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The Top End of Down Under

By KENNETH MACLEISH

SENIOR ASSISTANT EDITOR

Photographs by THOMAS NEBBIA

THE BUFFALO came out of the swamp a little before noon. They ambled, grazing, toward a paperbark thicket a quarter of a mile away. Peter Thomsen, the buff catcher, mopped his face and slumped at ease behind the wheel of his stripped-down four-wheel-drive truck.

"We'll wait," he said. "Cut 'em off when they get farther from the swamp."

January's summer sun blazed in the haze-heavy sky above Australia's tropic north. Clouds hatched by its heat roiled up over the land. On the floodplain where we waited in the shade of a pandanus patch, swamps simmered in a ferment of renewed life. Before evening, thunderheads ten miles high would drift across country already greened by rain, drenching it with new downpours.

Then the wide-spreading rivers would widen farther. Billabongs and lagoons would deepen in once-dry creek beds. A few more miles of bush track—back roads—would

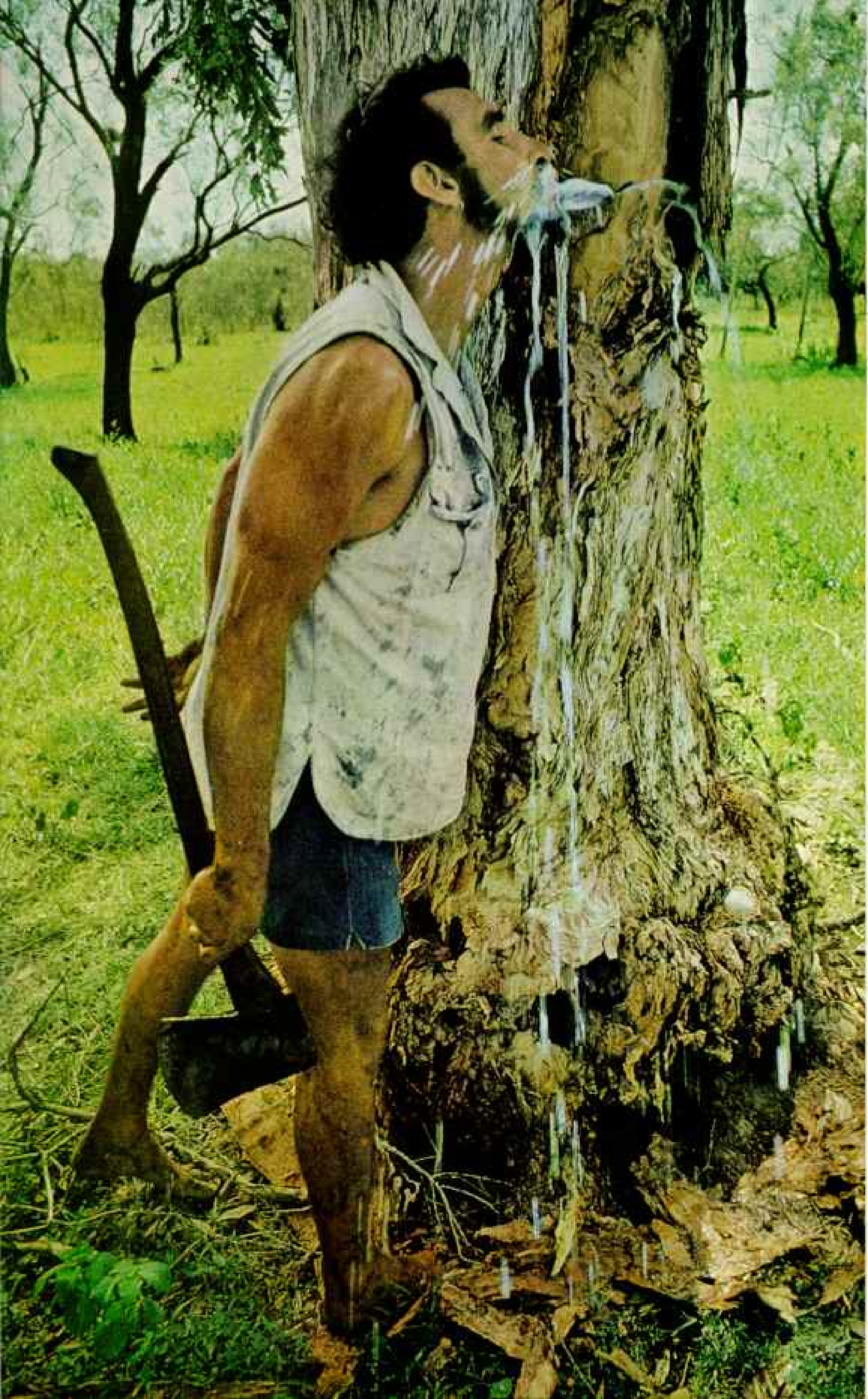
vanish beneath sheets of warm, slow-moving water.

The Wet season was underway, the Wet with a capital "W." It deserves that terse and graphic label. The Top End, which is the northern part of the Northern Territory, is an all-or-nothing sort of country: rich or ruinous, beautiful or desolate, Wet or Dry.

In the Dry, which lasts from May to October, it almost never rains. Then the Wet comes. Guaranteed. Thirty to 65 inches, depending upon where you are north of 15 degrees south, which is about where the Top End begins (map, page 150). That guaranteed Wet is the reason people live there.

"First we get storms, scattered ones, but enough to wet the ground and start the grass," Peter had told me. "It gets hot enough to boil your brains. Then the real rains come, the monsoon. No more storms, just a great gray sky and rain—sometimes days of it.

"It's late this year. If it wasn't, we wouldn't



be out here on the Adelaide River plains seeing if we can show you how we catch buffalo the hard way. But now let's go try. Toby?"

The tall Aborigine in the roping seat on the hood nodded gloomily and picked up his lasso. We moved carefully cross-country.

How to Lasso a Furious Buffalo

The buffalo Peter hunts are not native, but feral beasts descended from Asian water buffalo released on the north coast in the 1800's. These animals went forth and multiplied. Tens of thousands of their descendants roamed the Top End. Hide hunters shot them for their skins. Meat hunters shot them for pet food. Today the hide market is dead, but some buffalo are being redomesticated, professionally butchered, and shipped out as the good beef they are.

"I reckon buff domestication is going to be one of our big industries," said Peter, easing the truck through thickets and around craggy termite castles, trying to get between the buffalo and the swamp. "Hell, the animals are there. All you've got to do is go out and catch twenty or thirty and you've got a herd going. A lot of blokes just drive the buffs into a trap. But I like to catch them this way. You can pick the ones you want, and you don't run them to death."

Parrots, doves, and black cockatoos burst out of the scrub as we passed. A wild pig charged off through the grass. The air was humid enough to wash in, but it smelled alive and sweet.

Up front, Toby tensed and pointed. Five buffalo, dead black, massive, faced us less than a hundred yards away. They froze for a moment, then wheeled and ran. "Hold on," Peter said. "We'll try for the old bull."

The big beast headed straight for the swamp. We veered away after a young bull, tearing through the scrub flat out. We closed in. Toby rose and threw. Peter braked, the rope went taut, the bull wheeled, bucking.

"Now we throw him and hog-tie him," Peter said.

"He'll kill you," I warned, as the furious beast ranged back and forth at rope's end.

"He would, too, my word. But we don't

take him yet. We swing him," said Peter. He backed away, turning to left and right. The bull, resisting, swung out to one side, then another. Suddenly he fell. Toby and Peter were on him in an instant.

"How do you keep him down?" I asked.

"Ah, you've only got to sit on his rump. Keeps him off balance, and he can't get up."

Peter patted the heaving flank. "No worries, mate. You'll soon be away." And to me, "He's worth \$70 delivered, but I've got no way to deliver him now. Besides, I just wanted you to see how we catch 'em. Be up on that truck when we turn him loose, he'll be a bit stirrey. If he goes after you, he's out to gore you."

Peter and Toby were back aboard before the bull could decide whom to kill. We started up. So did he. Seconds later his horn whacked into the truck body inches from my hip. My fillings rattled, but my insides remained as physiology and panic had arrayed them.

"Good thing his aim was off," Peter said. "They don't usually miss, and it's a long way to the hospital in Darwin."

Boomtown With a Difference

Darwin, capital city of the Northern Territory, was my headquarters during my stay in the Top End. It contains more than half the Top End's population, all its government, and most of its commerce. It is also an amiable, easy, beery delight of a town (with 37,000 people it is a city only by protocol), as different from other Australian urban centers as they are similar to each other.

A boomtown—it has grown 70 percent in the past five years—Darwin seems at first glance to have no basic boom-worthiness. Industry appears to be lacking, and so it is until you reckon government as an industry. You're in a territory here, not a state, and so government comes from the national capital, Canberra. And comes, and comes.

Said a reporter friend of mine, "Take away the government, and the local commerce that serves it, and you'd have a ghost town."

There is some truth in his overstatement. Yet the amiability and individuality of the place remain unshaken. Darwin has a faintly

Wise in the ways of the outback, buffalo catcher Peter Thomsen spotted a telltale knot on this tree, which told him that a store of water lay trapped inside. A few blows of his ax turned on the natural drinking fountain. Seesawing between seasonal extremes—the Wet and the Dry—Australia's Top End yields its bounties only to a knowledgeable breed of men as tough as itself.

WILLIAM ALBERT ALLARD

Asian flavor; it is about as near to Singapore as to Sydney, and retains the remnants of a once-large Chinese population. These and Europeans of all kinds and many languages give the capital's quintessentially Australian pubs a curiously polyglot sound. Aborigines wander the town, good-naturedly watching its turmoil from their undefined place in its scheme of things.

Darwin owns a colorful set of statistics. It admits to the highest per capita beer consumption of any Australian city. The capital and its Territory also boast one of the lowest death rates in the land, and the highest rate of illegitimacy. And it is the most tolerant and cosmopolitan community in the land. Anyone who likes people (not just his own kind of people) would like Darwin.

World War II Left Darwin in Ruins

It is not a spectacular place. Largely rebuilt after the second World War, when Japanese bombs all but wiped it out, it contains a few fine old stone buildings, some handsome modern office complexes, a lot of small iron-roofed, well-stocked stores charging by reason of freight costs the highest prices on the continent, and acres upon acres of small, simple bungalows. "Instant slums," my friend called them. "Most of them look as if they just fell up." Not really. They're clean, comfortable, cheap, and uninspired.

Darwin dress is as unassuming and comfortable as the city itself: shoes, shorts, and a shirt. Add knee-length socks and you're wearing the uniform of businessmen and bureaucrats. Few occasions call for a tie—a visit to the office of the Administrator, chief official of the Northern Territory, or to Peppis, a first-class and deeply air-conditioned restaurant that requires the outlandish garb only to give local ladies a chance to show off their seldom-seen long dresses.

With my friend Gregson Edwards, a journalist in the employ of the Australian News and Information Bureau, I made my
(Continued on page 156)

Where the buffalo roam: From a mechanized steed (upper), Top End hunters lasso a water buffalo—wild descendant of tame beasts imported by early settlers. Floodplains make a soggy stomping ground (lower) for free-roaming buffs, whose lethal horns and ill-tempered ways discourage all but the most determined captors.





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Australia's Top End



LAND OF THE WET and the Dry, the Oregon-size Top End saddles the humpbacked north coast of Australia.

The two-act drama of its drip-dry climate usually begins around Christmastime, when monsoon-spawned clouds roll in to dump half the year's rain in a couple of months. As if a switch has been thrown, the land flashes from brown to green. Rivers leap to life in dry channels, at times blocking the only highway linking Darwin with the rest of Australia (right).

At Eastertime, the sun slides out from behind retreating clouds, and the Dry begins. In the wake of a passing truck (left), January's mud has turned to a plume of dust by mid-July. For months the dry-mouthed land seems to hold its breath. Then, with a sigh of wind and a drum roll of thunder, the Wet makes its dramatic reentry.







Town on a double frontier, the territorial capital of Darwin (right) faces seaward to Asia and landward to the burgeoning "back of beyond" on its rear doorstep. The Top End's only city, it thrives as a hub of government and trade and as Australia's northern gateway to the Orient.

Modish misses (above) call to mind Asians who came to Australia in the late 1800's to help build telegraph and railway lines and to try their luck in the goldfields; many settled in Darwin, helping to forge the city's polyglot character.

Their thirst prodded year-round by the Dry's long drought and the Wet's epic steam bath, Darwinites quaff a yearly average of nearly 62 gallons of beer per person. At the Pine Creek pub (above right) a four-legged regular contributes to the informal atmosphere by swilling a boxful of brew.







Aslosh in the Wet





DAMP BUT UNDAUNTED, Top Enders slog through a sodden game of Australian Rules football. Spectators find a circle of sanctuary beneath a large umbrella.

A sizable portion of the racecourse still sticking to his face, a motorcycle jockey (left) uncinches his crash helmet and heads for a hot shower after Sunday races near Darwin.

(Continued from page 148)

way along a crowded shopping street where swarms of cheery children attested to the town's high-ranking birthrate. Greg guided me to the Vic—the Victoria Hotel, "a good old workingman's pub." Every public house contains a bar where beer is cheap and a bloke can say and do what he likes, as long as he doesn't damage the premises. No man concerns himself with the next man's eccentricities. Unless, of course, the next man is trying to be different by virtue of superiority.

Despite the catholicity of taste in the Northern Territory, certain symbols speed acceptance. I was wearing mine—a filthy, battered, sweat-stained ruin of a hat that had belonged to Peter Thomsen until his wife, noting my awed admiration of it, had removed it from his head and placed it on mine. As we bellied up to the bar, my neighbors noted it with revulsion and reverence. No one with delusions of superiority would wear so insistently earthy a lid. I was clearly an ordinary sort of bloke and, as such, acceptable.

I made to place my badge of honor on the bar.

"Best keep it on, mate," my neighbor urged. "It might have something catching."

I knocked the edge off my thirst and looked around. The room was big and crowded, full of convivial din and cigarette smoke swirling in the downdraft of languid ceiling fans. Bottles and glasses were heaped high on tables at which Chinese merchants, Greek businessmen, Italian storekeepers, Anglo-Saxon clerks and cattlemen, full-blooded Aborigines, and long-haired pseudo-hippies downed their drinks in honor of the Great Australian Thirst and devoured the cheap and copious counter lunch.

"That's Darwin for you," Greg said admiringly. "Every kind of person, and all getting on together, bar the occasional split lip."

"All locals?" I asked.

"Well, no. Some are drifters who've come here to get away from somewhere else. This is as far from the rest of Australia as you can go and stay dry. But others came here on purpose. They'd heard that this is a land of opportunity. Then they couldn't find jobs to earn enough money to go home again."

In fact, the Top End is a land of opportunity—for the right opportunists. The people who fit that description are "big men"—operators on a big scale.



You can't fence out the Wet, nor would Top End ranchers want to, since it sustains the grasses that nourish their cattle in the Dry. Ray Townsend travels via airboat to mend fences on Stapleton Station's 770-square-mile spread—modest-size in this land of big operators.

The government wants them to be. It controls the land, leasing rather than selling it, for the admirable purpose of preventing speculation. Leases run long: 50 years for a pastoral lease, and renegotiable. But no parcel of land is leased that is deemed to be less than one living unit—an amount of land sufficient to support its tenants. In this vast empty region with its black-soil plains (great areas of which are inundated for months of every year) and sparse eucalypt scrub, most living units won't be much less than a hundred thousand acres. Some are a million.

No Place for the Small Operator

The land was cheap until a boom in the 1960's. As one cattleman said, "Where else could you get a million acres for half a million dollars?" Of course, aerial fertilizing and seeding—essential, if the country is to carry cattle in worthwhile numbers—costs several times what the lease does. Add fencing and firebreaks by the hundreds of miles and buildings, sheds, handling yards, wells, machinery, and you run into costs the smaller grazier can't handle. The Lands Branch reckons a man ought to have a couple of hundred thousand dollars left over after he's taken up his lease so he can develop it.

"And it's *still* cheap," said Ray Townsend, as we jounced across one of the drier sections of 770-square-mile Stapleton Station, some 45 minutes by light plane south of Darwin.

Four families of Townsends—Ray with his wife, his father and brothers with theirs—came out from Florida to settle here after Ray had found the land and fallen in love with it. They became Australian citizens.

"You look on a map, and it's a long way from there to here," Ray said. "But we figured we could do bigger things here than there, where the land's all taken up. There wasn't much here when we started. We made out by mustering cleanskins." He meant rounding up wild, unbranded cattle.

"We still catch cleanskins. I guess we can turn off a thousand of 'em a year. But, like many big stations, we're breeding up the wild herd with Brahman stock to get bigger, healthier animals. We've got 10,000 head on the place now, and it'll carry 70,000 when we get all the pasture improved."

Ray's wife, Elsie, and two of their daughters rode along with us on the flatbed truck, an agile four-wheel-drive machine armored with four-inch pipe and old tires against charging

buffalo or cleanskin bulls. Elsie looked at the good cattle, the new pastureland being cleared out of the bush, her happy husband, her healthy girls, and began to reminisce in the comfortable tones of one who knows the bad days are gone for good.

"I came out in September of '61 and came across from Queensland. The farther I came, the surer I was that Ray had lost his mind. That was just near the end of the Dry, but I didn't know that. Where was all that pretty grass he'd been talking about?"

"We lived in a shed. Talk about homesick, Ray put me a sprinkler on the roof, and I also had me a walk-in freezer. Then the rain started. It funneled in the front door and went out the back. January 10 that was. I just sat down and cried. Clouds rolled in and it rained for two weeks. Couldn't dry the baby diapers. And *this* was the baby." She pointed to the grinning 10-year-old beside her.

"Anyway, quick as I saw the swamp where we're going now, I knew how it could be. I knew Ray was right."

Ray said, "Now, here's what I bought the place for. What I had to show you because you'd never have believed it."

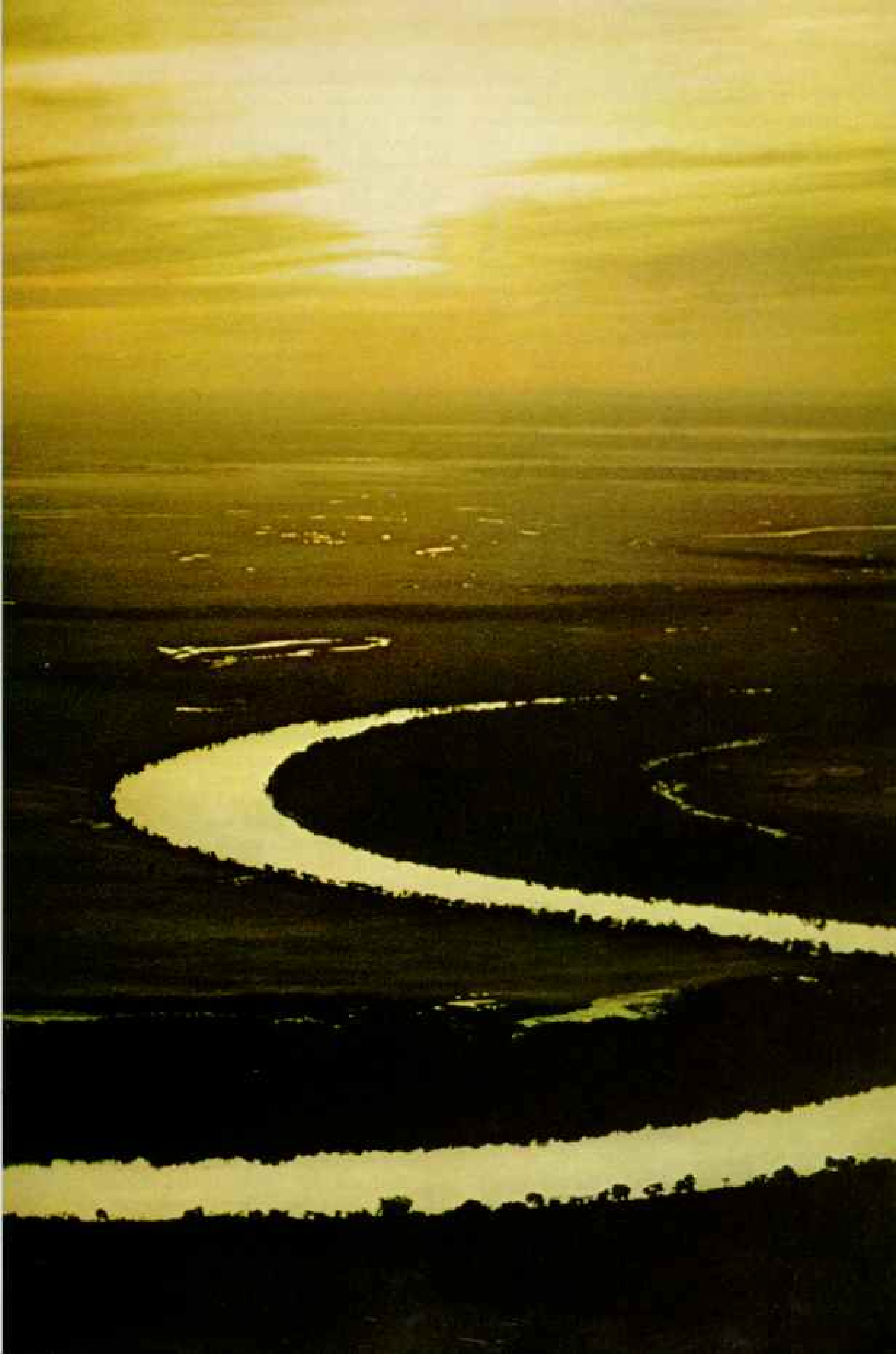
Ahead was an emerald swamp thick with bright, healthy grass. Some grew on moist land, some in gently flowing water.

"This here is Para grass," said Ray. "Comes from a river in South America and was seeded in here 70 or 80 years ago by the family of the lady I bought the lease from. It grows 8 feet high and it won't drown in 7 feet of water. I asked her how much she had, and she said 'too bloody much.' She was scared to ride her horse in it. There are channels through it where big crocs hang out. But when I saw that grass, that's all I had to see. That's good grass, and in the Dry, when the water goes down, it'll carry a lot of cattle. We've got 200 square miles suitable for Para grass."

Americans Invest in the Top End

Wallabies hopped through the high, lush greenery. Parrots and pigeons flew over it. The little girls got out and dove and rolled in it, playing hiding games. Ray watched them and said, "We've got our own country now, our own choice."

The Townsends, taken collectively, fit the Top End pastoral pattern in one essential respect—they're big operators. But they differ from many of their widely scattered neighbors in one basic respect: They are Australians





—albeit naturalized—working their own property. The greater part of the Top End's grazing country, which includes most of the land that can be tamed at all, is held by absentee landlords. Of these, many are foreign. And of the foreign, most are American. This fact has caused a certain amount of concern in the distant cities of the south, but surprisingly little in the Top End itself.

"We need Yank capital up here," said a tough old Territorian, adding that he would personally hang me if I mentioned his name. "Those blokes down south complain about 'American take-over,' but you don't find them investing in our enterprises. They still think this land isn't fit to live in. And that," he raged, removing his hat and trying to beat his truck to death with it, "makes me very [whack] bloody [whack] angry [whack]."

Money Does the Trick

"Look," he said, replacing his hat and curbing his fury, "this is rich, healthy, bloody beautiful bloody country. You've only got to bloody develop it. You don't fight it—you can't fight nature. But you can work with it. That takes money. Yanks have it. The improvements they make are there to stay. I don't begrudge them their profits."

At American-owned Mountain Valley, to which I flew next, the profits are reinvested. The thousand-square-mile station, 240 miles southeast of Darwin, is perhaps the most highly developed in the region. The management is Australian, efficient, highly professional. The homestead is a showplace, the staff quarters and shops a well-set-up and self-sufficient village.

"We've got 35,000 acres of improved pasture, all in Townsville stylo," said assistant manager Tony Doyle. (This stylo is a South American legume accidentally seeded decades ago near Townsville, Queensland, presumably from animal bedding dumped out of ships. It's now being spread at great cost all over the high-rainfall region.)

Saturated floodplain of the Adelaide River oozes with swamps in February. Later, during the major flooding of the Wet season, solid sheets of water will wash this same plain. By July many smaller rivers of the Top End will bake dry in the sun, leaving only isolated billabongs or water holes.



DAVID MUIRE, BLACK STAR; THOMAS NEBBIA (RIGHT)

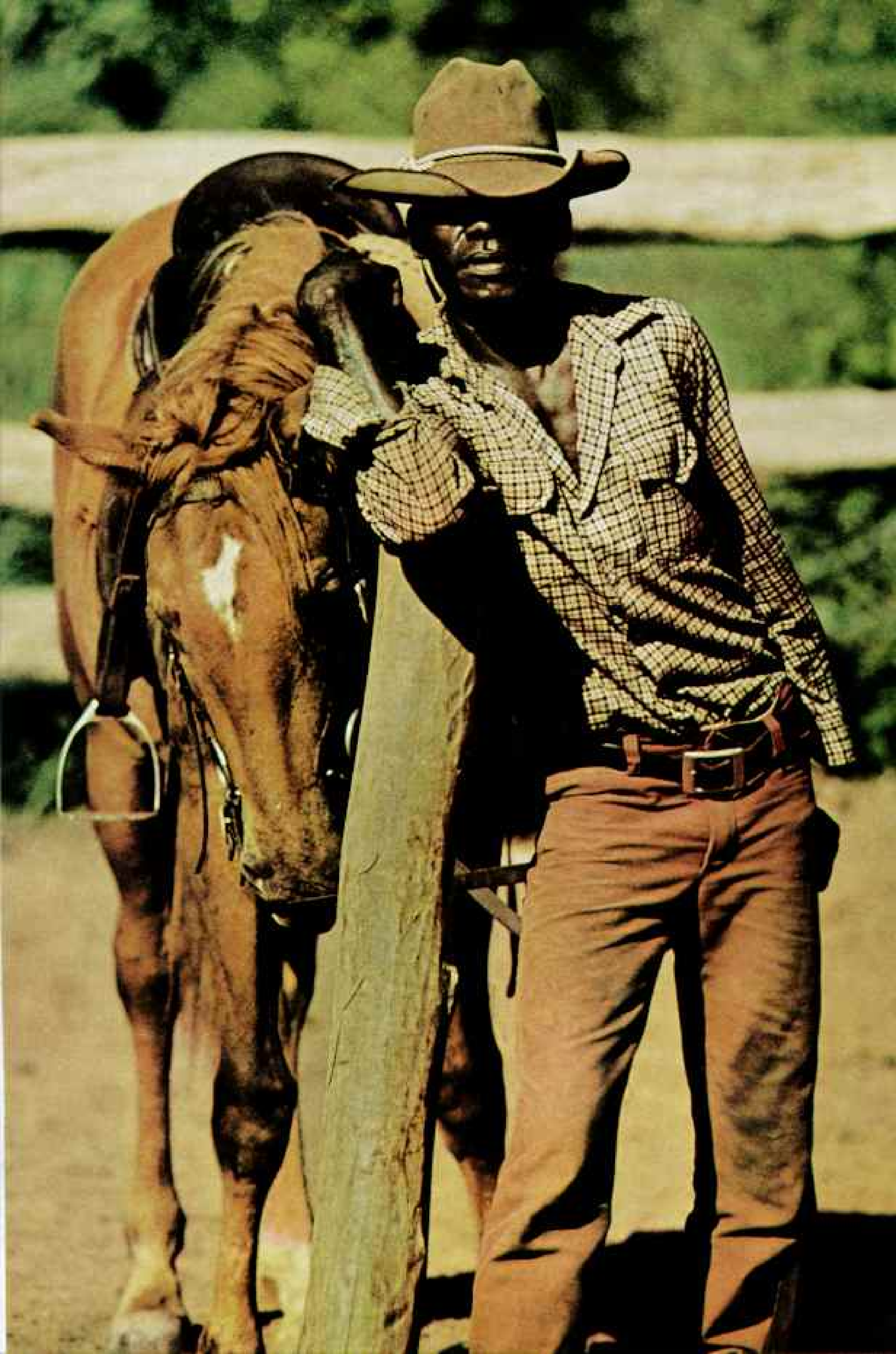


Saga of beef or bust: The Top End's wide-open spaces have long lured profit-minded cattlemen, but the going has never been easy in a region plagued by three D's: the Dry, disease, and distance from reliable markets.

The first beef boom ended in a catastrophic bust in the 1880's, when tick fever rampaged through the area's herds. A Brahman bull (left), prized for resistance to both drought and disease, passes through a deticking spray at Mount Bunday Station, southeast of Darwin.

Tail-yanking stockmen (above) muster animals for branding and earmarking. During the parched months of the Dry, most range cattle steadily lose weight, except on lands where the original low-quality pasturage has been upgraded by costly aerial fertilizing and seeding.

Despite such problems, stock raising remains big industry in the Top End, creating jobs where few would otherwise exist. Aboriginal stockman (right), whose forebears hunted kangaroos in these same wilds, uses his tracking ability to run down strays and cleanskins—unbranded beasts.



"We've also probably got the best-bred herd in the north. And we've done a fair bit of fencing. The small paddocks run about a thousand acres each, and the cows in them drop their calves in the Wet. That way we're safe in the Horror Stretch, the tail end of the Dry when there's been no rain for five months. A trailing calf hasn't much of a chance then."

"All that upbreeding is expensive," I said. "Is it worth it?"

"That's a sore subject. It's going to be worth it, my word. We turn off better animals. But right now the market's bad for beef. Our local slaughterhouses export hamburger meat to America. The lean scrub bulls are right for their purpose. The packers don't want better beef, and they won't pay a fit price for it. But the market can be developed."

Later, at dinner, Mountain Valley manager Bernie Warren told me: "The payoff here is in the future, and you've got to be able to wait. The land won't run a bloody bandicoot in its natural state, but you can give it everything it needs except rain, and you can count on *that*. We could make money right now, after four years on this station. But we'll do better later, so we're pouring it back."

"But you know, you come up here and spend a lot of money, and still you're pioneering. When you start up, you're sitting and wishing the wind would blow because you've got no fans. All for a million bucks."

The North Is a New-style Frontier

Nobody had a million bucks ninety years ago when people started trying to run cattle in the Top End. After a brief boom came a total bust. Tick fever and lack of reliable markets plagued many stations. Later booms were followed by similar disasters. A lot of people pulled out. I heard of a man who traded his whole property for a pound of chocolate.

But others have made a living out of the residue of past failures. Later graziers concentrated on harvesting the feral cattle descended from the early Shorthorn herds. A good man could make money, and he didn't have to spend much. But he took from the land without putting anything back. And so the land and the cattle degenerated.

Today the wide-open frontier where a wise and lucky loner might prosper is gone. The Top End has become a new kind of frontier, where spending, science, and system are needed, along with a new kind of frontiersman to see that they pay off. The new grazer

is a pioneer too—a risk taker, a breaker of new ground. But he's apt to be a corporate pioneer.

A good example of this new breed is Mike Brown, the boss of Mount Bundey Station, which is owned by the American firm of W. R. Grace & Co. An Englishman reared in Brazil's cattle country, Mike was hired to produce good cattle at a profit and domesticated wild buffalo as a second source of beef.

Only One Road to the Outside

"Meet me at the 22 Mile at eight tomorrow morning," Mike had told me in Darwin, "and I'll show you what we're up to." For once I could get where I was going by car. Mike didn't have to tell me which road to take. There's only one from Darwin to the rest of Australia. It follows the route of early Scottish explorer John McDouall Stuart, and it stretches almost a thousand miles south to Alice Springs in the continent's Red Centre.

The route, now called the Stuart Highway or simply "the bitumen," is a good two-lane road that becomes a fairly sporty course at night and in the early morning when wallabies and buffalo pop out of the high grass.

I transferred to Mike's car at the 22 Mile. We drove eastward on a side road.

"This gate's our back door," said Mike, getting out to open it. "Our front door's forty miles away. But we're not really a big station—just 1,200 square miles. There's floodplain country, good for buffalo and bad for cattle, and higher land where cattle will do well if you improve the pasture. So we plan to run both. In 15 years we should have 60,000 Brahman-cross cattle, and 15,000 buffalo; *tame* buffalo."

He showed me the strongly built yards where the taming takes place. "We drive the wild buffalo into a steel-railed trap, which they promptly try to demolish. Then they're brought by trailer here to the domestication center. They're fed from trucks so that they'll associate food with man, then branded and earmarked, sprayed, tested for TB. The positive reactors are destroyed. Oh, and we knock off the ends of their horns. That way they'll miss when they try to hook you."

"After a few days the animals can be worked—carefully—by men on foot and on horseback. Then they learn about fences. This is an important lesson, because buffalo can go through steel strands as though they were cobwebs. The buffs are put in one end of the yard, feed and water in the other. Between them is an electric fence. A few jolts

and they get the idea. After three weeks here in the center they're almost as tame and fence-respecting as dairy cows."

"Why go to all this trouble?" I asked. "The buffalo have multiplied with no help from man, and they do fine on native pasture. Why not just catch them when you want them?"

"Because catching wild ones is tough and dangerous work. Handling tame ones isn't. And they're handy when we want to sell."

"Who buys the meat?"

"It's gone mostly to Asia until now. But mark you, we hope to develop a market for it in European countries. It's good meat, leaner than steer beef, just as tasty, and cheaper. Anyway, the buffalo are the icing on our cake. We're primarily a cattle operation."

High Water Claims a Stockman

Before going on to the cattle-section homestead, we stopped for a bite with Frank MacLeod, the head stockman, and Stan Hales, a stockman whose wife did the cooking. Stan's young son and daughter accepted me as wholeheartedly as only secure, well-loved children can accept a stranger. She brought out her baby wallaby, he his pet piglet. They gave me a pair of buff horns when I left.

The next day Stan was drowned when his vehicle overturned in a flooding creek. Later, in Darwin for the funeral, the children saw me in the street and came up smiling to ask after my health and happiness. Stan would have approved.

"I like the tropics," Mike said, as we drove through cow country on the southern side of the station. "I like the Wet and the green it brings. Once we've seeded the land, we can run a beast to 4 acres instead of one to 50, as they do on the unimproved properties. All our cattle are fenced in. We don't have to chase after them, watching tails disappear in the distance. There's no future in that. This is a business. And it's a cent business, not a dollar business; small profit on a large scale. There's not much room for inefficiency, and none for small-scale attempts.

"This is cattle country: Cheap land and reliable rain will make it some of the best cattle country in Australia."

Graziers and government men generally agree that Mike is right. The Top End is cattle country. It's not that you can't grow crops here; you can, despite the risk that the long Dry will parch them and the long Wet will rot them. The trouble has been that no

one has produced crops for export at competitive prices.

The region is rich in tales of epic failures. Old-timers like to yarn about catastrophes that befell a government-backed experimental farm to the end that a \$50,000 investment resulted in one pumpkin—and the man who stole *that* threw it away as useless. A California consortium poured money into a rice project at Humpty Doo, where sparse crops were grown at ruinous cost. A Texas company invested heavily in a sorghum-growing scheme at Tipperary Station, which never produced a profitable export crop. Little sorghum grows at Tipperary today.

But it grows in abundance at Willeroo, a cattle station where a new bid for agricultural success is showing promise.

"We've got 12,000 acres planted this year," said Jock Bremner, the manager. "Next year we'll put in 25,000. The target is 60,000."

"The Willeroo people may well make a go of it," said an official in the Primary Industries Branch. "And the whole Top End will benefit. If sorghum can be grown successfully, soybeans and peanuts probably can too. Then living units will be much smaller. Men won't have to be millionaires to take up land here."

Backblock Battlers Prospect the Bush

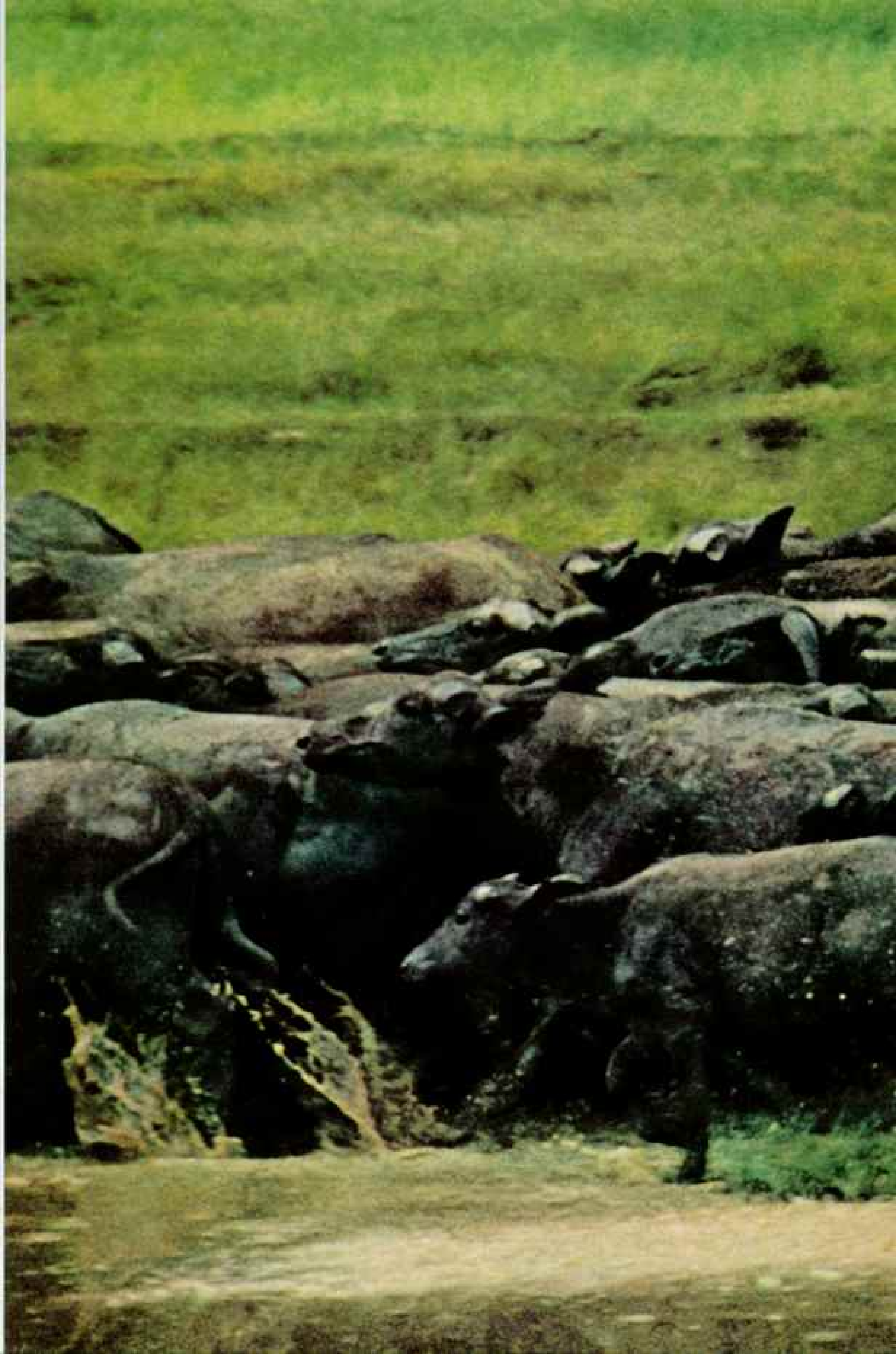
Whether or not agriculture flourishes in the Top End after its many flops, the area has another range of resources to add to its cattle potential: Mineral strikes are frequent, and some are rich. Mining operations are divided in true Top End style into impersonal, superlative-spangled, big-business operations, and the intensely personal scrabbling of backblock battlers who mine by muscle power.

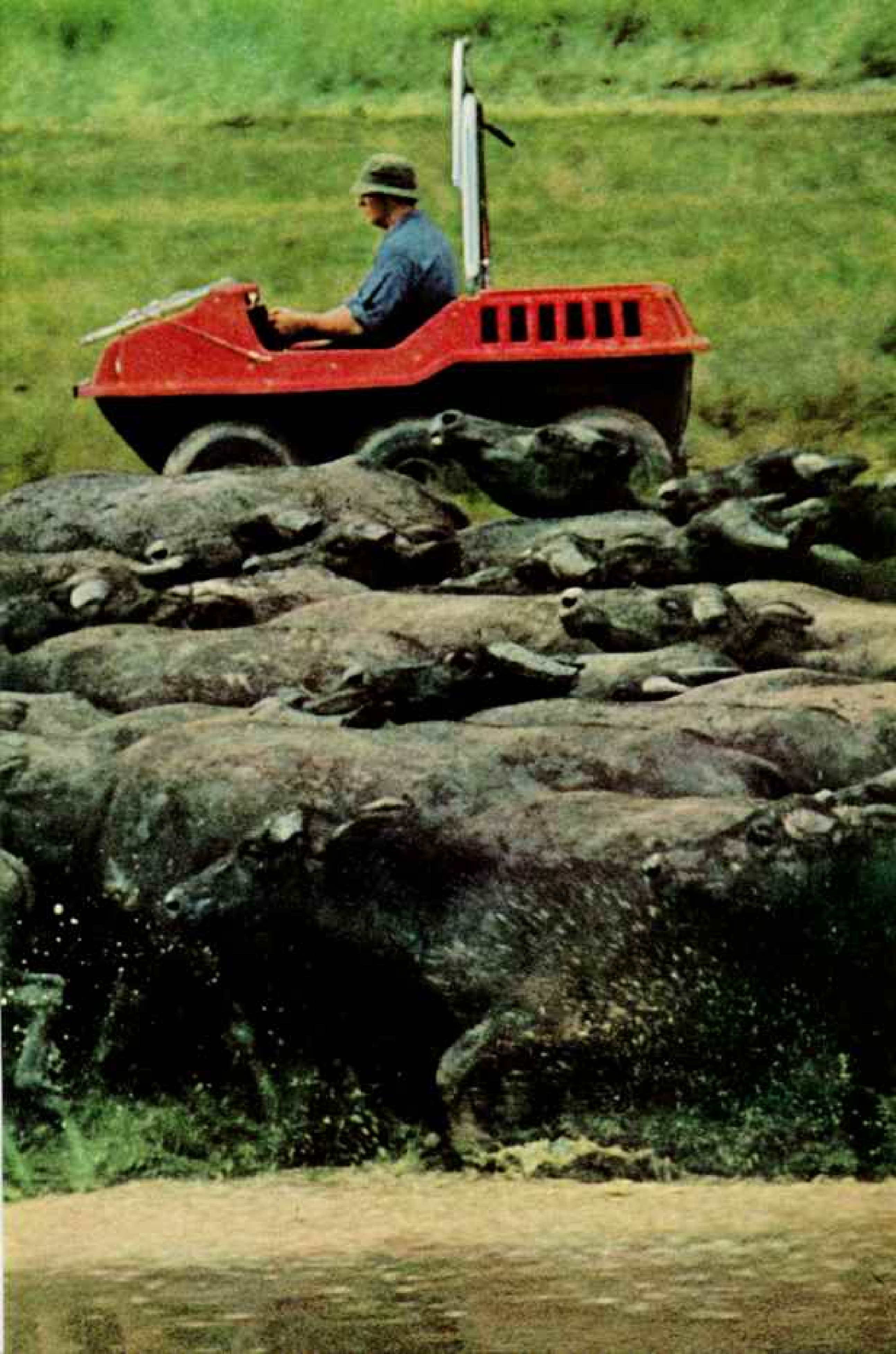
Setting economic importance temporarily aside in favor of human interest, I drove a couple of hundred miles in search of the pick-and-shovel boys. I found them in a corner of the country that civilization and the Stuart Highway had bypassed.

