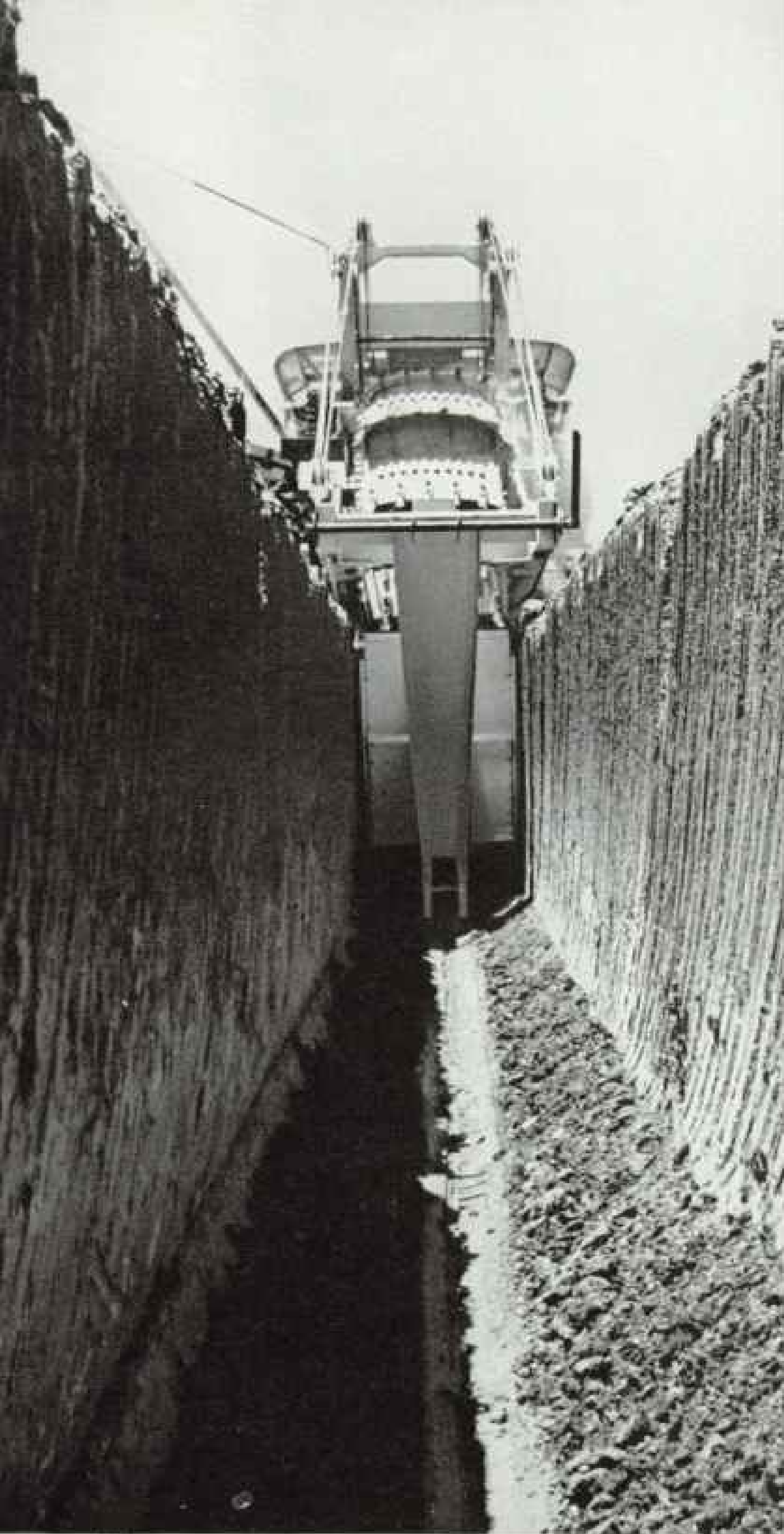
Gorge-leaping Pipe Line Feeds Gas to Los Angeles from La Goleta, a Dry Gas Field Now Used as a Storage Pool

La Goleta is one of the Nation's more than 100 rock reservoirs into which gas is pumped in summer, when demand is low, and released in winter, when consumers cry for fuel. Twice it saved Los Angeles during unusual cold snaps (page 558). Here an inspector rides a cable car along the pipe.

549

Southern California Gas Company





"Big Buck" Scoops Out a Bed for the Super Inch

Contractors spent more than a million dollars on construction equipment for the 34-inch giant pipe line. This 31-ton monster, largest wheel-type trencher ever built, digs a ditch 44 inches wide and 5½ feet deep. Scoops like Ferris wheels can gouge out a mile-long trench in a day.

set up in these hazardous areas from scrap iron buried near the pipe line to the pipe itself, and by completing a circuit it serves to stop corrosion.

Unless a line break is near the point of delivery—that is, just outside a city—the gas stored up under pressure in the line itself is enough to continue service for some hours, or until the repair has been made.

Delivering the "Line Pack"

The gas in the line on its way to delivery is known as "line pack," and the larger the pipe the more line pack there is to keep service going. In other words, a large-diameter pipe is one device for storing gas, for emergency as well as for regular use. The builders of the new Super Inch line from Texas to California had this fact in mind.

It was fortunate that by the middle and late 1920's technical advances in steelmaking,* pipe manufacture, and electric welding had reached a point where it was possible to lay and operate strong, high-pressure, long-distance, large-diameter pipe lines. The reason is that about the same time reserves of natural gas vast enough to amortize the investment had been discovered in the Monroe Field of northern Louisiana and the Panhandle Field of Texas.

Up to that time pipe lines had been strictly local in nature. Natural

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Pittsburgh: Workshop of the Titans," July, 1949, and "Steel: Master of Them All," April, 1947, both by Albert W. Atwood.



Steel Tube Flexes Like Wire as a Bending Machine Wrinkles a Big Incher

Surveying engineers of the Super Inch line, fitting the pipe to the earth's contour, mark the degree of bend on each section. Forced over a fulcrum, the pipe bends. This 90-foot section will take a 30-degree bend. Any larger deflection would have to be made with mitered segments welded into the line.

gas was first used for public purposes in this country in 1824 in Fredonia, New York. It was produced from a well 27 feet deep, carried through hollow logs, and used to light two stores. It also provided street lights to greet General Lafayette on his visit there in 1825.

An iron pipe line $5\frac{1}{2}$ miles long for natural gas was built at Titusville, Pennsylvania, in 1872, and by 1925 several pipe lines of varying lengths up to 300 miles had been laid.

From then on the distribution of natural gas ceased to be merely local and became regional in scope. Today it is almost national, and will be so as soon as New England, the Pacific Northwest, and a few South Atlantic States have been reached.

Being strong, the newer type of pipe can be made with thin walls, thus saving a vast amount of steel. Also, being strong, such pipe can stand great pressures, and that means more gas can be pumped through pipes of a given size.

Even though the walls are very thin, the

pipe has such great tensile strength that the walls do not easily tear or rip apart despite high pressures.

Some 25 years ago pressures in the pipes were rarely more than 275 to 350 pounds to the square inch; today, operating pressures of 700 to 800 pounds are common and in a few instances run as high as 1,350 pounds or more.

Although there is always some risk where very high pressure is present, it might be argued that pipe line transmission is better protected from both natural and man-made violence than other means of transportation. Interruption of service because of failure of equipment is rare.

Winter Complicates Heating Problems

It may seem strange to the layman, but a much more serious problem than line breaks is that of supplying all customers with enough gas on a very cold winter day. The greater part of the tremendous new demand for this fuel is for space heating—that is, for house

heating, a demand far greater than anything the gas companies had ever anticipated.

House heating creates sudden, sharp, high peaks in the use of gas. One company uses 15 times as much gas on a zero day as on a summer day; another company rises to 815,000,000 cubic feet a day in winter and drops to 48,000,000 cubic feet in summer.

The weather is an uncontrollable factor, and anyone who assumes that normal weather will be the rule is likely to be disappointed.

In January, 1948, the temperature averaged 23° F. in the territory covered by a large gas company, or 6° below normal. In January, 1949, the average was 38°, or 9° above normal.

Most house-heating customers begin to heat when the outside temperature falls below 65°, and a one-degree change of temperature for a month means a difference in the send-out of one large company of 350,000,000 cubic feet.

In addition, if there is a high wind, each increase of one mile an hour in velocity has the effect of a drop of close to one degree in temperature.

It takes about 2,000 cubic feet of gas to heat an average-size house in States like Ohio, Indiana, Illinois, and Michigan on a cold winter day. If 2,000 be multiplied by several million, some idea is had of the stupendous amount of gas required to heat houses during a cold snap.

Yet the long-distance pipe line transmission companies (wholesalers) and the distributing companies (retailers) in the cities have a fundamental legal and moral obligation to give domestic consumers a preferential supply, even in the coldest weather.

The gas must be on tap, flowing continuously, like water. Yet it is far more difficult to handle than water. The sudden onset of a severe cold wave is especially important, because gas usually moves at a rate of only 10 to 15 miles an hour. Therefore, many hours are required to deliver additional supplies at the end of a 1,000-mile line; two days, in fact, from Texas to Chicago or California.

Gas Dispatcher Is Always Prepared

The average customer would get much reassurance by visiting the chief dispatcher's office of a great gas system, as I did in Charleston, West Virginia, from which the supply for many cities and towns in such States as Ohio, Pennsylvania, West Virginia, Virginia, Maryland, and for the District of Columbia is regulated.

The dispatcher's office of such a system is rarely caught unprepared. The weather pattern comes out of the Northwest, usually on a 24- to 48-hour basis. If a blizzard is on the

way, someone along the line catches it. Temperatures are plotted regularly, and the barometer, snow, rain, wind, clouds, and sun are studied.

The office is in touch with every part of the system by telephone, teletype, and radio, and it controls flow from wells, flow into and out of storage, and line pressures. The requirements of customers are plotted, and the total supply is split up or allocated among them.

Until World War II, California and the great Appalachian region of the East were among the large gas-producing centers, supplying their own large needs. But although there are considerable quantities of gas left in both areas, they have had to draw heavily upon the Southwest since the war to meet their growing requirements.

The Appalachian wells are much more numerous than in the vast plains of Texas, but they do not now yield nearly so much. One Appalachian company alone has nearly 10,000 wells, and 44,000 cubic feet a day is not bad for one of these eastern wells. But 100,000,000 cubic feet is not uncommon for one of the big boys in the Southwest. This is exactly what one might expect!

Some Surplus Gas Stored Underground

It would be impossible to meet the winter demand in many areas, including California and such States as Ohio, Pennsylvania, and New York, except for underground storage of enormous surplus supplies in depleted or partially depleted gas fields.