At Grove Hill, a villageless place-name on an unpaved road, there is a bush pub whose

(Continued on page 168)

Mechanical buffalo pony, an all-terrain vehicle (following pages) assists in a round-up on Mount Bunday Station. Top End stock raisers often run water buffalo on land too soggy to carry cattle.







Life in the back of beyond has its convivial moments for these stockmen after a day of mustering buffalo on remote Mudginberri Station, 150 miles

east of Darwin. During the Wet, an all-but-impassable sea of muck sprawls between their sealed-off domain and the rest of civilization.



Ploughing its own channel through a vast quagmire, a lone horse heads for a stand of paperbark trees on an oasis of higher ground.

The Top End of Down Under



very existence is unknown to almost everybody. It is a perfect example of its kind—its kind being Sheet-iron Colonial. No one could have done better than its builders did with the materials at hand.

It stood shimmering in the stifling heat of afternoon, dead quiet beside the still and dusty road. It looked like a shed. Behind it a clutter of old machinery rusted quietly in weedy desolation.

Inside a grateful gloom pervaded. A long, dark bar, redolent of bygone beers, stretched across the front room. Beyond, painted partitions divided the echoing interior into lounge, dining room, kitchen, all open-topped and sheltered by the common roof high above.

"Rooms out back, 'n showers. Beer?" said a voice from the shadows.

"Lord, yes," I said. Unnecessarily. My host had already uncapped a "stubby" and wiped its neck. He slid it to me. When the cold brew had soothed my parched lips, I asked about the pub.

"She was built 40 years ago. A stock route came by the door then. Miners and prospectors were fossicking all over this country. The stock route's gone, but the battlers are still around. Here's one now."

Lone Miner Berates Big Companies

In came a man wearing boots, shorts, and a thirsty look. He said no word but held out a horny hand into which the barman delivered a chilled bottle. This he raised, emptied, and replaced carefully on the counter. He then wiped his palm on his pants, extended it, and said, "Mine's Bill."

"Mine's Ken," I said. "Aaorgh!" Despite my tensed tendons, his pick-wielder's grip had popped my knuckles.

"Ey?"

"Ah, nothing. A road train ran over my hand this morning, and it's still a bit tender." Hyperbole ranks almost with obscenity in these parts.

"My shout," he said. To shout someone a drink is to order one for him. Here no order was required. Fresh stubbies stood before us, oozing foam. We carried them out to a wall-less shed, a sort of galvanized gazebo. There Bill launched upon an analysis of Top End mining.

"I've dug up \$15,000, and the crushers took it all in fees for handling my ore. I'm still broke and still prospecting. The bloody trouble is, the big companies have all the

land taken up. See, they get AP's—that's Authority to Prospect—and then they don't do much with the land they've tied up. But the small man can't go in. And all the small man wants is the little alluvial pockets the big man would never ever bother with, even if he could find them, which he can't."

Other miners wandered in, joined the discussion. Beer flowed like a creek in the Wet.

Later, I learned that the laws have been changed so that the big companies can't hold huge tracts they're not working, and small operators can now have more room to roam.

Instant Town Built on Bauxite

The other end of the mining spectrum is Gove, a new mine, plant, and community at the northeast tip of the Top End (map, page 150). I had to get permission from the Commonwealth Government to go there because Gove is in the Arnhem Land Aboriginal Reserve. And I had to fly because no road reached the place. Consider: The second largest community of the Top End, the third in all the Northern Territory (Darwin and Alice Springs are bigger), the biggest bit of capital investment in the north, and one of the largest private business operations in Australia, yet no road connects it to the outside. I can think of few other modern urban establishments in the world of which one could say to a man in a car in the same country, "You can't get there from here."

Ships serve Gove, and airplanes. The road will come. After all, the whole 375-million-dollar complex is brand new.

And what brought this extraordinary establishment into being? Bauxite, the ore of aluminum. Two hundred and fifty million tons of bauxite. Not only is the red ore mined and shipped, but an immense plant has been built to produce a million tons a year of alumina, the floury white powder from which aluminum is made.

John Beaumont of the operations staff detailed further facts and figures: The community will soon contain 5,000 people. It has a hospital, a school, a good hotel, shops, services, pleasant bungalows and flats. This instant town has instant lawns, nearly two hundred thousand dollars' worth of them, sprayed on as seed and fertilizer and lush in three weeks.

"We've got a 12-to-20-foot layer of bauxite under a two-to-three-foot overburden," John said as we watched front-end loaders filling

50-ton dump trucks. "We take off the overburden, remove the bauxite, replace the overburden, seed it, and move on. The ore is crushed and fed onto a belt-conveyor system 12 miles long, which can carry it to ships at the end of our deepwater dock. It's one of the longest conveyors in the world."

We followed it along to the aluminum plant, whose strangely shaped structures and complex chemical operations are controlled by a computer center that looks like something out of science fiction.

"A handful of men could run this whole thing," John said. "In theory. But look here. Something you wouldn't expect in a place like this." He drove among the conduits and columns and tanks to a clear space in the midst of it all, where stood a great banyan tree. "That tree is sacred to the Aborigines who held this land. It cost \$60,000 to build around it."

"Where are the Aborigines now?" I asked.

"Over at Yirrkala. Let's go and meet some of them."

Galarrwuy Renews Ties With the Past

Yirrkala is a small community of houses surrounding a store, school, and service buildings. People wore European clothes—simple dresses, work trousers, sport shirts. One bore lettering: "Prime Australian Meat."

"There are 755 Aborigines here," said Keith Hendry, superintendent of Yirrkala. "Sixty percent of them are under 16. There's money for those who want to work—training allowances up to 45 dollars a week. But these people can live without working. Hunting, fishing, gathering will keep them fed. So they take off whenever they like."

Most of Yirrkala's older residents had little English. But Galarrwuy, a bright young member of the Village Council, was both eloquent and informative. A high-school graduate, he had come back to help his people.

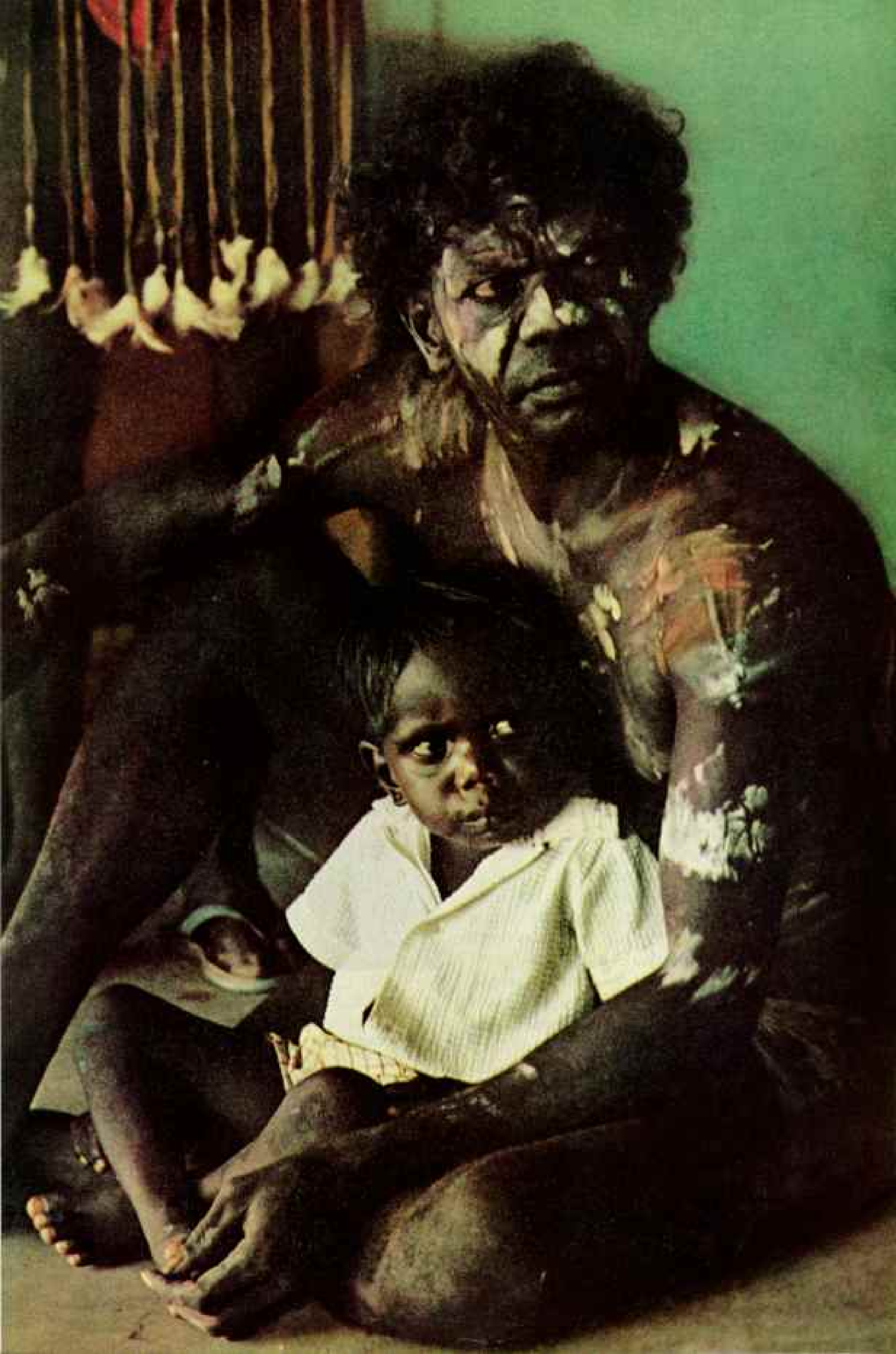
"In school I thought I'd given up the tribal life," he told me. "But when I returned, how could I help my people if I didn't know their ways? I learned the old ways, the old Dream-time stories. They are our mythology. They explain how things got to be the way they are. I'm glad I learned. I was empty before."

"Now I try to talk to our young people. They know little about their own civilization, but it's here. We look at the Europeans, and they at us, and we treat each other as fools."

"Yet the great bauxite find, it was all known



It's a shin-scraping job to dig out the Top End's mineral treasure, as this copper miner near Pine Creek attests. In times past, pick-and-shovel prospectors scratched many a fortune in gold from the ore-rich land; a few hopeful loners still prowl the wild landscape during the Dry. But today emphasis has shifted to large-scale mining operations that tap immense reserves of uranium, bauxite, manganese, iron, and other ores.



long before. Our people foresaw all this by prophecy. They were singing about white men and bulldozers and houses a long time ago. Now it's real, it's real!

"The government says the land does not belong to us, but we belong to the land. We say, 'Who dreams this land? Who sings about it? Who? We *are* the land.' "

Aboriginal Magic vs. Technology

Yirrkala and its people are in an abnormal situation. Their Dreaming rests uncomfortably beside the white man's realized dream; their spirit magic clashes, for the moment, with the magic of technology.

I went, again by special permission, to two other Aboriginal communities on the fringe of Arnhem Land: the government-operated settlement of Maningrida and the long-established Oenpelli Mission.

None of the Aborigines in the Top End live a purely traditional life. But they still move a lot, drifting like shadows across the coastal plains and canyon-cleft expanse of Arnhem Land's great stone shield. They run into the white man often. And since they do, they must learn to cope with him. At Maningrida a school and a training program teach them how.

"What we do here is simple," said John Wilders, the assistant superintendent of the settlement. "We show these people how to get along with white neighbors. Be acceptable. What they do on their own time in their country is their own business."

A smudge of smoke drew us to the beach. Three elders of the Gunavidji tribe, accompanied by a few women, children, and dogs, squatted around a great green turtle, presumably in the process of being cooked. I say "presumably" because the fire beneath the big animal would hardly have sufficed to roast a marshmallow. Nevertheless the turtle had a cooked look to him, and the feast was about to begin.

As we approached, the turtle's lower shell was cut away, releasing a cloud of more or less fragrant steam from within. The beast was indeed cooked. Hot stones had been pushed into his interior through a hole under

the throat, the hole then being blocked by a bunch of grass.

After dark, superintendent John Hunter returned to his house looking tired and carrying three spears. "Family troubles again," he told his colleague Wilders. "Brian's mob were getting ugly. They're Rembarnga. One of their women wouldn't stay with her husband, who belongs to another tribe and speaks another language. He protested, and the Rembarnga got their spears. I had to take them away. What's for tea?"

It was as well that Brian hadn't thrown his spear. Next day, when he went with me to visit some people living in bark huts out in the bush, he hit a buffalo skull at a hundred feet.

At dusk, near his tin shack in Maningrida, Brian and his mob sang for us to the deep snoring of the trumpetlike didgeridoo and the sharp clack of clapsticks.

"They sing their Dreaming," John Wilders said, "about their totems. No others can sing that Dreaming."

Rigorous Road to Manhood

Oenpelli is inland, under the rim of the rock country, and on the edge of verdant swamps. There Jacob Nayingul took me in tow. A tall, soft-voiced man, fairly fluent in English, he warmed slowly to his foreign guest. But he warmed. Enough to tell me something of his own tribal experience.

As we walked by the school, where little black children sat on the floor listening to a record of children's songs sung in exquisitely English accents, Jacob said, "I went to school here too. But I was born in the bush. And when I was 7 or 9 years old, I was circumcised, lying across the backs of the grown men. And later on I had to live in the bush for two months, and there were animals I could not eat. Then I was tested in various ways for a year or more, and then there was a big ceremony. I was a man then. I could eat anything. Then I took part in my first *kunapipi* ceremony—fertility rites."

As we passed down a line of huts, each with an outhouse behind it, a semi-tame emu five feet tall wandered into our way.

Keeping faith with past and future, Aborigines rear their children in two worlds. This father, adorned for a festive dance, preserves a culture with roots that date from more than 30,000 years ago, when his ancestors began to arrive from lands to the north. His son enters an era that will inevitably propel his people into modern society. About a fourth of Australia's 50,000 full-blooded Aborigines live in the Top End.

"Don't go too near that one," Jacob said. "He can kill you with his foot."

We skirted the surly bird and went on to the church, the shop, the dispensary, the leprosy treatment center. (Leprosy is almost endemic among Aborigines in the Top End.)

Jacob led me then to a shed where women wove mats of boiled pandanus strips. He pointed to a pretty young girl in a corner.

"My wife," he said, and smiled for the first time.

She came and stood beside him, watching me with those large brilliant Aboriginal eyes that see so much, but are so inscrutable to us.

As we parted, he asked, "Are there any people like us in America?"

"There are many black people," I told him. "But not like you. They are Africans, newcomers to America, as are we Europeans. Only the American Indians are the Old People, as old in that land as your people are in this one."

Jacob said, "That's very old. Perhaps as old as the Dreamtime. They must have sacred places in the land as we have."

Paintings Defaced by Itchy Beasts

I saw some of those sacred spots soon afterward, reaching them in the only way possible during the Wet. With Darwin artist George Chaloupka, one of the few men who knows the way by air, photographer Tom Nebbia and I flew by helicopter to Deaf Adder Creek, a clear stream which has carved a gorge in the edge of the Arnhem Land escarpment.

Trees and termite hills like tortured grave-stones cluttered the few patches of level land.

"I can get in," said pilot Ted Kennedy, "but I don't see how I can get out." So saying, he put the aircraft down.

A broad buffalo trail led straight to our destination, a wide, smooth section of cliff protected from rain by an overhang. On this inviting surface generations of Aborigines had painted pictures in white, red, brown, pink, and yellow ocher.

"Some may be thousands of years old," George told us. "Others only a century or so. They are marvelous, irreplaceable. A huge gallery of primitive art. But look at the damage.

Those damn buffalo have rubbed their bloody hides along the bottom; they've erased some of the pictures. And see the termite tunnels, those lines of mud that cross the rock face. This is a national treasure, and it ought to be fenced in, even walled in and roofed for protection."

Skulls Stare From the Rocks

Ted was able to get out, with nothing to spare. George guided him to a nearby region of scattered monoliths where trees grew in the sheltered corridors between the giant rocks, and there we landed again.

A few bark huts lay in ruins, their fires long dead. But man was there. Human bones, neatly ochered, nestled in small holes in the rock, the skulls sometimes staring out at the loveliness around them. Their spirits were surely close at hand, dreaming in the stillness. No birds sang.

Another short flight took us over a great natural wonder of the Top End: Jim Jim Falls, where a creek flowing across the rock country cascades over the escarpment into a pool 700 feet below, flanked by perfectly vertical cliffs. A patch of sand the size of a suburban lawn lay between the swirling waters and the precipice. And on that Ted deposited us as his rotor tips whipped the air a few yards from solid rock.

What myths the tribesmen recount about this beautiful place I do not know. Many sacred stories are not revealed to the white man. But that great plunging fall of white water must be locked in the legends of the Aborigines, whose words, Galarrwuy had told me, are "a pure poetry."

There is a piece of land under the escarpment—not far from Jim Jim's loveliness, Deaf Adder's magic gallery, and the serene skeletons in their shadowed niches—which seems to me the heartland of the Top End. In that single expanse there are forests and flood-plains and red cliffs rising in the distance to proclaim the frontier of the ancient Aboriginal country known as Arnhem Land.

Rain there is heavy. The Wet is very wet. No land route reaches it from Dry to Dry. The swamplands teem with buffalo; cattle

Plunging through a rainbow, twin-plumed Jim Jim Falls spills 700 feet from the sheer rock face of an escarpment at the western edge of Arnhem Land, homeland of many Aborigines. To the lonely country beyond Jim Jim, older Aborigines occasionally return to commune with their heritage in the hallowed secret places of their ancestors.



graze the highlands. Much of the rich wildlife of the Top End thrives between here and the edge of the continent, which lies not far to the north.

This bit of country, once empty Crown Land, now has a name. It has become Mudginberri Station, an enterprise as completely Australian as the 427 square miles it occupies. It isn't big. It isn't yet intensively developed. It isn't even a proven success.

"We *think* we can go broke," says manager Geoff Cross. "But we don't want to be in a situation where we *know* we will go broke. And we're not."

We sat on the terrace of what must be the most beautifully sited homestead in the entire Top End. A clean stream flows by, and pale gum trees gleam in the dark green forest along its bank. Flowering trees and shrubs stand on a well-tended lawn. The buildings are simple, pleasant, comfortable—above all, well suited to their situation. Our plane and Mudginberri's rested on the airstrip outside the front yard.

"We've got 10,000 buffalo on the property. We're going to domesticate them, and we're building up a herd of 5,000 crossbred cattle. We could make a quid on the buffs alone. But we need one thing more: We need to join the world. That little airplane isn't enough. If we're going to be part of the Australian economy, we've got to be linked to it; we need a sealed [paved] road.

"If the government wants the Top End to develop, then let the government help. Look, you've seen these animals of ours. They're mud-fat, now, in the Wet. But we can't get them out before the Dry. That road's got to come. Running beasts in the Top End isn't a hunter's game or a gambler's fling anymore—or shouldn't be. It's a businessman's considered venture."

Geoff went in to get a couple of beers. I sat in the soft evening, heard a kookaburra's mad laughter, savored the solitude here in the back of beyond. And sensed the relentless spread of civilization. Geoff was right. The road would come.

The Aborigines dream in their sacred places among the wild red rocks, dream of a time that is gone. But the big, tough, promising country below the escarpment is stirring with new life, new hope. The newcomers who hold that land dream too. Their dreams are of the future, and they put their money and their muscle where their dreams are. □

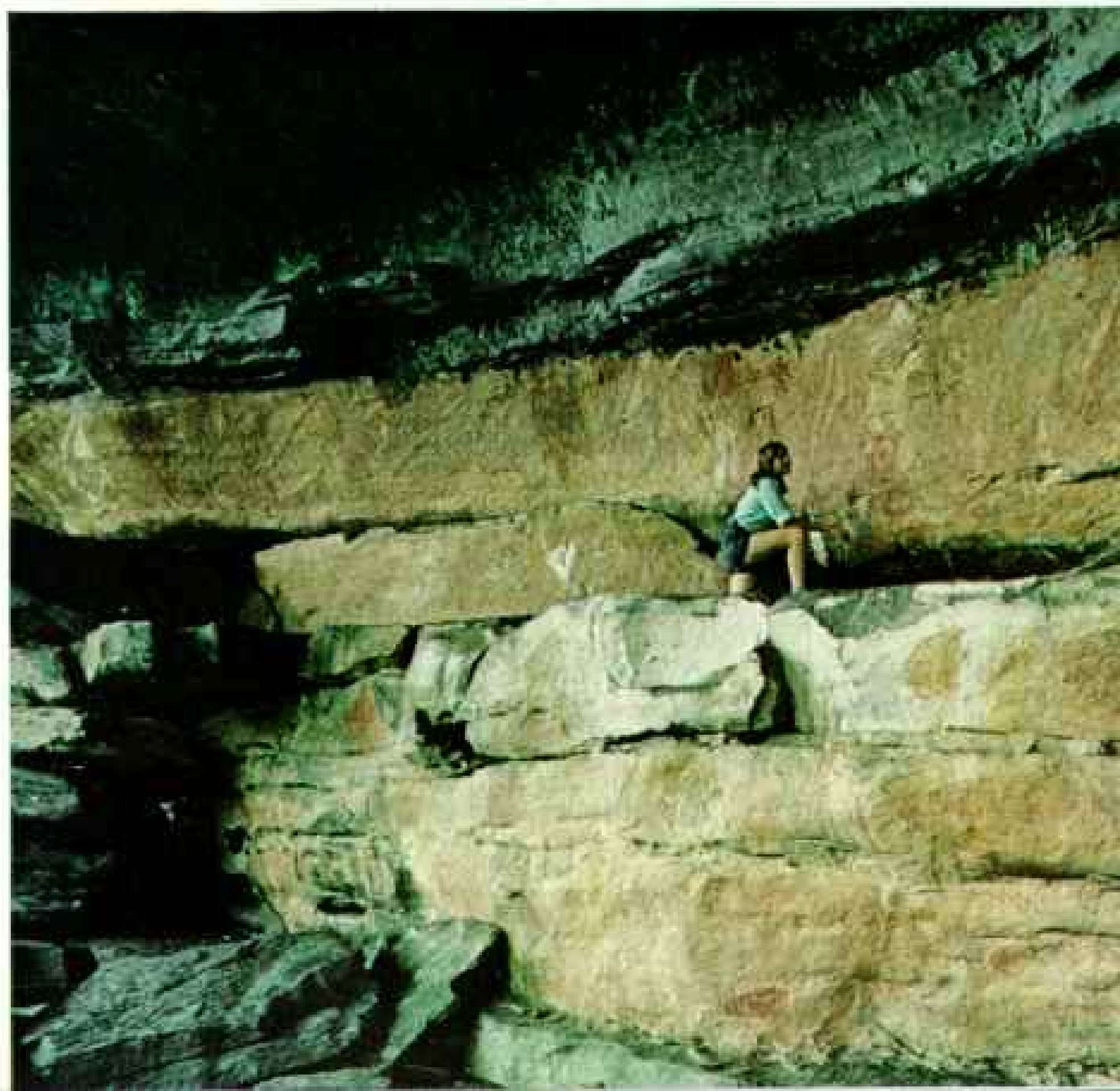
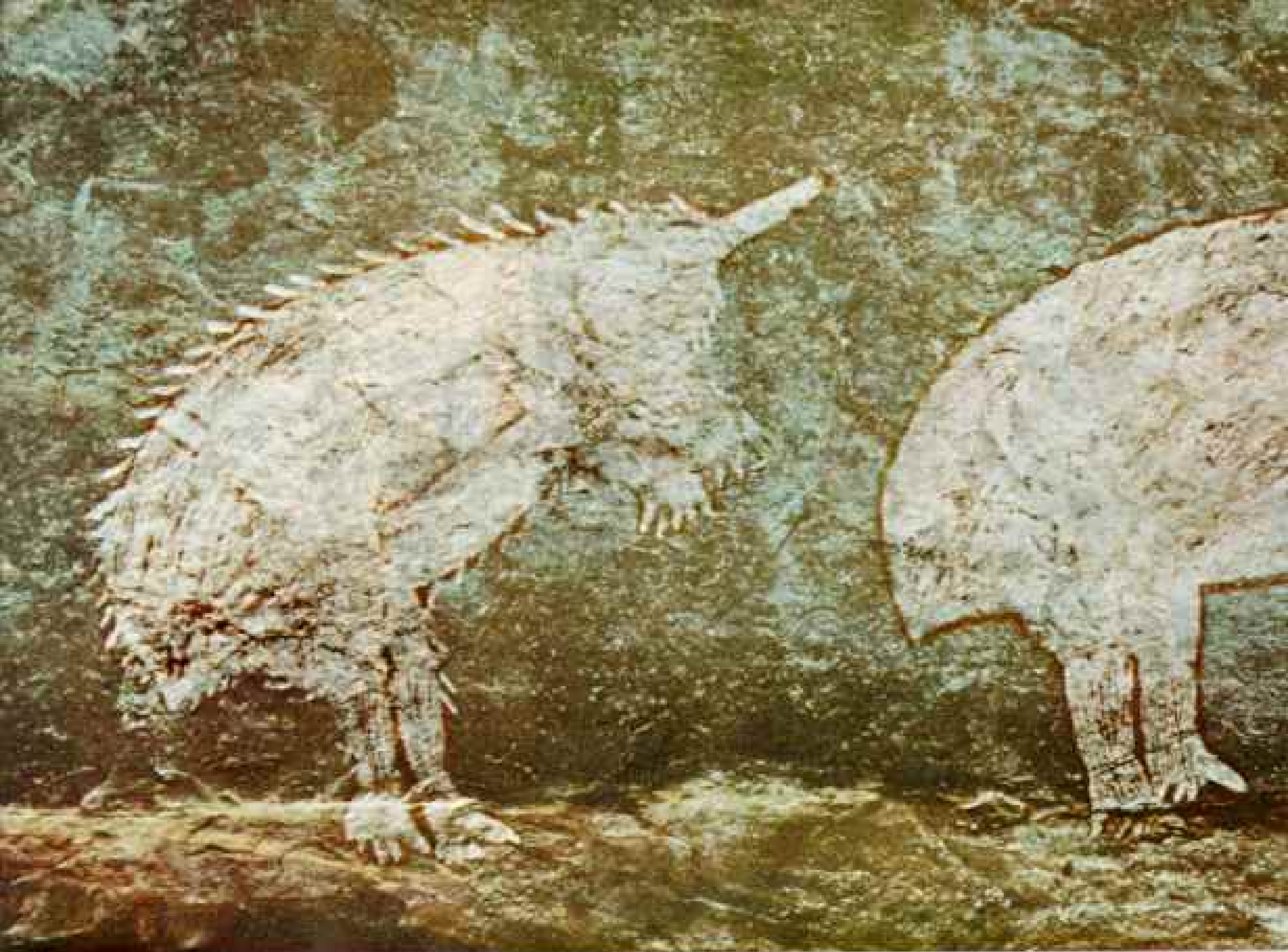
Rock Paintings of the Aborigines

In Australia's rugged Top End, photographers Kay and Stanley Breeden record the island continent's extraordinary outdoor art galleries.



A STONE AGE Picasso created this "owl-man" on a wall in northern Australia, where some of the continent's most spectacular Aboriginal art adorns caves and cliffs (map, page 150). A combination of hands, feet, and feathers, this rock painting at Bala-Uru may represent one of the half-human, half-animal ancestral beings that the Aborigines believe roamed the land during the "Dreamtime," or beginnings of life. A handprint appears just above it.

Decorating their stone canvases with pulverized rock mixed with water, nomads in Australia created a genesis in ocher with paintings dating from as long ago as 5,000 years. In other portrayals the Aborigines of Arnhem Land blamed their misfortunes on a bevy of evil spirits. Through pictures they directed punishment at an enemy, or appealed for more food. They also chronicled great hunts and contacts with the first Europeans. Now the ravages of time and the breakdown of Aboriginal traditions threaten to destroy these striking works of art.





SNOUTS HELD HIGH, spiny anteaters nearly two feet long parade across a rock wall at Bala-Uru (left). The egg-laying mammals, hunted as a delicacy by the Aborigines, may have been painted in the hope of magically increasing their supply.

At Obiri Rock (below, left) Kay Breeden admires a panorama of large fish, probably drawn to bolster their numbers in nearby pools. As if posing for its portrait, a spider perches near its likeness at Cannon Hill (below).

Rock painting and retouching by the Aborigines now have all but ceased, and the secrets of the paintings lie mostly with elderly tribesmen. When they are gone, this remarkable window on a unique culture may be clouded forever.





TWO SCHOOLS of art employed by the Aborigines stand side by side on a frieze at Obiri Rock (left). A tortoise appears in an "X-ray" style, in which internal organs as well as external details are drawn. This 22-inch-high creature's X-ray details include only a crude digestive system. Other body spaces have been shaded.

Next to the tortoise sprints a slim, hook-faced hunter drawn in the Mimi style. Tribesmen have long claimed that many of these older, single-line drawings were rendered not by men, but by wraithlike spirit

people called Mimi, who could melt into a cliff by blowing on the rock. Some of the figures, they insist, are not paintings at all, but shadows that remained when Mimi passed by.

Frozen in action at Obiri, more hunters on the same frieze run and hurl barbed spears, using cone-shaped throwers (below). Some carry goose-wing fans for brushing off flies, and long rectangular shoulder bags. Standing in their midst are two tall, thin red-and-white female figures known as Namarakain—malignant spirits waiting to steal the souls of the sick.

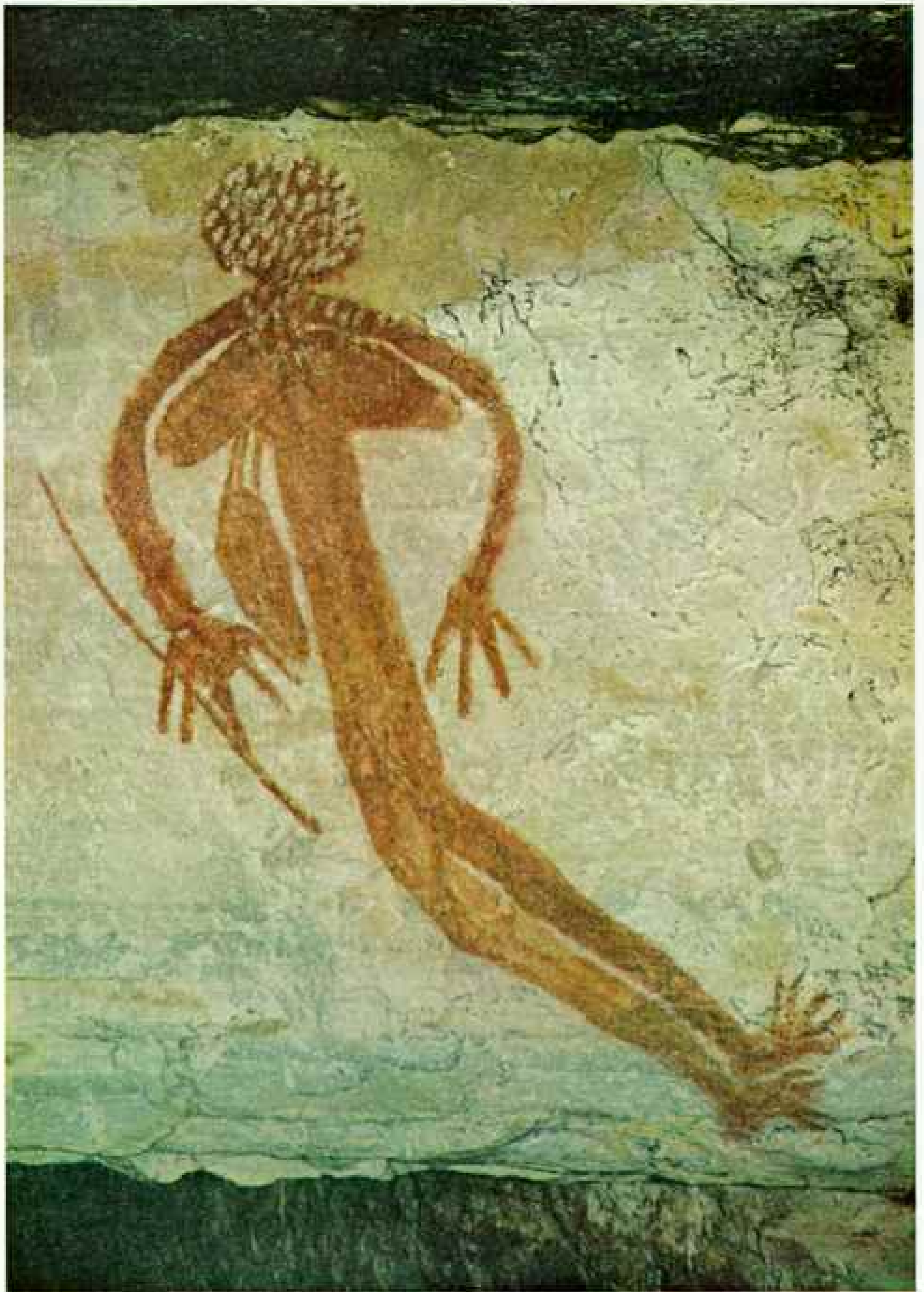
LAYERED HISTORY

covers a wall at Bala-Uru (following pages). Most recent portrayal is a lifelike school of black bream drawn with the X-ray technique. A fading barramundi of the same era swims behind them; two women dance at opposite ends of the five-foot-long fish. In the background loom two paintings of earlier generations: a kangaroo drawn with white pipe clay, and at far left a big-eyed "thunder-man," who terrifies humans with fearsome storms.









POCKMARKS left by wasp nests scar the head of a yard-high figure carrying a dilly bag (above) at Kolondjorluk Creek. Ripping away nests has torn loose pigment. A vengeful husband may have sketched the stick through the woman's finger to cause his wife pain.

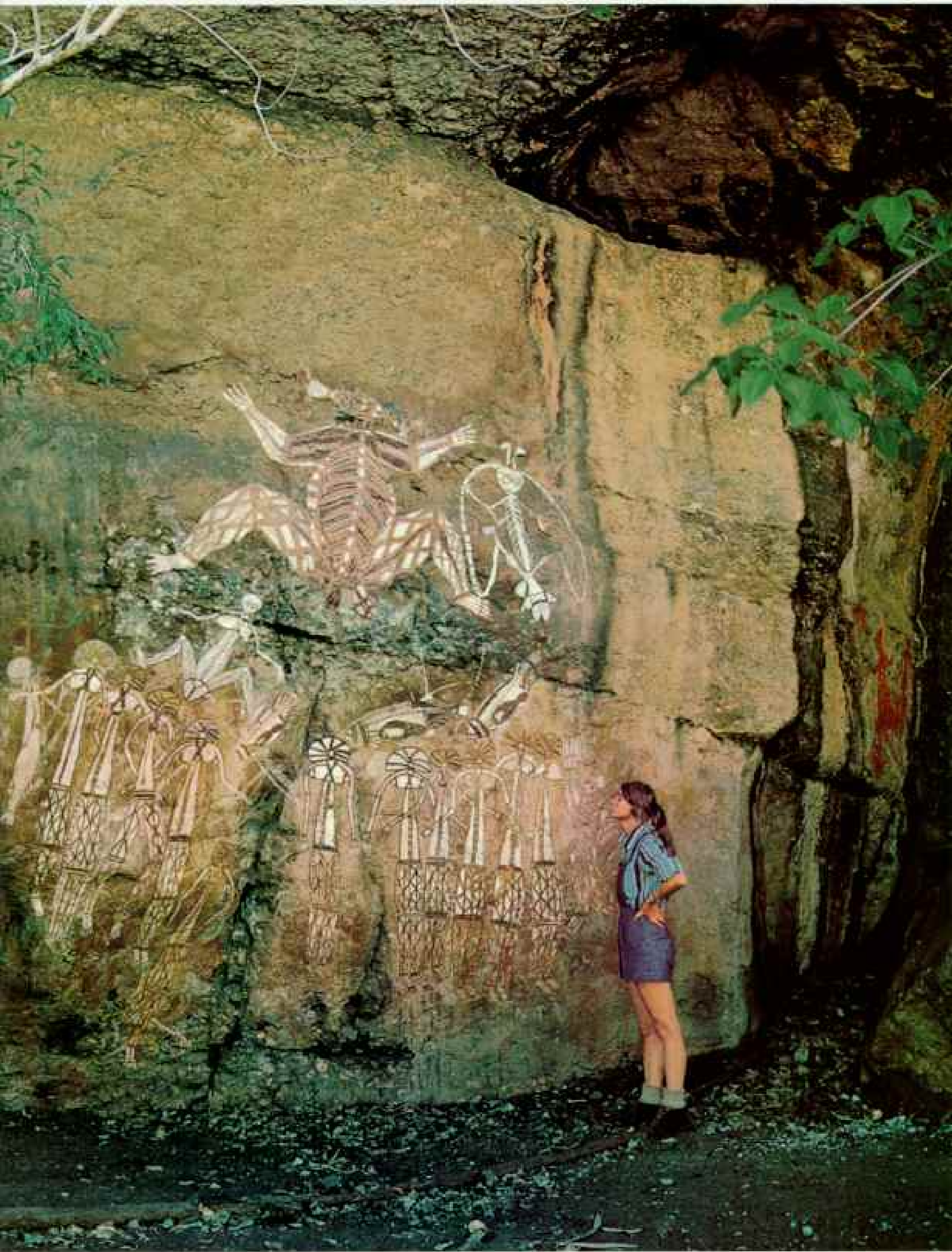
ASERPENT-HEADED Namarakain woman writhes on a wall at Cannon Hill (right); the 24-inch spirit figure fingers a loop of string that magically moves her from one sick bed to another. Spirits were common themes in art that attempted to explain the forces of nature.



WHERE TRIBESMEN
once met in solemn ritual, tourists now gather at Nourlangie Rock. Busloads of visitors from Darwin regularly reach the stone outcropping to view one of the most beautiful collections of rock art yet discovered.

Kay studies a complex cliff-side mural of spirits clustered beneath a larger central figure. Thunder-man, to the right of the figure, holds a lightning bolt in his hands. Backbones and hatching designs of the X-ray art style decorate the bodies. Tribal elders once explained each detail of such secret places to young initiates. But with the shift of tribes from their traditional lands, many Aborigines near Nourlangie find local paintings as baffling as do the tourists.







STYLIZED MIRROR to the Aborigine's world, a foot-long wallaby stands in vivid likeness to a living one we photographed in the bush (right). No class of artists dominated Aboriginal creativity. Painters of a variety of talents left their marks, from simple handprint signatures to the intricate designs painstakingly applied in the drawing of this marsupial. Fine feather or human-hair

brushes were used in the delicate cross-hatching; twigs, frayed at one end by chewing, traced broader lines.

Conservationists urge that measures be taken to prevent deterioration of the cave art, and that native artists be encouraged to perpetuate their traditional skills. With adequate protection and periodic restoration, the immortality of such cliffside masterpieces could be assured. □



From the spirit-filled world of the Aborigines, the Breedens turned their cameras on the natural beauty of the bush. The portfolio that follows captures some of the most unusual denizens of this forbidding land.







WALLABY, *MACROPTUS AGILIS*, 3 1/2 FEET TALL; HOURGLASS FLOWER, *TRICHOSANTHES CUCUMERINA*, 2 INCHES ACROSS

Eden in the Outback

By KAY and
STANLEY BREEDEN

NURTURED by the Wet's drenching rains, the remote forests and floodplains of Australia's tropic north guard a richly endowed museum of natural history. Propped up by its muscular tail, a wallaby interrupts its grazing to relieve an itch (left). Steaming heat fosters the lush pasture and promotes a galaxy of dazzling blossoms, among them the pristine flower of a snake gourd (above).

A seawater barrier—created when Australia drifted away from the primeval southern landmass—isolated the Top End's denizens from predatory immigrants for millions of years, thus permitting their evolution into the unique life-forms we know today.

Camped 40 miles southeast of Darwin, we roam eucalyptus forests and marshy flats along the Adelaide River to record this dynamic but little-known ecosystem.



OUR BAIT, a fish carcass, draws a young white-breasted sea eagle within camera range, to squabble briefly with a whistling kite (left). The mottled juvenile eagle, whose wingspread already exceeds six feet, has not yet acquired the snowy breast and blue-gray back of its parents. For a few exhilarating moments we sit face to face with this spectacular bird in its wild free state.

For sheer beauty, however, we have long yearned to photograph the rainbow pitta, whose flashing colors and strong, pleasant voice never fail to lift our spirits. Amid the bamboo, fig trees, palms, ferns, and thick woody vines of the monsoon forest, it takes us several days to locate a nest. When the parent bird finally arrives—just four feet from our hiding place (upper right)—we are so spellbound we almost forget to snap what are probably the first photographs of one of these birds feeding its young.

Hot sun and heavy rains support a tremendous food source for the numerous species of birds, but the swampy floodplains present soggy challenges to the bird-watcher. Plunging into bogs up to our hips, we soon become covered with sticky gray mud. In a forest stream Stan wades shoulder deep (lower right) to inspect a finch nest in a pandanus tree.



SEA EAGLE, *HALIETUS LEUCOGASTER*, TO 24 INCHES LONG; ROSE-PALMFINCH, *SPHENAURA*, 27 INCHES; PITTA, *PITTA MIA*, 8 INCHES



MIRACLES of miniature life often absorb us in the Top End. Fresh from its nymphal skin, a grasshopper spreads long wings to dry while clinging to a tasseled grass stem (left). A small jumping spider with a striking clown face and a green translucent body (right) carries off a large fly it has nabbed.

One day we watch an unbelievable display of teamwork as a swarm of green tree ants sews together a nest half the size of a football. Each ant clamps its jaws on the waist of the one in front, forming chains that draw together living leaves (below). Other ants then weave a web across the gaps by touching their own silk-producing larvae—held in their jaws—to one leaf and then another, cementing anchor lines to each.



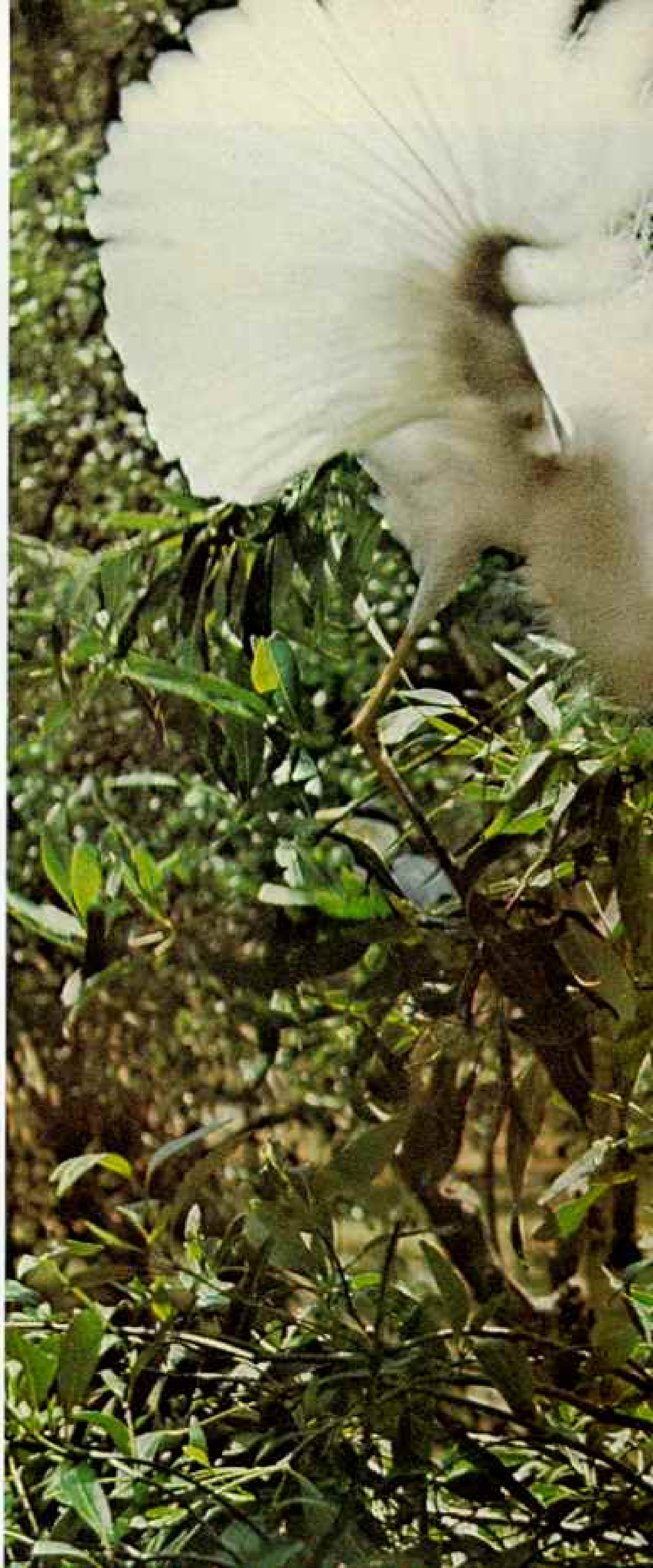
GRASSHOPPER, GENUS *HELIOPUS*, TO 4 INCHES, SPIDER, FAMILY *ARANEIDAE*, TO 1/8 OF AN INCH, ANTS, *COCCOPHILA* *THAMNANDRA*, TO 1/16 OF AN INCH



ELABORATE ceremony marks each meeting of plumed egrets at their nest. No actor's entrance ever surpassed the approach of one of these milk-white birds, with plumes on its back and chest rising like lacy veils. In an instant of incredible beauty the two egrets touch each other tenderly. Chest to chest, beaks together, they momentarily entwine their necks. Before either leaves again to seek fish and frogs for the young, it adds a stick to the nest.

From a blind just eight feet away we are able to witness the 15-second greeting ceremony each time one of the pair returns. Our hideaway also gives us a view of activities in fifty other egret and heron nests nearby. As heat and humidity rise inside the blind, our perspiration trickles onto the camera eyepiece and forms puddles at our feet—a price we willingly pay to watch this feathered theater.

EGRETTA INTERMEDIA, 2 FEET LONG









REDISH TREE FROG, *LITORIA RUBELLA*, TO 1 1/2 INCHES;
GREEN TREE FROG, *LITORIA GRACIOSA*, TO 2 INCHES LONG

BULB-TOED PRINCE of the marsh, a green tree frog eyes us during one of our after-dark excursions at Humpty Doo, amid the din resonating from thousands of ballooned vocal sacs (above). The swamp symphony ranges from the deep "crawk, crawk" of larger species to the squeaky-gate voice of the dwarf tree frog (below).



LITORIA BULLOCKI, TO 1 1/2 INCHES



FEEDING its sweet tooth, a sugar glider laps nectar from the flower of a woolly butt tree. One of the liveliest of marsupials, the squirrel-like woods dweller leaps and dashes from blossom to blossom, then hurls itself from dizzying heights to another tree. Sailing on parachute membranes between outstretched legs, it can volplane as far as fifty yards at a time.

A tuan, or brush-tailed phascogale, holds its black banner aloft as it zips

through a hollow log (below), a familiar haunt of the carnivorous marsupial. Toppled trees—victims of termites—abound in the Top End's eucalyptus forests.

Australia numbers more than 120 marsupials among some 230 species of mammals. All marsupials are born helplessly immature; the young of ninety species are kept in the mother's pouch until they develop more fully. In pouchless species, newborn young cling to external nipples.



SUGAR GLIDER, *PETAURUS BREVICORIS*, 14 INCHES LONG; WOOLLY BUTT TREE, *EUCALYPTUS MIMRATA*; TUAN, *PHASCOGALE TAPLEATA*, 14 INCHES LONG





LEARNER, CHLAMYDOMYXUS RINCHIL, 60 INCHES LONG, LOTUS, BELIEVED PROTEIN

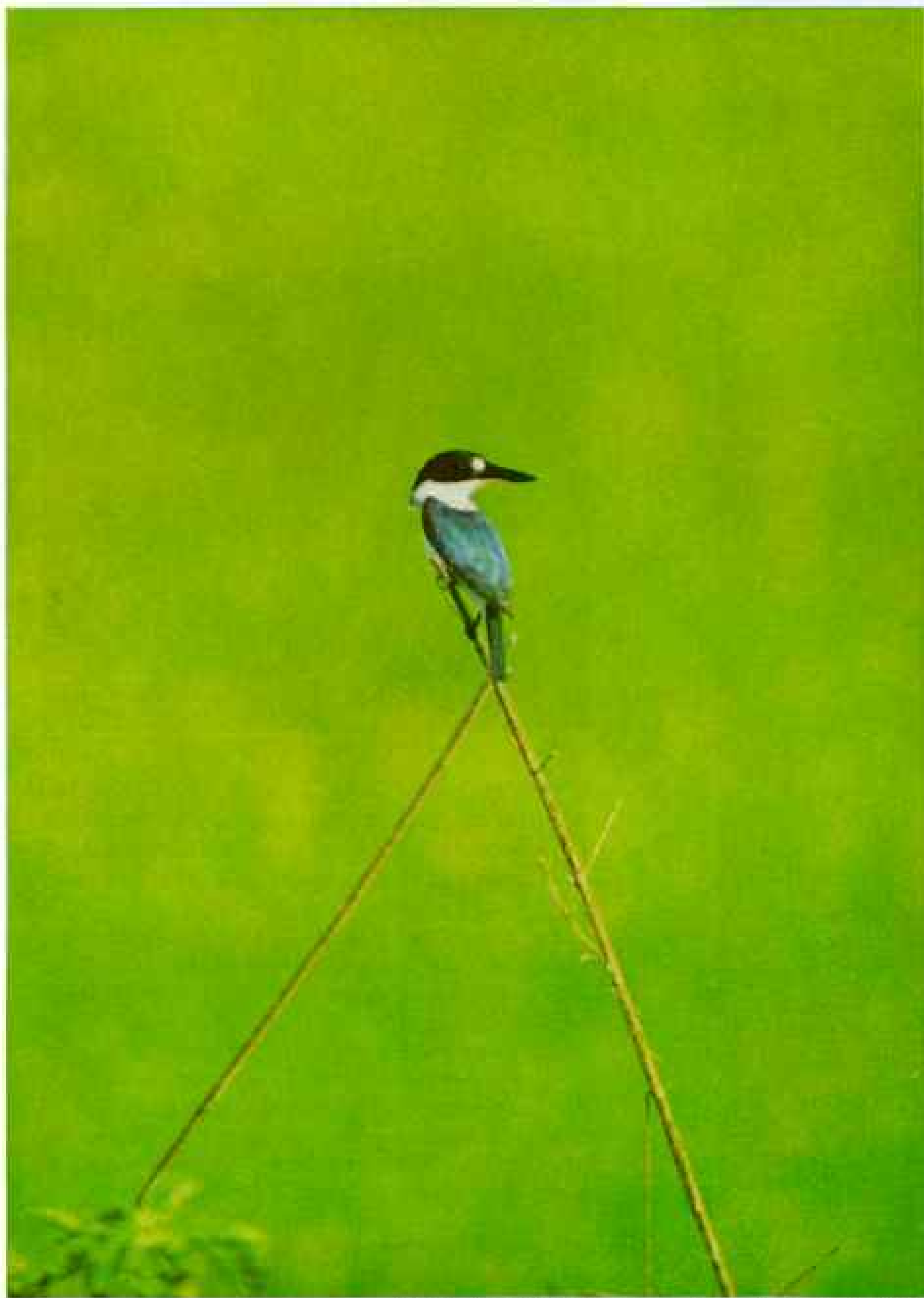
WINGED-DRAGON MASQUERADE of the frilled lizard may dissuade its enemies: When alarmed, the reptile raises a foot-wide neck membrane and displays gaping jaws, but bites only if extremely provoked.

Kay wades into a lagoon to admire lotuses growing higher than her head (**above**), unaware that she is trespassing on a dangerous reptile's lair. We learn later that a big crocodile lives in the pool.

On a forest shrub we touch the green caterpillar of a swallowtail butterfly. It rears up, defensively thrusting out the vivid forked osmeterium located behind its head (**below**); the organ's sudden movement, bright color, and foul odor make us draw back. A hungry bird might do the same.



CATERPILLAR, GENUS PAPILIO, TO 3 INCHES LONG

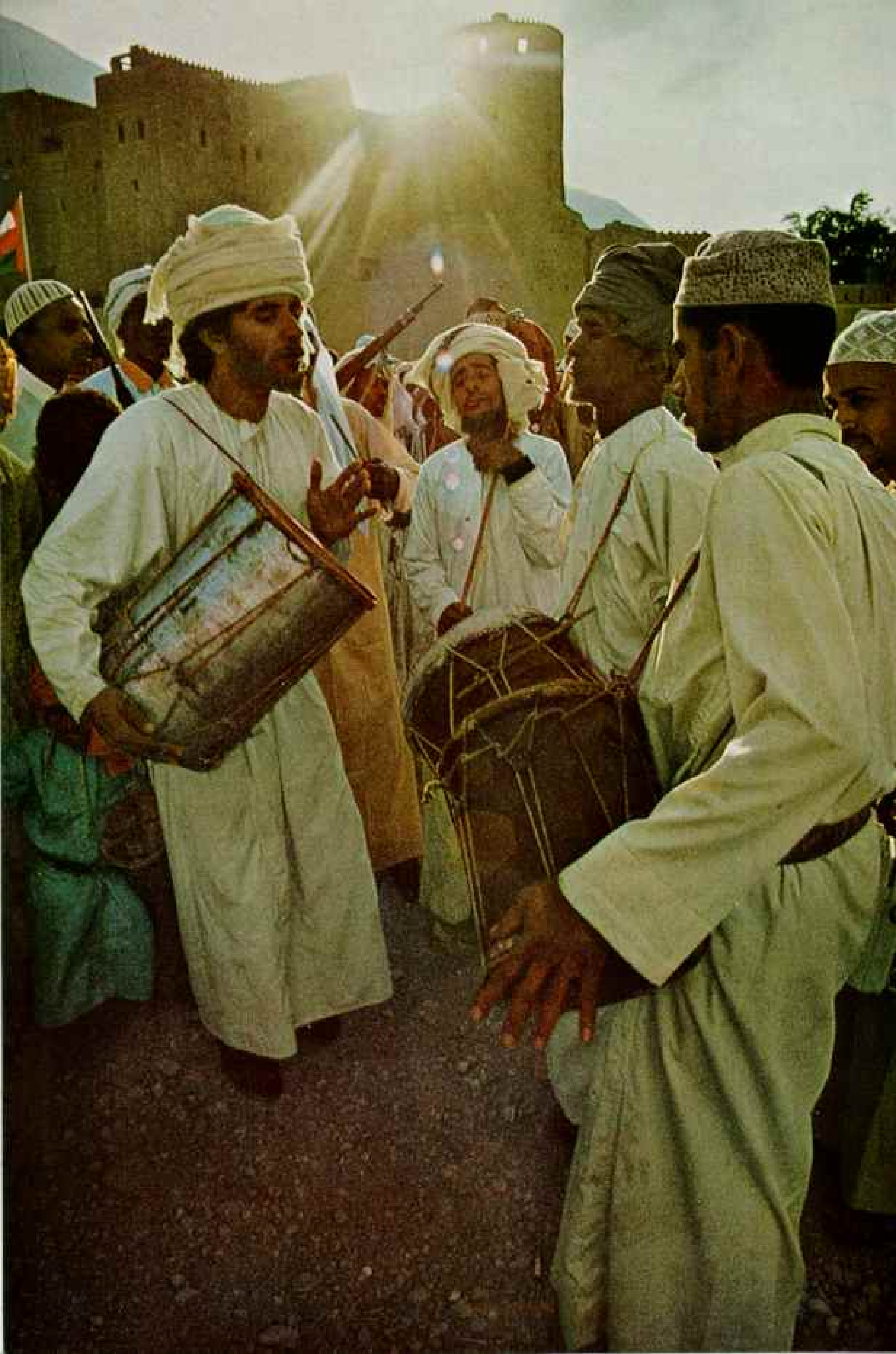


KINGFISHER, HALCYON BACILLATA, IN A FOREST OF BAMBUSOIDEAE, AUSTRALIA

IN MANY HOURS of exploration, we marvel at the profusion of color. Often it is thrust upon us suddenly, unexpectedly; a flash of movement catches our eyes as a forest kingfisher alights, its perch giving it the appearance of a

stiltwalker (**above**). The bird's bejeweled coat gleams bright against the foliage. In seepage along a cliff, bladderwort flowers cluster in rich and somber beauty (**right**), fitting finery for one of Australia's most exciting wilderness areas. □





THROUGH THE VIEWFINDER of my camera, I sighted at blank eyeholes piercing a tile set into a second-story window of the sultan's residence. People around me in the palace compound followed the aim of my lens, and some smiled.

They knew, as I had learned, that until he was deposed by his son in 1970, Sultan Said bin Taimur used to sit there in his palace at Salalah, southernmost city of the Sultanate of Oman, and place binoculars to those eyeholes, watching subjects passing below and waiting to apprehend any who violated his prohibitions. His rules had been plentiful and petty: No smoking, playing music, or even wearing sunglasses.

Prison sentences and floggings were meted out to those foolish enough to violate the finicky code of conduct by which the sultan rejected the material and cultural features of 20th-century society and enforced his national policy of strict isolationism.

Whoever might sight through the sultan's spy holes today would observe, as I did, a dramatic relaxation of the old restrictions. Strolling about the *sag* below the palace walls, I saw shoppers in sandals buying flashlights, watches, and cigarettes. A small Japanese automobile honked insistently at pedestrians. Somewhere a transistor radio blared. And a movie-projection crew was setting up for one of the regular shows that citizens now enjoy without charge, with the palace wall serving as a screen. Few of the hundreds who view the films ever saw a movie before the old sultan was deposed.

Desert Oil Fuels Oman's Future

A journey through Oman today often directs the traveler's gaze backward through the eyeholes of tradition. But more than that, it provides a forward look at a land where modest but persistent progress steadily improves the Omanis' lot. Funding new construction and social-service projects with money from oil royalties—\$150,000,000 in 1971—the Kansas-size Moslem monarchy at the eastern tip of the Arabian Peninsula has swung open to the world the door that it kept locked for generations. It is a welcome development.

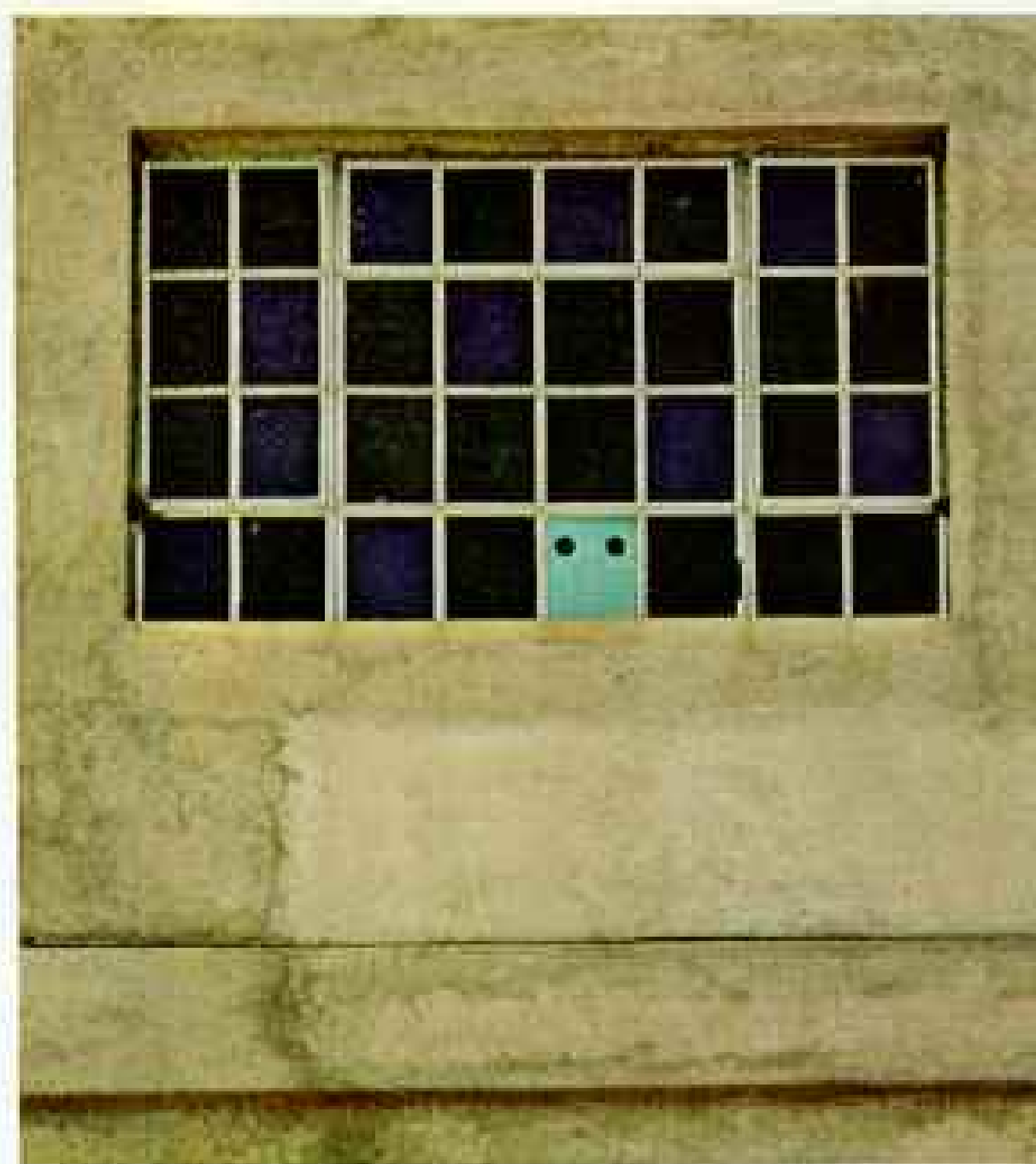
As an American photojournalist based for four years in the Middle East, I had witnessed the gradual evolution of new freedoms in Oman during earlier travels in 1970 and 1971. Startling advances greeted me last year on my third visit to the country.

I found a ferment of growth in Muscat and Matrah, neighbors on the north coast. Lava hills

Oman, Land of Frankincense and Oil

ARTICLE AND PHOTOGRAPHS

By ROBERT AZZI



The sultan who spied from within: Through peepholes in the palace window at Salalah (above), Oman's eccentric Sultan Said bin Taimur could peer out on his subjects in the streets below, searching for violators of his harsh edicts on dress and behavior. When his son ousted Sultan Said in 1970, delighted Omanis danced in the streets. In Rustaq, drummers (left) beat out rhythms of a new era during the Islamic Feast of the Sacrifice.

Clouds of fire—burn-off of gas separated from freshly pumped oil—scorch the desert at Fahud (below). Discovered in 1962, oil has become Oman's lifeline with the 20th century; royalties provide almost all the country's income. Reserves of the black bounty, however, may be exhausted in a few years.



CHRISTIAN WORTY, RAPHO GULLURITTE

Kneeling at sunrise in Muscat (right), Omanis in a mosque courtyard pray as the new sultan inaugurates the Feast of the Sacrifice. A military honor guard waits outside. Shops and schools close for the four-day festival, which commemorates the Koran's story of Abraham and Isaac. Lava ridges rim the outskirts of the city, the nation's capital.





Specialists in guerrilla warfare, British mercenaries and regulars advise Omani troops attempting to quell an insurrection in the rugged mountains of Dhofar Province. For the past five years, leftist rebels supported by neighboring Yemen (Aden) have tried to seize control of the sultanate to install a Marxist government.



separate the cities—ancient Muscat, the capital, and Matrah, the commercial hub whose population has outstripped its sister city's, 16,000 to 6,500.

In Matrah I had a carpeted, air-conditioned room, plus use of swimming pool and tennis courts, in the new Hotel Al-Falaj. Almost next door, mud-brick houses and shops are virtually unchanged from the 17th century.

In a building not far from the Al-Falaj, I stood one morning listening to Ali Sultan, a leading Omani businessman.

"Look at these people, the busy streets, the harbor, the mountains. Everything you see has been touched by Allah since 1970. Trade brought us our former prosperity, and it can again. The oil money we are getting permits us to build an economic base that will sustain us, Allah willing, regardless of the future of our natural resources."

Ali Sultan waved his hand at the scene before us. Earthmovers were grading a highway leading to the northern shore, where a

deepwater port was taking shape (pages 216-17). Workers swarmed over new concrete-block buildings. Automobiles and motorbikes, mostly Japanese, crowded the roads.

"It's a new day in Oman," said Ali Sultan. "Soon I'll be moving from this old building to that new one." He pointed to an architect's drawing on his office wall. It showed a modern concrete-and-aluminum structure with asphalt driveway, green trees, and figures of suited businessmen.

Coup Liberates Repressed Omanis

I glanced at Ali, standing in his white *dish-dasha* (the long everyday robe), embroidered cap on his head, silver-handled curved dagger—no Omani is without such a *khanjar*—tucked into his belt. Would Ali, I wondered, really like a business suit?

When Ali mentioned "since 1970" and "a new day," he referred to events occurring in Oman after July 23, 1970. On that date Sultan Qabus bin Said bin Taimur Al Bu Said



OMAN Kansas-size sultanate that once ruled the East African sea trade, Oman from 1798 until recent years permitted the British to handle its consular matters abroad. Arable regions of the primarily desert land are Al Batinah on the north coast and a fertile crescent between the sea and the Qara Mountains in the south.

AREA: 82,000 square miles. **POPULATION:** About 1,000,000, mostly Arab; significant groups of Africans, Baluchi, Indians, and Persians. **LANGUAGE:** Arabic. **RELIGION:** Islam, chiefly Ibadi, Sunni, and Shia sects. **ECONOMY:** Oil, dates, herding, and fishing. **CITIES:** Capital, Muscat, 6,500; Matrah, 16,000. **CLIMATE:** As hot as 130° F.; humid lowlands.



overthrew the repressive rule of his father in a palace revolution. Suddenly a neglected people were granted liberties and opportunities denied them for nearly four decades.

"It was as though a constricting steel band had been removed from the chest of the nation, and people could breathe again," said Dr. Donald Bosch, an American medical missionary long resident in the country. "Omanis danced in the streets for days. The nation was a hermit emerging from its cave."

Soon after my arrival, I drove along the cliff-hanging coast road to Muscat to observe al-Id al-Adha, the Feast of the Sacrifice, an Islamic holiday that celebrates the Koran's poignant account of God's testing of Abraham and Isaac. In Muscat I stood on the parapet of Fort Mirani, built in 1588, one of two grim Portuguese fortresses that guard the harbor. With a gruff roar, its antique guns proclaimed the Id, the salvo echoing from the crenellated buildings of a city that has always reminded me of a set for the filming of a Kipling epic.

Waging war on malaria, a traditionally garbed medical aide works at a Taqah dispensary, where she issues free medicines. Malaria strikes a majority of Omanis.





Below the fort, in the Khor Mosque, 32-year-old Sultan Qabus (left) attended prayers to formalize the start of the four-day festival. His honor guard stood outside, braced at parade rest beside the new military trucks that had brought them (pages 206-207).

To see traditional dancing of the Adha feast, I drove 90 miles west next day, partly over a new paved road, into the mountains. On a plain before the fort of Rustaq, I sat on a palm-frond mat with a wiry old sheik, Mohammed bin Hilal, and watched bands of tribesmen converge, each leader festooned with cartridge belts and bearing aloft the Omani flag.

"It's a happy day," said Mohammed bin Hilal. He added with a smile, "Even the women will be willing to be photographed at the feast."

Flashing Blades Enliven Dance

Tall and thin, the men stood in circles. They swayed gently, chanting in low tones, their dishdashas rippling about their ankles. Hide-covered drums boomed a rhythmic monotone, and wooden flutes sounded a low vibrato (page 204).

In each ring the action was the same. I watched the center of the nearest where two warriors, wearing turbans of bright Kashmiri scarves, paced out the steps. One brandished an ancient sword. The other flashed a vicious curved khanjar. The drummers picked up the beat and the men moved closer—whirling, spinning, leaping. Nearer and nearer flicked the khanjar blade to the neck of "Isaac," the man with the sword. At each stroke I winced. But the hand of "Abraham" was always stayed, and my look of relief won smiles from men comfortable with a stranger in their midst.

At last, when the setting sun began to brush Al Jabal al Akhdar, the Green Mountain, the dancing and merriment abruptly halted. It was time for the warriors to return to their houses for evening prayers.

Back in Muscat, wandering through the shadowed suq, I pushed among turbaned men who strolled the streets swinging their camel sticks, short lengths of bamboo crooked at the end, which Omani men carry in the streets. Heavy cartridge belts hung about their waists. But on their wrists they wore Swiss watches, and they had clipped ball-point pens to their robes. They flopped along in pink, yellow, or blue plastic sandals, shopping bags



"I am a man with one foot in my country—backward as it is—and the other in the 20th century," says Oman's new sultan, Qabus bin Said bin Taimur (left). Educated at England's elite Sandhurst, the young ruler brings a modern outlook to a land until recently locked in its own dark ages. Kept virtual prisoner by his father for six years, he engineered the bloodless palace coup in 1970 that sent the elder sultan to exile in London.

Loyal family retainers (above), carrying attaché cases and submachine guns, wait for the sultan to alight from a plane upon his arrival at Bait al Falaj.

bulging, typically, with dates, dried fish—and light bulbs.

Most worldly goods from abroad were prohibited before Sultan Qabus deposed his father. The xenophobic old Sultan Said had forbidden his subjects newspapers, flashlights, and umbrellas. He banned dancing, singing, photography, and Western apparel.

A London hotel suite became the exiled ruler's realm after the palace coup; he died there in October 1972.

When young Sultan Qabus—Sandhurst-trained, bilingual, music-loving, and approachable—came to power, he at once set in motion the economic and social reforms that are wrenching Oman out of the Middle Ages.

Sultan Qabus still holds to the strong-roots

of Moslem tradition. Islam's religious authority remains unchallenged, though the muezins who once manned the minarets have been supplanted by loudspeakers that broadcast recorded calls to prayer. Women, even those who wear bell-bottom slacks at home, on the street are always shrouded in the loose-fitting long black *aba*.

Little Farming in Sunbaked Land

For all the country's sudden progress, you don't go far in Oman without learning the limits of its resources. Arid gravel flats and sandy desert cover most of its 82,000 square miles. Much of the year malevolent heat curses the land, and a shortage of water restricts the agricultural potential. Farmers



coax some grains from the thirsty soil, but dates, limes, and pomegranates are the chief export crops. Modest quantities of bananas, grapes, and coconuts are also marketed, as well as dried fish.

The country's income is derived almost entirely, however, from oil royalties. Since 1967 petroleum for export has flowed from fields near the edge of Arabia's vast and sandy Rub al Khali, the Empty Quarter.

Oman's million people reflect the country's turbulent history. Most of them are Ibadī Moslems. The rest are adherents of the Sunni and Shia sects, many of them from Baluchistan, Persia, India, and East Africa. Still evident are remnant populations of ancient tribes that lived here before the advent of

Islam—the Mahra, Harasis, Jeballi, and Shi-hub peoples.

Arabs from other parts of the Arabian Peninsula settled in Oman between the first and sixth centuries A.D. Early in the 16th century the adventurer Alfonso de Albuquerque asserted Portugal's rule. But in 1650 the Portuguese were expelled.

Turning to the sea, Oman became an aggressive trading nation, shipping the fragrant gum resin known as frankincense, as well as ivory, pearls, and other gems. Sometimes employing English captains, Omani dhows were familiar sights in ports from East Africa to China. By the 18th century the Omanis ruled the sea lanes of the Persian Gulf.

In 1749 Ahmad bin Said Al Bu Said became



Marching manholes mark the route of a subterranean aqueduct (above) bringing water from the mountains to the desert. Close-spaced holes provide air for workmen who periodically climb down to repair the centuries-old conduit. Rubble dug out from within creates the anthill-like rings around each crater. At Wadi Sumail oasis (left), palms will be planted in holes irrigated by the diverted mountain streams. The waters also nourish nearby alfalfa fields.



ruler, the first of a long line of Al Bu Saïd monarchs. Sultan Qabus, the reigning ruler, is the fourteenth in the dynasty.

Oman's maritime ascendancy and footholds in East Africa brought the country into conflict, then into accommodation, with imperial Great Britain. Throughout the 19th century and continuing in the 20th, the British have exerted strong military and political influence in Omani affairs.

Sultan Qabus has been luring back Omanis who had fled his father's repression or had been refused reentry out of fear that they would bring home progressive ideas from abroad. Typical of this breed of repatriated Omani is Nassir Seif el-Bualy, Director General of Information and Tourism.

"I came back two months after the coup," Nassir said to me, "and it was as if a great load was lifted from my shoulders. I was home. When I went to Izki, the home of my parents, I was treated like a returning hero."

Another returnee, Abdul Hafidh Salim Rajab, left Oman in 1952 and went on to earn a degree in technical sciences at the University of Kiev in the Soviet Union. In 1971 he was invited back to Oman to join the government as the Minister of Economy.

War Drains the National Treasury

In Abdul Hafidh Rajab's home province of Dhofar progress is still hampered by a stubborn war, waged for more than five years by leftist Omani insurrectionists supported from neighboring Yemen (Aden). The bitter Chinese-backed insurgent group bears the identifying initials PFLQAG—Popular Front for the Liberation of the Occupied Arabian Gulf.

I visited Dhofar to get a glimpse of the grinding conflict that has been costing Oman nearly half its total income each year.

Dhofar gained fame in antiquity's lucrative trade in frankincense. Ships and caravans carried it north from Dhofar to Egypt, Syria, and distant Rome, and eastward to the temples of India.

In a red-and-white Viscount crowded with robed and turbaned travelers, I flew 500 miles south from Muscat over barren mountains, vast dunelands, and desolate coast to Salalah, Dhofar's capital. A city of 10,000; it stands at the seaward rim of a verdant, fertile crescent walled off from the interior by the Qara Mountains (map, page 209).

Rains from the southwest monsoon blowing in from June through August nourish



Dwellers in the hinterland reflect the heritage of ancient Persians, early Portuguese navigators, African slaves, and Semitic tribesmen who settled the Arabian coast and shaped the sultanate's history.

The leader of a Jeballi tribe (left) spares first one foot, then the other from Dhofar's searing sand. He wears his cartridge belt for decoration, leaving his rifle at home.

A Shihuh tribesman (upper) carries alfalfa home from market on his *gerz*, or ax—a badge of his tribe.

Masked woman of the nomadic Harasis (above) makes instant camp by spreading a blanket over a bush.

dense palm groves, mostly coconut. Green pastures and fields of golden grain provide welcome contrast to the barren interior.

In the polyglot Salalah suq, where the numbers of black people attest Oman's centuries of contact with East Africa, I shouldered my way among fierce Baluchi soldiers in their baggy-bloomer trousers, graceful dark-skinned Zanzibari women, upright British military officers in khaki slacks, proud Dhofar sheiks in robes and turbans.

When I stepped into the shade of a doorway, a Brooklyn accent made me turn. "What part of the States are you from?" the voice asked. I had stumbled on the hardware shop

of a man called Ahmad, a former merchant seaman who had lived in the United States for seven years and become an American citizen. But when he heard of the 1970 coup, he had hurried back to Oman.

"It was a chance to come home," Ahmad said. "I miss some of the things I had in the States, but I've married an Omani and I intend to stay here. Having an American passport never really made me an American."

Despite the debilitating war, a bullish mood pervaded Salalah. I saw new buildings going up everywhere.

"We had only 13 people unemployed in all Salalah last month," Robin Young, Dhofar's



development director, told me. Robin is one of the knowledgeable British Arabists found in responsible administrative posts all over the country. "Opening of a new port at Risut next year should stretch the boom."

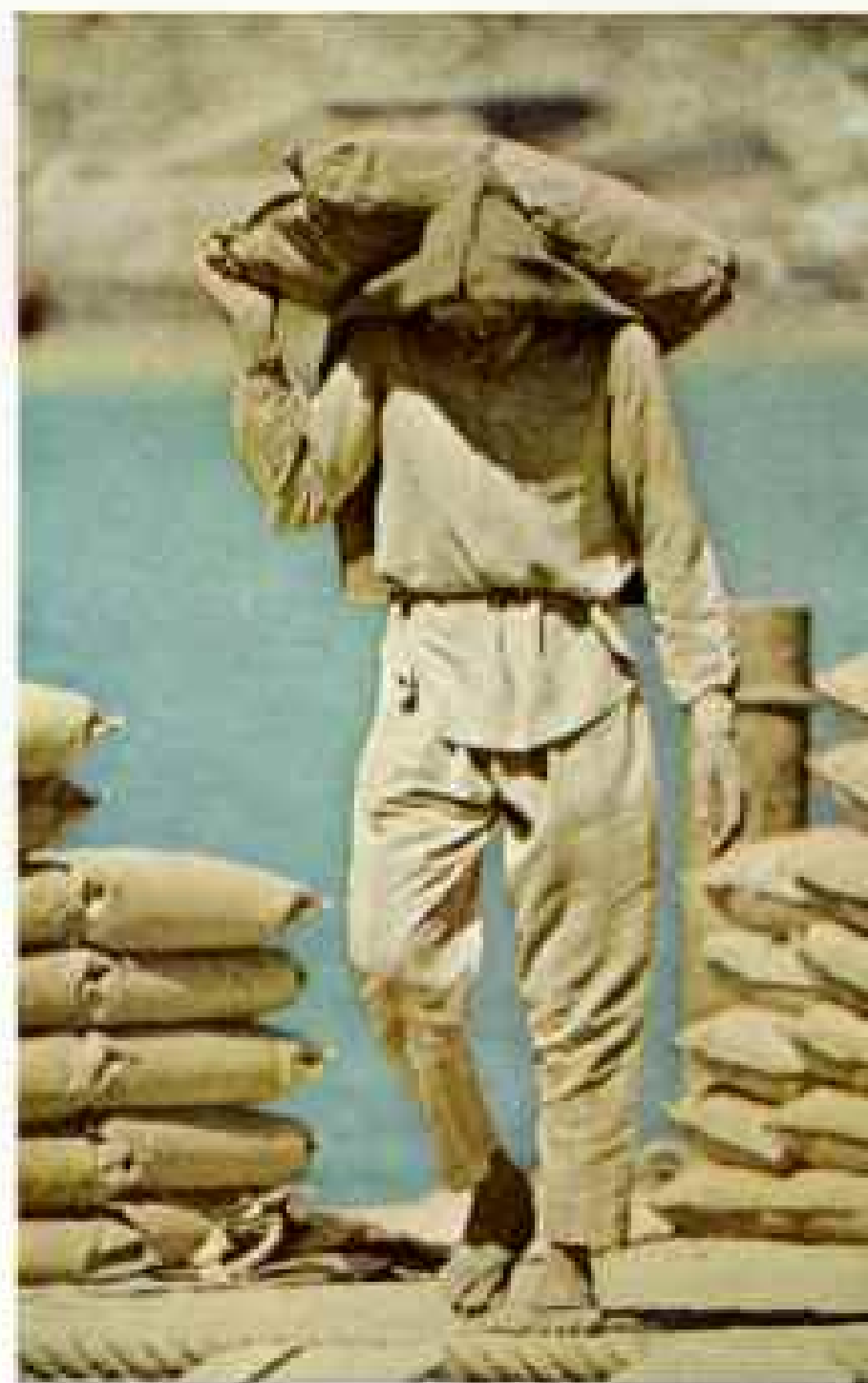
On a square at the edge of the sea stands the sultan's palace, now one of the new monarch's official residences. Until two years ago it was the hideaway of the embittered Sultan Said, and here still in place is his viewing window, with the blank stare of its eyeholes.

In the market below I met a wizened old man who gave no other name than Said. He talked of Dhofar's storied past, then guided me to a wide, shallow draw west of Salalah

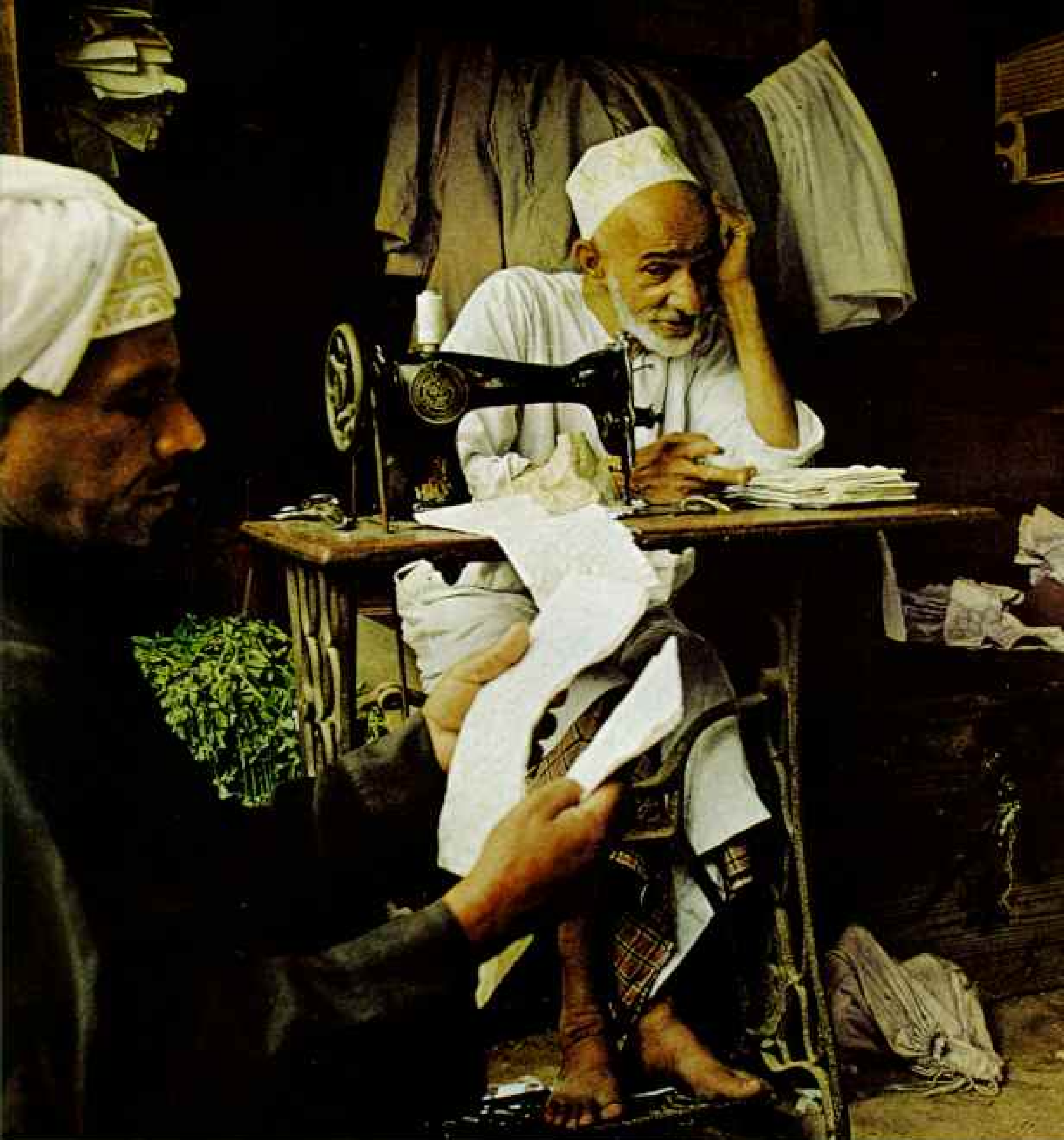
where a patch of gnarled frankincense trees stood amid worn-out tires, rusty tins, and other refuse. Squat and gray, with grotesquely outflung limbs, the trees had an unreal—almost supernatural—look.