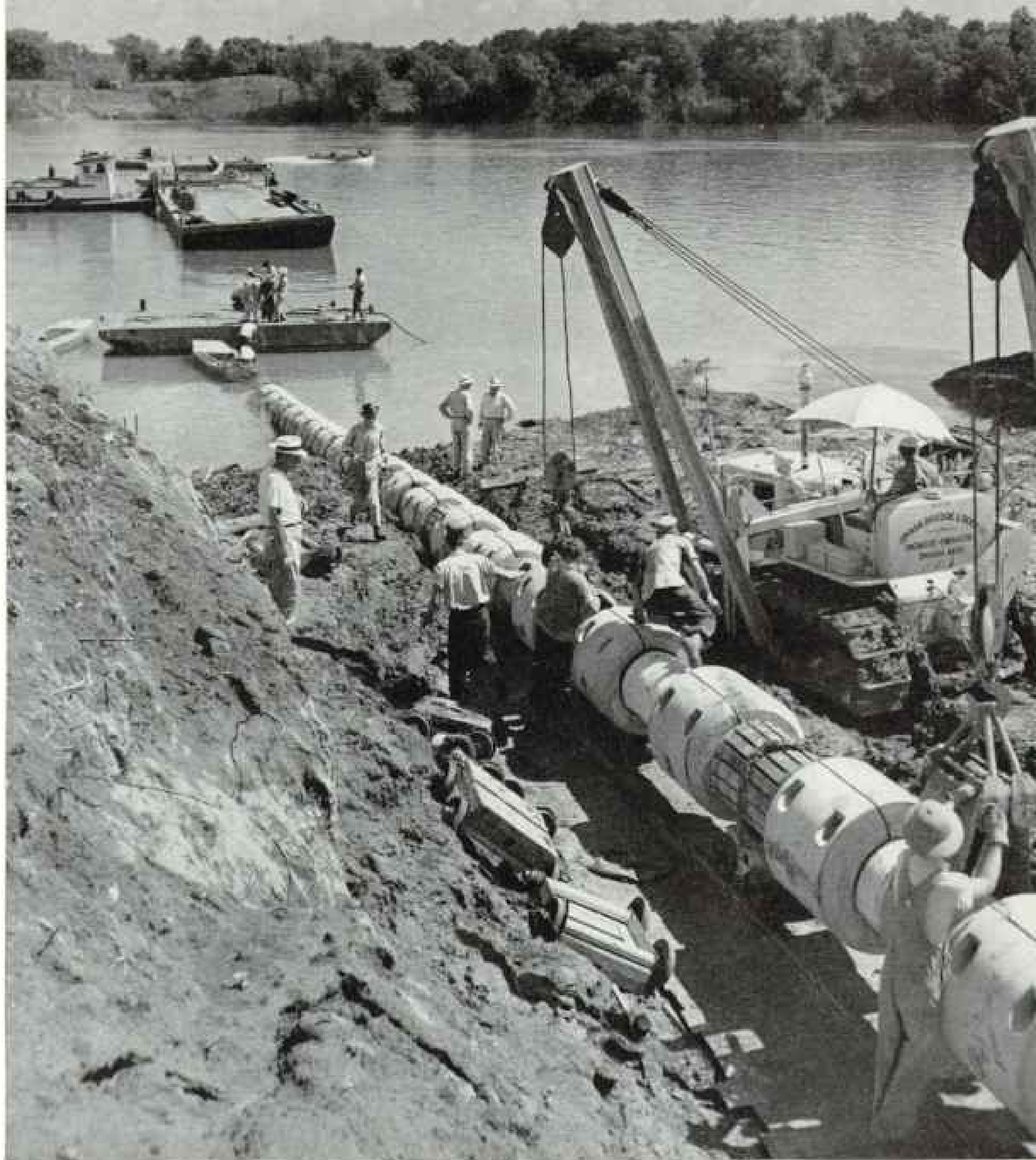
The manufactured gas companies, it is true, have long stored gas in tanks, or holders, which add little to the beauty of our cities. But the scale on which natural gas is now being used makes the so-called holder seem pitifully inadequate.

There are only a few holders in the world that have a capacity of 15,000,000 cubic feet, and a 10,000,000-foot holder is considered large. Moreover, they are very expensive to build.

But a single one of many wholesale gas companies now stores more than 100 billion cubic feet underground; before long, this company hopes to store nearly 160 billion cubic feet. It would take a prohibitive investment in thousands of the largest holders to equal this storage.

There are many exhausted oil and gas fields that lie abandoned. But the porous rock, with its holes, pockets, cavities, and fissures, is still there, capable of absorbing and retaining gas if it is pumped in through old wells.

It is not every old oil or gas field that can be "tightened up" enough to use for storage. To be sure that the gas pumped in will not



A Weighted Pipe Line Rolls on Rails into Its Tennessee River Bed. Tractors Inch It Along

Some gas lines cross turbulent or erosive rivers by hitching rides on railroad or highway bridges or their own suspension spans (pages 549, 554). Most lines, however, are buried beneath rivers. Concrete blocks girdle this 26-inch artery of the Texas Gas Transmission Corporation. The 800-mile line runs under 15 rivers, including the Mississippi and Ohio.

East Texas Gas Spans the Red River on Steel Wings

The Red River, constantly changing its course, makes submarine pipe-line crossing hazardous. This suspension bridge, one of the world's largest for gas pipe lines, crosses the unruly stream near East Point, Louisiana. Over the span runs part of a 142-mile, \$7,500,000 artery that taps the Carthage Field in east Texas.

For many years the extent of that 500-square-mile natural reservoir was unknown. Production in important volume began after sufficient wells had been completed to prove it was one of the world's largest natural-gas fields.

Late in 1945 the United Gas Pipe Line Company linked the field to its facilities near Monroe, Louisiana, to supplement the dwindling Monroe Field and to meet increased demand of northern and eastern markets.

Maintenance inspectors frequently patrol pipe lines from the air. Leaks are easily spotted because escaping gas discolors vegetation. One system maintains round-the-clock line crews every 90 miles (page 544).

Modern pipe layers are descendants of the old-time railroad gangs and logging crews. Most come from the Texas-Oklahoma-Arkansas area. Their trailer-borne families follow them from one field-office town to another.

National Geographic Photographer
H. Aubrey Herbert



New York Welcomes Texas Gas Flaring Between Two Flags

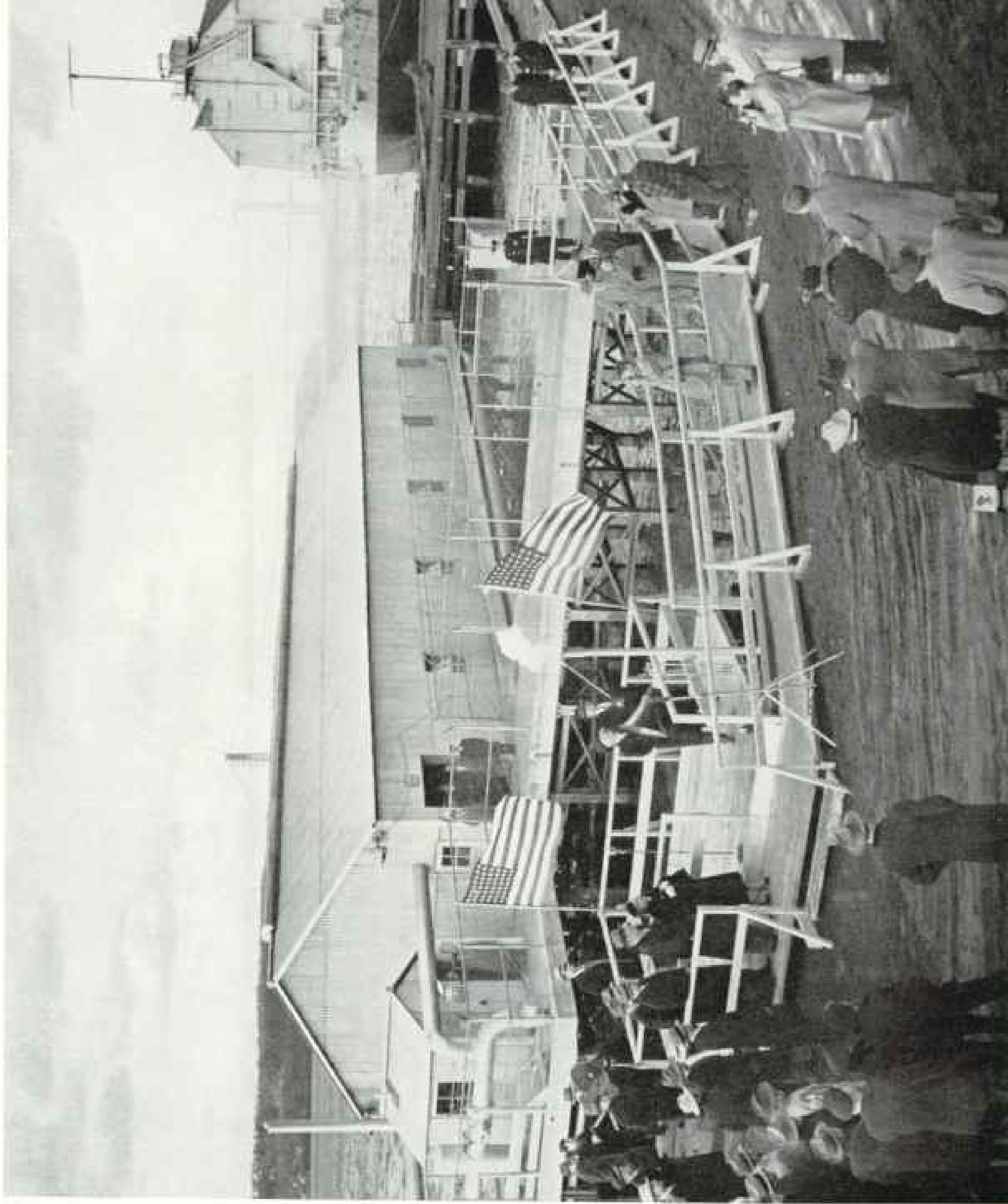
Longest pipe line in the world, the 1,546-mile Transcontinental gas line serves some 20 million customers along the route from Mercedes, Texas, to Manhattan Island (pages 540 and 542). In a single day the \$270,000,000 artery can deliver the equivalent in heat energy of more than 3,000,000 gallons of oil or 10,000 tons of coal.

The main line has 40 major crossings. Longest and most troublesome was the Hudson at journey's end. The contractor, attempting to blow a trench in the river bottom with compressed air and water, found the fibrous clay bed unyielding. He finally resorted to dredging.

New Jersey's Palisades (background) rose so abruptly above the river that they left little working room. Pipe layers had to abandon the usual method of pulling a complete welded pipe across stream. Instead, they assembled 300-foot lengths on an earthen apron, welded them into line, moved them out on barges, and pulled them to the dredged channel.

Last January's ceremony inaugurated service to distributors. It was held at the 134th Street terminal, close to the George Washington Bridge.

This was not the first natural gas to reach New York. Texas Eastern Transmission Corporation, using the former Big and Little Big Inch oil pipe lines, fed Staten Island in 1949.