"This ancient tree still yields frankincense," he said, tapping one of them, "but to gather it I would have to make three collecting trips over the 40 days that the resin exudes. Not worth it. Easier to be a laborer."

Back in Salalah, where only a year earlier mortar fire of the rebel insurrection could be heard close to the city, I was introduced to the *wali*, who perhaps has most at stake in gaining peace for Dhofar. The wali is the



Concrete knuckles will armor a breakwater at new Port Qabus (left) near mist-shrouded Matrah, the nation's commercial center. A laborer (above) carries cement for the construction of a pier. By 1974 eight deep-water berths will service ships for trade with India, Britain, Australia, and Japan. Roads now under construction will eventually carry imported goods to isolated villages in the interior.



province's civil governor. He reports directly to the minister of the interior.

Wali Braik bin Hammoud administers 35,000 square miles of mountains, desert, and fertile plains. One of the new sultan's most trusted aides, Wali Braik was a key figure in the 1970 coup.

"Come!" said Braik to me one morning in his office. "We shall go to Taqah." He fingered the neckline of his pink dishdasha and picked up his Belgian-made Fabrique Nationale automatic rifle. "I want to visit with the sheiks

and let them know that the people in the big city still care about them."

In his Land-Rover we raced down the beach to Taqah, arriving in time for lunch at the home of the chief sheik, who wore a flowing dishdasha of royal blue. I was introduced to other dignified local leaders, who reminded me of proud, disdainful hawks.

"*Bismi llahi r-rahmani r-rahim*—in the name of Allah the Compassionate, the Merciful," intoned our host, and we squatted down to help ourselves to rice and toothsome



chunks of goat meat. After a tour of the town and a couple of hours of friendly gossiping, Wali Braik and I drove back to Salalah.

Next day my stomach was still queasy from overeating when I dropped down through Dhofar skies in a camouflaged helicopter that was losing altitude at 2,000 feet a minute. My companion was a British officer serving with the Dhofar forces.

We were preparing to land in the Qara Mountains, on a small plateau 30 miles east of Windy Ridge. Our pilot, a British flight

Treasured sewing machine proves a happy convenience for a barefoot maker of *knommas*, the distinctive embroidered caps of Oman. Customers in this cubbyhole Muscat shop make their selections from stock that pours from the one-man production line.

lieutenant, noted my ashen face. "The faster we come down," he apologized, "the less chance the rebels have of hitting us."

The Omani army is staffed with many British officers, some under private contract to the country, others attached temporarily—"seconded," it's called—to local military units. Great Britain still advises Oman on the handling of external affairs.

In the mountains I visited several encampments of soldiers (page 208). "Those are Firqa companies," my officer guide said, pointing to one group. "Made up of former rebels who have come over to fight for the sultan, the Firqas are to us what the Indian scouts were to your U.S. cavalry.

"Only about 500 to 600 hard-core rebels are left in the mountains," he declared. "Traditionally, we've managed to contain them between September and May, but when the monsoon strikes, we've been pulling back because bad weather prevented flying in supplies. Then the rebels have been able to retake positions. This year it will be different. We have stockpiled supplies, and we're going to stay up here through the monsoon."

Oil Seekers Probe the Interior

We returned to Salalah and there, with Wali Braik's help, I laid out an overland trip by Land-Rover through the stark interior of Oman. I flew over the mountains to the crossroads town of Thamarit and met my escort, John Carter, a young British liaison officer for Petroleum Development (Oman) Ltd.

Controlled 85 percent by Shell, PDO supervises all oil production in the sultanate and pays the royalties which are the lifeblood of Oman's economy.

For days we followed dim tracks across sunbaked gravel flats. Oil-exploration campsites are strung out the length of inner Oman. We planned each day's travel to bring us to one of these oases of hospitality at nightfall.

Near the Wadi Mughshin the year before, the oil company had drilled a water well to supply local Bedouin. Thus we came upon what seemed a mirage—an artesian lake a

*"Every soul shall come disputing on its own behalf,
and every soul shall be paid in full for what it wrought. . . ."*

After reading this passage from the Koran, the *qadi*, or legal arbiter (below), listens to a family's dispute (lower) in Salalah. The 1,300-year-old system of justice used in Oman and throughout the Arabian Peninsula is based on literal interpretation of the Koran. Barred from court, women testify through a window (right); a man's word equals that of two women. When testimony ends, the judge delivers a verdict supported by appropriate passages from Islam's holy book. Sultan Qabus plans to incorporate Western legal concepts into the traditional system to help his countrymen cope with changing commercial and social conditions.





mile long and 300 yards wide. Animals and birds have found it: We saw flamingos wading and gazelles drinking along the shores.

Our journey ended at Fahud, main base camp for PDO. The facilities there are unimpressive. Pumps, pipes, generators, radio masts, and a trailer town fail to suggest the real importance of these installations to Oman's well-being. A pipeline carries the oil 170 miles to a terminal at Mina al Fahal near Matrah (map, page 209).

Oil Boom May Be Short-lived

Serious oil exploration began in Oman in the 1950's, with concessions to Cities Service Oil Company and the Iraq Petroleum Company. Discouraged by dry holes, both gave up the search by mid-1960. Shell and Partex, members of the IPC group, continued exploration on their own, and two years later found oil in commercial quantities. In 1964 they struck another pool at Fahud, less than a mile from a dry test hole drilled by IPC.

PDO men told me that Oman's 1971 daily oil production of 285,000 barrels fell slightly below the previous year's output. To worldwide oil supply, the country's contribution is but a trickle—half of one percent. It represents only 2 percent of the Middle East's production. A third of Omani oil goes to Japan, most of the rest to Western Europe.

Omani Arabs are aware of the vast wealth and economic development that oil has brought to the nearby Persian Gulf states. They know that their neighbors in Abu Dhabi enjoy one of the highest per capita incomes in the world. The expectation that Oman will enjoy a similarly fantastic boom is only natural. But, unfortunately, the oil resources of Oman appear quite limited, and reserves at Yibal, Natih, and Fahud are expected to be exhausted within a few years.

West of Matrah lay an important part of Oman still to be visited. I now had a driver, a young man called Jumma. He and I set out for the coastal Batinah district. Related to the Arabic word for belly, its name is an appropriate one for the most productive agricultural region in northern Oman.

We entered the Batinah when we started

passing vast date palm plantations and villages of palm-frond huts called *barastis* (page 226). Camels and donkeys burdened with firewood and alfalfa plodded toward the markets at Matrah.

The Batinah is thousands of shallow wells nourishing date palms and wheat fields. It is alfalfa and maize grown for stock feed, and gardens of vegetables. It is fishermen along the beaches hauling nets laden with mackerel, sardines, and sharks.

At a low mud-brick building in Suhar, I spoke with Clair Tafts of Lancashire, England, a volunteer for Save the Children, a British-based international agency that trains disadvantaged mothers in child care.

"We don't attend to sick children," Clair told me. "There is a dispensary for that. What I do is see thirty or forty mothers each morning to teach them ways of improving the care and health of their babies."

Before Sultan Qabus came to power, Oman's major public medical services were provided by the American Reformed Church Mission, based in Matrah. Trachoma—a contagious eye affliction—and malaria were endemic; knowledge of even the simplest hygiene was almost nonexistent.

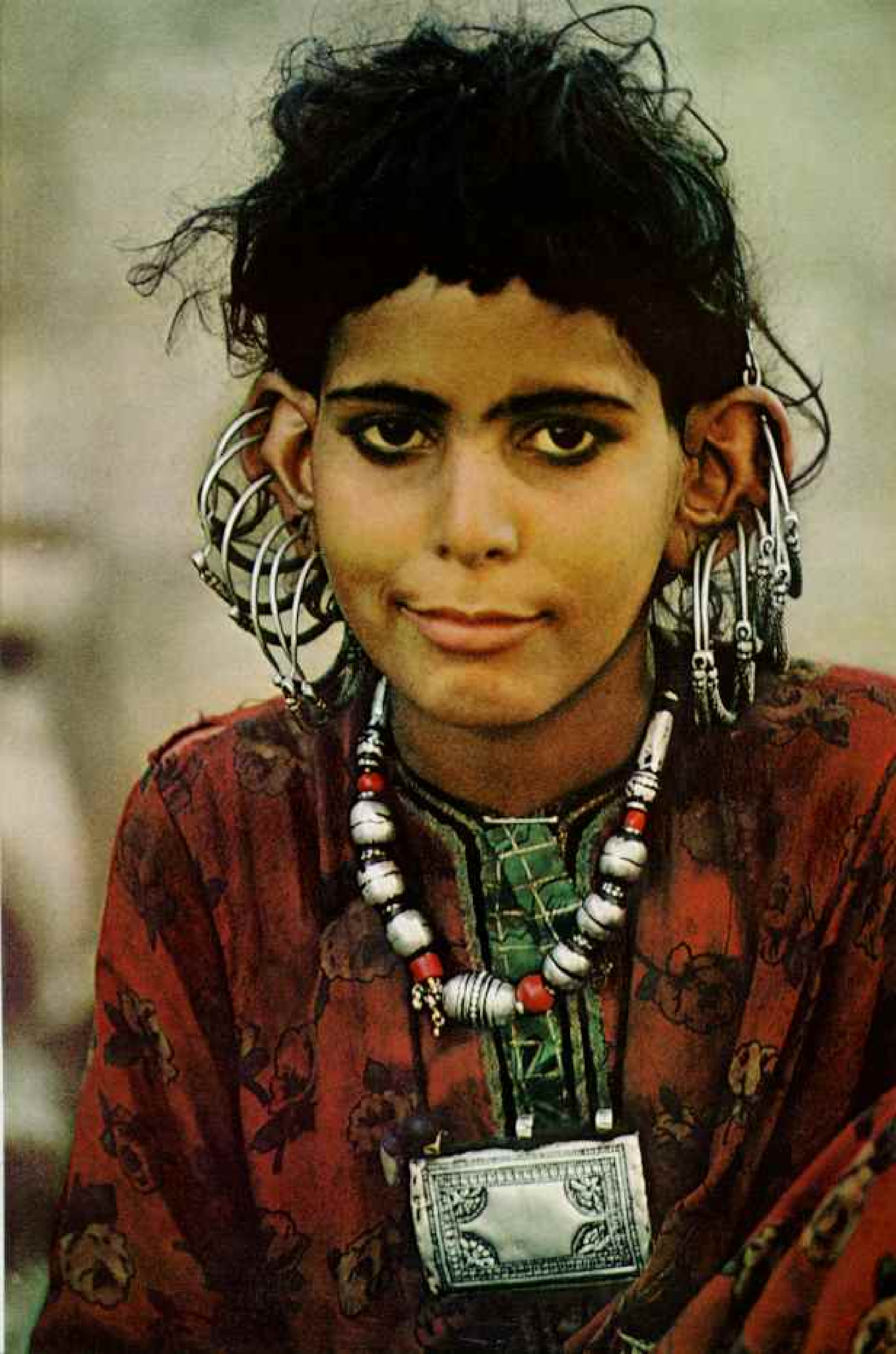
"One of the new government's first moves made medical care free to all Omanis," mission head Dr. Donald Bosch told me. "The mission offered its help to the country. We agreed to stay on for at least three years to help establish national health programs. In the first six months the administration set up 20 dispensaries throughout the country."

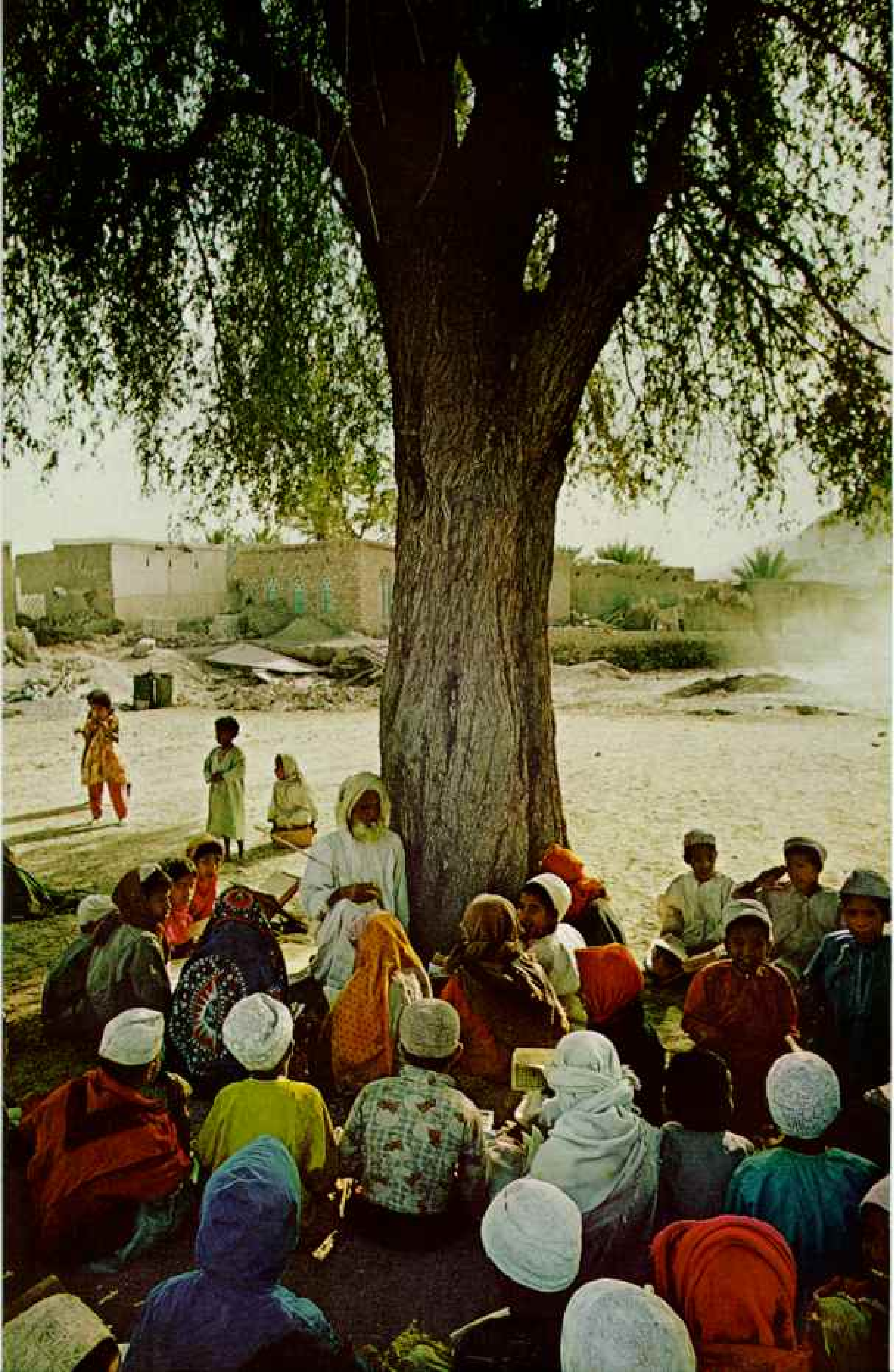
Two Nations Share Oasis

From Suhar we drove 70 miles west to Al Buraymi, historic landward gateway to inner Oman. The border oasis is shared by Oman and the United Arab Emirates—formerly called the Trucial States. I had first seen Al Buraymi in 1970, when Sultan Qabus made his first visit to the oasis, which had been rewon in 1955 after seizure by Saudi Arabia.

On the Emirates side there are opulent residences, lighted plazas, handsome municipal buildings, a dual highway, and even a Hilton hotel. But the road from the Persian

Silver rings dangling from her ears, a country girl dons family wealth for a visit to Matrah, Oman's largest city. The tooled case contains Koran verses for good luck. At puberty, wealthy girls begin wearing veils before strangers. To keep clan ties strong, an Omani father traditionally tries to marry his daughter to his brother's son.







Tree of knowledge now spreads a wider shade in Oman. For centuries, Oman's "one-tree" schoolhouses (left) taught only passages from the Koran. Sultan Qabus has now opened scores of schools. In Muscat, at the nation's first school for girls, youngsters study embroidery in a home economics class (above), as well as English, Arabic, and mathematics. Boys of Al Masmah (below) ride home after class.



Palm-frond "planking" forms both homes and boats along the Batinah coast. *Barasti* huts (below), fashioned so that cooling breezes can pass through their walls, cluster within fenced family compounds. While their husbands fish, women tend the animals and prepare food. Boats called *shashar* (right) carry fishermen plying the sardine-rich Gulf of Oman. Most fishermen own two, so that when one gets waterlogged, a dry one is available. An important Omani industry dries sardines for camel fodder and fertilizer.



Gulf coastal city of Abu Dhabi comes to a dead end at the border. The Omani side, with mud huts, ancient forts, and rutted gravel tracks for roads, still has a long way to go to catch up with its rich neighbor.

I returned to the Omani capital to keep an appointment with Sultan Qabus. Pending completion of his new palace, the sultan lived in a modest white house in the old walled city of Muscat.

In his private office the sultan shook my hand, saying, "Good morning. Welcome. It is good to see you again."

He wore an elegant brown aba, embroidered with gold thread, and a gold khanjar at his waist. His head bore the multicolored



turban that is worn only by the Al Bu Saïd.

"Since 1970, we have come far," the sultan said as we sipped glasses of the popular iced lime drink called loomey. "A national feeling of working together has developed. This is generating great progress. I am encouraged by the spirit of the returning Omanis. Not only do they bring skills we need, but they make no complaints about the lives they have given up abroad."

Sultan Qabus is convinced also that his troops are winning the war in Dhofar.

"We have eliminated most of the problems that gave rise to the rebellion," he said. "Now we are fighting only Marxist insurgents supported by troublemaking outsiders."

Important to Sultan Qabus is support from the powerful sheiks of the interior, men cautious in accepting change. My final overland journey took me to the old desert towns beyond the northern mountains.

"Go to Nazwa," Nassir Seif el-Bualy, the information director, had told me. "There you will find the traditional Oman."

A hundred miles southwest of Muscat I reached the ancient capital of Oman. A drowsy place, Nazwa is nevertheless the most important city in the interior, albeit the most strictly conservative.

At a historic round fort I paid my respects to Hilal bin Sultan al-Hausani, wali of Nazwa. I found him presiding over the *majlis*, the





open meeting attended by petitioners and friends each day.

Beside him sat the district's *qadi*, the arbiter of legal questions. Essentially a judge, the *qadi* of a region runs the courts, basing his decisions and interpretations on the teachings of the Koran.

The assembly place was a dark, cool room. I removed my shoes at the door and exchanged greetings with the wali. Sitting on one leg and taking care not to show the bottoms of my feet (a rude gesture), I looked at the spectators, friends of the wali listening to those who came seeking his counsel. They shared one identifying feature—each held a rifle.

One petitioner needed a new water pump, and two others wanted the wali to settle a dispute over an automobile accident.

Nickname for an American Friend

After Wali al-Hausani had dealt with these problems, he turned to ask me what I desired.

"I would like to photograph this assemblage of fine warriors," I replied.

The wali asked those present if they objected. Qadi Sheik Saud bin Suleiman al-Kindi, interpreter of the Koran, promptly demurred. I began to return my camera to its case. Moments later, the *qadi* quietly rose, courteously saying that he would leave the room while I took pictures—because, he said, he could see how much I wanted them.

When I had finished, the *qadi* returned and we drank the traditional three cups of coffee. Incense was then brought around, and the bearded men with clean upper lips were delighted to see me waft the fragrant fumes through my mustache. The wali laughed and named me Robert abu Shuwayrib—Robert, Father of the Mustache.

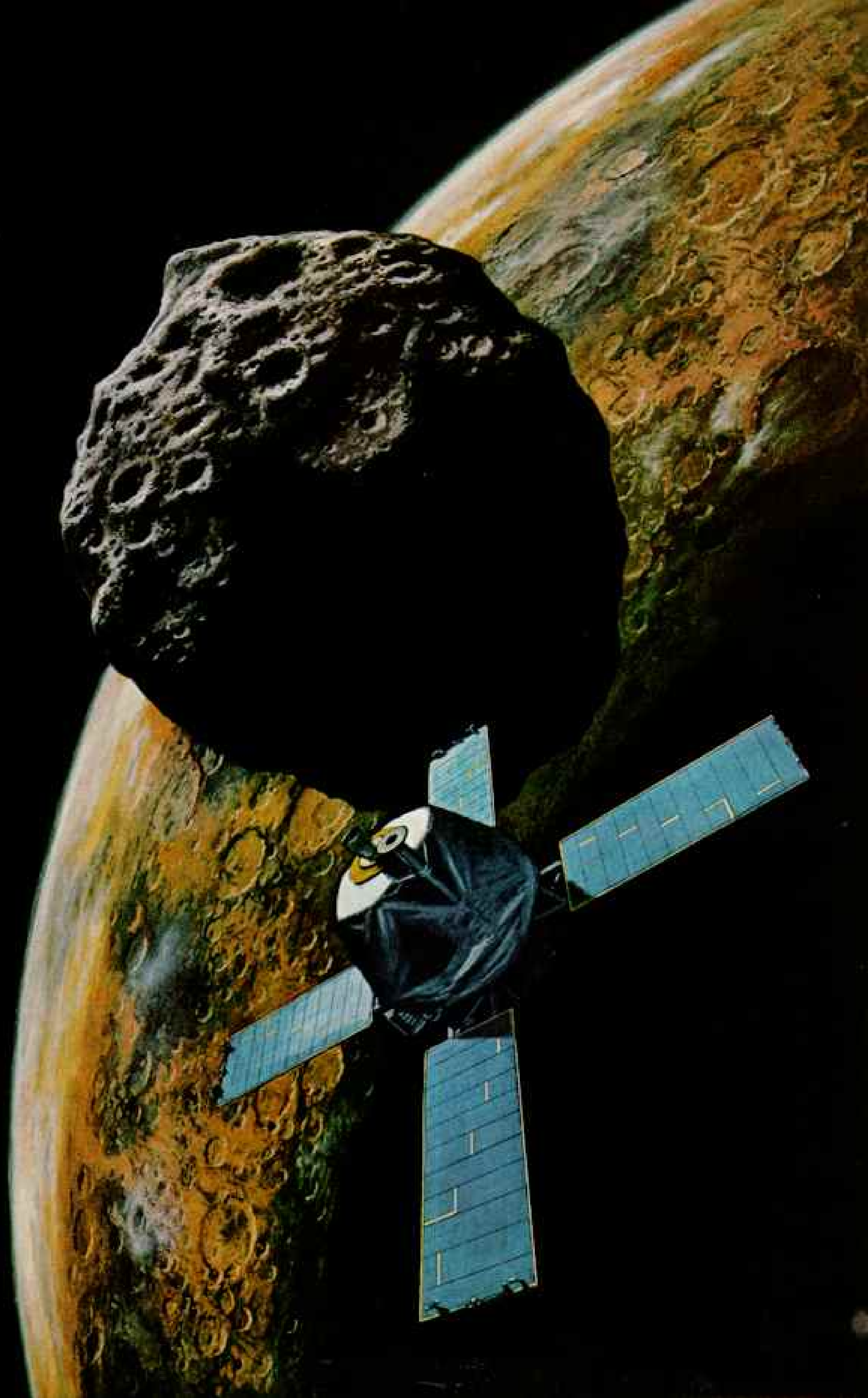
The span of miles from Nazwa to the coast led through the wild and awesome Sumail Gap, the road bringing me out of the Middle Ages to the paved roads and the brand-new hospitals and ministries, past the new international airport that on completion will be able to handle jumbo jets, within hearing of the jackhammers and the bulldozers building Matrah's deepwater quays.

Leaving Oman, I considered it still slightly unbelievable that two years had wrought such dramatic changes in technology, culture, and point of view. But in a land that once held powerful sway at the gateway to the Persian Gulf, an economic and social rebirth was, after all, not so strange. □

Sanctuary of green surrounds the ancient city of Nazwa, former capital of Oman (facing page). Its palms bear dates, the country's principal crop. Each tree is registered in its owner's name; often dowries consist of these alone.



Desert parking lot: New prosperity and a new ruler helped motorcycles become the most popular means of transportation in Salalah, where mechanical conveyances were once banned. Oman's cities increasingly buzz with 20th-century traffic.



MARINER 9

Journey to Mars

By KENNETH F. WEAVER
ASSISTANT EDITOR

Paintings by LUDEK PESEK

Satellites, man-made and Martian, orbit the red planet, whose splotchy face lies less than 4,000 miles below. Here artist Ludek Pesek "maneuvers" the instrument-laden Mariner 9 spacecraft to within 85 miles of the dark, 17-mile-long moon Phobos—a much closer approach than was actually permitted by technicians controlling the craft from the Jet Propulsion Laboratory in Pasadena, California. The clarity of airless space shortens the apparent distances between Mariner, Phobos, and Mars.

THE AFTERNOON SUN, glowing in a black vault, seems strangely diminished. Its light is muted, like the unaccustomed dimness that shrouds earth when the moon half crosses the sun. Yet shadows fall with sharp outline on every crater wall.

Low on the horizon the black of the sky dissolves to deep blue, softened by faint ribbons of haze. No cloud is to be seen, save for a rippled plume that stretches from the high scarp ahead.

All about is the eternal stillness of the desert, an eroded wasteland of reddish ocher. So overpowering is the garish russet landscape that it is a relief to find occasional outcroppings and flows of dark lava—the telltale signature of the volcano. It is another Death Valley, arid and cold, but glowing as though from the reflected fires of some ancient inferno.

No human traveler has yet gone to Mars. But, thanks to a little blue-winged satellite named Mariner 9, I can write about the red planet's cold and tortured face almost as confidently as if its landscape lived in my memory.

The details are all to be found in a flood of information gathered by the first spacecraft to orbit Mars. Circling twice each day since November 13, 1971, Mariner 9 has photomapped the planet's entire surface, probed its atmosphere, taken its temperature, and assayed its chemistry.

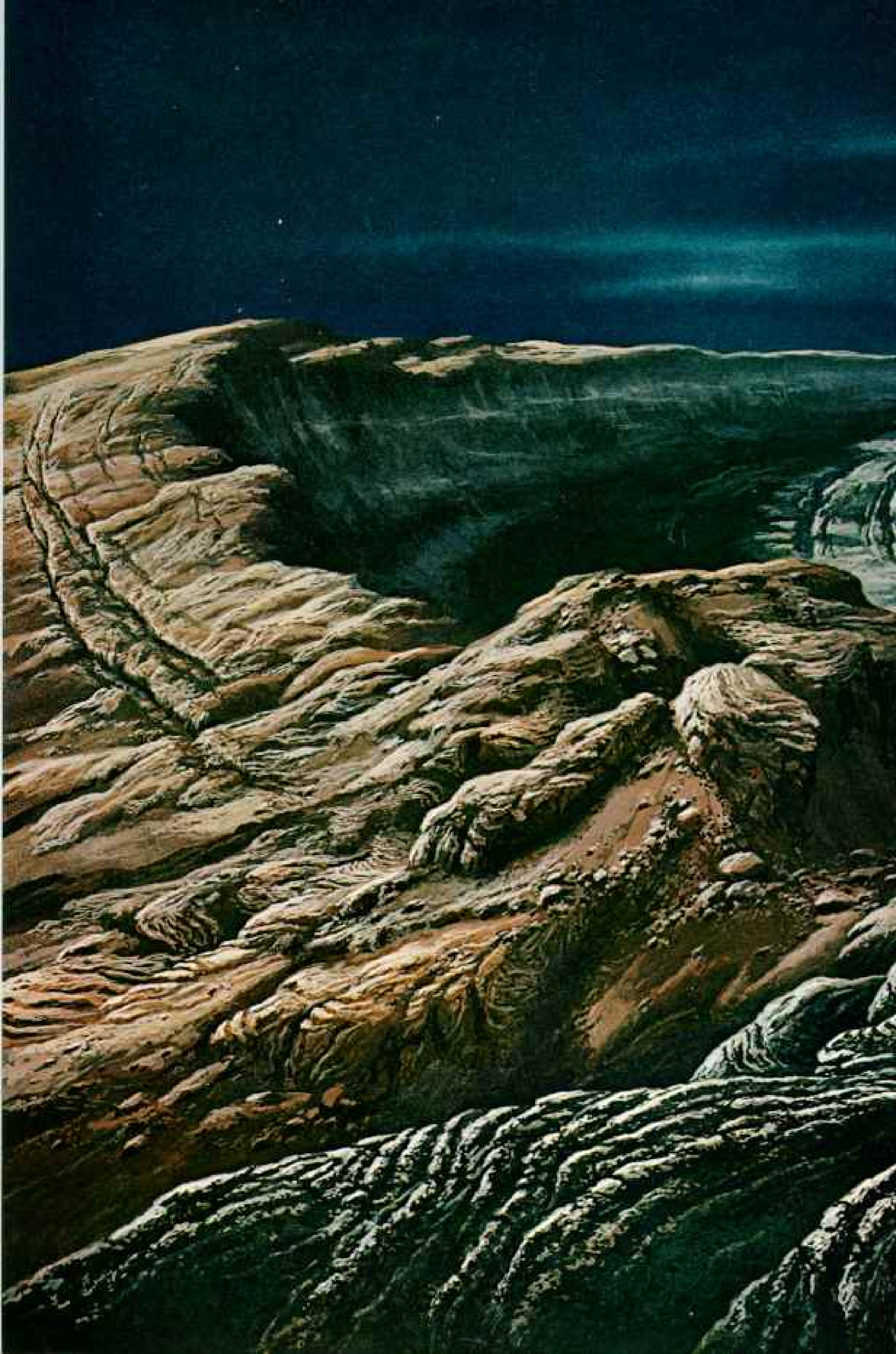
During a year of triumphantly successful operation, the satellite, with scarcely 150 pounds of scientific instruments, radioed back to earth more than 50 billion bits of information. These signals, captured by the huge radio telescope at Goldstone, in California's Mojave Desert, have been reconstructed at the Jet Propulsion Laboratory in Pasadena, California.

Some of the signals have been turned into more than 7,300 spectacular pictures, hundreds of them with resolution so fine that an object as long as a football field can be detected. Others have produced untold thousands of measurements in the infrared and ultraviolet portions of the spectrum.

Martian mysteries that have baffled observers for a hundred years or more may now be solved. But new ones, just as intriguing, rise in their wake.

When Mariner 9 was launched on May 30, 1971, earth and Mars were headed for their closest approach since 1924. Our view of Mars via earthly telescopes suggested that all was serene. But 167 days and a quarter of a billion miles later, Mariner approached a planet in turmoil. Two months previously, a dust storm had appeared in the regions of Noachis and Hellespontus and swiftly encompassed the entire globe. Nothing so extensive and long-lived had ever been seen by earthbound viewers.

Local dust storms are common enough on Mars,





and usually they subside within several days. But not this one. On November 13, as Mariner fired its braking rocket and swept into orbit, the storm had gone into the record books as the longest lasting, the most intense, and the most widespread in the history of Mars observations. And it showed absolutely no signs of abating.

So dense was the yellowish pall that at first only five surface features could be distinguished: the south polar cap, and four dark spots that later turned out to be the cratered summits of four huge volcanoes (page 249).

But subside the storm did, finally. And when the dust had cleared, in early 1972, we saw revealed a Mars we never knew.

Before the Mariner 9 mission, some scientists had said that Mars was a dead planet, like the moon. It was generally monotonous terrain, they said, with no mountain ranges, no great faults, no volcanic activity. That indeed seemed to be the evidence of the limited views of Mars photographed during the earlier Mariner flybys in 1965 and 1969.

But today we see a Mars that is internally alive, more like the earth than the moon, yet different from both, with dynamic forces shaping its surface. Our astonished eyes see geological forms of extravagant variety—volcanoes larger than any on earth; canyonlands that sunder the Martian crust for thousands of miles; giant dusty basins; jumbled uplifts and fractures; dry arroyos with intricate tributaries.

THE LIP OF THE CALDERA drops sharply away to a black and rugged floor. No red glow suggests the fires that may be burning far beneath that floor. But heavy scallops mark the distant wall, each the memory of a day—perhaps not so long ago—when a crater in the caldera filled with molten lava from the volcano's throat. The lava spilled over the lip to the slopes beyond, and then the crater floor collapsed.

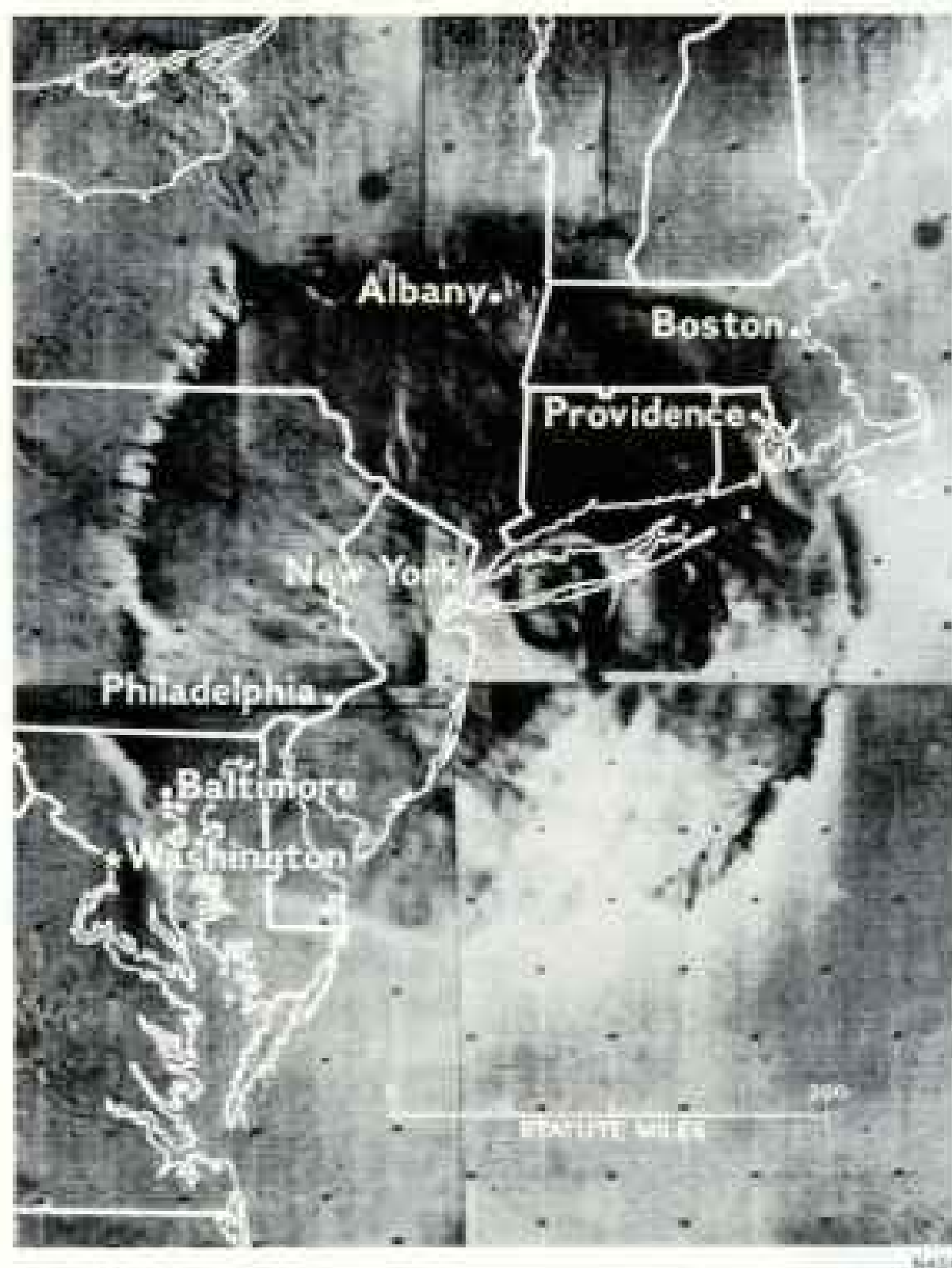
The footing is treacherous. Collapsed
(Continued on page 243)

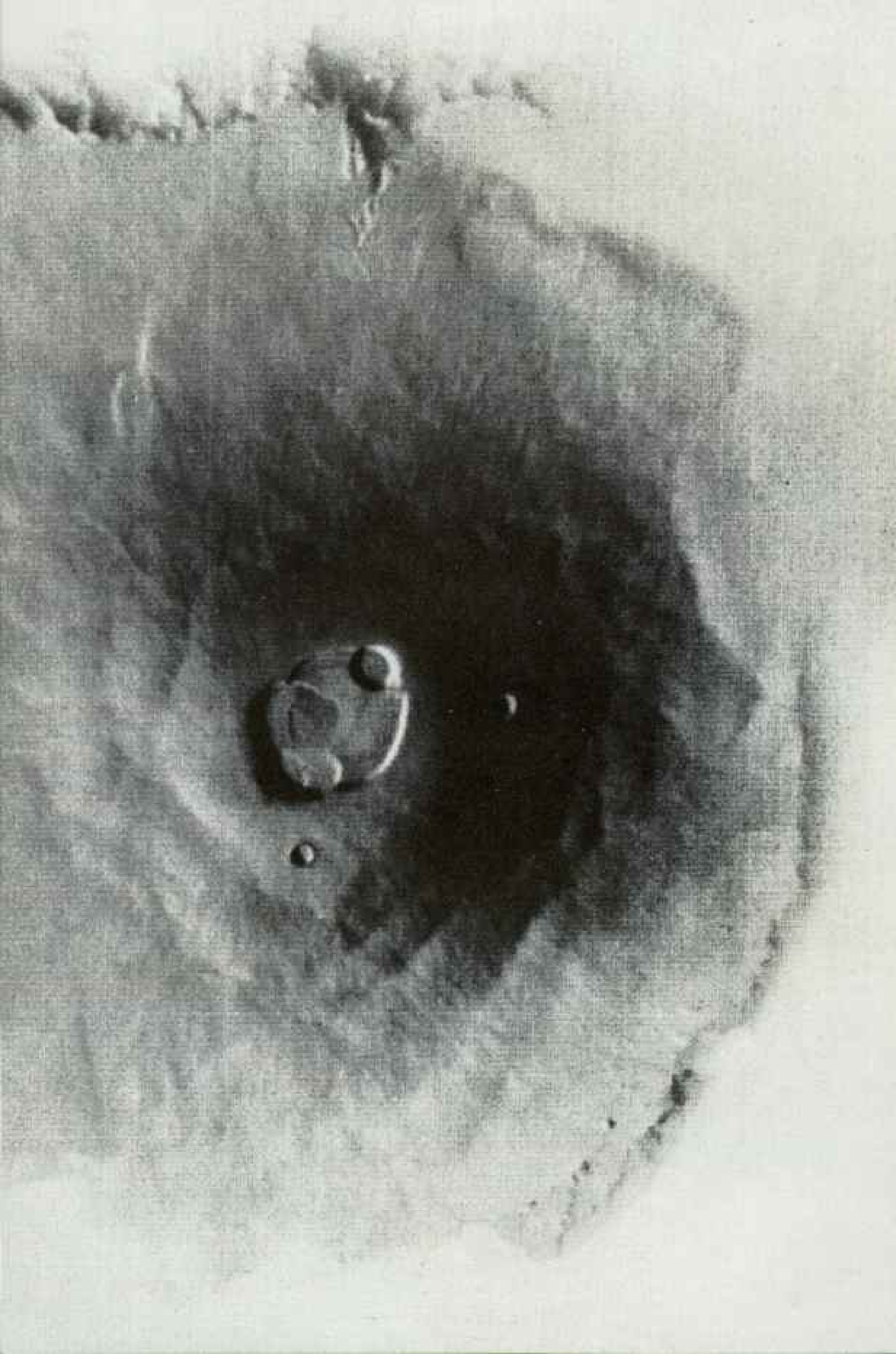
Mightiest of Martian mountains, the volcano Nix Olympica embraces a vast caldera some fifteen miles above a plain (next two pages). Its harsh features, and those of the entire planet, bared themselves to NASA's Mariner 9 during an incredible year of discovery.

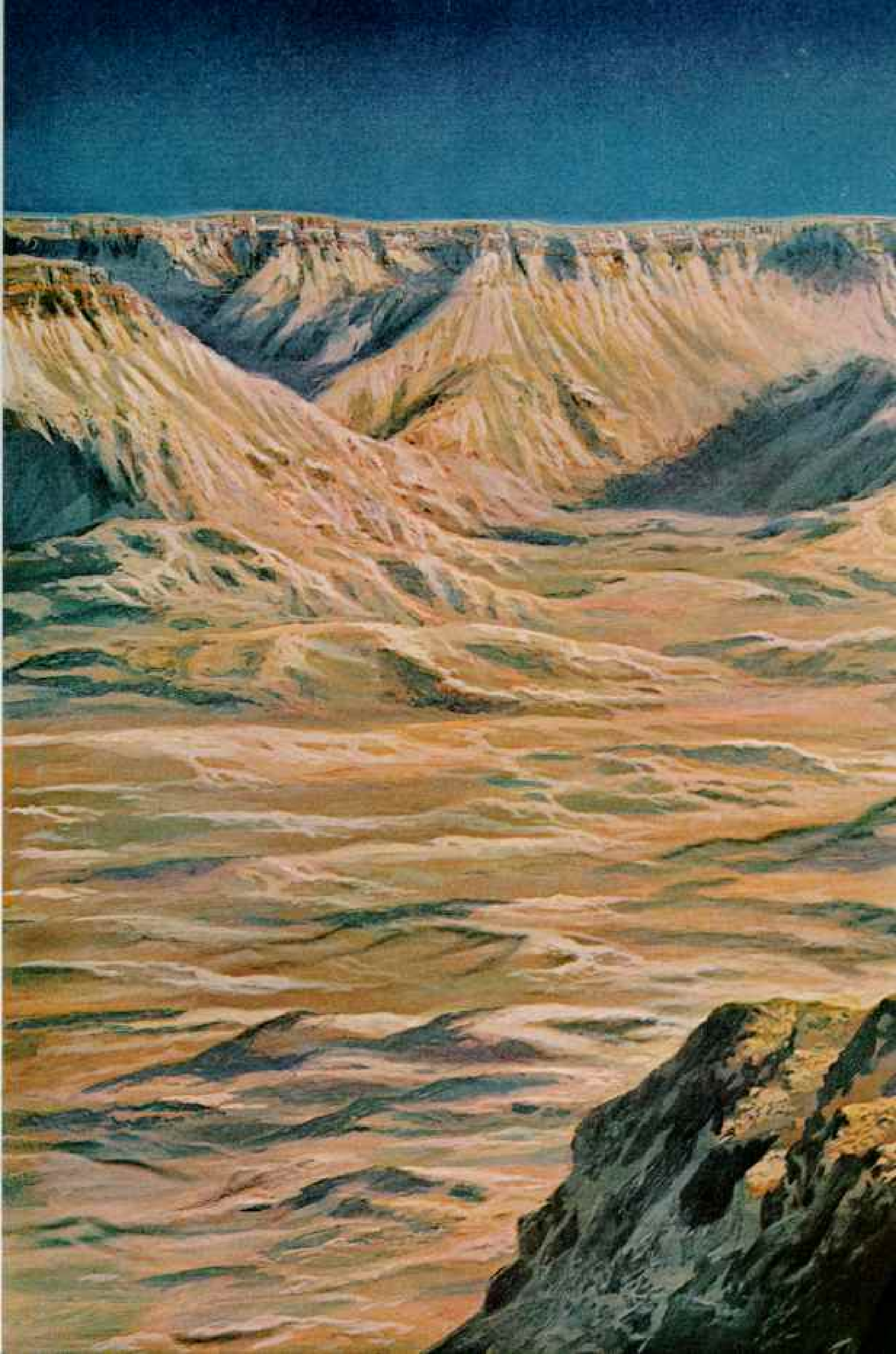
Forbidding summit of Mars, Nix Olympica reveals several craters within its 40-mile-wide caldera in the computer-enhanced photograph at right. Is the mighty volcano still active? Mariner 9 detected no heat, but the mountain's flanks, little scarred by meteorites, indicate that eruptions built it relatively recently in the planet's 4½-billion-year history.

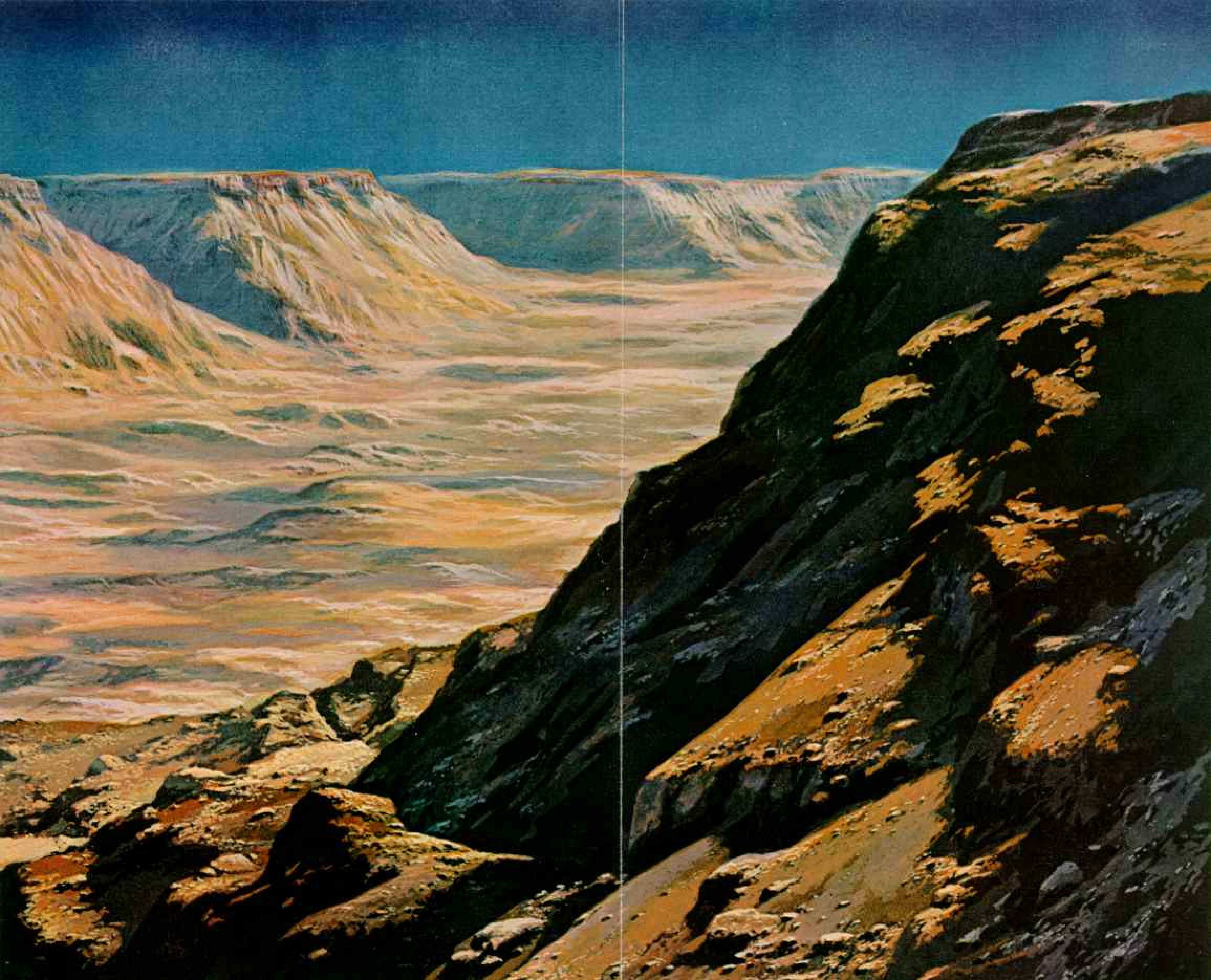
Steep cliffs that form the volcano's nearly circular base show up vividly in the mosaic below. As shown by the overlay, the huge ring—335 miles across—would reach almost from Baltimore to Boston.

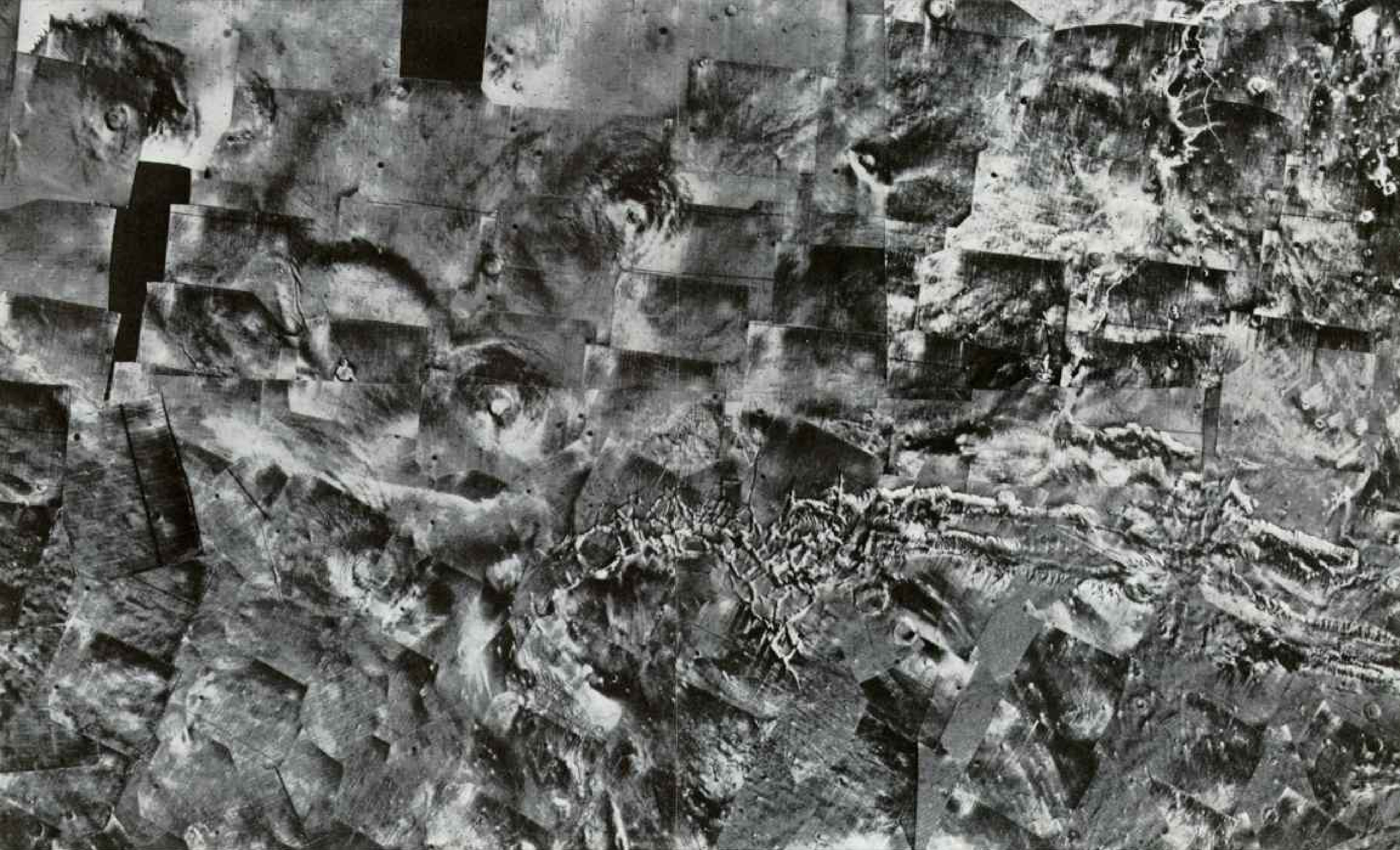
Circling Mars twice each earth day, Mariner peered through paired cameras, one equipped with a wide-angle lens and the other with narrow-angle. Arriving at the planet in November 1971 for what had been planned as a 90-day mission, the spacecraft functioned almost flawlessly for a year, photomapping the entire surface and earning plaudits as one of the most successful space explorations ever launched.











◀ **Dwarfing the Grand Canyon, Mars' great rift cleaves the planet's equatorial zone for 2,300 miles (preceding pages). Plunging to 20,000 feet—nearly four times the depth of the Arizona chasm—the rift measures as much as 150 miles from edge to edge. Here the artist portrays a narrow section only two miles deep. Fierce winds and landslides formed the fluting along the rim.**

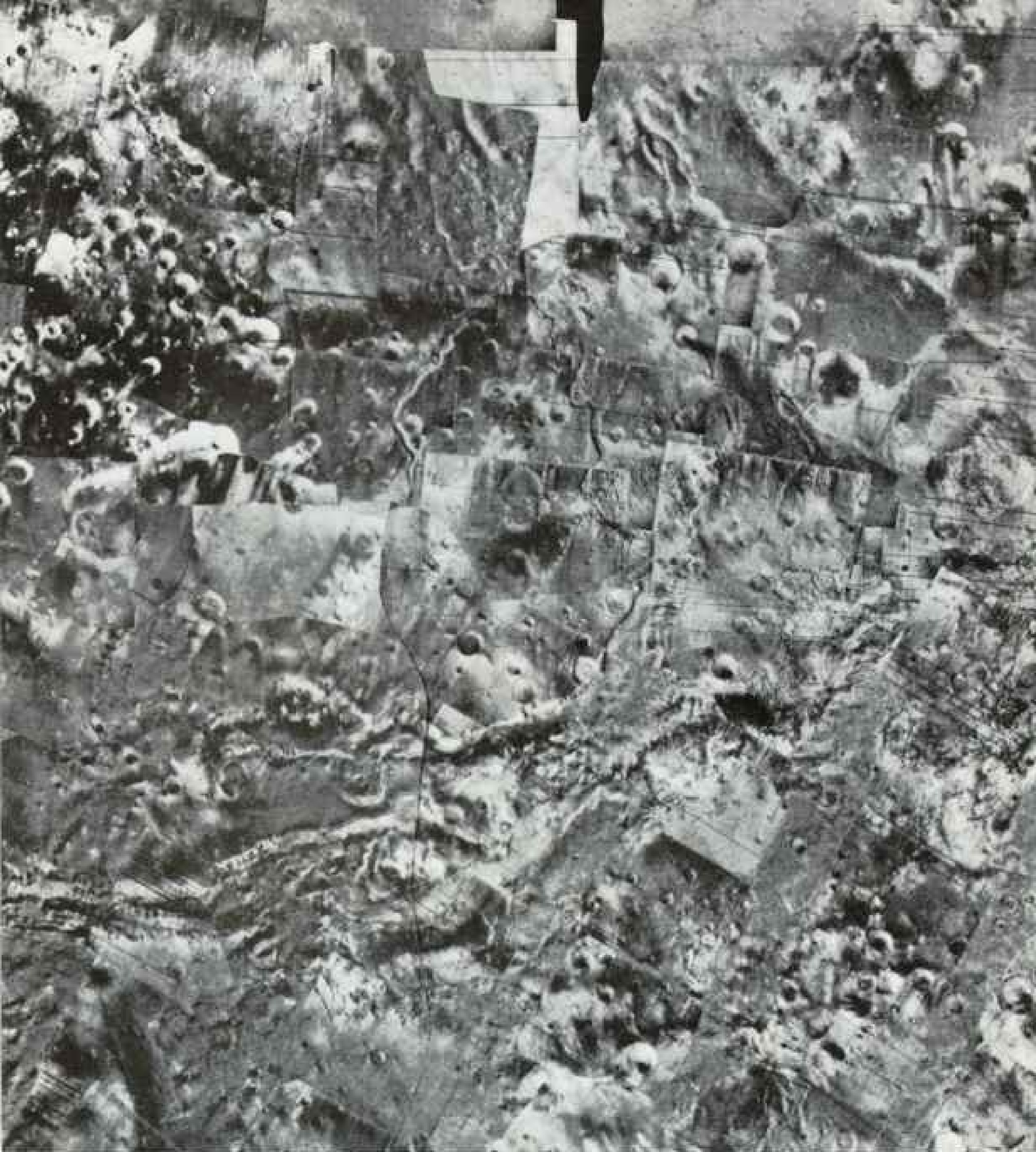
THIS PAGE FOLDS OUT

Extraordinary mosaic of Mariner 9 photographs reveals about a seventh of the planet. The complex terrain, its features color coded on the map at far right, startled scientists; flyby photographs made by earlier Mariners had suggested a relatively simple surface dominated by cratered plains. Many

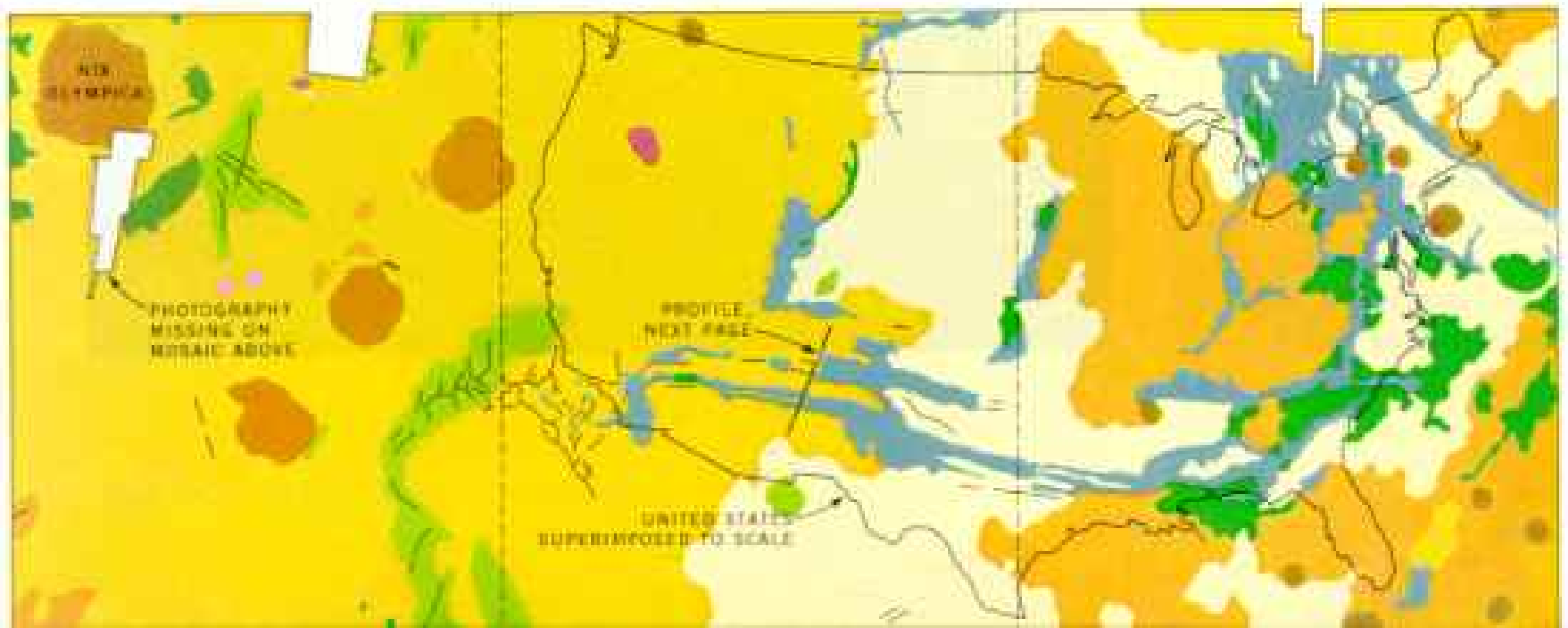
geologists now suspect that Mars represents an intermediate stage in planetary development, between the primitive moon and the restless earth. Slashing across this panorama, the planet's awesome rift system would more than span the United States. Probably caused by subsidence

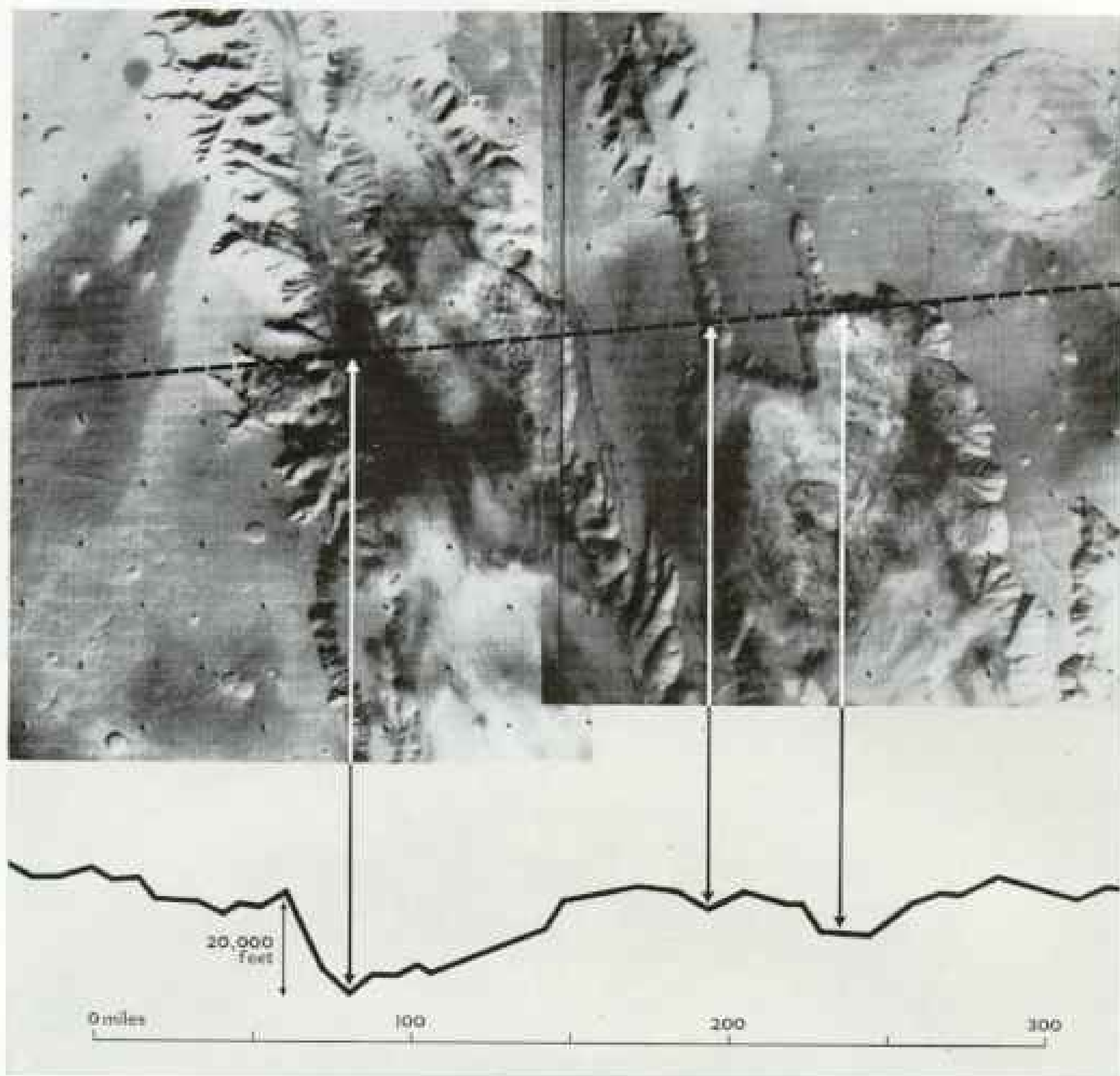
between surface fractures, the huge rift proves that the planet's interior is geologically alive. The system's western end thrusts toward a broad volcanic zone crowned by Nix Olympica at far upper left. Surprisingly, the colossal canyon escaped detection until the probe of Mariner 9.





MOSAIC ASSEMBLED BY JET PROPULSION LABORATORY AND U. S. GEOLOGICAL SURVEY FOR NASA, 40088, 940 BY U.S.G.S.





NASA, SPACE LOWELL BEINHOLD

Plotting a profile of Mars, Mariner scans a track across the canyon region (dashed line) with an ultraviolet spectrometer. The instrument reveals surface elevations by detecting pressure changes in the thin Martian atmosphere. Solid line shows the main rift, a graben with volcanic vents, and a valley.

Dr. Charles A. Barth (far right), principal investigator for the ultraviolet measurements, discusses a contour model of the equatorial region with colleague Rudolf A. Hanel. Dr. Hanel developed another spectrometer that used infrared radiation to measure atmospheric and surface temperatures.



lava channels, fissures, and ridges block the way. Occasional ropy flows seem substantial enough, until the deceptive surface breaks through in glittering showers of black glass.

To those who have studied the Mariner 9 photographs, the marvel is that the Martian volcanoes were not recognized in the pictures from earlier flybys. Nearly half the planet is now seen to be volcanic, with extensive lava flows. Nineteen large volcanic features have been found. The largest of these are shield volcanoes created by repeated flows of lava of low viscosity that pile up in thin sheets, forming gently inclined slopes.

Granddaddy of them all is Nix Olympica, Snow of Olympus, which showed in earlier Mariner photographs as simply a bright ring. Now we see that that ring is a circular scarp, 335 miles in diameter, that soars high above the plain (pages 234-5). Like a gigantic retaining wall, it encompasses the largest known volcanic pile in the solar system, twice as wide as the volcanic piles that form the major islands of the Hawaiian chain.

Mariner 9 has shown Nix Olympica to be the highest point on Mars. By one measurement, its summit stands some 15 miles above the plain, nearly three times the distance from sea level to the tip of Mount Everest.

Are the Martian volcanoes still active? No direct evidence yet says they are. Mariner's infrared radiometer has measured surface temperatures that suggest a maximum of 80° F. near the equator just after noon on a summer day, and a minimum of 190° below zero in the polar regions. It has not, at the same time, found any unusual hot spots in calderas.

Many volcanoes on earth erupt very infrequently. Vesuvius had never been known to erupt before it buried Pompeii in A.D. 79. So it is not surprising that we haven't found active volcanoes on Mars. And we cannot conclude that volcanism is no longer at work there.

Scientists do find indirect evidence on Mars of current volcanic activity. Earth-bound observers of the planet have long noted that certain regions at certain seasons frequently become brighter during the afternoons. Today we can see that these brightenings are associated with the appearance of afternoon clouds around the high volcanoes.

It is true, as some scientists believe, that these clouds could be formed simply by water vapor in the atmosphere condensing as it rises above the volcanoes.

However, the two substances most commonly exhaled by volcanoes are carbon dioxide and water. So it is quite possible that the clouds often seen around calderas, and the low-lying clouds or fog near the bases of volcanoes, may be from venting. If so, the Martian fires are still burning.

BENEATH THE SPACESHIP unrolls a badlands panorama of savage roughness. So jumbled and chaotic are its ridges and troughs that they take on strange resemblances: a tangled pile of jackstraws, a broad expanse of elephant hide.

Beyond lie the canyonlands, long gouges separated by flat-topped plateaus or mesas. As deep and wide as the earth's Grand Canyon, the chasms seem enormous until they, in turn, give way to the great rift of Mars (pages 236-41). Twenty thousand feet deep and so wide that one rim can barely be seen from the other, it slashes nearly a fifth of the way along the Martian equator.

Mars is a far more complicated body than we had thought. Far from being dead, it evidences internal forces that constantly alter its surface. In places the planet seems to be collapsing in on itself in a welter of uplifts and fractures. These are especially noticeable in the high plateau country east of the major volcanoes, around Phoenicis Lacus, Noctis Lacus, and Tithonius Lacus.

It is curious that for many years observers of Mars thought they saw connecting canals, which we now know were an illusion, yet they never suspected the existence of the great rift. Although it is enormously large—2,300 miles long and 75, 100, and even 150 miles wide, it shows up from earth only as dark markings with no hint of depth.

Harold Masursky, leader of the Mariner television team, compares the great rift system of Mars to the Great Rift Valley of Africa. Neither was cut by water, he says, but rather both are the result of massive faulting of the crust—dropping of huge blocks between parallel lines of crustal weakness. With the passage of time, the walls of the Martian rift have slumped, and subsidence has created many short side canyons.

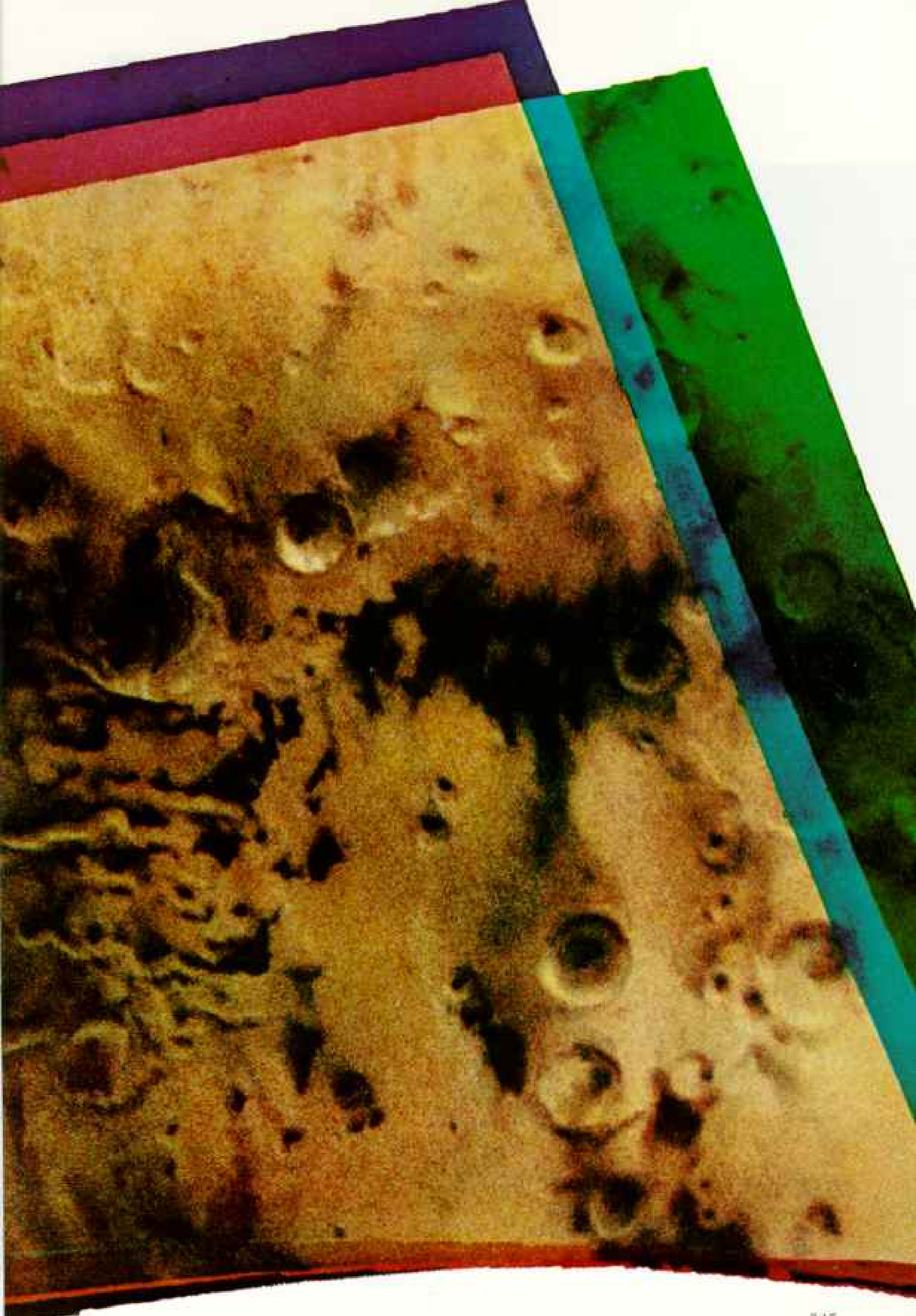
Dr. Conway Leovy believes that since this deep trough is warmed by the sun at one end while it is still dark at the other, tremendous temperature differentials are set up each day that create violent winds. Roaring back and

Dramatic color portrait covers 205,000 square miles of the south polar region. Mariner's wide-angle camera took three separate pictures of the area through violet, orange, and green filters. After computer processing at the Jet Propulsion Laboratory, the photographs were reconstituted at the National Geographic's color laboratory to create this panorama. Soon after the spacecraft took these pictures its filters jammed, ending color photography for the rest of the mission.

Ancient craters blasted by meteorites surround a characteristic dark splotch at right; scientists believe the marking could be dust blown over the dominant ochre surface, or darker bedrock whipped clean of the planet's pervasive dust, or even two different kinds of dust. Wavelike formations at left, known as the "Rifles," are a form of layered terrain found in the polar regions (page 251).

Mariner transmitted a flood of more than 7,300 photographs to earth. Some, taken from as low as 850 miles, show objects as small as 300 feet across. ☐







Frayed remnant of the south polar cap survives summer's inroads (left). The cap has shrunk to about 32,000 square miles from a winter expanse 100 times as large.

Scientists believe snows of dry ice enlarge the cap in winter; this ice then evaporates with warming. Summer's residue could be

forth through the canyon, these blasts have left their mark in the extensive fluting of the walls and the sculpting of the tributaries (painting, pages 236-8).

Some evidence of what has happened geologically inside the planet during its 4½ billion years comes from analysis of the Martian dust. An ingenious instrument known as an infrared interferometer spectrometer (IRIS) rides aboard Mariner 9. It measures the thermal energy radiated by Mars and reveals the intensity of that radiation in various parts of the infrared spectrum.

Fortunately for spectroscopists, the dips and peaks in infrared curves can be used as fingerprints to identify chemical substances. And so when Dr. Rudolf A. Hanel (page 242), who is primarily responsible for the IRIS instrument, studied his data from Mars, he found strong indication that the Martian dust consists of minerals that include some 60 percent silicon dioxide, a concentration close to the average for the earth's crust.

"This not only tells us the basic chemistry of the Martian crust," says Dr. Hanel, "but it also tells us something quite significant about what has been going on inside the planet. Silicon and oxygen form light minerals; since

we find these elements in such large proportion in the crust, we know that Mars has probably differentiated. This means that at some time during its geological history the interior was at least partially melted, permitting these lighter minerals to rise to the surface as magma."

DUST MANTLES the landscape at every turn. Thick, powdery, clinging dust, settling in every crevice, covering the bottoms of craters, and cloaking the rocks with coats of salmon hue.

With the coming of the wind, dust devils whip the fine soil into whirling columns of monstrous height. The wind intensifies, becomes a shrieking blast. The sands of Mars come alive, trembling under the impact of the storm.

The thin, clear air turns to a veil of haze. High overhead the blackness of the sky yields to a yellowish pallor through which the disk of the sun is indistinctly seen.

Mars is a dusty place—far more than most scientists had realized—and the dust is often in motion. The Mariner 9 infrared observations show that large areas of the globe are



REVOLUTION 114
JANUARY 15, 1971



REVOLUTION 201
MARCH 6, 1971

water ice, which remains frozen. Perhaps half a mile thick, the summer cap could hold a vast amount of life-supporting water.

To monitor the cap's retreat, Mariner focused its narrow-angle camera on a feature known as the "Fork" (arrow in photograph at far left) and made the above three pic-

tures over a 101-day period. The rapid vaporizing of the frost tells that it was only an inch or so thick; unevenness of the evaporation indicates variations in the thickness of the cap. The third picture shows the dark riverlike features to be slopes composed of layers of dust and volcanic ash.

covered with dust, finer than we usually see on earth.

The most common particles in a Martian dust storm are estimated to be about 10 microns (less than a thousandth of an inch) in diameter, something like finely powdered talc. The smallest particles are so light that winds may carry them as high as 35 miles.

The triggering mechanism for Martian dust storms is not clearly understood, but it seems to be tied to the heating of the planet. We observe that the storms are most frequent and severe during the southern hemisphere summer, when Mars is near perihelion, its closest point to the sun. Apparently the increased heating at this time severely disturbs the atmosphere and generates the winds and storms.

On earth, surface winds of 15 miles an hour can raise dust. On Mars, the experts say, the very thin atmosphere (about 1/100th as dense as our air) requires winds of about 100 miles an hour to begin a dust storm. But such winds seem common in some seasons, and at least one scientist believes that they can increase in ferocity to as much as 300 miles an hour.

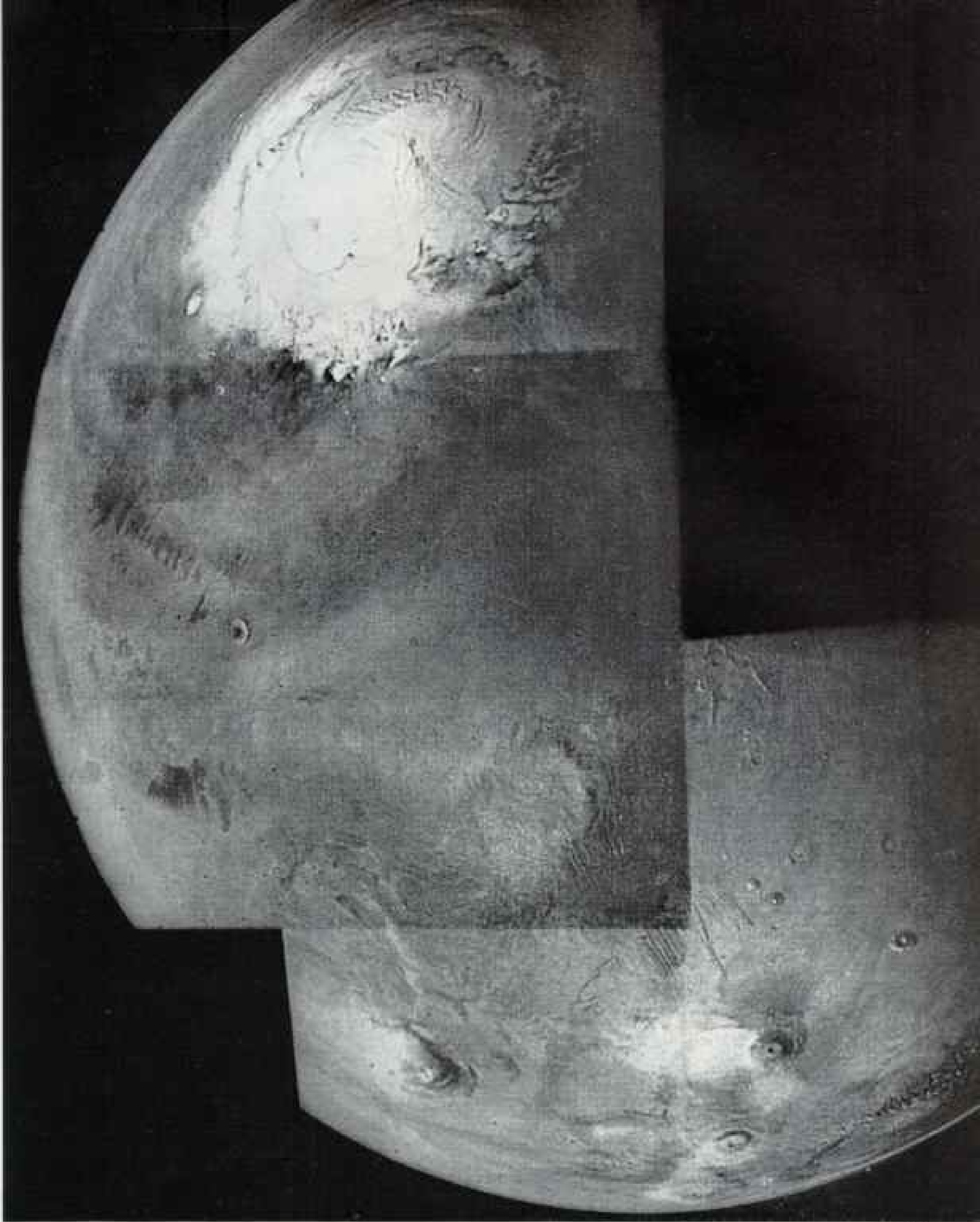
Long before Giovanni Schiaparelli, who a century ago reported that he saw *canali* on

Mars, men peering through telescopes at the other disk had observed peculiarly shaped dark areas against generally light regions. These areas were given names drawn from the classics and from mythology. We speak, for example, of Solis Lacus (Lake of the Sun), Aurorae Sinus (Bay of the Dawn), Nodus Gordii (Gordian Knot), and Hellas (Greece). The first two are dark regions, the third is associated with a large volcano, and Hellas is a bright flat-bottomed basin that is larger than Mare Imbrium, the biggest circular impact feature on the moon.

Some of the markings remain reasonably stable over the years. Others change with the passage of time, in brightness or outline, to the great puzzlement of observers.

Much speculation has surrounded these variable features of Mars, especially the so-called wave of darkening that seems to change in harmony with the seasons. Many observers have interpreted the variable markings as the growth and spreading of vegetation during the Martian spring and summer, when conditions were supposed to be warmer and wetter.

But others—notably Dr. Carl Sagan and Dr. James B. Pollack—have argued that the



NASA

Unveiled from crown to midriff, Mars bares its boldest features to Mariner, 8,500 miles above. A shrinking polar cap tops the northern hemisphere in springtime, at upper left. Wreathed by clouds, Nix Olympica, left bottom, and three other massive volcanoes guard the jagged end of the canyonlands. In striking contrast to this clear view, Nix Olympica and its neighbor volcanoes are almost engulfed by a global dust storm (right) that obscured the planet during the first six weeks of Mariner's visit.

changing patterns of light and dark are the result of dust shifted by the winds.*

And today most scientists would agree. Mariner 9, which has been able to look at selected areas repeatedly for nearly a year, seems to prove that windblown dust is the answer to the mystery. It could be that the varying shades result from two different types of minerals.