Gas Torches Cut Sprockets from a Steel Plate

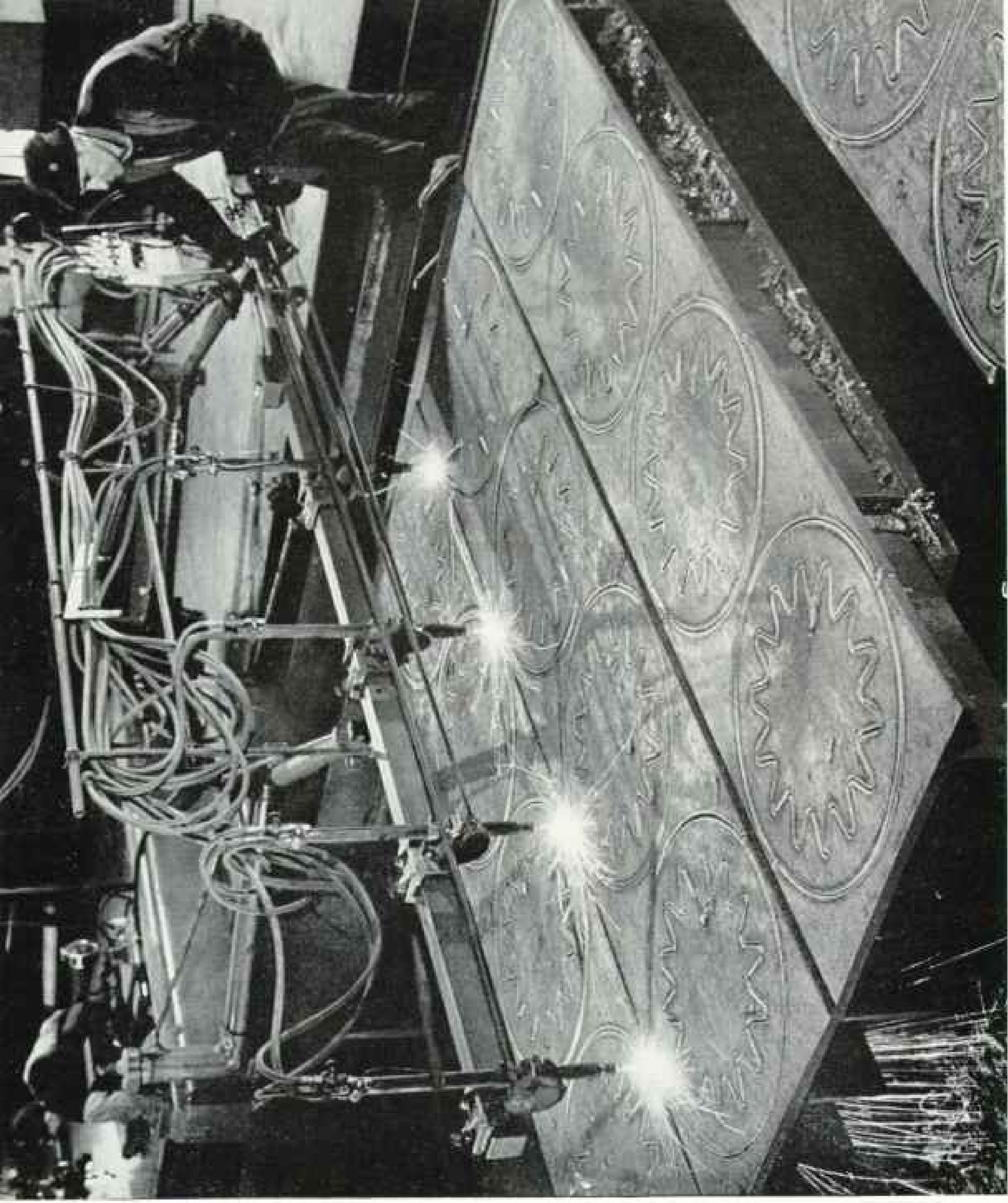
Despite rapid pipe line expansion across the Nation, Texas, Louisiana, Oklahoma, and Mississippi still consume half of all natural gas produced. About three-fifths goes to industry for many purposes. It dries alfalfa and tobacco, roasts coffee beans, and sweetens bananas.

Gas oven process bricks, glass, cement, aluminum, and ceramics. Gas is used in air conditioning, refrigeration, lumber drying, candymaking, painting, shipbuilding, and the chemical industries (pages 557, 559, 560, 562).

Some 274 billion cubic feet of natural gas flow into American steel plants each year.

Twelve million feet burn each day at the Lukens Steel Company, Coatesville, Pennsylvania. More than 50 gas-cutting machines in one of its plants turn out uniform parts. Some, traveling on tracks and carrying up to 10 torches, can cut patterns of unlimited length. Thin steel sheets, piled 100 to a stack, are cut economically as a unit. Ingots more than four feet thick melt under the torch's flame.

This travograph machine operator scars through 1½-inch plate. Combined with streams of oxygen, the gas burns at 5,000° F.

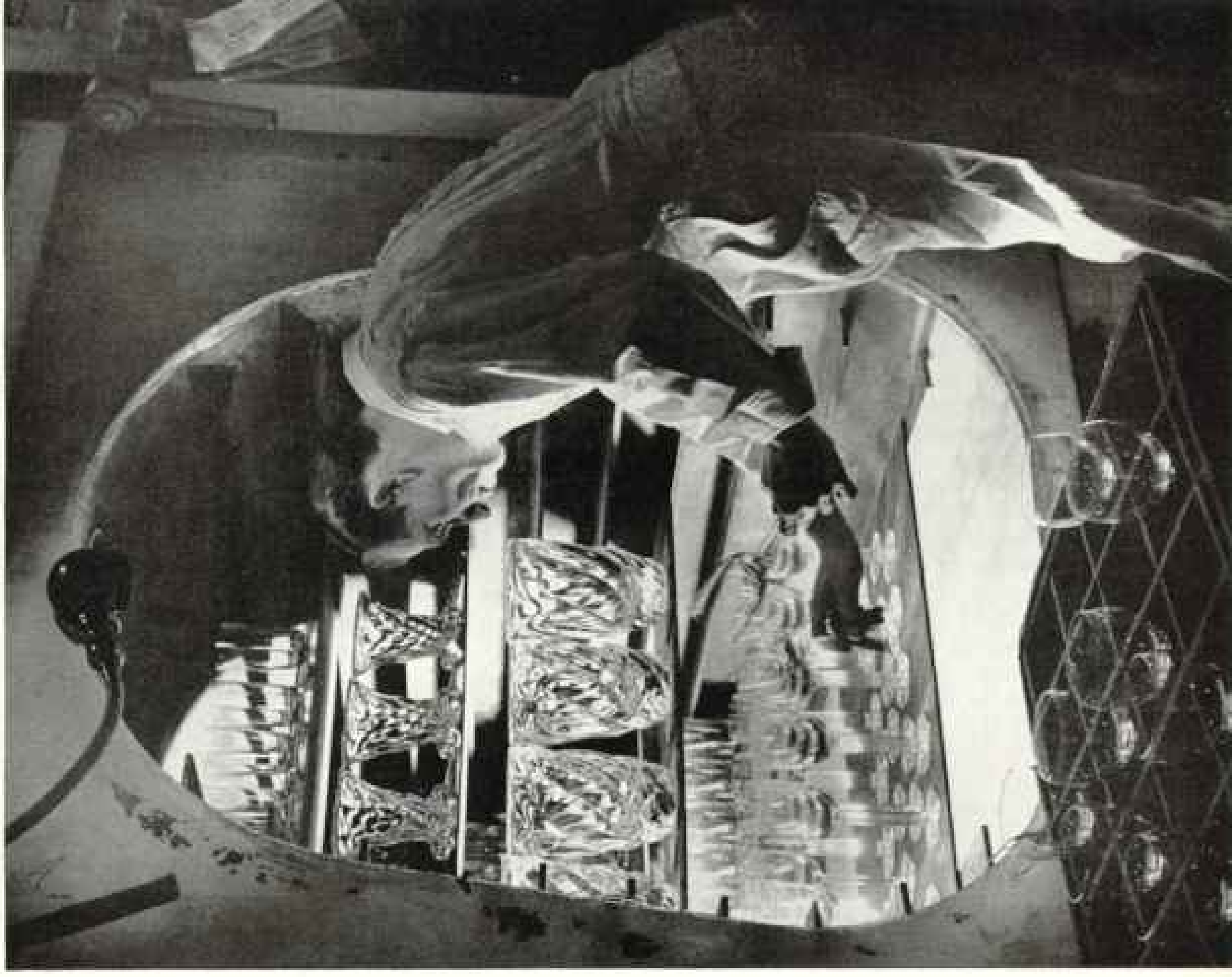


Gas Flames Smooth the Lip of a Glass Mug

Natural gas, easily controlled, free of ash, and exact in desired temperatures, is ideal for the glass industry's purposes. Some 30 billion cubic feet of gas are consumed each year by the Owens-Illinois Glass Company. In its Toledo, Ohio, plant, an annealer (right) places crystal ware in a gas-fired lehr. Reheating and gradual cooling will reduce internal stresses.

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National Geographic Photographers William H. Culver and Robert F. Blain



leak away, it is necessary to study the history of the field, including the record, or "log," of every well in it. Usually it is necessary to have a surrounding ring of dry holes to indicate the limits of the field.

The rock held gas for millions of years without a leak and will do so again if the operator is not too smart and does not try to crowd in more gas than the normal rock pressure will tolerate.

The entire acreage must be owned or leased to control every well that taps the field. It is certainly a boon to farmers to be able to lease their dry wells and be paid for them even after they have stopped producing.

A storage field must have lots of pressure in it, in the form of a cushion, to push out the gas that is wanted on a cold day. What the companies must have on a very cold day is fast delivery, and there must be a cushion, or spring, to deliver rapidly.

If a field is completely depleted, it may be necessary to fill it for several years before any gas can be drawn off. The more of a backlog is built up, the more extra pressure there will be when zero weather strikes.

The companies which have large storage capacity are able to buy "Southwest" gas every day of the year in approximately the same amount, summer and winter. This enables the costly long-distance transmission lines to operate at maximum efficiency.

Storage Pool Is a Giant Bellows

An underground storage pool is like a giant bellows that fills in summer and squeezes out in winter.

There are well over 100 storage fields in the United States. The smallest owned by one company covers $2\frac{1}{2}$ square miles, and the largest, 64 square miles.

One of the well-known storage fields is La Goleta, northwest of Santa Barbara on the Pacific Ocean (page 549). The latter part of December, 1948, and much of January, 1949, was unseasonably cold in southern California. There were unprecedented snowfalls in Los Angeles and other places, and the low temperature on January 10 was 20° , with an average mean for the day of 36.5° .

The result was that well over a billion cubic feet of gas were used that day, or 100,000,000 cubic feet in excess of any previous estimate of a possible maximum demand. It was only the ability of the companies to withdraw 262,000,000 cubic feet from underground storage that made it possible to heat more than a million homes.

Underground storage fields are not available everywhere. Heavy peak demands are met in different ways in different parts of the country. Several companies store gas in nests

of bottles or sections of pipe underground. Others use "bottled gas," the so-called liquefied petroleum gas.

In time it may be possible to store all the gas that is needed by refrigerating it into liquid form. As such, it occupies only $\frac{1}{600}$ of the space required for gas and can be quickly restored to the gaseous state as needed.

Pressure Pushes Gas Along

To distribute natural gas through pipe lines and to get it into storage or to the consumer requires pressure to push it along.

When a drill bores through the overlying strata down to the gas "sands," many wells come in with a roar. Since the pressure in the reservoir where the gas has been trapped may be from 2,000 to 6,000 pounds to the square inch, the gas naturally rushes to the surface (page 546).

Other wells must be "shot." Sometimes about half a ton of explosives is lowered to the bottom of the hole and touched off, the explosive charge breaking up the rock, releasing the gas with a roar, and shooting rocks and rubble skyward.