Another explanation is that finely divided dust offers more surface area than large particles or rock, scattering more light and thus appearing brighter in color. Consequently, when dust is sifted down from a major storm, it brightens the areas where it lands. But later, when local gusts scour the fine dust away, underlying areas may appear dark again. Or perhaps varying wind speeds determine whether small bright particles or heavy dark particles will be moved in a given area. Thus, in either case, seasonal wind variations might account for seasonal changes in brightness.

Mariner's pictures pinpoint many irregular dark splotches, as well as long roughly parallel streaks, both dark and light, streaming away from craters, ridges, or hills. Careful examination shows that areas covered with these splotches and streaks coincide with some of the classical markings of Mars.

If the riddle of the large-scale variable markings may be solved, another has taken its place. What causes the localized streaks? At first glance it would seem that the bright

streaks represent light-colored dust streaming out of craters. And, in other areas, the dark crater tails might be interpreted as wind "shadows," where crater rims have interrupted the passage of bright material blowing over the area (page 253).

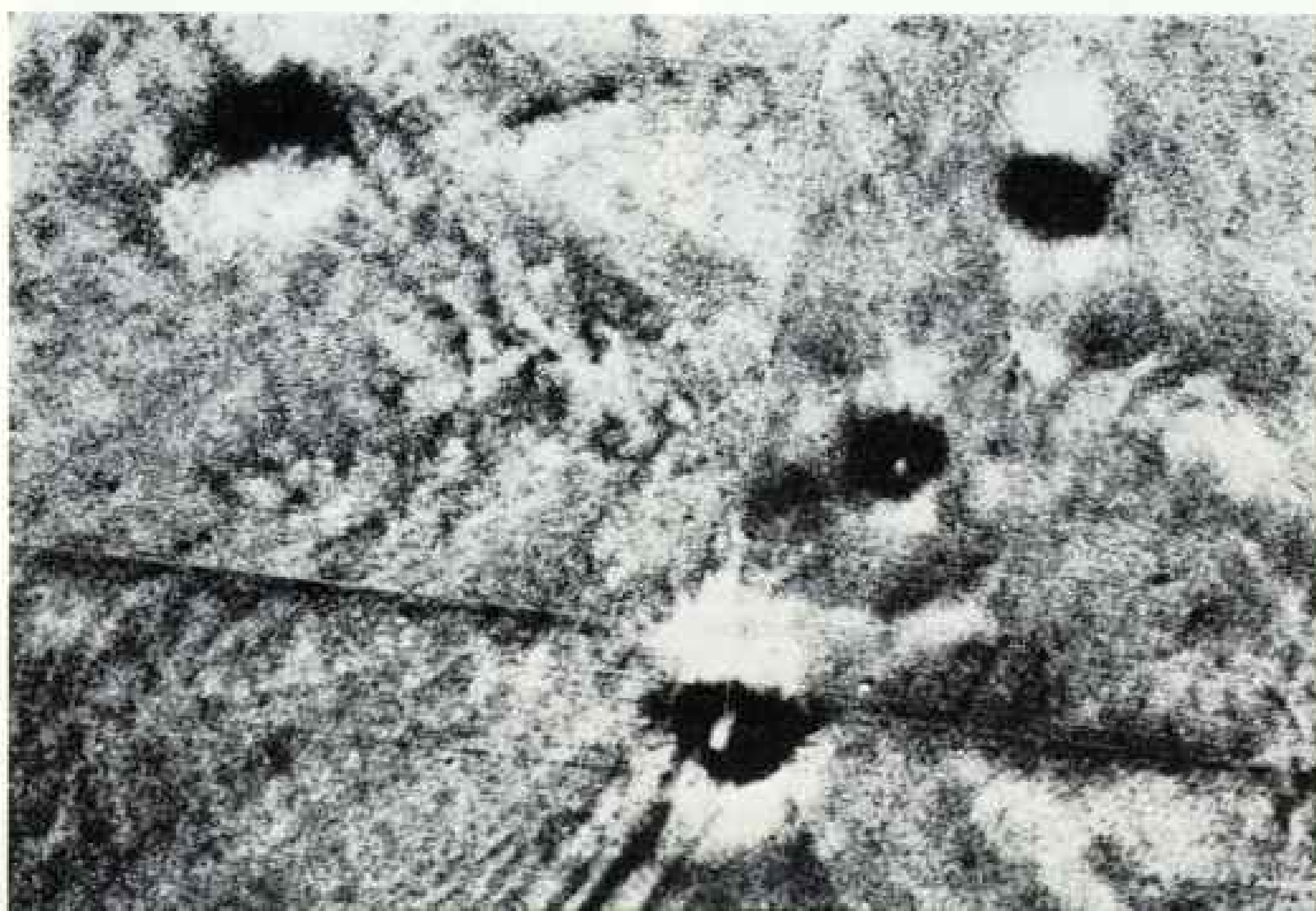
But how does one account for both dark and light streaks appearing at the same time? Could both dark and light materials blow out of craters in the same area? Still more puzzling: How do dark and light materials remain separate over the eons? Clearly, there is no lack of Martian mysteries to occupy us.

WATER NO LONGER *courses through the arroyo, but, from the bluff above, its former passage is clear enough. Slumping walls have not concealed the terraces left by successive floods that cut ever deeper into the banks. In the bottom, old-time channels weave their sinuous ways, sometimes blending, sometimes crisscrossing to leave a braided pattern.*

At intervals along the bluff, tributaries enter the main stream. From those tributaries multitudes of smaller branches reach far across the arid plain, as though in search of water long since disappeared.

Probably the biggest surprise from Mariner 9 is the appearance in some of the pictures of meandering "riverbeds." With their branching tributaries, they resemble dry watercourses of earth (pages 260-61).

"There is simply no way to account for



*Dr. Sagan wrote of "Mars: A New World to Explore," in the December 1967 NATIONAL GEOGRAPHIC.

some of these channels except to say that a liquid once ran through them," says Professor Bradford A. Smith, Director of Planetary Research at New Mexico State University and one of the Mariner scientists (page 255). "Close examination shows that they are definitely not faults in the crust. Faults do not wander over the surface in the same way these structures do. And, unlike some of the other sinuous channels we see on Mars, these could not have been formed by lava, for there are no craters or vents associated with them from which lava could have flowed.

"So we are forced to the conclusion that they are exactly what they seem to be—the beds of ancient rivers through which large amounts of water once flowed."

Water on Mars? Unthinkable.

We know that over much of the planet today, liquid water simply could not exist. In

the ultrathin air of Mars, except in the lowest areas, the atmospheric pressure is so slight that water would quickly evaporate.

And the frigid atmosphere can hold very little water vapor. Infrared measurements show that all of Mars' atmospheric water vapor, if condensed and distributed evenly over the planet, would measure only about a thousandth of an inch thick. It would be like a spoonful of water spreading out on a table. By comparison, the water vapor in earth's atmosphere, if condensed, would cover the surface of our planet to a depth of an inch.

Yet—despite these facts—there is much evidence that large amounts of water must exist inside Mars, just as inside earth. Here is some of that evidence:

- Low clouds at the bases of several of the larger volcanoes are condensed water vapor that may have escaped from volcanic vents.



Before a computer lends its magic, a typical "raw" picture (above) gives a washed-out view of Nix Olympica's caldera. By intensifying contrast of the limited gray tones, the computer "stretches" the picture to yield the detail at right.

Enhanced by similar stretching, an oval tableland near the southern cap displays the distinctive



NASA

polar layering known as "laminated" terrain (opposite). The layers, each at least 100 feet thick, are thought to be a mixture of dust, volcanic ash, dry ice, and water ice. Scientists believe the laminations could unfold an exciting account of the planet's climatic and volcanic activity.

- Clouds hanging over Nix Olympica and other volcanoes are thought to be substantially water ice (page 248). The same is true of the clouds at the edges of the polar hoods.

- Ultraviolet measurements from Mariner 9 indicate that the hydrogen escaping daily from the atmosphere of Mars amounts to the equivalent of that in 100,000 gallons of water. Dr. Charles A. Barth (page 242), who is in charge of Mariner's ultraviolet spectrometer, suggests that the hydrogen comes from water vapor high in the atmosphere that has been dissociated, or chemically split, by the effect of the sun's ultraviolet radiation.

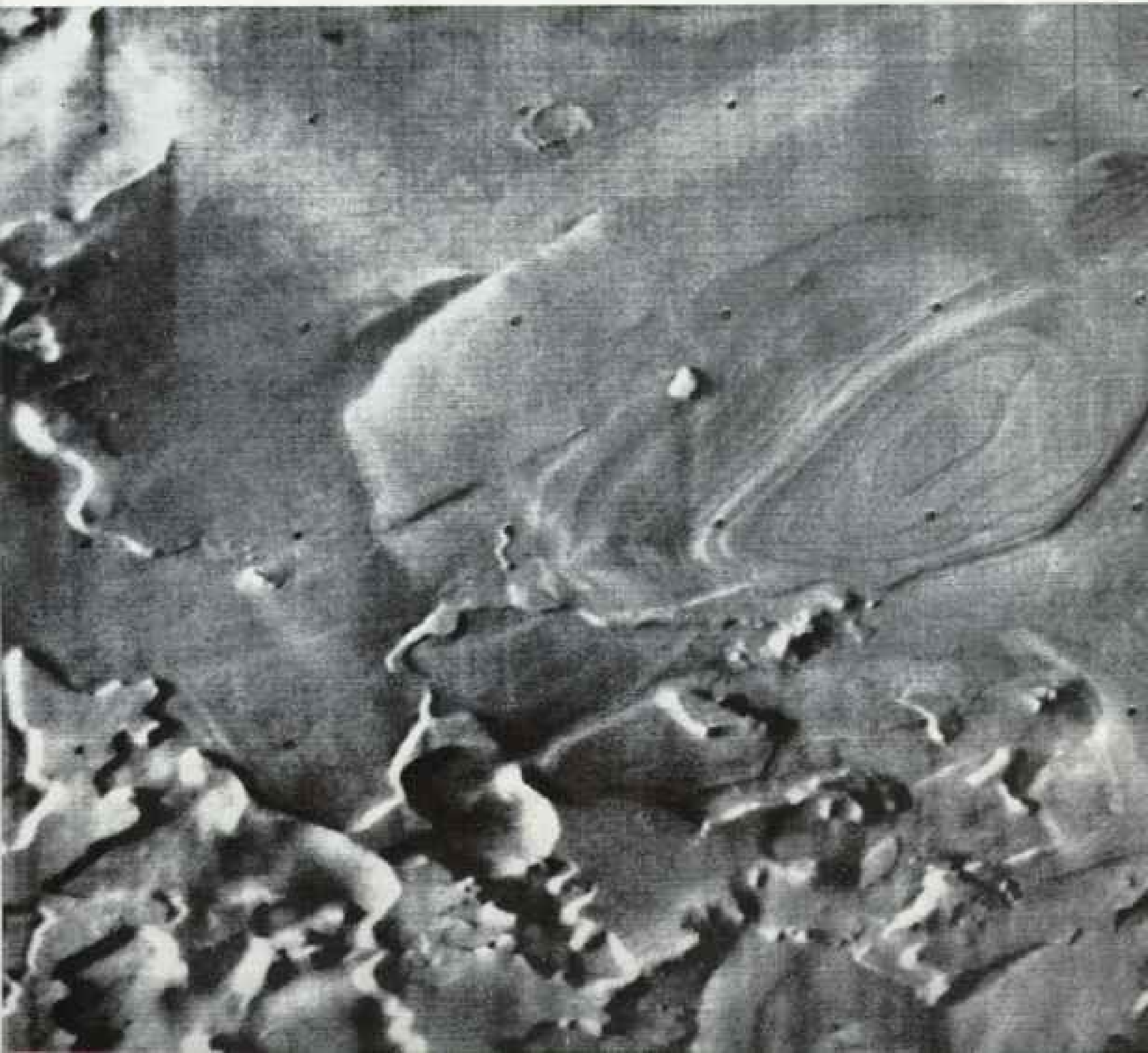
How much water is still on the surface of Mars remains something of a mystery. The vast quantities of carbon dioxide on Mars (at least 90 percent of the atmosphere and the bulk of the polar caps) suggest that large amounts of water in some form have in past

eons been introduced to the surface and into the atmosphere.

As Dr. Norman Horowitz of the California Institute of Technology explained to me: "No planet can make a lot of carbon dioxide without producing even larger amounts of water. Remember that hydrogen is by far the most important element in the universe, so we should see much more oxygen combined with hydrogen [water] than with carbon [carbon dioxide]. But on Mars we don't."

Has most of the hydrogen and oxygen been lost to space, or does more of it reside, unrecognized, somewhere on or in the surface?

Perhaps the polar caps hold great reservoirs of water. These caps act as dehumidifiers, or cold traps. When winds blow across them, the air condenses because of the extreme cold. It is just like ice forming on the walls of your home freezer:



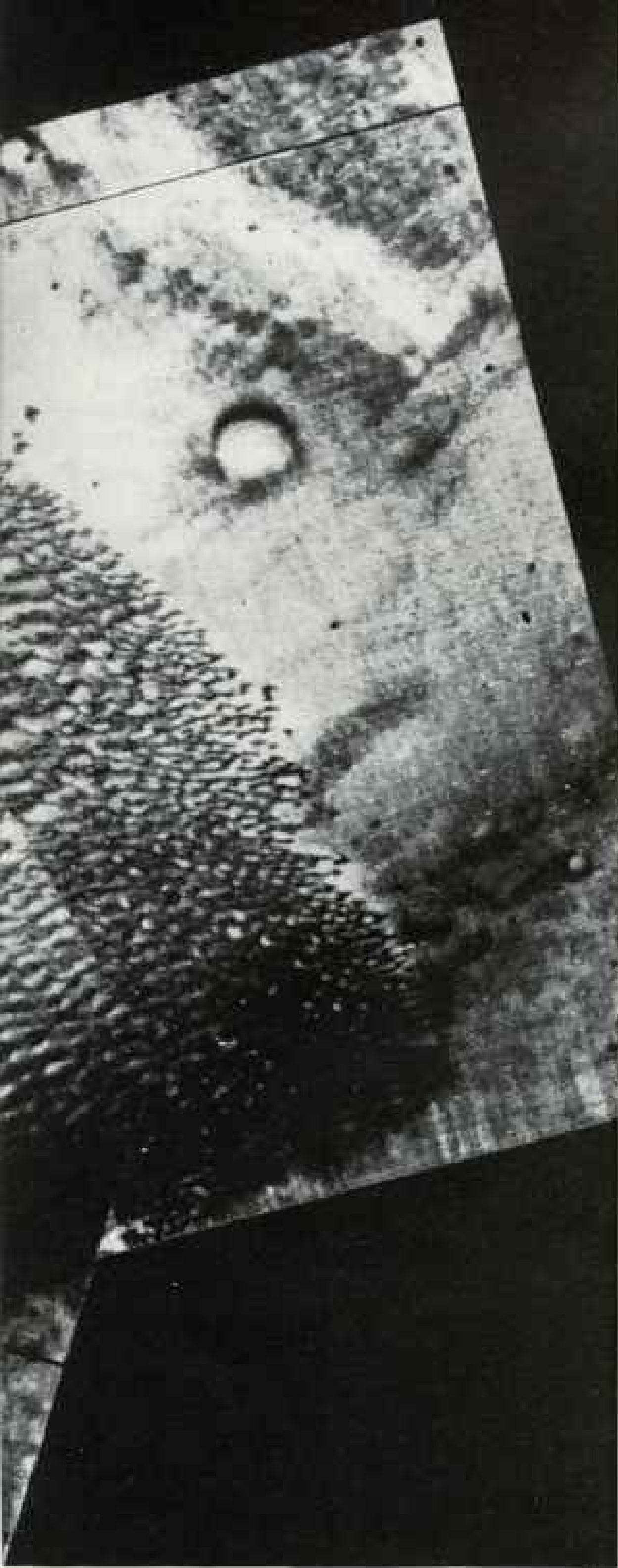


Shifting sand dunes shimmer across a crater floor. Measuring a mile between crests and spanning 80 miles, the dunes betray the presence of strong prevailing winds.

Mariner depicts Mars as an abode of wild winds that, one scientist conjectures, may rage up to 300 miles an hour. They erode surface features and

whip up dust storms that sometimes obscure the entire planet.

Mariner photos also show small fields patterned with light or dark streaks that usually trail from craters and promontories (**opposite**). Some scientists believe the light streaks may be bright dust blown out of the craters, while the dark may



0410

represent wind "shadows," where crater rims block spreading dust. Most perplexing of all, some fields show a mixture of the streaks.

The spacecraft's sensors have detected evidence of great cold fronts similar to earth's and surface temperatures that range from -190° F. at the poles to a balmy 80° in the equatorial region.



Both the carbon dioxide and the small amount of water vapor it carries freeze out and are locked in the polar caps until the temperature warms up enough to vaporize them again. And as soon as spring arrives in one hemisphere and that cap begins to evaporate, winter temperatures at the other pole begin freezing out water and carbon dioxide.

The amount of water that participates in this annual migration is extremely small in planetary terms. If it were spread evenly over the surface of Mars it would be thinner than a sheet of paper. However, some scientists believe that water could be trapped for thousands, if not millions, of years in the core of perennial ice found at both poles. How much water could be there? No one really knows, but the core of the north polar cap may be several miles thick.

Some of the Mariner 9 observations lend support to this view. The south polar cap of Mars was observed to shrink during summer and then to stabilize at 250 miles long and 190 miles wide long before autumn. One explanation is that the dry ice had all vaporized and disappeared, leaving a white substance that requires much warmer temperatures to melt. If the explanation is valid—and Mars is such a complex planet that Mariner scientists are cautious on this point—the residual material could only be water ice.

Water could be trapped in another way. Scientists think that as volcanic water vapor moves upward inside the planet, it may freeze before it reaches the surface. Only about a foot below the surface, even in the hottest regions, temperatures probably stay well below zero, cold enough to maintain thick layers of permafrost.

But water frozen in polar caps and permafrost is not liquid water. Scientists still are trying to determine how Mars could ever have had enough flowing water on the surface to cut winding river channels that run for hundreds of miles.

Perhaps, they say, large areas of permafrost are suddenly melted by volcanic action—by rising magma. As large-scale evaporation takes place, the atmosphere over the whole planet becomes denser and more loaded with water vapor. Then evaporation begins to slow. Eventually water could remain on the surface in liquid form.

Another explanation involves climatic cycles related to a wobbling of the planet's axis and changes in the shape of its orbit that

bring Mars closer to the sun than it can now reach at perihelion. The wobbling occurs over a 50,000-year span, and the orbital changes have a short period of 95,000 years and a longer one of two million years. Both the wobbling and the orbital variation affect the distribution and rate of absorption of solar energy over the planet. They may at times trigger intense dust storms which—as Mariner 9 has shown—heat up the atmosphere in the polar regions. Perhaps when conditions for frequent, long-lasting storms are right, the resultant temperature rise in the polar areas would release enormous amounts of frozen carbon dioxide and water from both poles and create a much denser atmosphere. Then, for perhaps several thousand years, until the cycle begins to change again, rains could fall on Mars and water could erode the surface. That, at least, is the theory.

TO THE NORTH lies an ancient cratered terrain, battered and bleak like the moon. To the east and west is a land of barren rock, smoothed and flattened as though by glacier ice. Winds screaming off the pole have swept away debris and dust, leaving only eroded etch marks and pits.

To the south a cascade of laminations, or steps, dark against white, rises to the gleaming snowcap on the horizon. Bands of thin clouds hang above it all.

Among the first features men saw on Mars with their early telescopes were the brilliant polar caps, which—just like the caps on earth—wax and wane with the seasons.

Quite invisible to the telescope viewers, however, are dark bands that curve through portions of both polar caps and that show up in the Mariner 9 pictures. Close examination reveals these as slopes that have lost their frost cover in the polar summer. In the highest-resolution pictures a strange layered or laminated appearance is evident in the slopes (page 251), reminiscent of flat-lying sedimentary rock strata seen in the canyons of the Colorado Plateau.

"Our best guess," says Dr. James A. Cutts of the Mariner TV team, "is that these Martian sediments are composed of dust and volcanic ash. We suspect that the snows in the polar regions wash the dust from the air and carry it to the ground. There it becomes a dirty frozen crust. Year by year these crusts build up—we have counted one series of 30

or 40 layers each about a hundred feet thick.

"So the caps—or at least the permanent portions that are left at the end of the summer—must be a mix of dust, ash, water ice, and frozen carbon dioxide. It is likely that the layers are associated with periods of climatic alteration, and millions of years of Martian history may be trapped in them. If we could only take samples, we could learn a great deal about the climatic and volcanic history of the planet."

THE MARTIAN HEAVENS blaze with stars, brilliant and unwinking. One, shining much more brightly than the rest, hangs like a tiny lantern in the sky.

Another rises abruptly in the west, quickly tops the horizon, and sets a swift course toward the east. It seems strangely small, not half the size of earth's moon. Its lackluster glow, like that of a guttering candle, reveals a dark and irregular face.

The moons of Mars were hardly on my mind that November day more than a year ago. At the Jet Propulsion Laboratory, Mariner's home base, we were watching the instrument readings telemetered from 75 million miles away, waiting excitedly to see if the spacecraft would go into orbit around Mars. Then the pressure in Mariner's thrust chamber dropped to zero, and the announcer in the control room said matter-of-factly, "We are captured by the gravity of Mars as of now." Applause filled the room.

But I soon felt a sense of disappointment. The great dust storm of 1971 had so obscured the face of Mars that the TV pictures beginning to come through on the screen showed none of the closeup detail for which we had waited so long.

Then the camera turned its eyes away from Mars, and a blob swam into view. It was somewhat fuzzy, but it restored my sense of elation: I was looking at the smallest body in the solar system ever photographed at close range. It was tiny Deimos, Mars' outer moon. Until Mariner 9 it had never been seen except as a point of light. And small wonder, for it measures only 10 by 6 miles (page 262).

Deimos is that extra-bright "star" in the Martian sky. To an observer on Mars, 12,500 miles below, it would appear as a barely discernible disk. It spangles the Martian sky for $2\frac{1}{2}$ days as it goes from horizon to horizon.

Phobos, Mars' inner moon, orbits less than



WARFIELD PARRIS

Artist and scientist combine talents to portray the face of Mars. Luděk Pešek (seated) consults with Professor Bradford A. Smith of New Mexico State University, deputy team leader of the spacecraft's TV experiments and one of a dozen Mariner scientists who advised Mr. Pešek on the paintings for this article. Mr. Pešek also created the paintings for the *GEOGRAPHIC's* August 1970 article "Voyage to the Planets." His vivid scene of a Martian dust storm (below) appears on the reverse of the map accompanying this issue.



4,000 miles from the surface. Our moon is 240,000 miles away, on the average.

Phobos presents a number of oddities. Because it orbits so low over the equator, it can never be seen from the polar regions. Also, its apparent size changes as it crosses the sky. Overhead, it is about 40 percent of the diameter of our moon as seen from earth. But on the horizon, where it is farther away from the observer, its apparent size is only about 30 percent that of the moon.

But most peculiar of all, Phobos rises in the west. It hurries across the sky in four hours, and it rises and sets twice each day.

Few objects in the solar system are as dark as Phobos. Partly because its reflectivity is so low, the Martian satellite appears only 1/25th as bright as our moon.

Battered, cold, and dead, Phobos is no great shakes in our solar system population of 32 moons. It is simply a chunk of rock 17 miles long and 12 miles wide, much like an asteroid.

Yet scientists find it of special interest. Meteorite craters riddle it so completely that new ones form only by destroying old ones. The crater density is nearly a hundred times that of Mars. At the same time, it may be a sample of the original solar system material, unaltered by melting, by lava and faulting crust, or by water and wind erosion.

Some years ago, a remarkable notion concerning Phobos was advanced by the famed Soviet astrophysicist I. S. Shklovskii. At that time, because of some calculations made by an American astronomer, it appeared that Phobos was speeding up in its orbit and, therefore, that it was gradually circling closer to Mars. Shklovskii reasoned that for Phobos to be affected by any kind of atmospheric drag, it would have to be far less dense than a solid body.

"Could Phobos be indeed rigid, on the *outside*—but hollow?" he wrote. "We are led to the possibility that Phobos—and possibly Deimos as well—may be artificial satellites of Mars. . . . Perhaps Phobos was launched into orbit in the heyday of a technical civilization on Mars, some hundreds of millions of years ago."

Unfortunately for those to whom such an imaginative idea would appeal, the measurements on which Shklovskii based his assumptions were later discovered to be erroneous.

But if Martian man has not set foot on Phobos, earth man will, in time. And when he does, he will have to move with the utmost care

because of Phobos's extremely low gravity.

As Professor Bradford Smith mentioned to me one time: "If you were on Phobos and threw a rock at 12 meters [40 feet] per second, it would leave the little satellite forever. But if you threw the rock at only 8½ meters [28 feet] per second, parallel to the ground, it would come back around in about an hour and a half!"

IT WILL BE POSSIBLE to see cities on Mars, to detect navies in [its] harbors, and the smoke of great manufacturing cities and towns. . . . Is Mars inhabited? There can be little doubt of it. . . . conditions are all favorable for life, and life, too, of a high order. Is it possible to know this of a certainty? Certainly!"

This buoyantly optimistic prediction was made in 1895 in a book called *World Making*, by Dr. Samuel Phelps Leland, a professor of astronomy. He was describing what he thought man would be able to see with a new 40-inch telescope being built by the University of Chicago.

Of course a terrestrial telescope cannot detect life on Mars. Neither could the Mariner flybys. And it is most unlikely that Mariner 9 could have detected life, on Mars or even on earth, from a distance of 850 miles and more. What is important is that nothing discovered by the Mariner missions excludes life; indeed, the evidence of Mariner 9 somewhat *increases* the probabilities of Martian life of some kind.

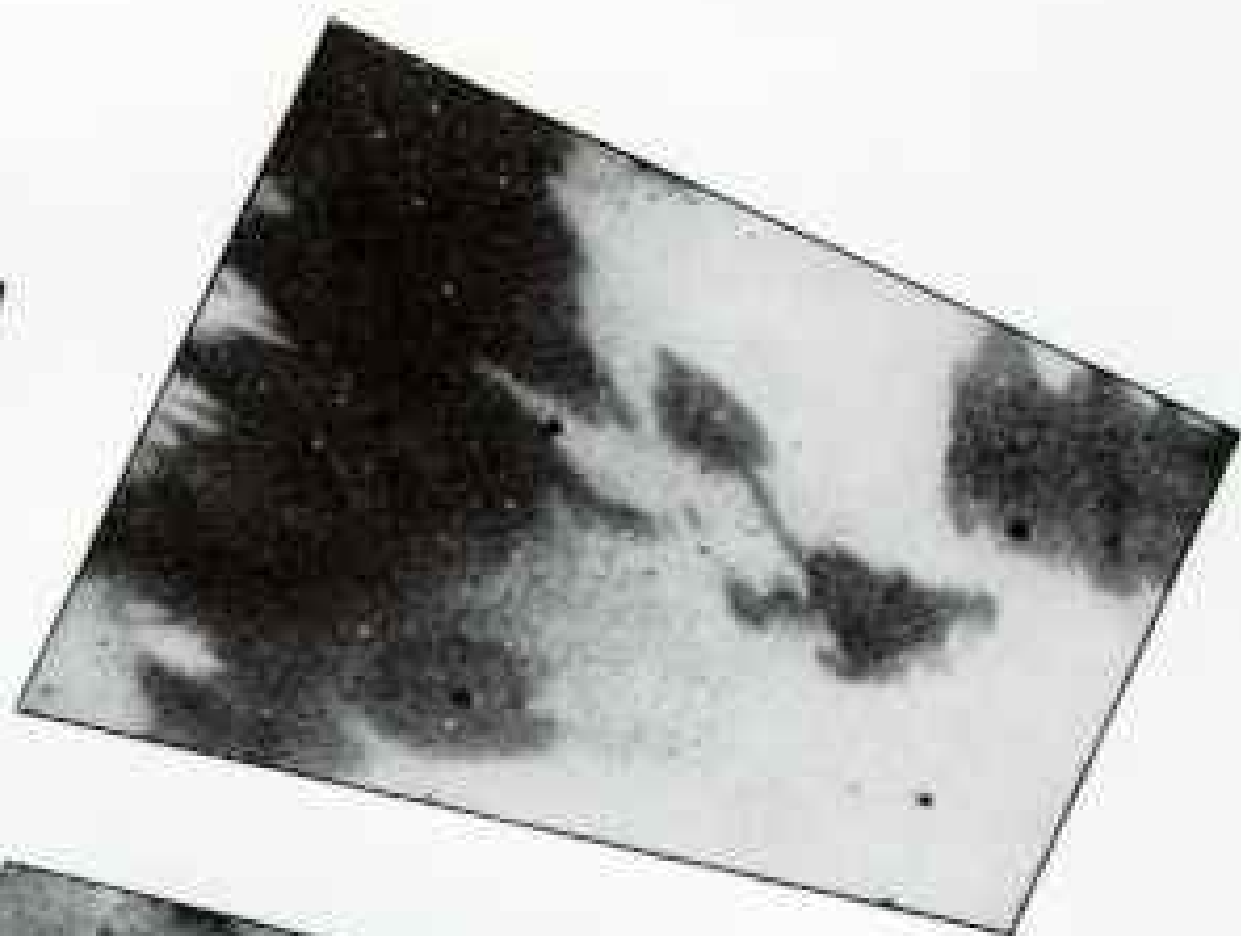
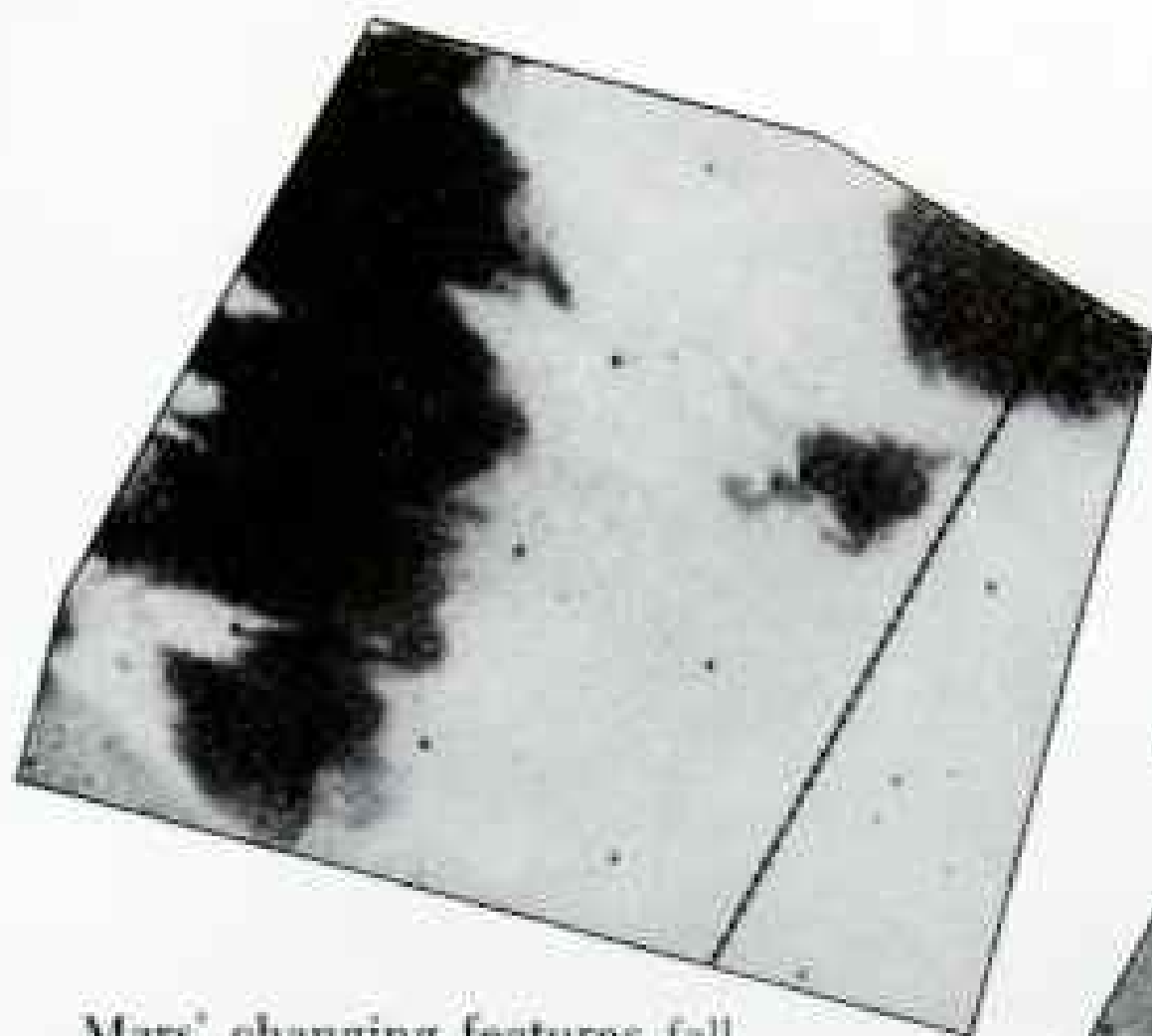
The hazards of life *as we know it* are still there, of course, and they make a formidable list. To begin with, there is the lack of liquid water. In earthly experience, water is an absolute essential to life. Some forms of terrestrial life adapt to very arid conditions, but the atmosphere of Mars contains hundreds of times less moisture than the atmosphere of the driest places on earth.

Second, high-energy ultraviolet radiation from the sun blasts Mars with little hindrance from the atmosphere. This energetic radiation ruptures the very bonds of molecules in living cells on earth.

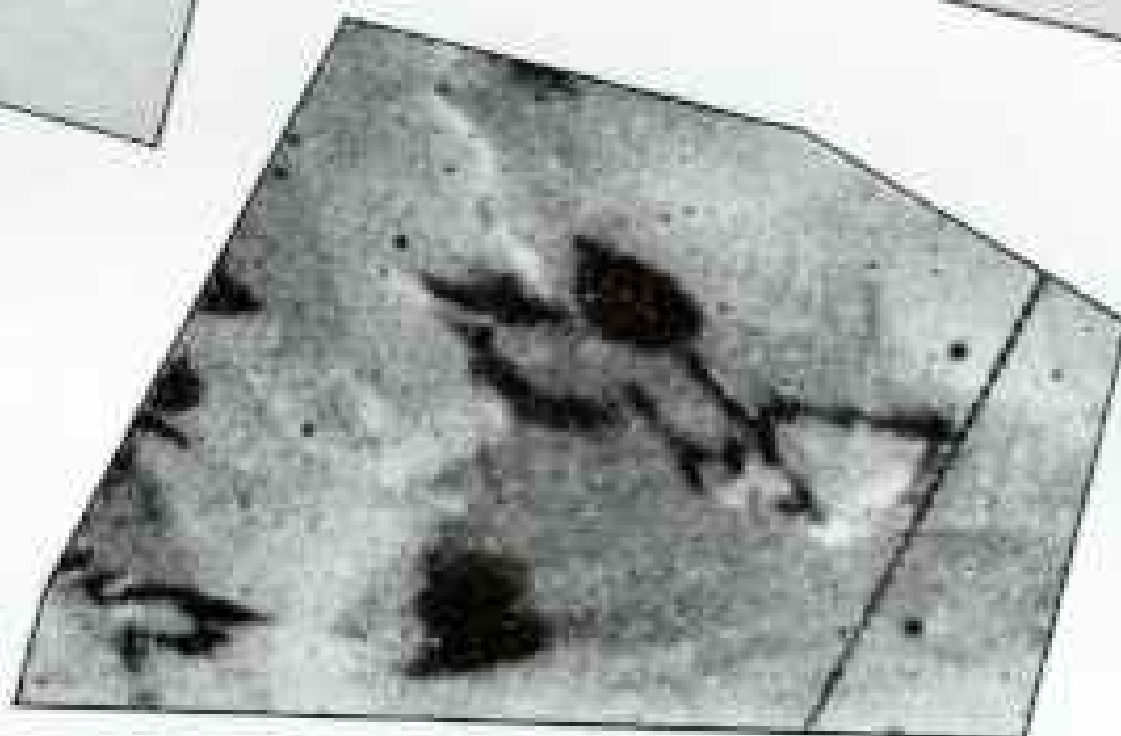
Third, there is almost no oxygen, a prerequisite for higher forms of life on earth.

Fourth, the nightly temperature drop of as much as 180 degrees would be intensely uncomfortable, if not fatal, to higher organisms.

(Continued on page 262)



Mars' changing features fall captive to Mariner photographs. The dark area resembling a spearhead (upper right) appeared 13½ days after an earlier picture showed no such feature (above). To determine the extent of the darkening, scientists fed the images of the two scenes into a computer at the Artificial Intelligence Laboratory at Stanford University in California. The differences between the two came out in a third picture (right), dramatizing the change.

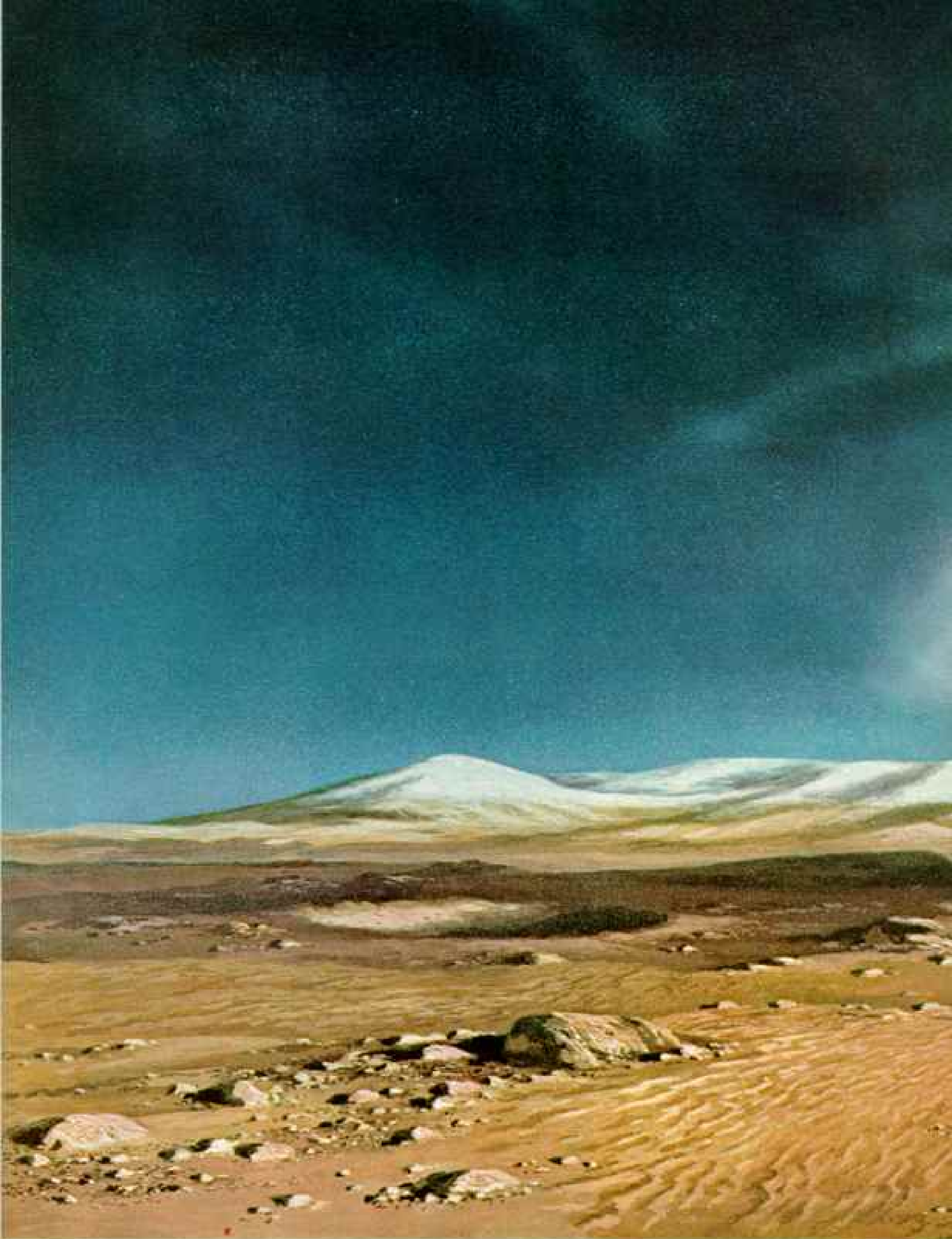


Some scientists believe that sudden appearances of dark areas, common Martian features, occur when winds sweep bright dust from underlying dark surfaces.

Washboard waves of cirrus-like clouds form in the turbulent air downwind of a giant crater ringed with winter frost. Known as lee waves, the clouds often stream in plumes hundreds of miles long, creating huge areas of brightness visible through earthbound telescopes.

The clouds form when water vapor, rising up the crater slope, cools and condenses into visible ice particles. As wind currents rise and fall, the ice particles alternately descend and become invisible vapor, then rise and freeze again. Earth clouds often occur in similar fashion on the lee sides of mountains.





Veil of herringbone clouds hovers above a frost-rimmed crater in the polar north: Thus would an observer on the surface see the wave clouds photographed on the preceding page. Ice still cloaks the crater's sun-warmed slopes long after the polar cap has retreated hundreds of miles farther north, suggesting that it may



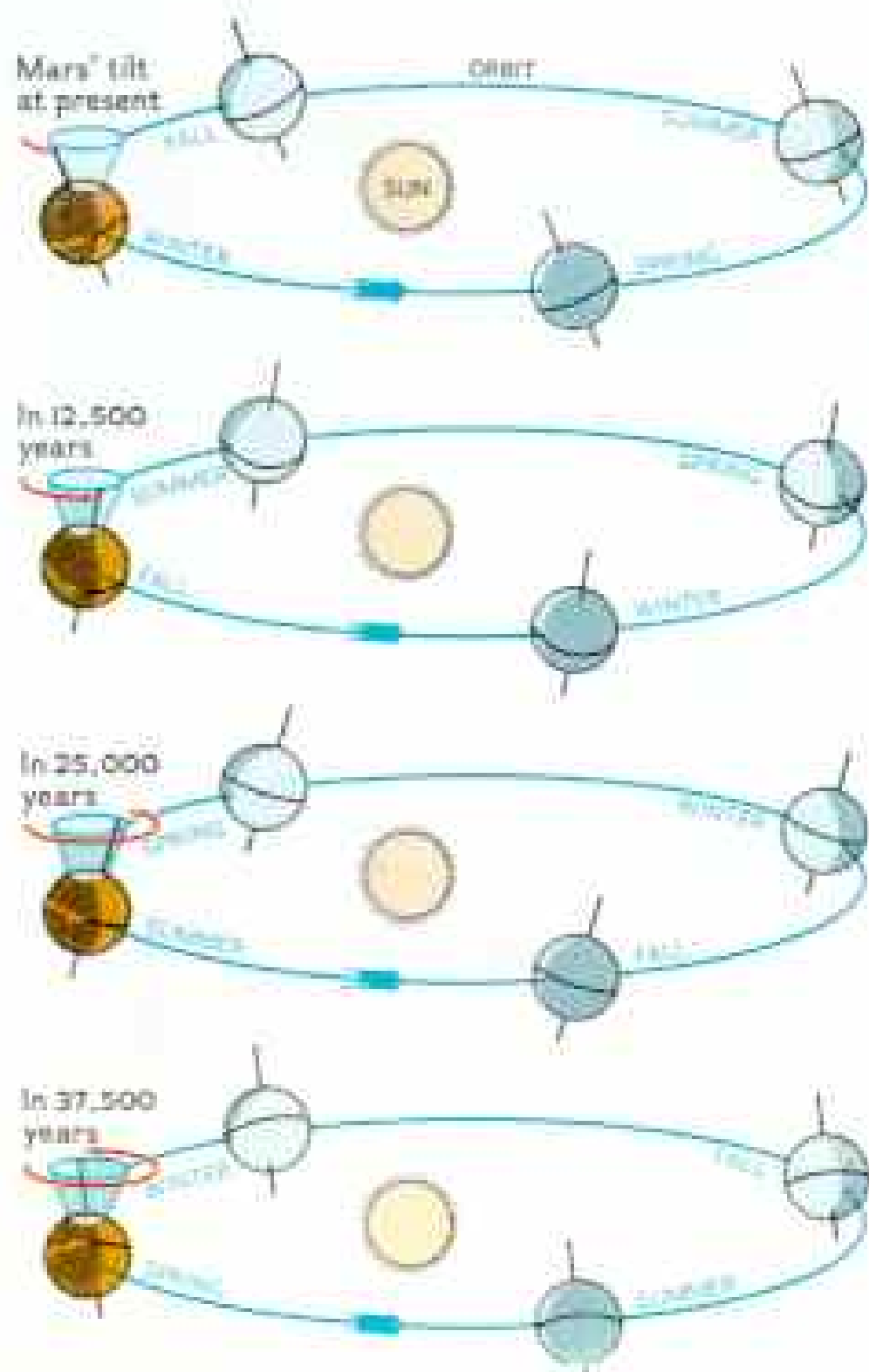
be frozen water rather than carbon dioxide. Because of the thinness of the Martian atmosphere—about 1/100th as dense as earth's—blue sky gives way to the blackness of space only a few degrees above the horizon. Mostly carbon dioxide, the atmosphere also shows traces of water vapor, carbon monoxide, oxygen, and ozone.

Rivers on Mars? Among Mariner's most startling finds are great sinuous channels like that at lower right, powerful evidence that rivers once coursed the planet.

Meandering for hundreds of miles, the channel has small tributaries, suggesting water erosion. Such riverbeds also reveal patterns of braided channels—old beds carved by shifting currents.

Traces of both show in the painting at right. High canyon walls three miles apart attest to the stream's past erosion.

Some scientists speculate that Martian riverbeds, like arroyos in the Southwestern United States, may stem from infrequent cataclysmic floods. Whence comes the water? One theory holds that climatic changes, caused by the 50,000-year cycle of axis tilt (diagram below), combined with an irregular orbit that periodically brings Mars closer to the sun, affect its atmosphere and trigger rains.



Torrential rains may result in part from the 50,000-year cycle of Mars' wobbling axis (left). Summer now comes to the northern hemisphere—when the north pole is tilted toward the sun—at a time when the planet's orbit takes it farthest away from the sun. Summers thus are cool, and allow a large northern icecap to persist, locking up vast amounts of water.

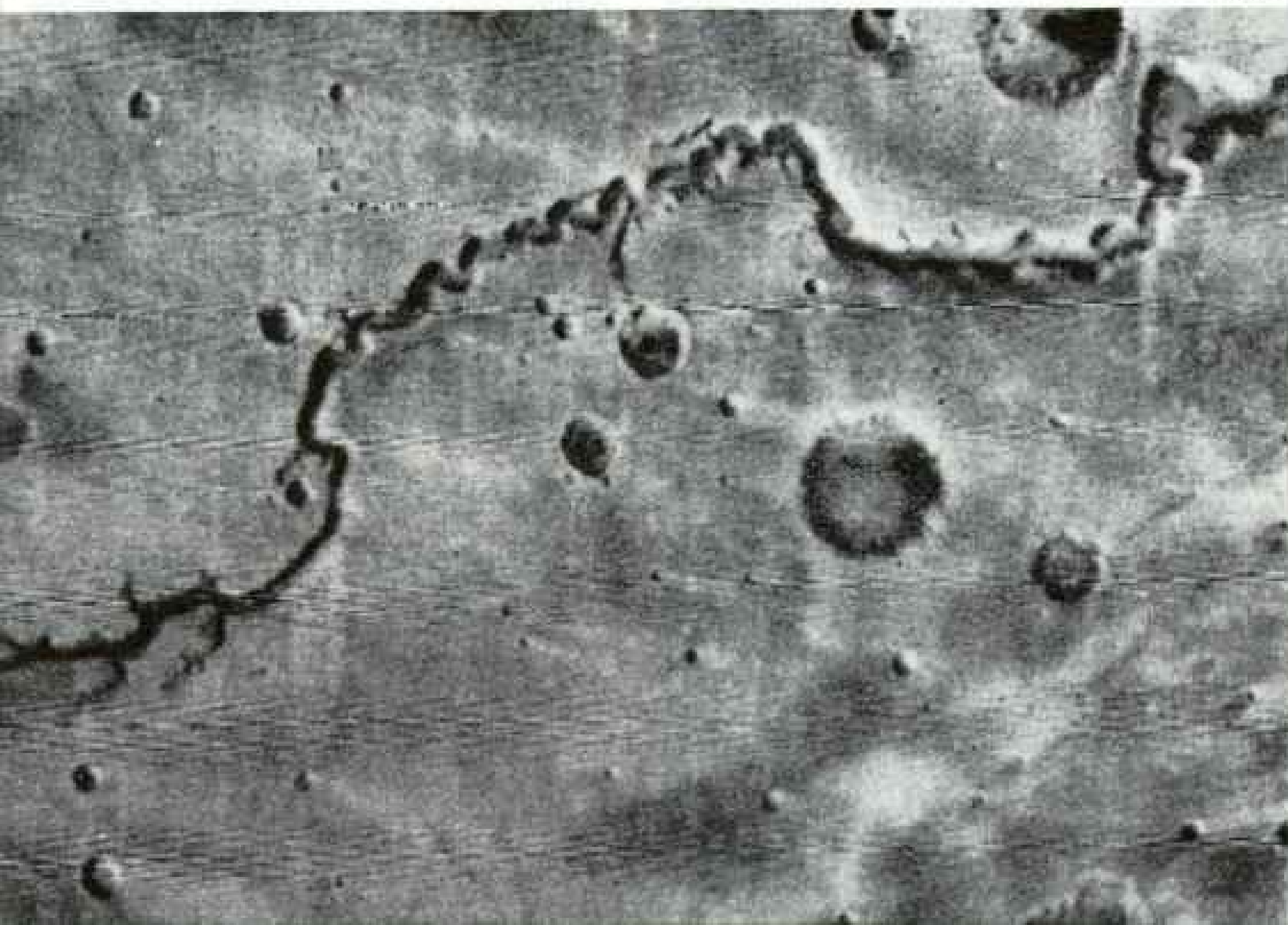
In about 25,000 years the southern hemisphere will have cool summers and the south polar cap will be the main reservoir of moisture. Both conditions result in a dry climate.

If Mars does have torrential rains, they will probably occur at some time between these two extremes (second and fourth diagrams), when neither cap is able to trap the planet's available moisture.





MARK (BELOW)



But the information from Mariner 9 begins to throw a new light on these hazards. For example, the discoveries of volcanism and of the riverbeds on Mars indicate, as we have seen, that the planet may have had a substantial supply of water that at intervals became available in liquid form.

And perhaps in the very lowest parts of Mars, where the atmosphere is denser and therefore exerts more pressure, water from melting permafrost might linger below the surface or perhaps even briefly on the surface.

Another possibility is shown by infrared spectra that suggest huge amounts of water on Mars bound up in minerals of the soil—perhaps a thousand times as much as in the atmosphere. This is not liquid or frozen water, but the same water of crystallization or absorption that we find in earth rocks.

Could this water be available to living things on Mars? Dr. Harold P. Klein thinks it might be.

"I don't know of any organism that can pull water out of a crystal on earth," he told me, "but perhaps there is an analogy with the halophiles, or salt-loving bacteria. These are pink or purplish creatures that live in salt water and can be seen in large numbers at the edges of bays. Some species cannot grow unless they have at least 20 percent salt in their environment.

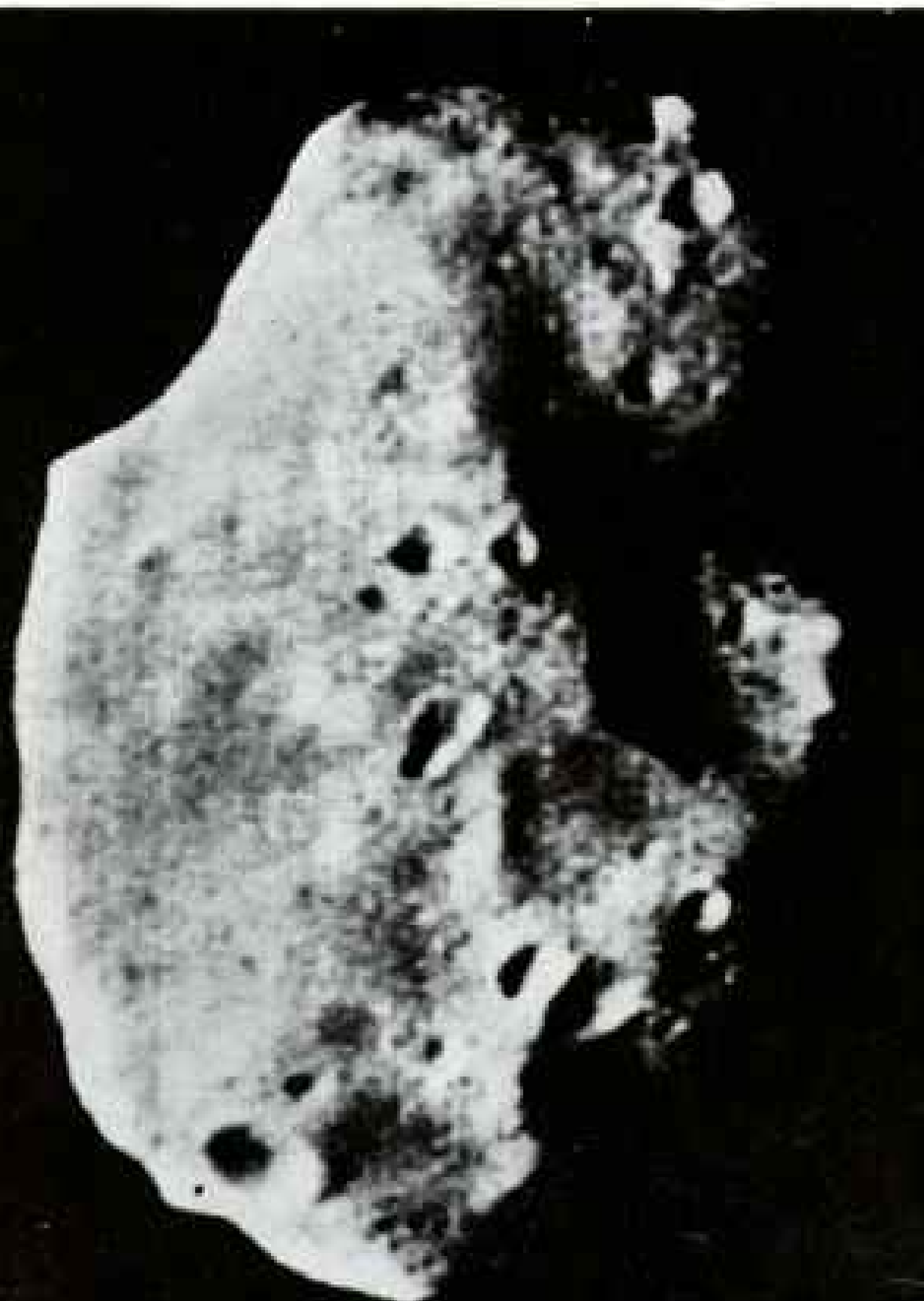
"I don't see why Mars could not have evolved organisms that could adapt equally well to extreme situations. If water gradually became scarce, they could have worked out ways to extract water from minerals."

As far as free oxygen is concerned, some lower forms of life on earth do not need it. In the early history of earth, oxygen was absent from the atmosphere or present only in small amounts. Oxygen was probably at first poisonous to earthly life, and for some organisms still is. The bacillus that causes tetanus, for example, cannot grow in the presence of oxygen. So perhaps Martian organisms would not need free oxygen.

ULTRAVIOLET radiation is a somewhat different problem, because it is hard to conceive of Martian organisms that would not be damaged by ultraviolet, *if it reached them*. But several protections seem possible. Dust in the air would reduce ultraviolet during storms.

Similarly, Mars likely has plenty of iron-bearing silicates in its soil, and perhaps organisms there have evolved silicate shells like those of diatoms, tiny algae in the sea, with ultraviolet-blocking pigments.

It is important to remember that life on earth has developed to accommodate to the terrestrial environment. In the billions of



Black and battered, Mars' two tiny moons reflect the wear of billions of years of meteorite bombardment. Phobos (left and page 230), a craggy oval 17 miles long, speeds around the planet twice each Martian day. Deimos (above), only 10 miles long, is the solar system's smallest known satellite. In a fleeting solar eclipse, Phobos throws its shadow on Mars (far right), 4,000 miles away.

years that life could have evolved on Mars, it would doubtless have produced quite different organisms with different requirements.

It is always fun to speculate on the forms Martian life might take. Edgar Rice Burroughs, whose *A Princess of Mars* and other Martian novels of half a century ago influenced a generation of boys, told of dying races of men and spectacular animals living near the dry ocean beds of a nearly airless planet. But perhaps his description of life that may come closest to the truth is found in the scene when his hero, John Carter, first arrives on the fictional Barsoom:

"I found myself lying prone upon a bed of yellowish, moss-like vegetation which stretched around me in all directions for interminable miles."

Most biologists believe that if life does exist on Mars, it will be primitive—microorganisms, or possibly even something like scraggly moss or lichens.

If there are any large organisms, they would be few compared to the primitive ones, for larger forms always depend on a vast array of microorganisms in the environment.

As Dr. Klein told me, "For one pound of elephant on earth, there must be a thousand pounds of bacteria. So our search should be for microorganisms."

Dr. Sagan, on the other hand, has always been optimistic about the question of varied life on Mars. Only a few months ago he told me, "I wouldn't bet too much money against finding complex life-forms there." He added, "There is no reason to believe or disbelieve that there are larger organisms on Mars. Mars has had 4½ billion years for independent evolution. Therefore the Martian organisms, if any, are not like us. The slate is clean on that subject. We won't know until we land."

AND THAT is precisely what we plan to do a little more than three years from now. In the summer of 1976, the two-hundredth anniversary of the birth of our Nation, NASA hopes to soft-land at least one unmanned scientific laboratory on Mars to test for life. It will be called Viking.

If the spacecraft's parachute and retro-rocket system land it safely in a smooth spot, if it escapes the threat of fierce winds and blowing dust, and if it survives overnight plunges in temperature, Viking is designed to detect many kinds of living forms.

And, of course, even if it sends back only

negative results, that will not disprove life. It may mean only that Viking landed in the wrong place.

Stringent measures are being taken to assure that if Viking does detect organic materials, they will be truly Martian and not contamination brought from earth.

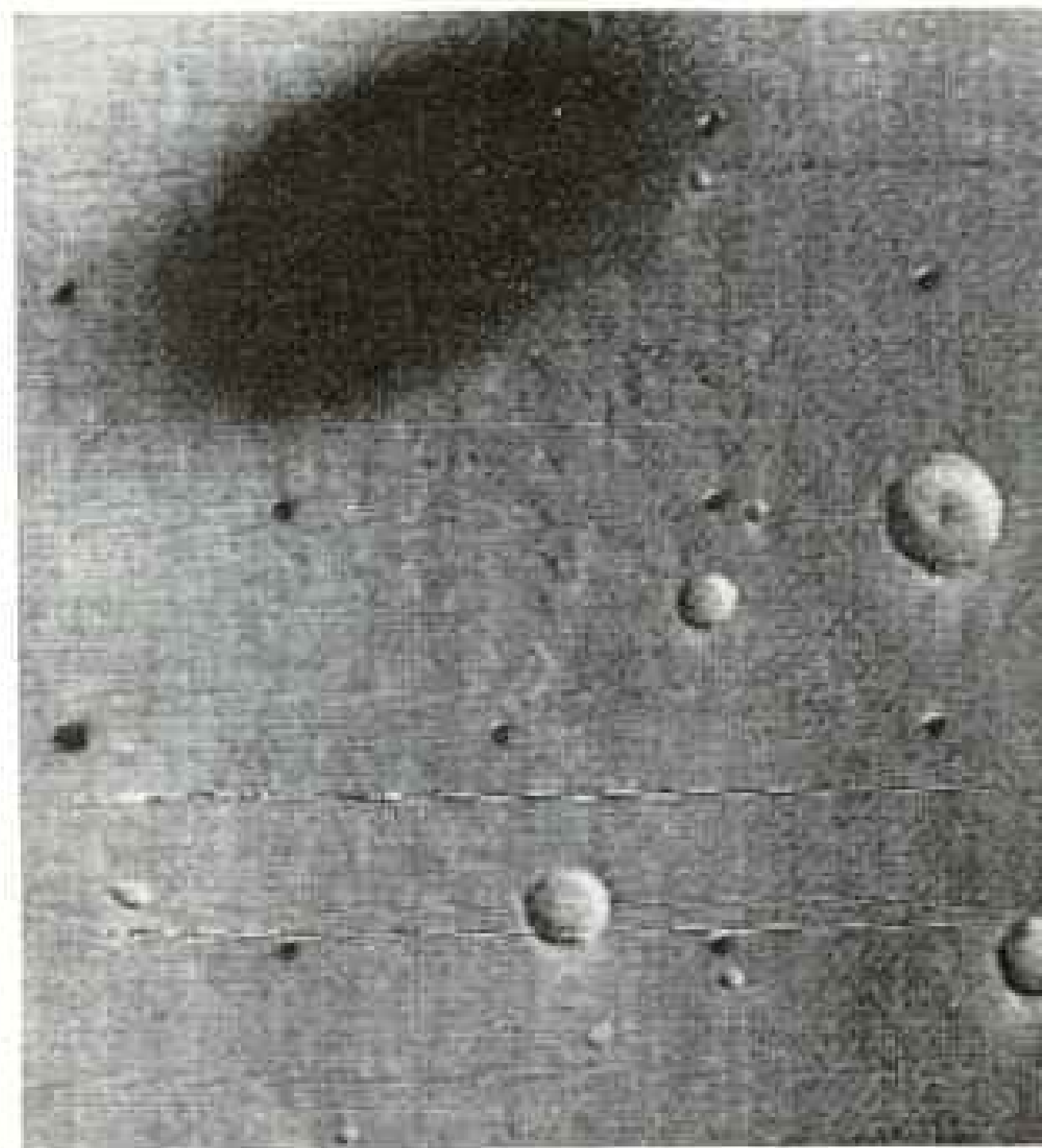
One thumbprint, for example, on a piece of Viking equipment would leave as many as 10 trillion molecules of amino acids, building blocks of life.

Or, as I learned at Martin Marietta's Denver plant, where the Viking lander is under construction, if 1/500th of a flyspeck of paint from the spacecraft fell into the Martian soil being analyzed, Viking could detect it.

Thus the utmost cleanliness is required in manufacture. In addition, the entire lander—electronics and all—will be sterilized for up to 40 hours at a temperature of 233° F.

And so, in a few years, we may have an answer to the major enigma that has confronted philosophers for thousands of years: "Does life exist elsewhere besides earth?" And we may have proved the truth of the words attributed to the Greek philosopher Metrodoros of Chios in the 4th century B.C.:

"To consider the earth as the only populated world in infinite space is as absurd as to assert that on a vast plain only one stalk of grain will grow." □



The Search for Life on Mars

By KENNETH F. WEAVER

ASSISTANT EDITOR

In quest of living organisms, Viking landers such as this full-scale model will scoop up Martian soil with ten-foot retractable arms. Inside the spacecraft, miniature laboratories will analyze the samples; dish antennas will then transmit the findings back to earth. Here the model rehearses in a Colorado gravel pit.

Two such craft are scheduled to reach Mars in 1976. Launched from orbiting mother spacecraft, they will depend on parachutes and retrorockets to bring their fragile cargoes of instruments to gentle landings. LINDA BROWN

THE SLENDER STEEL ARM reached out until it was ten feet long. It turned at the wrist, dropped to the ground, and paused. With a loud click the shovel at the end of the arm opened, pushed firmly into the soil, and closed.

I was in the Denver laboratories of the Martin Marietta Corporation, but for all practical purposes I might have been on the surface of Mars. In front of my eyes, the Viking lander was going through its automatic paces, taking a sample of soil just as it will on Mars if it lands successfully in 1976.

As I watched, the wrist rotated again. The arm retracted all the way to the spacecraft, swiveled, and stopped over a cylinder covered by a wire screen. With a violent chattering the shovel lid began to vibrate. Dust mixed with bits of rock streamed from holes in the shovel and disappeared inside the spindly-legged, turreted craft.

The rest of the process I could not see. But I knew that the sample goes into a rotating conveyor that distributes measured portions to several test cells. Then one of the most complex pieces of electro-mechanical-chemical machinery ever devised undertakes to answer the question: Is there life on Mars?

At TRW Inc., in Redondo Beach, California, I saw the innards of this remarkable device. Nothing like it has ever gone into a spacecraft before. In just one cubic foot have been compressed three automated chemical laboratories complete with a computer, tiny ovens, counters for radioactive tracers, filters, a lamp to simulate Martian sunlight, and a gas chromatograph to identify chemical substances.

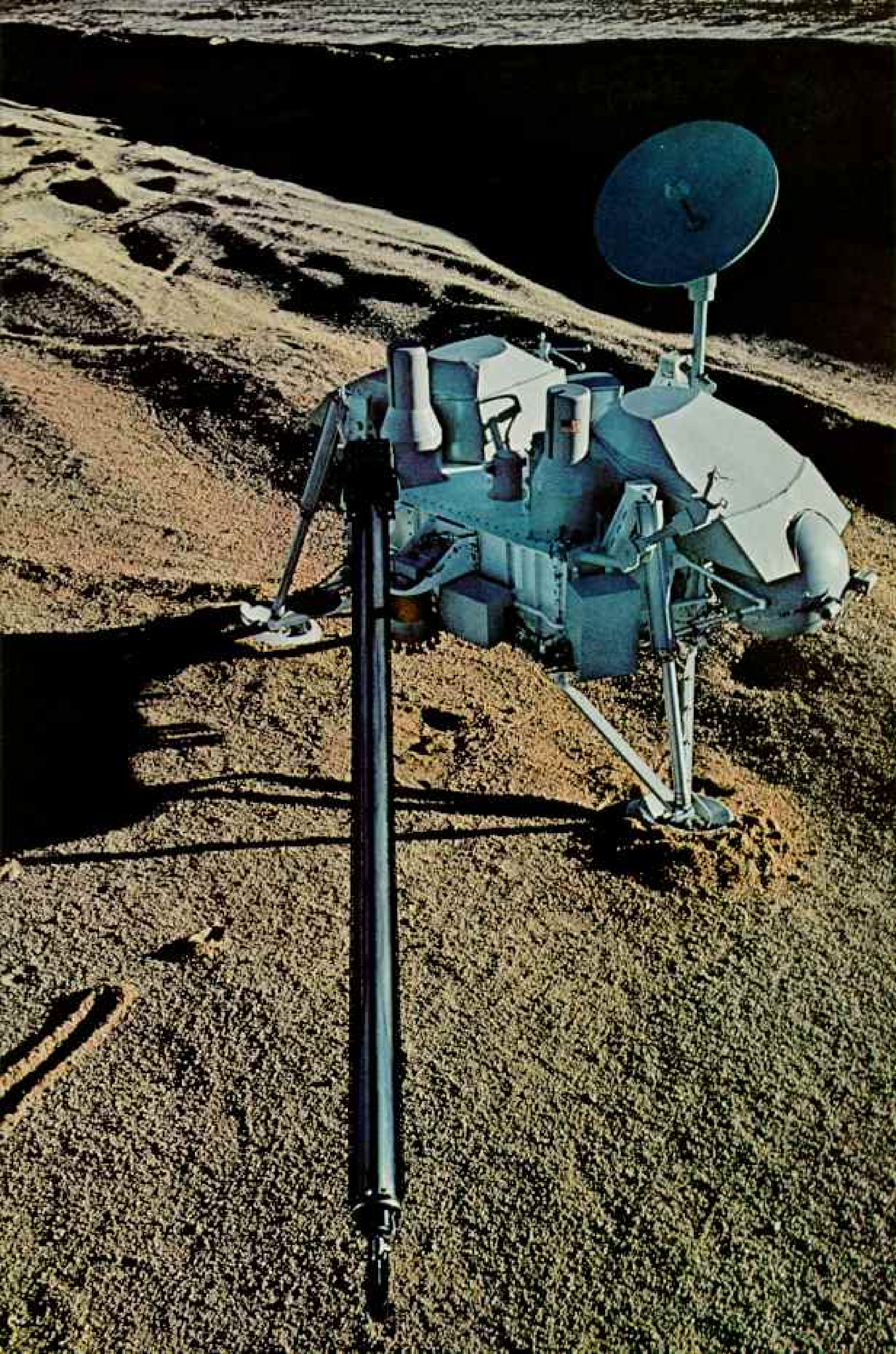
In that one cubic foot are 300,000 transistors and 2,000 other electronic parts, 1,000 wire connections, and 37 miniature valves.

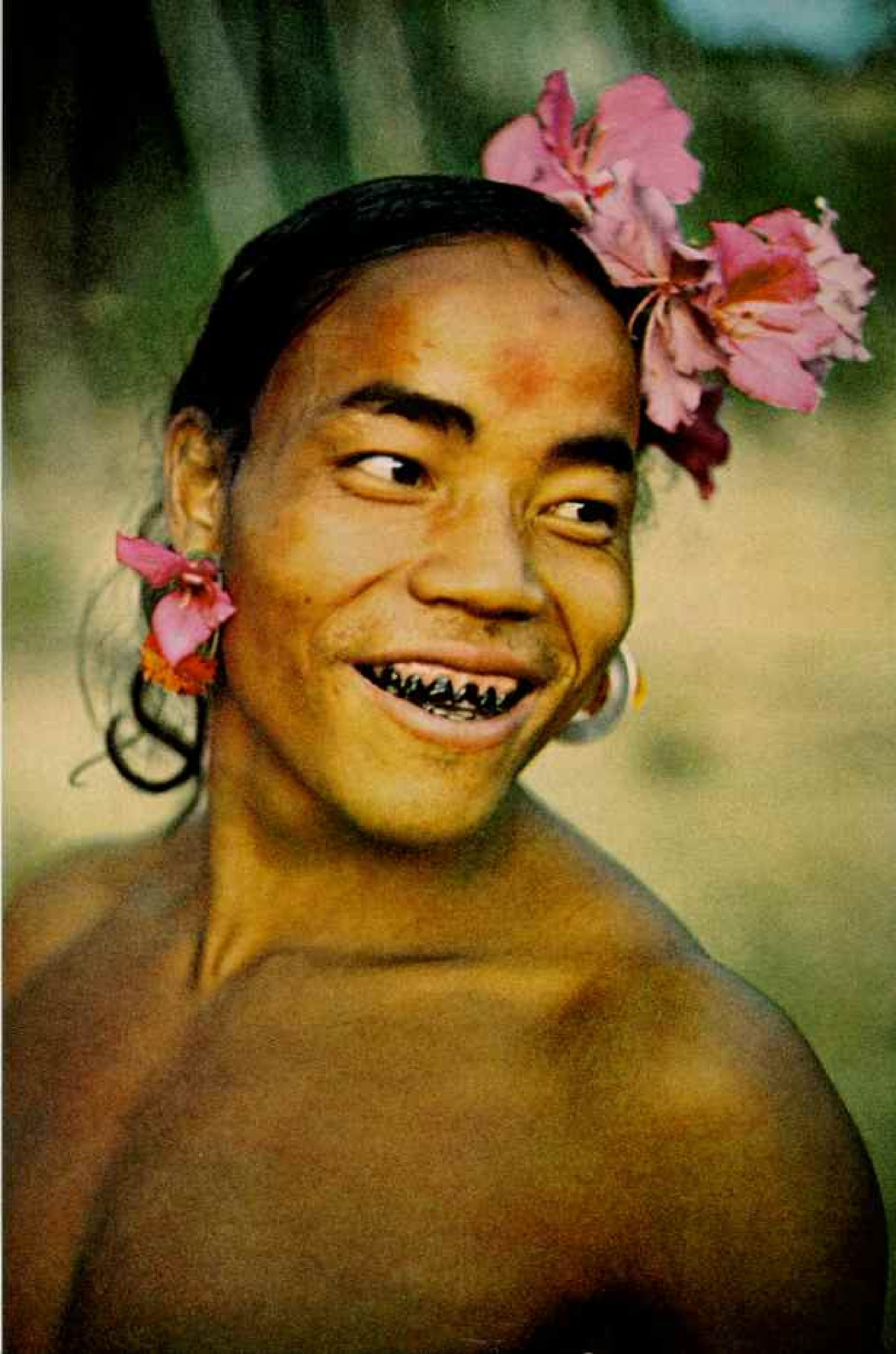
One of the cells supplies nutrients that some scientists call "chicken soup" to feed the Martian bugs. If the organisms grow, metabolize, or reproduce, they will betray their presence to Viking, which will relay the news to a waiting world.

Meanwhile, other parts of Viking will analyze the atmosphere and measure pressure, temperature, and wind velocity, identify the minerals of the soil, and watch for Mars quakes. And a facsimile camera system with two nodding mirrors instead of moving lenses will take stereo pictures in color and infrared as well as in black and white.

The pictures and data will all be transmitted to earth by telemetry.

All this is accomplished with 50 watts of power from radioisotope thermoelectric generators—hardly more than the amount of electricity used by the light bulb in your refrigerator! □





The Peaceful Mrus of Bangladesh

ARTICLE AND PHOTOGRAPHS BY
CLAUS-DIETER BRAUNS



“WHY, NANGLA, why do you wear earrings and tie blossoms in your hair? Why do you blacken your teeth and paint your forehead?”

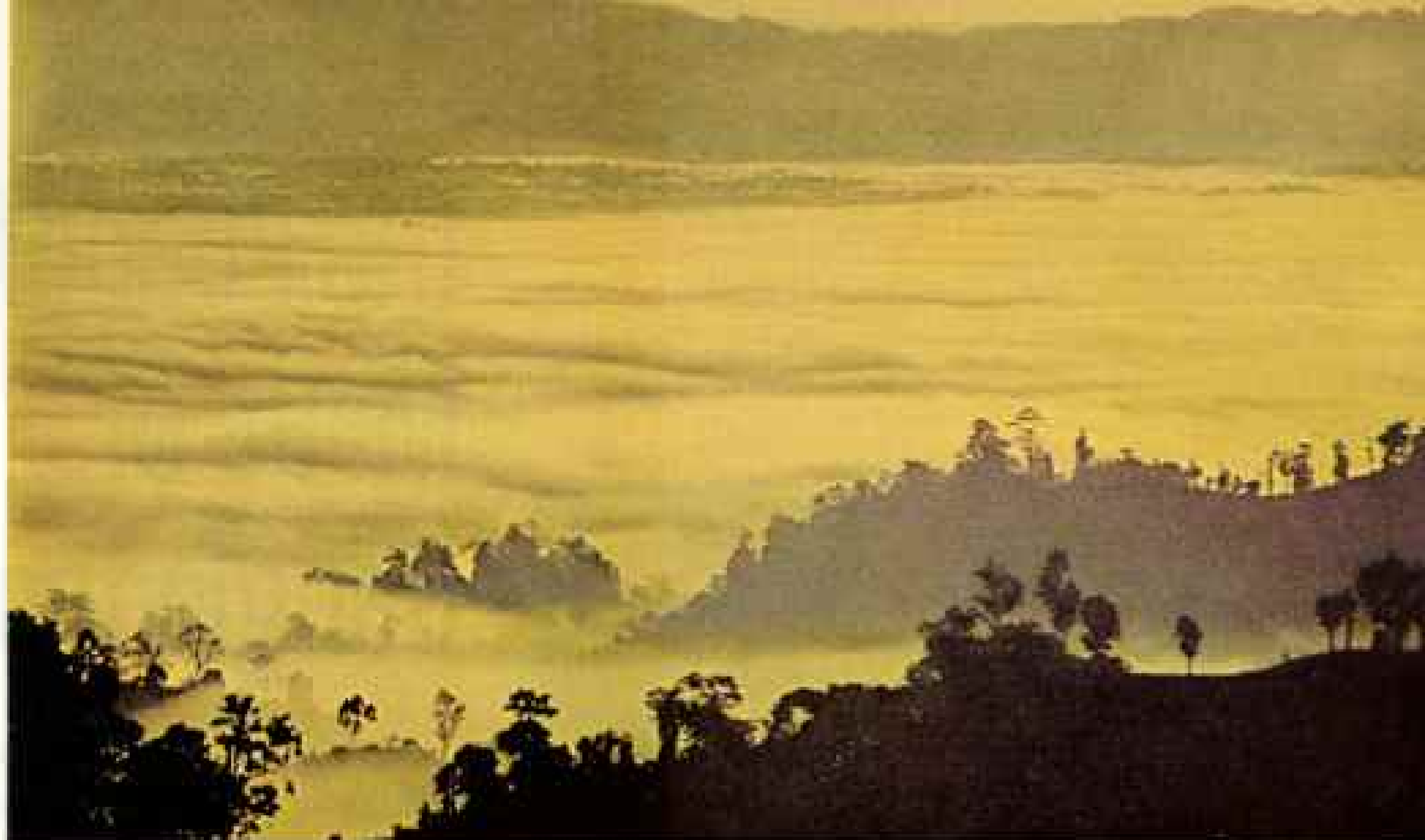
The young bachelor laughed. “Because that is what our girls like!”

Indeed, romance occupies much of the leisure time of the Mru teen-ager and turns him into a peacock.

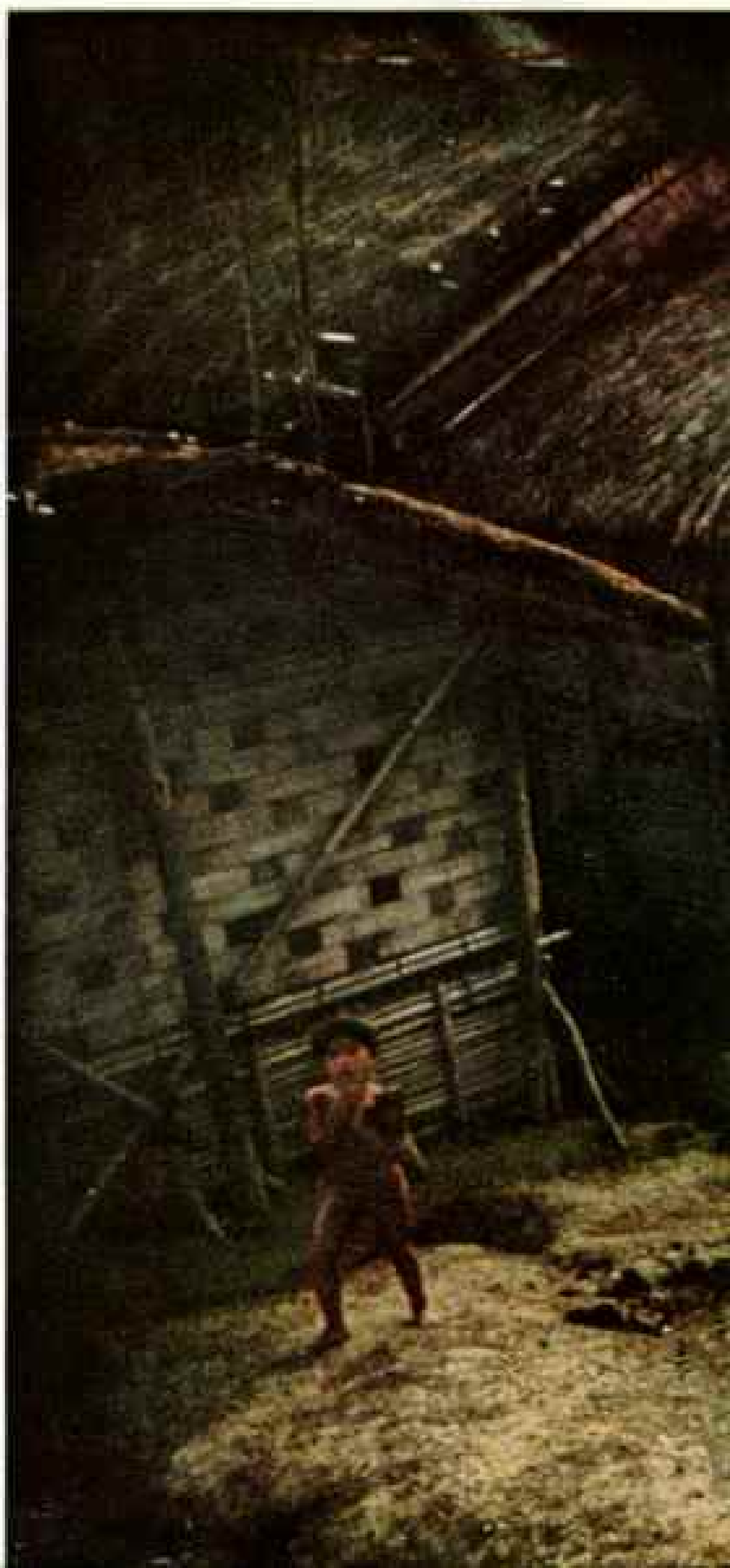
I had journeyed from my home in West Germany to the Chittagong Hill Tracts of Bangladesh to study the little-known Mru tribe before outside influences could deeply affect it. Like many seminomadic hill peoples of southern Asia, the Mrus practice slash-and-burn agriculture and cater to nature spirits with animal sacrifices. But the courting of the young fascinated me most.

Often on winter nights I heard the drone of a bamboo pipe, speaking of a young man's love. The lilt of a flute responded, played by a sweetheart who by custom was older than her suitor. Together the couple drank rice wine, and the young man sang: “Oh, beauty, you are lovely as a flower. . . . I am a poor man, but we will be rich together.”

To such an offer a girl can signal refusal by silence, by neglecting the cooking fire, or even by sweeping the bamboo floor.



AVID SMOKER AT SIX, Kaijung puffs on a Burmese cigar, a feat I never accomplished without coughing. But the villagers prefer the even stronger tobacco they grow on their own garden plots.



FOG SPREAD LIKE A VELVET CLOAK over the Matamuhari River valley on the cold December morning when I first climbed to Menjongpara, one of perhaps 200 villages that shelter some 20,000 Mrus. Its 21 bamboo houses gripped a ridge with spider legs of teak and bamboo; livestock was penned under each home.

Suspicious of outsiders, the Mru men glowered at me and the women hid. The headman, Menjong, suspected I would undermine his authority and spread a new religion. My Bengali translator-guide assured him that my "weapon"—actually my camera tripod—"would keep robbers at bay."

Gradually I was accepted. Rumroi taught me how to split bamboo (below), a skill needed to produce most items in the Mru culture. On my last visit Menglong, the brother of the headman, insisted, "You will live in my house and not in the visitors' hut as before."