Or a well may be acidized, as many as 1,500 gallons of hydrochloric acid being lowered into the limestone formation to eat into the rock and open up its pores.

When gas is released, it not only leaves the well with a rush but is such an obliging substance that it lifts itself to the surface and starts to transport itself to market.

But friction against the pipe naturally reduces the pressure behind the gas, unless it is helped or pumped along by booster, or compressor, stations. These relay stations are located every 80 or 90 miles on a very long line. The Transcontinental line from the Gulf of Mexico to New York City, 1,840 miles, requires 19 of these compressor stations.

Gas may enter a line at a pressure of 750 pounds to the square inch and drop to nearly half that figure by the time it reaches the first booster station. Here a large number of huge pumps take the gas from the incoming line, compress it to its original pressure, and send it on its way to the next station.

In the prosaic everyday operations of the industry, natural gas is referred to in astronomical terms. Even experts become momentarily confused as they slither back and forth among millions, billions, and trillions of cubic feet.

Pipe Line's Merits as a Container

For this bulky substance to reach the burner tip of a housewife's kitchen range, it must come from the gas or oil fields in a continuous, tight container—that is, in a costly pipe line, and in no other way.



Electrotype Finisher Paints Carbon Film on Nickel Plate with a Gas Torch

When the carbon-coated surface is polished with a rubber eraser, soot reveals any imperfect low areas. These sections, marked on the back of the plate, are pounded out with punches. Finisher Arthur Graf here works on a NATIONAL GEOGRAPHIC cover at Judd & Detweiler, Inc., who print The Magazine in Washington, D. C.

At first glance, natural gas may seem to be at a great disadvantage as compared with its competitors, coal and oil. These can be carried in almost any kind of container, large or small, even in an old tin can. Indeed, in the case of coal the container is not even closed; the largest industrial users dump a season's supply on the ground in any available lot.

But there are great advantages in this very limited form of transportation known as a pipe line. The gas is delivered continuously, minute by minute, second by second. The customer does not have to use his space for storage or his capital to build fuel tanks, and he does not have to buy supplies in advance, because the pipe line maintains his fuel inventory for him.

Although a pipe line is costly to build, its operation is almost automatic, requiring very little labor.

Once the line is built, there are no car shortages to contend with. There are no wheels, rails, or wings. It is a single, one-

way operation, with no problem of two-way traffic and therefore no collisions.

A pipe line, of course, is stationary, and the gas in it cannot be shifted with the flexibility of coal and oil, which can be transported almost anywhere by motor truck or boat.

Natural Gas Serves Homes and Industries

Yet natural gas can be and is used for thousands of industrial purposes. About 60 percent of all the gas produced goes to industry, despite the swift, enormous expansion of residential house heating.

The steel industry alone is now using 274.5 billion cubic feet a year! "In normalizing, annealing, and heat-treating furnaces," says the chief combustion engineer of one large steel company, "we use natural gas regardless of cost."

Gas provides ease of control and fuel uniformity, two important factors in many industries, including not only steel but glass, aluminum, brass, ceramics, machine tools, and many



Tongues of Flame Form Carbon Black from the Incomplete Combustion of Natural Gas

Next to heating, the carbon-black industry takes the biggest slice of natural gas. Tire manufacturers mix the product with rubber to increase toughness. Paints, printing inks, and cosmetics also require gas black. This sooty worker adjusts a scraper bar at United Carbon plant, Borger, Texas.

others. Flame temperatures go as high as $3,200^{\circ}$, occasionally $3,700^{\circ}$, in some of these industries, and gas helps to control both the temperature and the direction of the flame.

Gas baked or processed or molded the bricks, glass, cement, and steel in your house, the tires and enamel on your car, and the buttons on your coat (p. 556, 557, 559, 562).

It dries alfalfa and tobacco and roasts coffee beans and nuts. It bakes bread (page 563) and ripens and sweetens bananas. It bakes enamel on prefabricated houses.

It helps raise orchids, dehydrates fruits and vegetables, and plays a part in air conditioning, refrigeration, cremation, lumber drying, paint and varnish manufacture, candymaking, canmaking and detinning, newspaper printing and the allied arts, shipbuilding, and the chemical industries.

To those parts of the country where natural gas is being piped for the first time it is a brand-new story, whether used by householders or by industries. But it is an old story

in California, Texas, and the other sections.

Despite shipment to other regions of increasingly enormous amounts from Texas, Louisiana, Oklahoma, and Mississippi, these States still use nearly half of all natural gas produced. Its availability in Texas and neighboring States is a major factor in the great wave of industrialization in that region in the last decade, especially in the chemical industries.

In these States virtually all electricity is produced with natural gas as fuel. It is also used as fuel by the petroleum industry, by synthetic rubber plants, and to make carbon black, an essential ingredient of automobile tires; it is used in sugar refineries and in pulp and paper mills.

Because of the mild climate and availability of low-cost natural gas, practically all house heating in California is by this type of fuel. Today 2,500,000 homes, plus 200,000 multiple dwellings and apartment buildings, are heated by gas.

When natural gas was first made available for general and domestic uses, huge quantities were blown into the air or wasted in the producing fields. This was particularly true during those months when gas was not needed for heating.

This surplus gas was thus available for sale to industry on an "interruptible" basis, at a price competitive with fuel oil. This means that, in return for lower rates, the industrial interruptible customer is subject to shutoff during periods of cold weather because domestic customers have a priority on the use of all the gas available.

As compared with 2,700,000 residential users in California, there are only 2,000 large industrial users.

In the case of these interruptible contracts, the user has other so-called "stand-by" facilities which he can use when the gas goes off. In fact, there are powerhouses in California which can switch from gas to oil, or vice versa, on a few moments' notice.

When natural gas comes into a community, the householder does not need to be told that it has many advantages—that it is free from ashes and smoke, from waste and residue of any kind; that it is easy and convenient to handle; and that it lends itself readily to automatic heating, which he so insistently demands.

Nor is he too surprised, in this age of mechanical and chemical marvels, to learn that burning gas will also operate his refrigerator and air-conditioning and cooling system as well as his furnace!

How Does Natural Gas Differ from Manufactured Gas?

But those who use natural gas for the first time do ask several questions, the most obvious being, How does it differ from manufactured gas?

The answer is that its heating value is greater—not that it will heat twice as hot or twice as fast, but simply that one cubic foot of natural gas will do as much work as two cubic feet of manufactured gas.

Methane, chief constituent of natural gas, has no odor, and therefore the gas itself has practically no odor as it comes from the earth. To enable users to detect leaks, an odorant must be inserted in the gas.

This is done by placing in the gas a liquid sulphur compound, which vaporizes when it is inserted. The amount is often about one pound of evil-smelling odorant to one million cubic feet of gas, or, in the language of the trade, 100 pounds of odorant to one hundred million cubic feet of gas.

As the domestic use of natural gas runs into billions of cubic feet a year, it can be

seen that considerable odorant must be used!

A question frequently asked when natural gas enters a community is, How long will it last? How is it possible for the earth to yield up the vast quantities of gas now being used and the even larger amounts which the pipe-line companies have contracted to supply in the next few years?

Although Nature may still be making natural gas, we are burning it up millions of times faster than it can be replaced through the incredibly slow processes of geological time.

Natural gas, like oil, is an exhaustible, un-renewable source of energy, and it is being exhausted. Depletion finally comes to every oil and gas field, even the greatest.

But this is not a peculiarity of natural gas. It is true of all mineral resources—of iron, copper, oil, sulphur, and others. Any mineral resource is, in a sense, irreplaceable once it is mined and put to use.

But the development and use of these resources have built our present civilization and are responsible for our high standard of living.

Reserves Are Increasing

Fortunately, there is no immediate or even early danger of the country running out of natural gas. The situation is like that which arises when a man dips water out of a barrel and a windmill pumps more water in.

As long as the water level in the barrel continues to rise as the result of more being pumped in than the man can dip out, no time can be set for the barrel to become empty.

In spite of increasing production and use of gas each year, more gas is being discovered than is produced and used. Proved reserves are three times as great as they were 12 years ago and 10 times greater than they were 30 years ago. Today's reserves are 185.6 trillion cubic feet.

The demand for natural gas has been described as "insatiable, incalculable, and un-suppliable," and the past five years have been the period of greatest expansion in its use. Yet during that time proved reserves have risen from 147.8 trillion cubic feet to 185.6 trillion.

No pipe-line company can get permission from the Federal Power Commission to build or expand, nor can it persuade insurance companies and other large investors to finance its requirements, unless independent geologists testify that it has reserves of its own, or has contracted with other producers for reserves, assuring it in the neighborhood of 20 years' supply of gas.

The tendency is to drill deeper for oil. Pressure is greater at the lower depths, and the deeper the producing formation is found,



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National Geographic Photographer Howell Walker

Pottery on a "Merry-go-round" Streams from a Gas-fired Kiln

Some 3,500 pieces of pottery pass through this kiln every 24 hours. Fired and cooled, dull, mushy clay emerges 18 hours later as glazed and fragile pitchers, vases, bowls, and other items. An S-shaped salt shaker is held by the attendant at Camark Pottery plant, Camden, Arkansas. The plant ships finished ware as far away as Africa and Hawaii.

the greater, as a rule, is the proportion of gas to oil.

One productive well in California is 15,530 feet, or three miles in depth. There are wells in the Southwest driven through as many as 35 gas-bearing sands. Each sand is cemented off when the drilling is completed, and in production the sands are tapped one at a time by exploding projectiles to open the flow.

It is known that under some of the deepest strata of rock that have already produced oil and gas lie similar formations that promise to provide even deeper fields.

Coal, Oil, Gas—Different Forms of Same Thing

It is sometimes argued that oil and gas are not irreplaceable because both can be made from coal, of which there is a huge supply.* After all, coal, oil, and gas are merely different forms of the same thing.

"Oil is just toughened-up gas, and coal is just oil in hardened form," said Senator Tom Connally of Texas in a recent Senate debate.

Of course gas has long been made from coal, but not at a price or in sufficient quantities to meet the present demand. There are, however, some new processes known to sci-

ence for making both oil and gas from coal.

Persons who enjoy gazing into the crystal ball of the future like to toy with the idea that both oil and gas will ultimately be made from coal at the mine head, especially since many major oil and gas pipe lines cross the coal regions.

Prodigal Waste of Natural Gas

Unfortunately, natural gas was wasted in the early days in a manner so prodigal as to stagger the imagination. Half a century ago natural gas street lights were left on all day, and in the Pittsburgh area it is recorded that kitchen stoves were left on all winter; if the room became too hot, windows were opened. There was no metering; one paid a flat charge of \$1 a month for all the gas desired.

Citizens held indignation meetings and newspapers ran denunciatory editorials in Indiana in 1897 when someone tried to pass a law requiring metering, but by 1907 many of the gas fields were exhausted.

In early days gas wells were lighted just to make a show. There is a story that the

* See "Coal: Prodigious Worker for Man," by Albert W. Atwood, NATIONAL GEOGRAPHIC MAGAZINE, May, 1944.



Pans of Bread in Endless Parade Pop Out of a Natural Gas Oven

Running three shifts a day, six days a week, the 110-foot range can turn out 4,000 loaves an hour. This baker dumps bread into a cooler trap at the General Baking Company, Washington, D. C.

Pennsylvania Limited was stopped one day for 15 minutes a few miles east of Pittsburgh so that President Grant might see a well with a daily production of 15,000,000 cubic feet put on a show.

Near Findlay, Ohio, in 1886, a permanently lighted well shot up such a flame that it showed men clearly half a mile away at night, and it was so hot that 100 feet was the nearest one could approach it.

Waste that was almost unbelievable continued to a much later time. As late as the summer of 1934 one billion cubic feet of gas were being burned in flares in one field, and many great oil and gas fields in the Southwest have looked like prairie fires, day and night.

Much of the waste in the past was due to the fact that the gas produced was found by men who were not looking for it, but for oil. Often the gas was regarded as a nuisance. But as systems for transporting it to market developed, oil men realized its value as fuel and also learned more about the work it does in moving oil and bringing it to the surface.

Important reductions in waste have been made in recent years through the joint efforts of the industry and Federal and State agencies. But loss and waste of gas are still large; a recent conservative estimate is from 11 to 12 percent of production.

Sometimes the gas is at such low pressure, or the wells so widely scattered, or their prospective life so short, that sale does not pay for the cost of gathering and compressing it for market. When vented, the gas is usually ignited at the vents to reduce the danger of accidental fires and explosions, thus creating the spectacular "flares" of the oil fields.

Natural gas is frequently found without any oil, but oil is almost never found without natural gas. More than a third of the country's gas production comes from oil wells.

Gas Nearly Always Associated with Oil

Gas is nearly always associated with oil, commingled with it and dissolved in it. In most oil formations there is gas at the top, because it is the lightest; next comes the oil, then water.

Gas is the expulsive force, the lift, the reservoir energy, the power which brings oil to the surface, for oil has no mechanical energy in and of itself.

The oil is forced to the surface by the gas bearing down upon it. Also there is a certain amount of gas entrapped in the oil under pressure; once an opening is made, the expansion of this gas helps push the oil out. In the same way when you open a bottle of ginger ale, the gas forces the liquid out.

In many fields, when a prospector drills he cannot tell whether he will get a "dry" gas well, an oil well, or a dry hole.

Until comparatively recent years a producer in some areas who hit several gas wells in succession would go broke. No matter how isolated or remote from great markets an oil well might be, the oil could be taken out in barrels; but there was no market or value for the gas, because there was no transportation.

A "dry" gas well can be shut off, if there is no market for the product. But oil well, or casinghead, gas cannot be shut off unless the oil itself is shut in.

"Natural gas—the bastard offspring of a feverish wooing of the earth for oil," is the way the late E. Holley Poe, natural-gas consultant and pipe-line director, expressed it. "The idiot industry that waited and wasted until steel men developed the necessary pipe to transport it economically from one end of the Nation to the other."

As pipe lines were built, casinghead gas began to have a market, and with a market it took on value. Besides, as the oil companies learned to produce oil more efficiently, they discovered they could conserve both oil and gas.

Casinghead Gas Works Hard

Gradually casinghead gas has become one of man's most hard-working substances. First, it lifts oil to the ground. Second, hundreds of millions of dollars are being invested in plants to scrub or strip it of its "fractions." Finally, as "residue" gas it goes to supply fuel for industries and for the heating of homes in every section of the land.

Much gas still goes into pipe lines just as it is, without processing. But today the greater part is treated beforehand to recover its valuable components. Gas is treated also to remove water vapor, which causes various difficulties in the pipes, and impurities like hydrogen sulfide, which promotes corrosion.

The processing plants may be at or near the point where the gas enters the main pipe line, or, frequently, on or near the site of the pipe line system's first compressor station.

The fractions are of many kinds and supply materials for the chemical industries, butadiene for the making of synthetic rubber, "natural" gasoline, which furnishes quite a respectable proportion of the country's gasoline needs, and finally the so-called "bottled gas."

Bottled Gas—a Familiar Sight

Cylinders of bottled gas have become one of the most common of domestic sights not only in this country but in Canada, Mexico, and Europe. Whether you travel by air, highway, or railroad, you will see the cylinders close to the backdoors of suburban and rural homes. Wherever a truck can go, there one or more cylinders of bottled gas can be delivered.

Twenty-five years ago only a few thousand customers used bottled gas; now it goes to several million families.

It is a common saying that the market for bottled gas lies beyond the city gas main. But the saying is not quite accurate, because numerous city gas companies use bottled gas to enrich their own supply or as an additional reserve to their own gas.

It is surprising also how many large communities there are in this country, as well as in Canada and Mexico, which do not have city gas companies and therefore must use bottled gas.

Bottled gas is also known as liquefied petroleum gas, or L.P.G. It consists chiefly of propane and butane, which are constituent parts of the original gaseous mixture. When separated from natural gas and pressurized, they become liquid and can then be placed in cylinders and delivered to customers.

By touching a valve, the customer causes the pressure to be released, and this act flashes the liquid back into gas again ready for use.

Notice of change of address for your NATIONAL GEOGRAPHIC MAGAZINE should be received in the offices of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your December number, The Society should be notified of your new address not later than November first. Be sure to include your postal-zone number.

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To carry out the purposes for which it was founded sixty-three years ago, the National Geographic Society publishes the National Geographic Magazine monthly. All receipts are invested in The Magazine itself or expended directly to promote geographic knowledge.

Articles and photographs are desired. For material The Magazine uses, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico, The Society and the Smithsonian Institution, January 16, 1920, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 A. C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

On November 17, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,305 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

A notable undertaking in the history of astronomy was launched in 1949 by The Society in cooperation with the Palomar Observatory of the California Institute of Technology. This project will require four years to photomap the vast reaches of space, and will provide the first sky atlas for observatories all over the world.

In 1948 The Society sent out seven expeditions to study the eclipse of the sun along a 5,320-mile arc from Burma to the Aleutians. The fruitful results helped link geodetic surveys of North America and Asia.

The Society granted \$25,000, and in addition \$75,000 was contributed by individual members, to help preserve for the American people the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California.

One of the world's largest icefields and glacial systems outside the polar regions was discovered in Alaska and Yukon by Bradford Washburn while exploring for The Society and the Harvard Institute of Exploration, 1938.

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William Kapell at the Steinway

PHOTOGRAPH BY ARRIAN SIENEL

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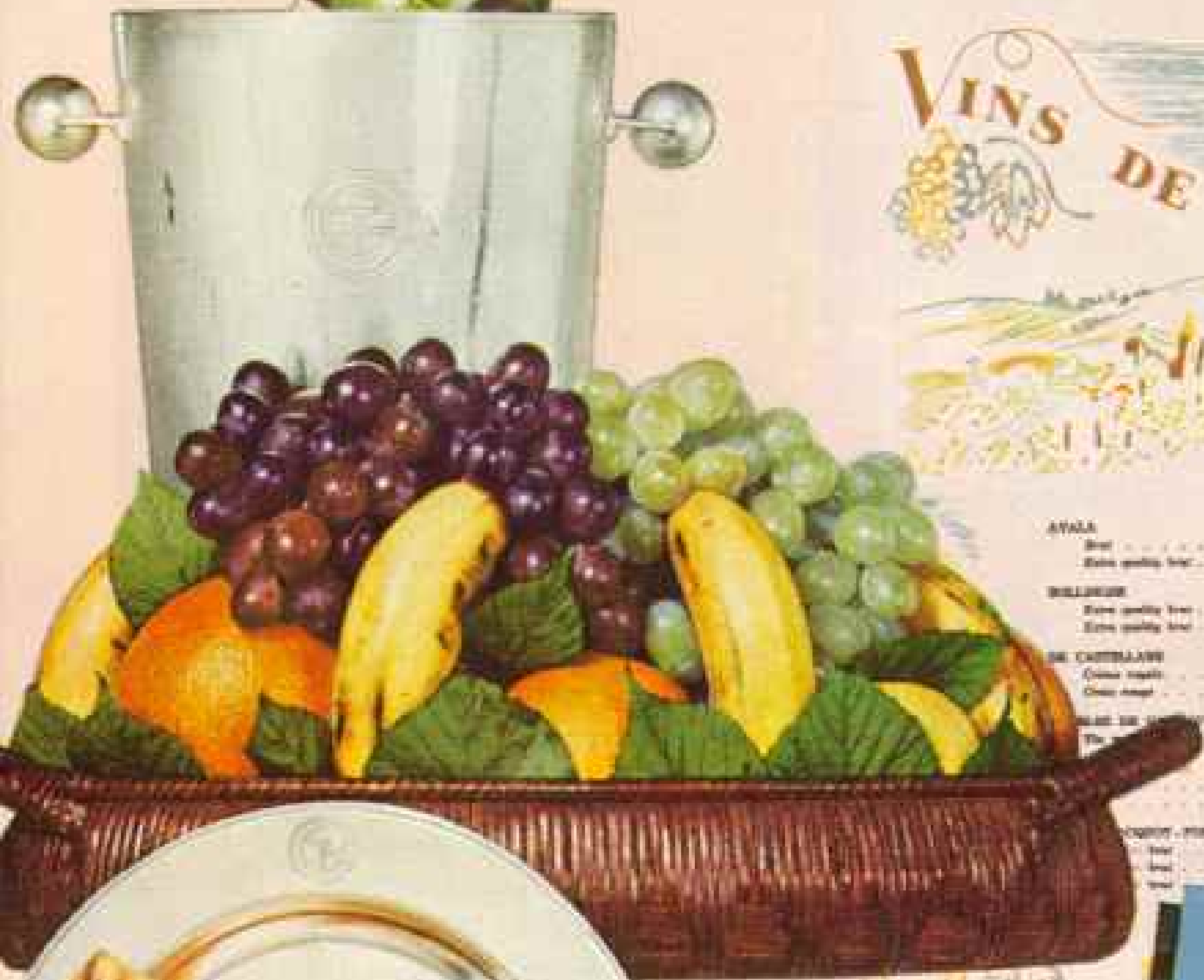
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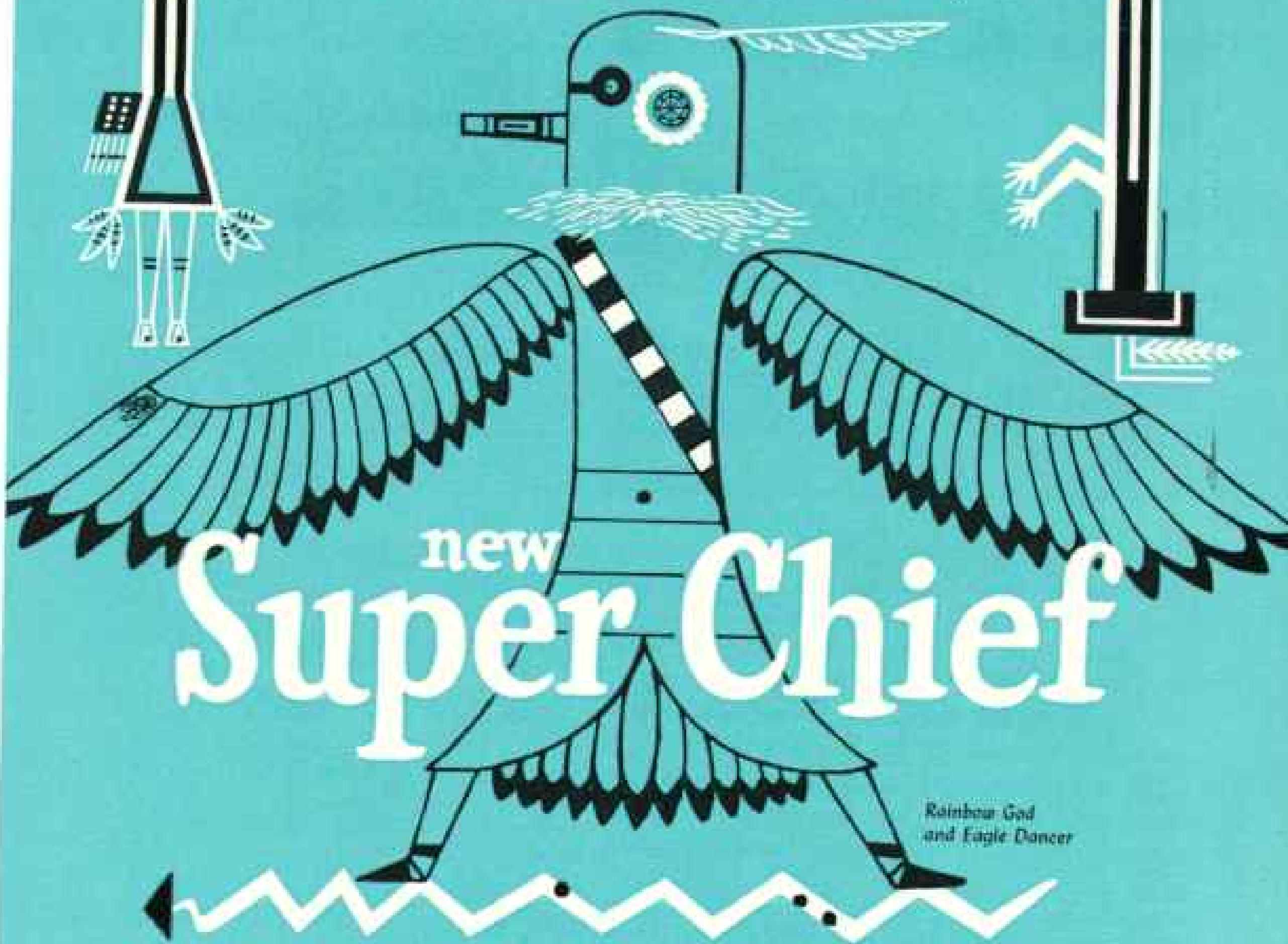
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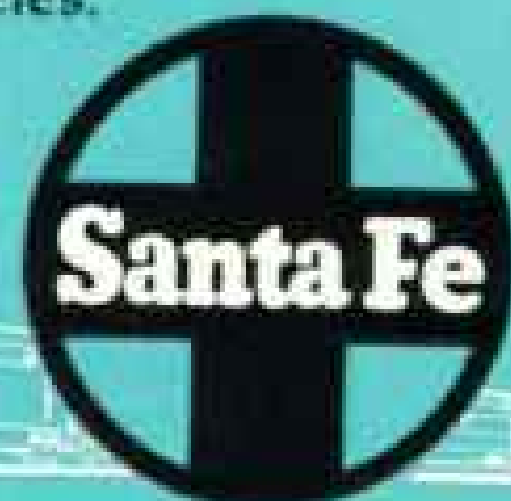
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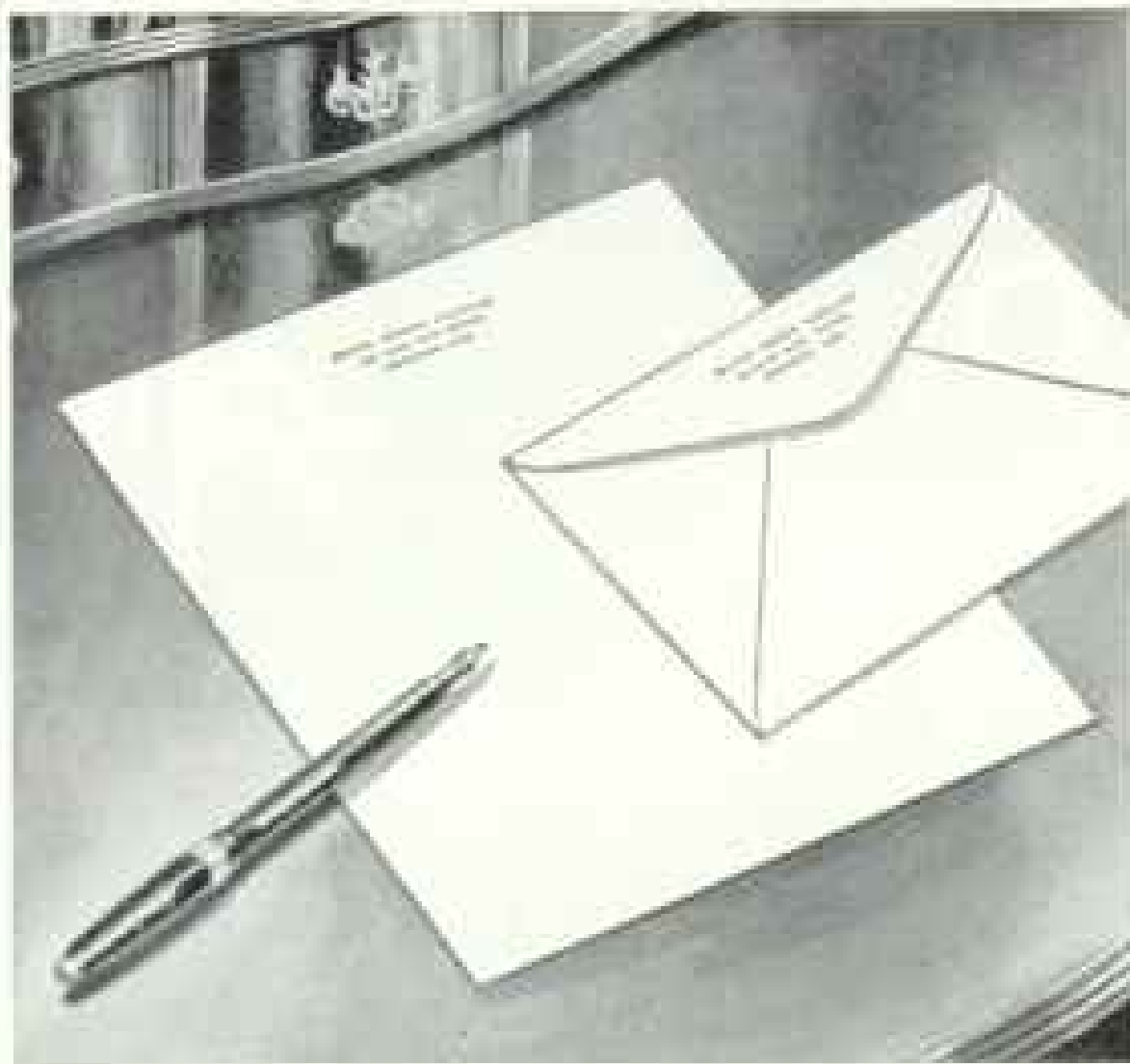
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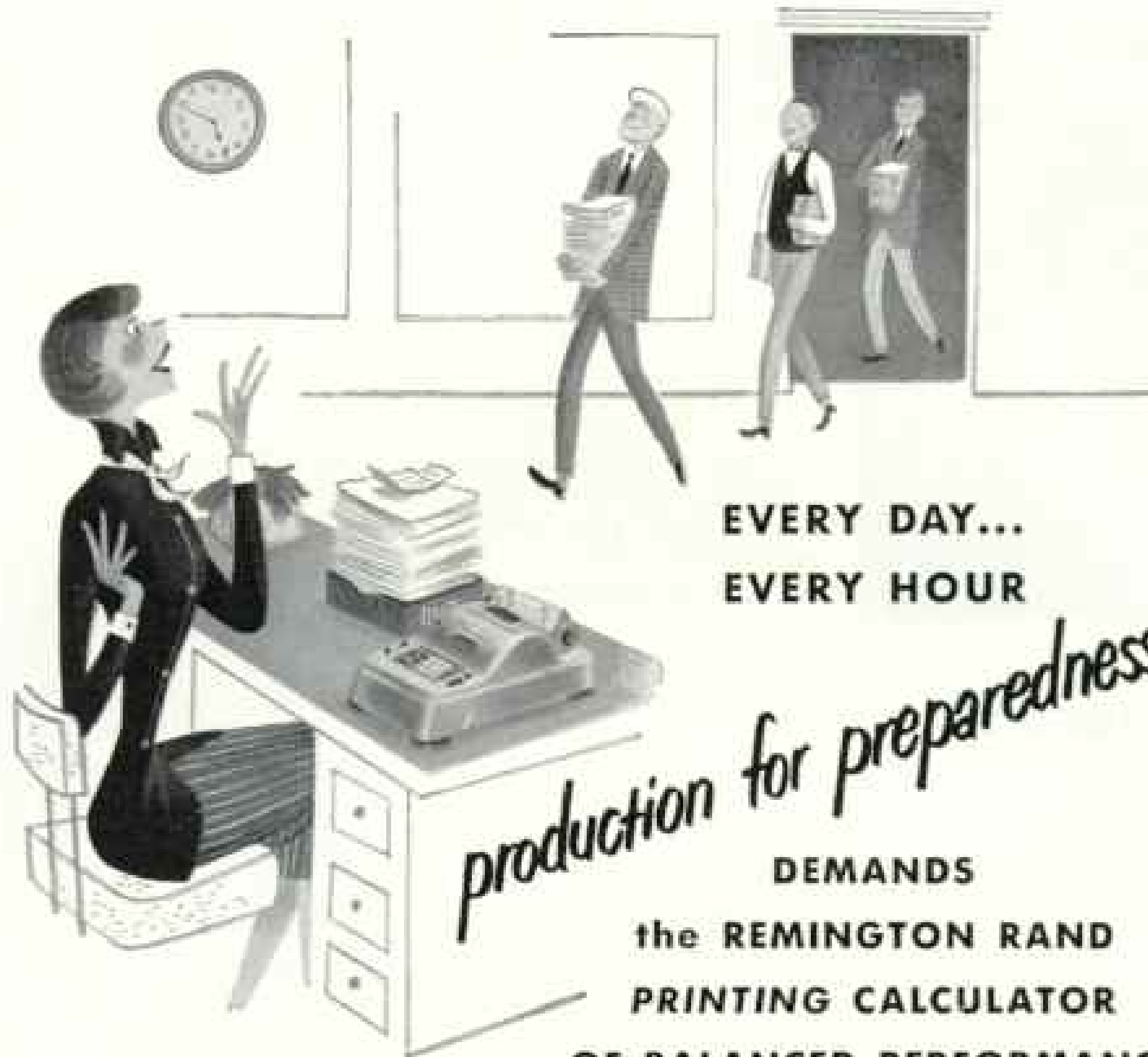


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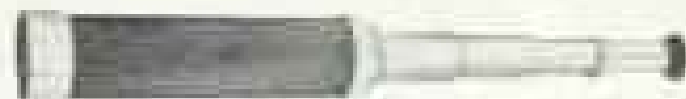


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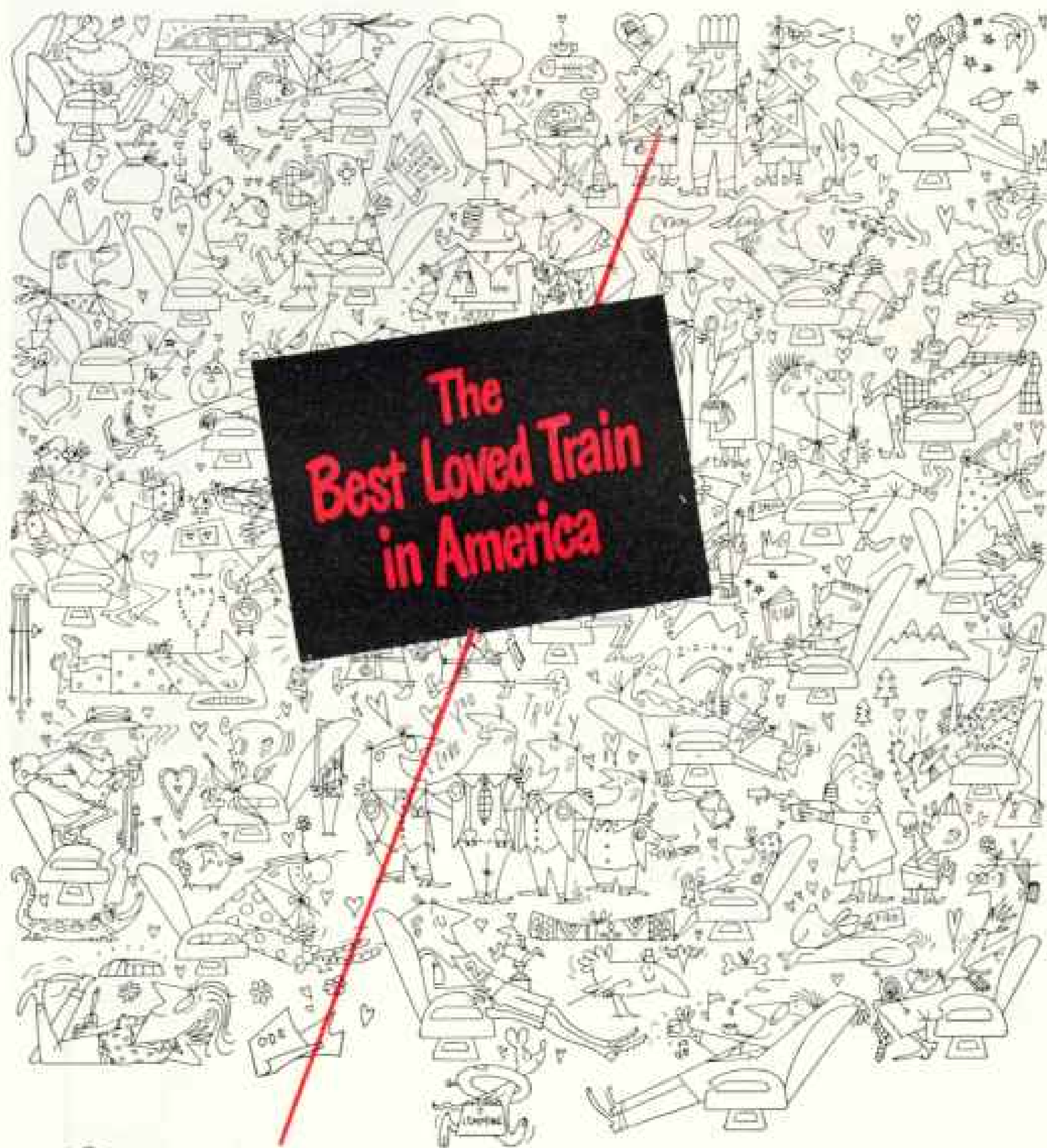
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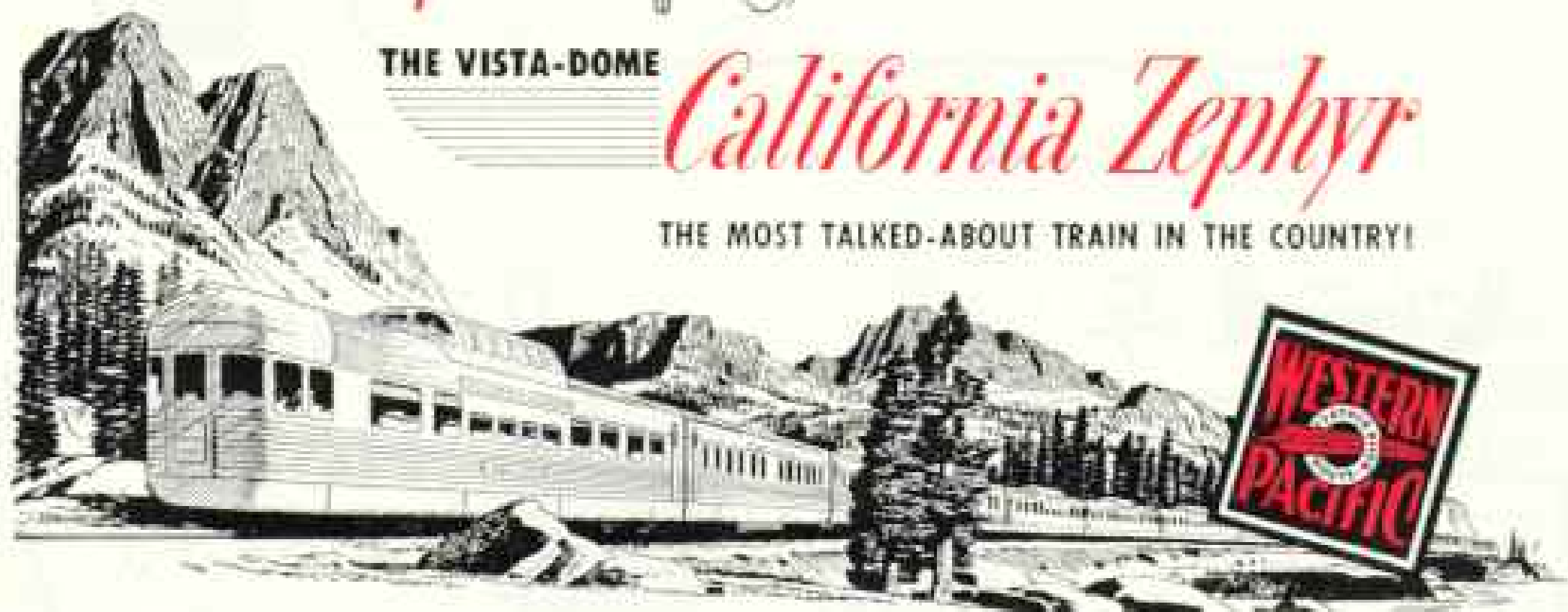
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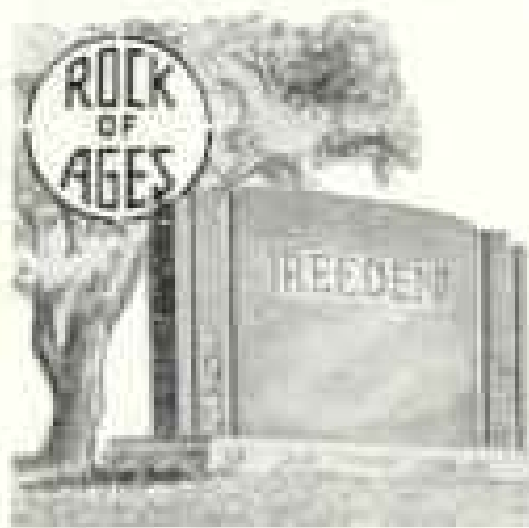
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1. What is Arthritis?
2. What are the most common forms of Arthritis?
3. What causes rheumatoid Arthritis?
4. Is there hope of conquering Arthritis?
5. Has a "sure cure" been discovered for Arthritis?
6. How can you guard against Arthritis?



Can you answer these questions about ARTHRITIS?

1. Q. What is Arthritis?

A. Arthritis is the term applied to many different diseases affecting the joints of the body. All of the arthritic diseases are characterized by inflammation or swelling of the joints, but these conditions differ widely as to causes, symptoms, and the kind of treatment required. In its various forms, arthritis affects more than 3 million Americans. In fact, it is a leading cause of chronic illness in our country today.

2. Q. What are the most common forms of Arthritis?

A. Of all types of arthritis, the chronic forms, *osteoarthritis* and *rheumatoid arthritis*, are by far the most common. Osteoarthritis is primarily the result of aging, or normal wear-and-tear on the joints. It rarely develops before age 40 and it seldom causes severe crippling. Rheumatoid arthritis is a much more serious disorder. It usually strikes between the ages of 20 and 50, and unless it is properly treated the joints may become permanently damaged.

3. Q. What causes rheumatoid Arthritis?

A. Although the exact cause of rheumatoid arthritis is unknown, a variety of factors are involved in its onset. In this condition, there is usually evidence of disease of the entire system—such as loss of weight, fatigue, anemia, infection, emotional strain, and nutritional deficiencies. Since many factors may be involved, doctors stress the importance of a *thorough physical examination* of each patient. This is essential to proper diagnosis and treatment, which in all cases must be based upon the patient's *individual needs*.

4. Q. Is there hope of conquering Arthritis?

A. Yes, indeed! Methods of treatment for all types of arthritis are constantly being improved. The outlook for further advances is now more hopeful than ever before—thanks to research which is yielding new facts about the underlying causes of arthritis, especially the rheumatoid type.

5. Q. Has a "sure cure" been discovered for Arthritis?

A. No, indeed! Yet, many people are still misled by claims that are made for certain "arthritis cures" or other forms of therapy that are worthless. Authorities emphasize that proper medical care offers the only hope of permanent relief from arthritis. Today, about 60 percent of the victims can be greatly benefited, *and in some cases completely relieved*, if proper treatment is commenced early.

6. Q. How can you guard against Arthritis?

A. Doctors say there are certain precautions that everyone can take to help prevent arthritis, or to lessen the effect if it should occur. Here are some of them: keep weight normal . . . try to maintain good posture . . . get sufficient rest, sleep, and exercise . . . eat a balanced daily diet . . . have regular medical and dental examinations . . . maintain a calm mental outlook . . . *see your doctor whenever persistent pain occurs in any joint.*

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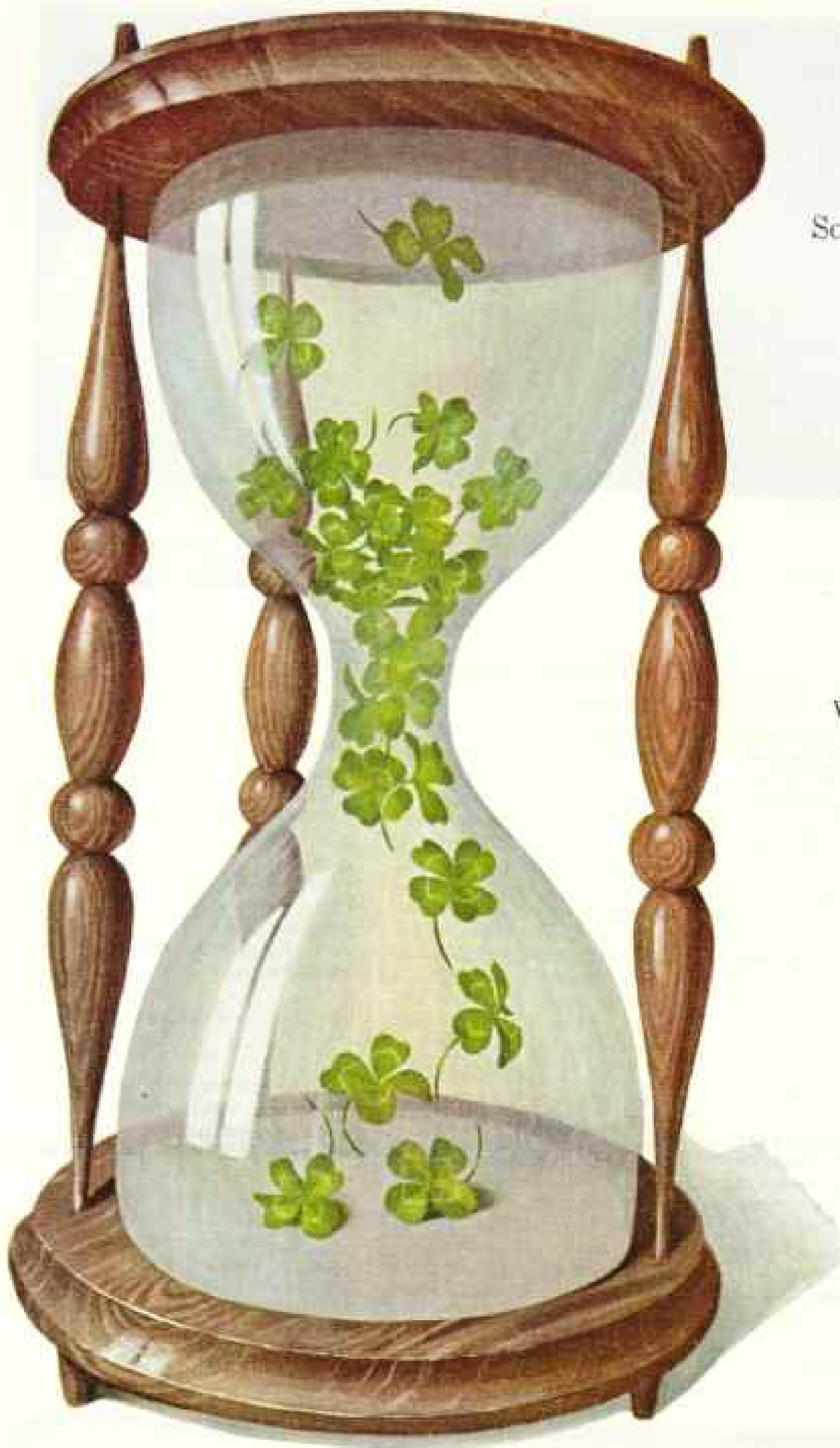


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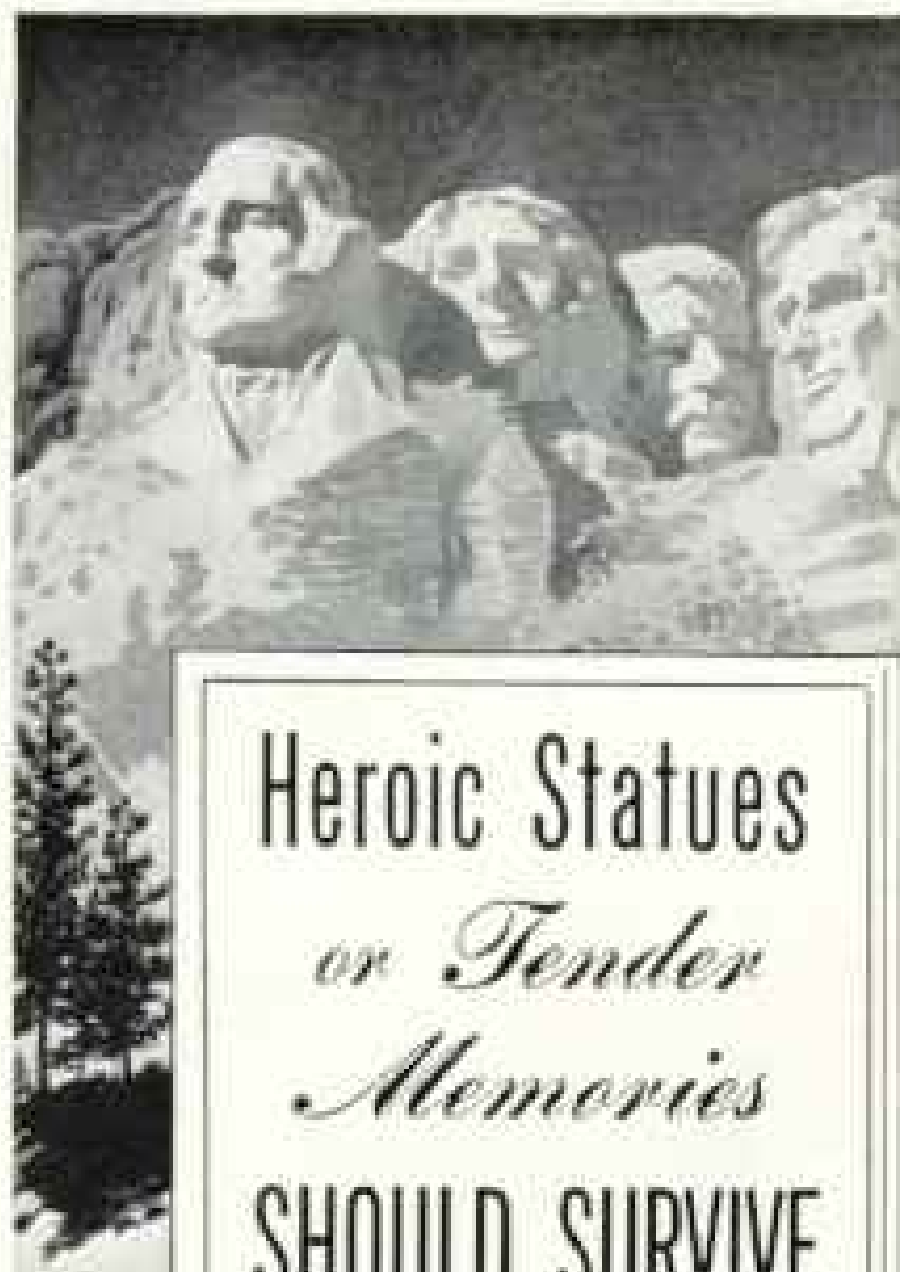
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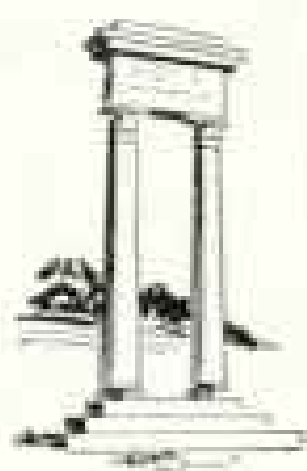
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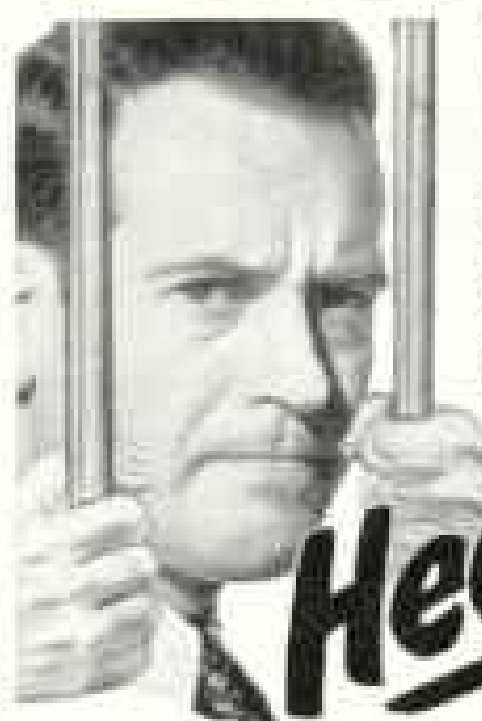
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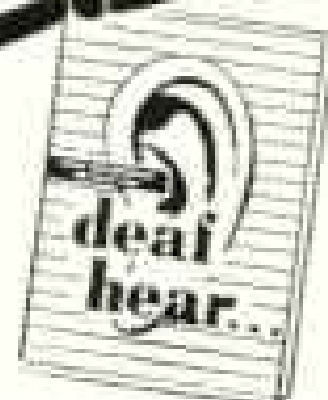
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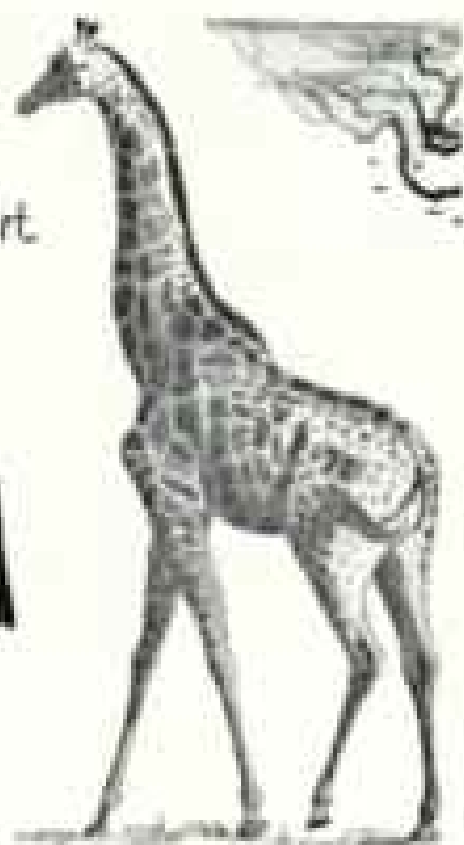
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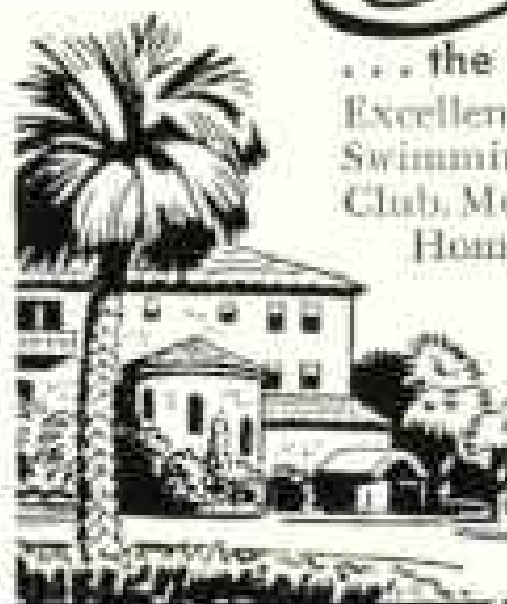


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