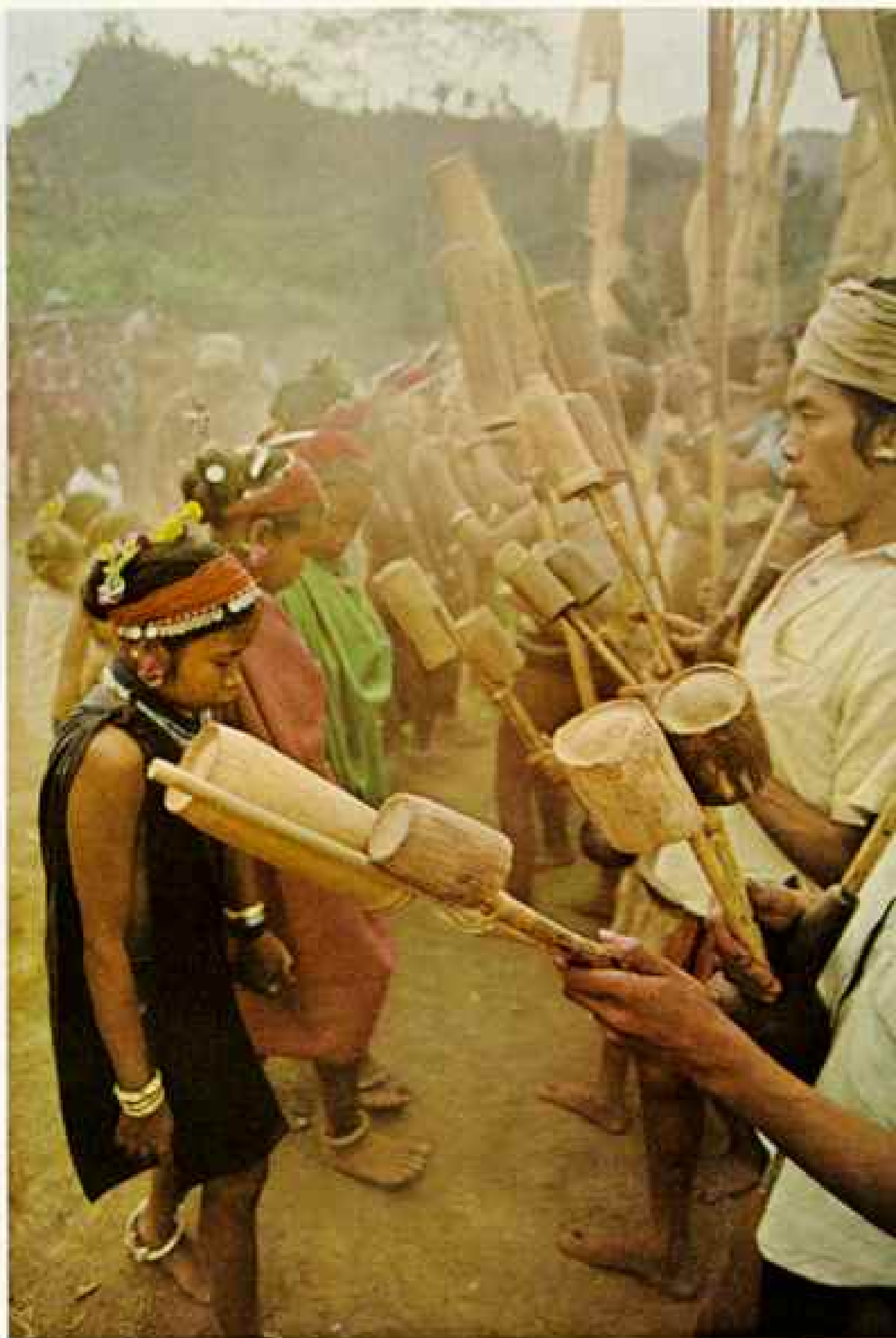


IN GROWING FRENZY a celebrant dances during the two-day festival of the cow sacrifice, a highlight of the Mru year.

Since the harvest in my village of Menjongpara was poor and my friends could not afford a cow, they accepted an invitation from more prosperous Boleipara. There all the men formed a half circle around a caged cow and blew incessantly into bamboo-and-gourd instruments. To the sound—a monotonous “na hang hang”—unmarried girls danced a simple shuffle step back and forth and sideways (right). As the day wore on, they shed their cotton wraps. One by one the celebrants paused to drink rice wine mixed with water (lower right).

An elder explained the sacrifice scheduled for the next day. “Long ago the great spirit, Torai, gave all other people a written language and rules for their lives. Only we Mrus were left out by some dreadful accident. Our desperate forefathers—hungry and ill—sent a cow to Torai to ask for help. Torai wrote his rules on banana leaves, but the evil animal ate them. We remain poor. Our revenge is this sacrifice.”

The myth gives the Mrus both a sense of their place in history and a justification for their poverty.



YOUNG MIMICS practice the shuffle step behind a line of older girls at the cow festival. Rupees from the British colonial period—now family heirlooms—form a toddler's bandolier. Mrus also use the coins as the bride-price a groom's family pays the bride's father.

Like the children, I too joined the festivities. When someone handed me a heavy bamboo pipe, I jumped along with the men and made my own music. Everyone looked proud, and I received a treasured compliment, "You are a Mru."

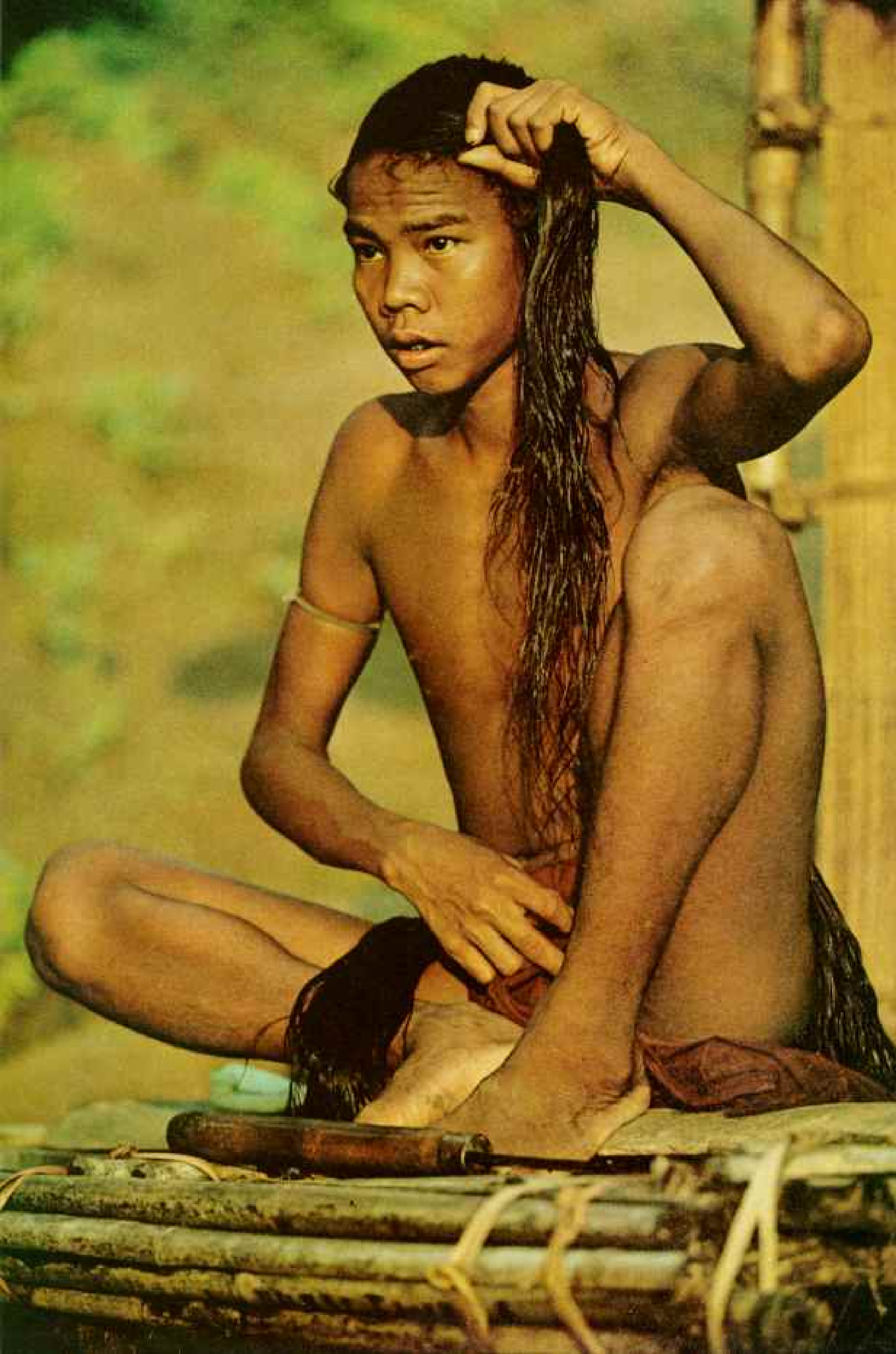


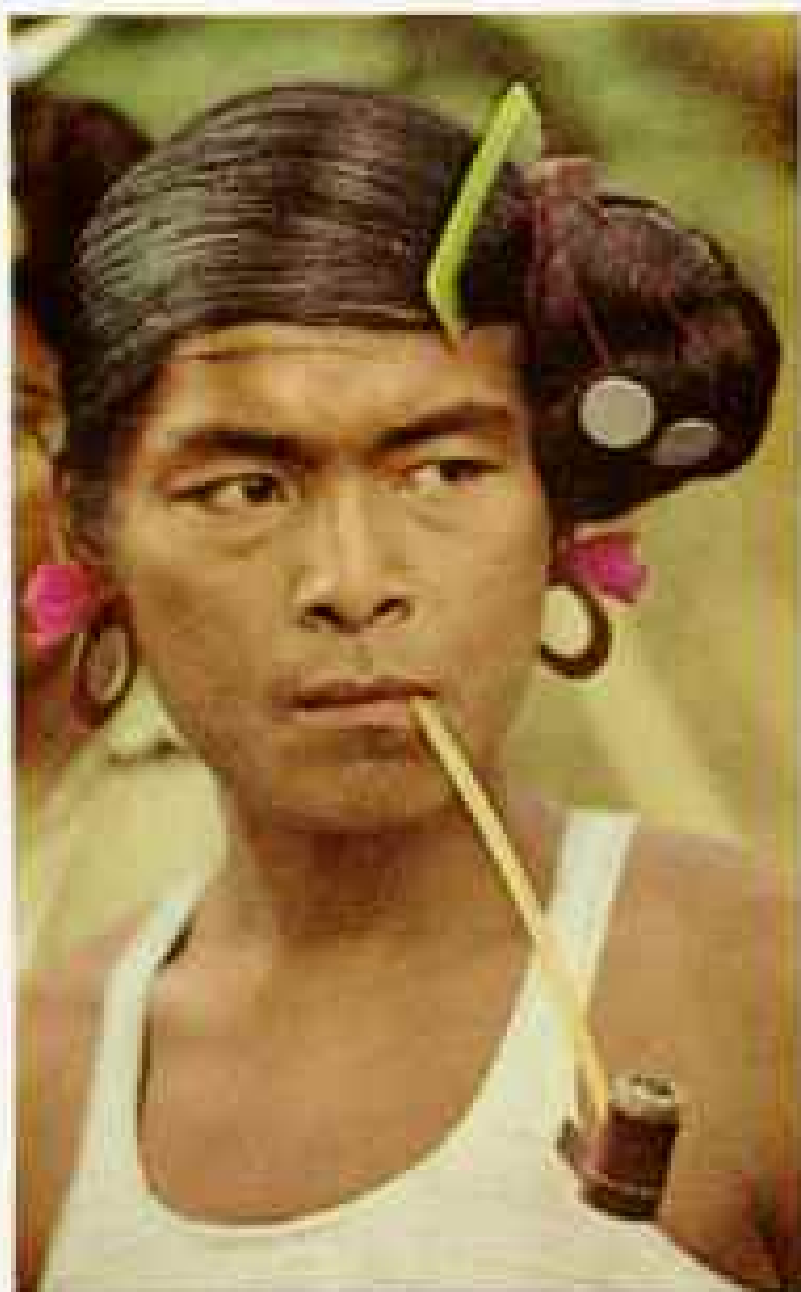
ACCOMPANYING the "accursed cow," which has just been killed by the ceremonial butcher, girls continue their rhythmic step from the village square to the veranda of the animal's donor. There men cut the



meat into chunks, season it with salt and chili, and stew it in huge iron pots. The animal has atoned for the act of its ancestor, everyone joins in the feast—a great thanksgiving—and the donor gains prestige in his

community. My friend Menglong saved a part of the cow's stomach to show me. "You see—the book of the Mrus." The ridged tissue actually resembled a stack of pages.





WITH MARRIAGE on their minds, bachelors vie for attention with an intensity and originality that amazed me. Sixteen-year-old Toinlog (opposite page) arranges his hair before adding the hairpiece in his right hand. He will knot the tresses, always on the left side.

Lengpung (left) embellishes his coiffure with coins and a plastic comb. His matchbox rests on top of the knot. A cigar and wooden comb add variety to the floral headpiece of Kainwoi (below, left). Walking home from the rice fields, Angsa plucked zinnias and marigolds to adorn his turban (below).

Treasuring their customs, Mru men withstand the taunts of Bengali lowlanders at weekly markets at Lama and Alikadam. There the hillmen exchange their raw cotton for more ornaments, as well as for cloth, salt, oil lamps, knives, pottery, and dried fish. There, too, they meet girls from other Mru villages. Most people in Menjongpara are related, and marriage within a clan is forbidden.





BOTH SHELTER and work of art, a house without nails rises in Boleipara. Bamboo fiber binds studs, walls, floor, and leaf roof, all also crafted from bamboo. A bamboo beam even becomes a hard

communal pillow. "That way we wake up fast during danger and when the first cock crows," Menglong explained. A log ladder leads to the airy veranda. I saw such dwellings withstand even the fierce monsoon.



UPLAND RICE fills women's baskets, while men thresh the grain in the hut beyond (following pages). The Mrus also grow melons, chilis, and yams. "But no matter how hard we work," they say, "our crops are never as good as in the valleys."



MEN TRANSFORM bamboo into traps, toys, looms, and containers of every size. Nangpog (above) fashions a basket for carrying cotton to market.

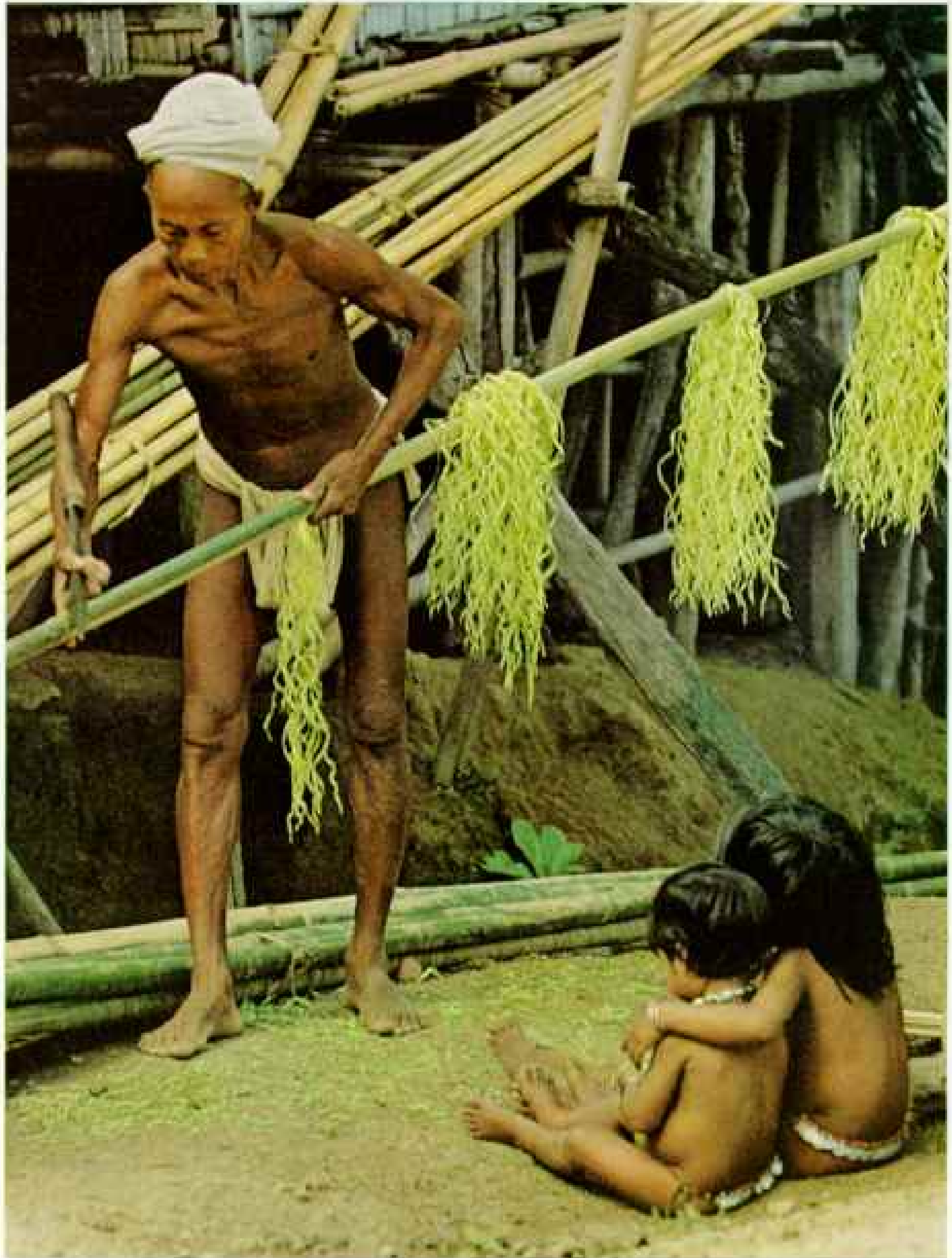




WONDERFULLY self-sufficient, each household produces its own goods, dividing most tasks according to sex. Men fence and till the fields, conduct ceremonies, and work with bamboo. Here Rumroi scrapes bamboo tassels to decorate religious offerings. His granddaughters watch; the experience of daily life is their only schooling. Rumroi also uses his *dao*—a heavy-bladed knife purchased from a Hindu blacksmith—to plant seed, kill animals, and trim his nails.

Every evening women of each family prepare rice for the next day's meals. Pau-sing (right) winnows grain husked by her mother-in-law, bending at left. The women also fetch firewood and water, collect wild plants, weave their brief cotton skirts, and share some fieldwork with the men.

Animals, searching for scraps, represent wealth and status; they are sometimes sacrificed to appease nature spirits the Mrus hold responsible for their well-being.





IN A CIRCLE of good fellowship, villagers ward off the chill of a winter evening. Every night when they visited my house, I gave them cigars and tea. They plied me with questions: "Why do you wear long pants instead of a loincloth?" "Did you arrive in the silver bird?" (They had seen the Chittagong-Rangoon airplane.) "What will you do with the pictures you take?" To help me understand their culture, they showed me how to start a fire with dry bamboo sticks, how to prove one's strength at arm or leg wrestling, how to fashion animal toys from bamboo fiber. They even taught me a little of their Tibeto-Burman language.



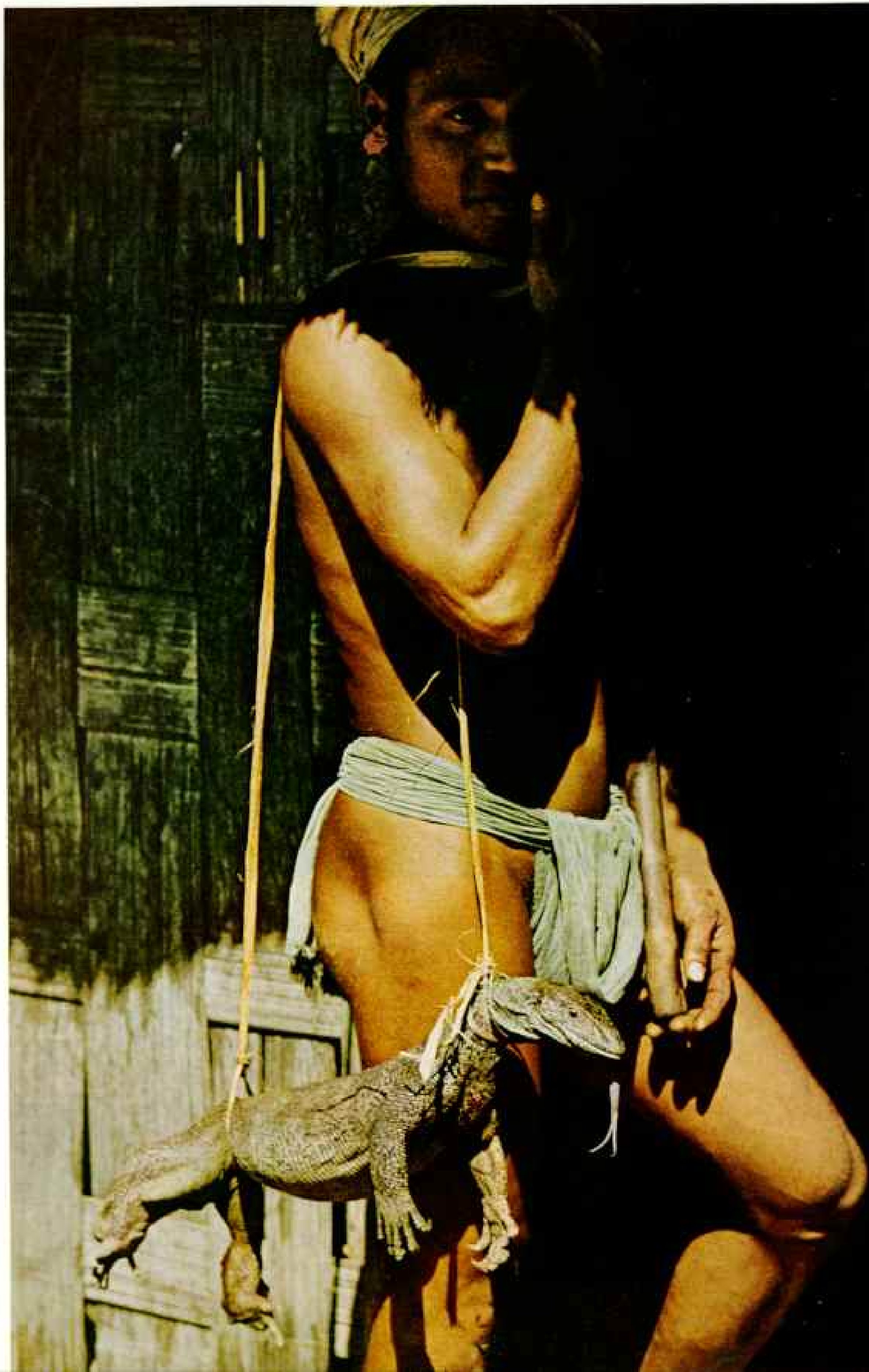


THE BUSINESS OF BOYS—trapping birds—sends Angsa deep into the jungle. In a coconut shell he carries raw gum to wrap around a bamboo pole. With bamboo fibers he attaches large live flies. The lures draw a bulbul (lower left). Later, two tiny white-eyes (below) land on the sticky rubber. All the birds will go into the cooking pot.

Toting a welcome burden, Enong brings home a lizard, whose flesh the Mrus consider a delicacy.

Villagers complain that outsiders with firearms overhunted larger animals such as deer and wild boar. But the Mrus can still catch squirrels, bats, snakes, and tortoises. As I walked the hills, I had to be careful not to step on bamboo traps armed with spring-loaded spears.







HEWN-LOG STAIRCASE leads from field to home. Here Tanjong and his son descend a slope after a day of gathering rice.

For the moment, these tribal people remain isolated, under a national policy that restricts visitors in the strategic border area and forbids outsiders, even Bengalis, from acquiring land there. But the hills are rich in lumber and hydroelectric potential. Someday

more roads will come, and schools, hospitals, dams, and factories.

What, I wonder, will become of the so-called primitives? What aspects of Western culture will the Mrus adopt, and what will they keep of their present ways? One day, perhaps, I will know. I remember their last words to me, the alien they befriended: "You will have to come back. We want you to live with us." □

Visit to an angry planet—our own earth



FROM THE FRAGILE SECURITY of your living room the night of February 15, tune in CBS-TV for a nerve-jolting glimpse of nature's mayhem going on around you. That evening—barring earthquake, volcanic eruption, flood, or hurricane—the National Geographic Society will bring you "The Violent Earth," second in our 1973 series of color documentaries. Narrated by Leslie Nielsen, the program was produced in association with Wolper Productions. Sponsors are Lincoln-Mercury and Western Electric Company, Inc.

286B



Pulse taker of a feverish world, volcanologist Dr. Haroun Tazieff (upper left) wears a heat-resistant suit to descend into the maw of 11,385-foot Nyiragongo Volcano in central Africa's Republic of Zaire. Film makers shoot from the lip of the crater (upper right) as scientists work beside the lava lake in its fuming interior (lower left). They send their findings to the Smithsonian Institution Center for Short-Lived Phenomena in Cambridge, Massachusetts (lower right), where the hot-off-the-volcano information is disseminated to the scientific community.

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COVER: Spirit figure decorates a rock wall in Australia's Top End (page 183). —ALY AND CHARLEY BREIDEN

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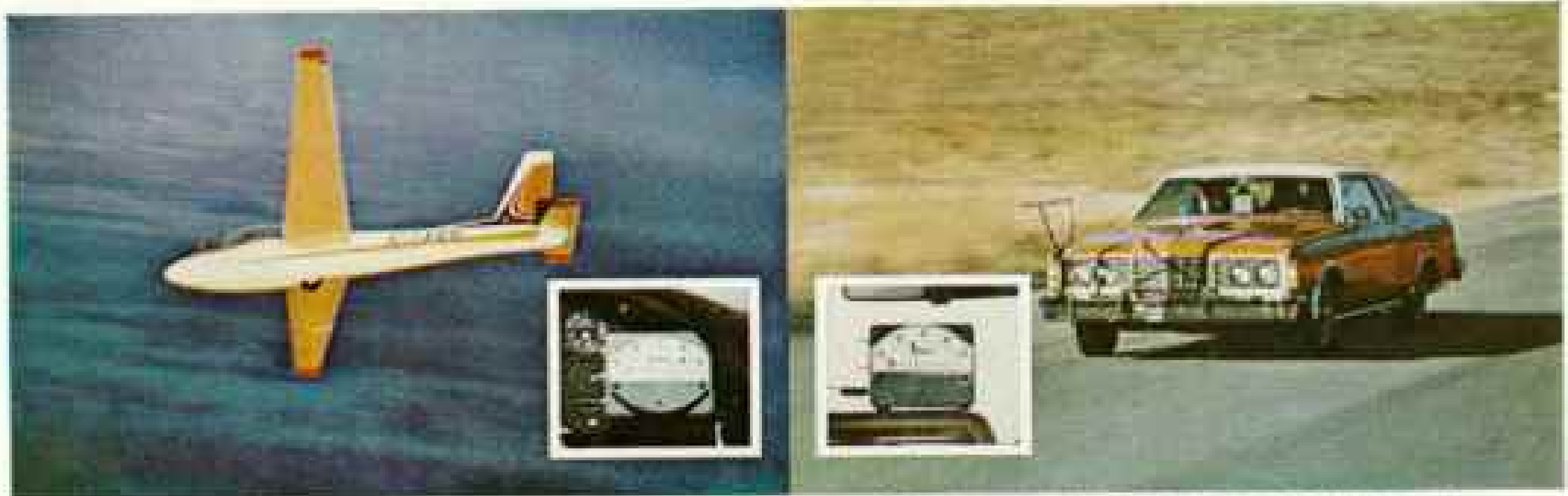
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Meeting the Mrus

CIVIL WAR and the worst tropical cyclone of the century interrupted his work, but persistence paid off for West German photographer Claus-Dieter Brauns. Bent on studying the Mru hill people of Bangladesh—a group outsiders sometimes confuse with neighboring Murungs—Mr. Brauns three times visited the remote Chittagong Hill Tracts. Each time he won new friends and new awareness of Mru ways.

Here he helps Kaisong sort a cotton crop that survived the disastrous 1970 storm. The girl will spin thread and weave it into skirts, shirts, and blankets. The bachelor Omdoi (below), adorned for a festival, plays a bamboo instrument that Mr. Brauns tried unsuccessfully to master. In the article beginning on page 267, the self-taught, self-financed ethnographic researcher reports on the unique tribal people at a challenging moment in their history.

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The plain truth about your sweet tooth

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We hope you didn't get the idea that our little diet tip was any magic formula for losing weight. Because there are no tricks, or shortcuts, the whole diet subject is very complicated. Research hasn't established that consuming sugar before meals will contribute to weight reduction or even keep you from gaining weight. But if sugar isn't thinning, it isn't fattening either.

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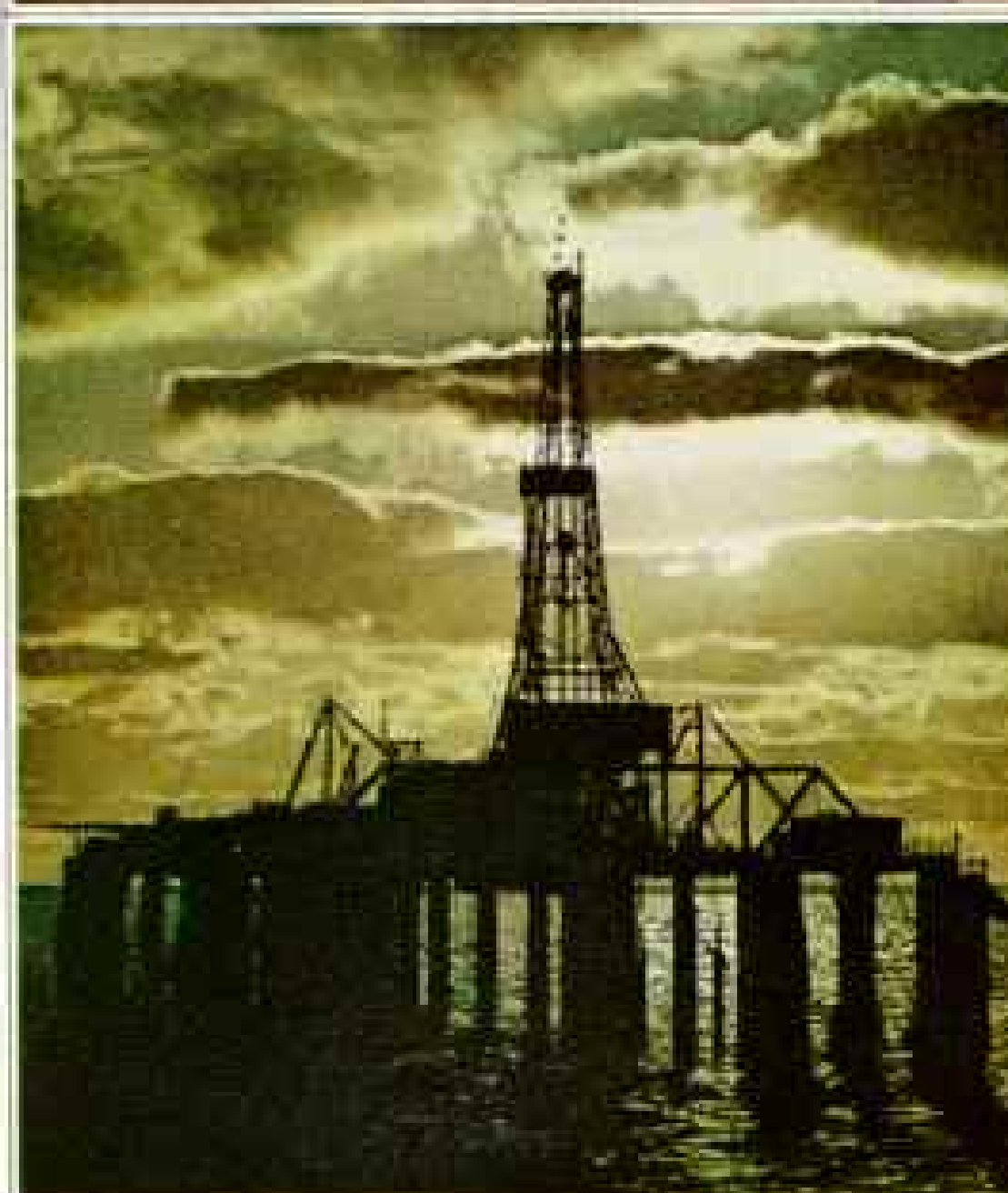
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Yet, more often than not, it is a failure.

Nevertheless, the search goes on—and for good reason—to help make sure there will be enough energy for everyone who needs it—now and in the future.

So the Exxon explorers keep on exploring, seeking the well that will not be dry. Sooner or later, their perseverance pays off, when they drill that rare well that opens up a major new source of supply.

In the U.S. the Exxon explorers search from coast to coast and beyond, far out onto the continental shelf. They are drilling on every continent, with recent successes in Alaska, Australia, Canada, Florida, and in the North Sea off Scotland.

As a result of these efforts Exxon has over 20,000 oil- and gas-producing wells in the U.S. and another 7,000 abroad.



At any given time Exxon is moving 4.5 billion gallons of oil, in tankers, barges, pipelines and trucks.

As you read this, the oil is moving. It is moving in tankers across the oceans of the world and up and down the coasts of every continent. The Exxon tanker fleet is among

the world's largest. Steaming along at a sedate 15 to 20 miles an hour, a single Exxon tanker can deliver 20 million gallons of crude oil from Texas to a New Jersey refinery in eight days.

Pipelines silently move oil, natural gas, gasoline, jet fuel and other products around the country. Exxon and other companies often share these lines.

Oil products travel the inland waterways—the Mississippi, the Ohio, the Hudson—by barge. One tug, the *Exxon Tennessee*, can push eight barges at a time, loaded with 750,000 gallons of oil, all the way from Louisiana up to Pittsburgh in 14 days. Slow but steady.

Where the tankers, pipelines and barges can't go, the tank truck takes over, delivering to homes and service stations.

It's a complex and astonishingly efficient transportation system that keeps the oil moving from our wells to our customers.

Many of the world's refineries use at least one of the refining processes developed by Exxon.

Stated as simply as possible, the job of an oil refinery is to transform crude oils into products that are useable: gasolines, heating oils, diesel and jet fuels, asphalts, chemicals and hundreds more. Exxon has pioneered many of the processes with which the complex needs of modern living can be met from nature's raw materials.

In the U.S., Exxon has five refineries. Its affiliates abroad have another 60.

Today it's common to relate petroleum and chemicals, but before 1920 it was practically unheard of. It was in that year that an Exxon refinery produced the first commercial "petrochemical."

From this beginning, Exxon Chemical Company has grown into a business with 60 plants in 24 countries. Its products are used in everything from plastics to cosmetics. Today, petroleum is the source of 80 per cent of the raw materials of modern chemistry.

Exxon is making a determined effort to minimize pollution, both from its operations and its products.

Simply running the business of oil efficiently these days is not good enough. That's why Exxon is investing some \$200,000,000



every year to remove sulfur, to clean up water and to do a lot of other things to help the environment. Here are just a few.

Because oilmen, even old-timers, rarely see a well out of control, Exxon has established a special school in "blowout" prevention techniques in Texas. It teaches drillers what to do if and when confronted with one of these rare crises.

Tanker captains receive unique training at a facility Exxon built in Grenoble, France. Here, in realistically scaled model tankers, they learn the special skills they'll need to handle and berth the largest super-tankers afloat.

Exxon has been instrumental in setting up many organizations dedicated to rapid and effective cleanup in the event of oil spills. Each of our U.S. refineries has a full-time staff of environmental specialists.

All of this is part of a continuing battle to get ourselves and our industry in harmony with the environment.



Exxon research scientists average a patent a day every working day.

Exxon scientists and engineers are involved in about 1000 different projects at any given time.

These projects could range from the development of offshore mooring devices for very large tankers to the study of unique methods for burning high-sulfur fuels in order to create as little pollution as possible. They cover everything from waste water treatment to new engineering for modern refinery processes.

Exxon researchers are developing better ways to make synthetic rubber, and better ways to extract more oil from underground reservoirs.

With an overall research program that is costing \$100,000,000 a year, every day

Exxon is coming up with something that, in one way or another, helps you.

And this is helping all over the world because Exxon research is multinational. It focuses the talent of more than 5,000 scientists and engineers in seven countries on solving the problems of our company and meeting the needs of our customers.



If you're like most people, the only time you come face to face with Exxon is at a service station.

The chances of coming face to face with an Exxon service station are pretty good—because there are 25,000 of them from coast to coast.

Over the years you've probably come to know your local Exxon dealer and the fine products and services he can offer you.

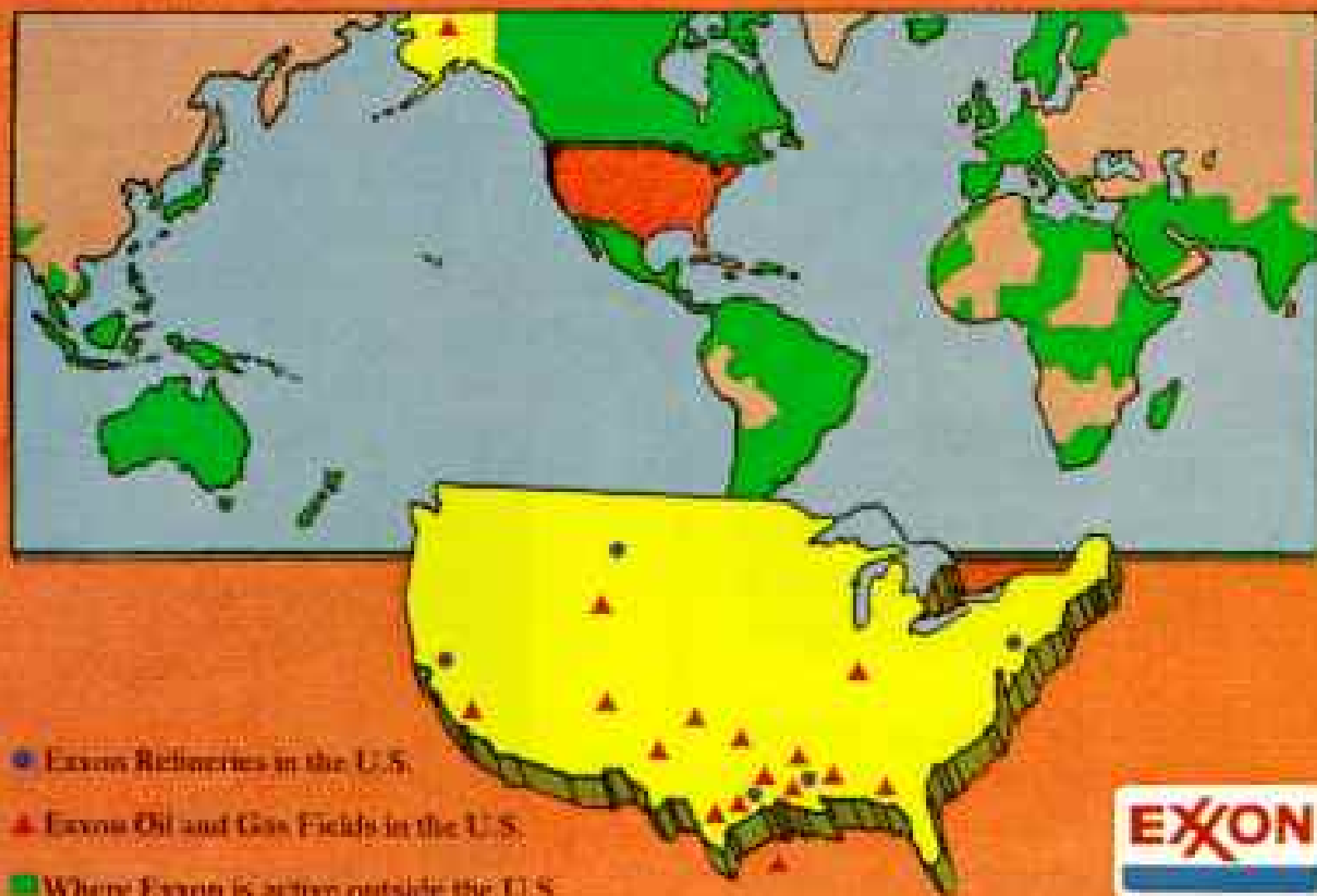
Perhaps you have also learned to depend on our touring service or road maps—Exxon was the first oil company to offer road maps, way back in 1922.

If you've had some trouble with your car you might have driven it into one of the many Exxon Car Care Centers where the problems were diagnosed rapidly and repaired efficiently.

Exxon Marinas, Travel Parks and Avitats catering to the needs of boaters, campers and flyers can be found in many parts of the country, and of course, your Exxon credit card can be used at all of them.

Abroad, you can buy equally fine products through our affiliates in more than 100 countries.





A corporation should be a "corporate citizen" as well.

The people of Exxon Corporation have made sure that the company is committed to goals that go beyond the primary responsibilities of conducting their business efficiently. There is also a commitment to society, and that commitment is an integral part of the business of Exxon.

The Exxon Education Foundation, for example, has a seventeen-year history of financial support to higher education—in fact, it has contributed over 34 million dollars to date.

And for nearly as long, Exxon has supported fine arts through competitions around the world, educational experiments like Harlem Prep, and excellence in TV programming like *An Age of Kings*, *Play of the Week* and, more recently, *Vibrations*.

Beyond this are the individual activities of our many employees working, often with Exxon support, in community projects as varied and numerous as the skills they offer.

We'd like you to know Exxon.

We hope these pages have told you something about Exxon Corporation—who we are, what we do and where we work.

We are U.S.-based with many affiliates abroad. There are, in fact, 143,000 Exxon employees around the world. Our primary task is finding, producing, transporting, refining and selling oil and natural gas to millions of customers.

In the United States, there are 40,000 of us; most of us work for Exxon Company, U.S.A., in itself one of America's leading

oil and gas enterprises. In recent months Exxon Company, U.S.A. has carried out the change to Exxon that you have seen at your service station.

An important part of our worldwide business is chemicals. This is guided by Exxon Chemical Company, U.S. chemical operations are conducted by Exxon Chemical Company U.S.A.

We are also companies that do research and engineering, international exploration, development of non-petroleum energy sources, and land development. This should give you an idea of our scope.

Although the name of Exxon Corporation is new, we realize that our reputation will continue to depend upon the quality of our products, the service we offer and the way we conduct ourselves.

J. K. Jamieson
Chairman,
Exxon Corporation

C. C. Garvin, Jr.
President,
Exxon Corporation



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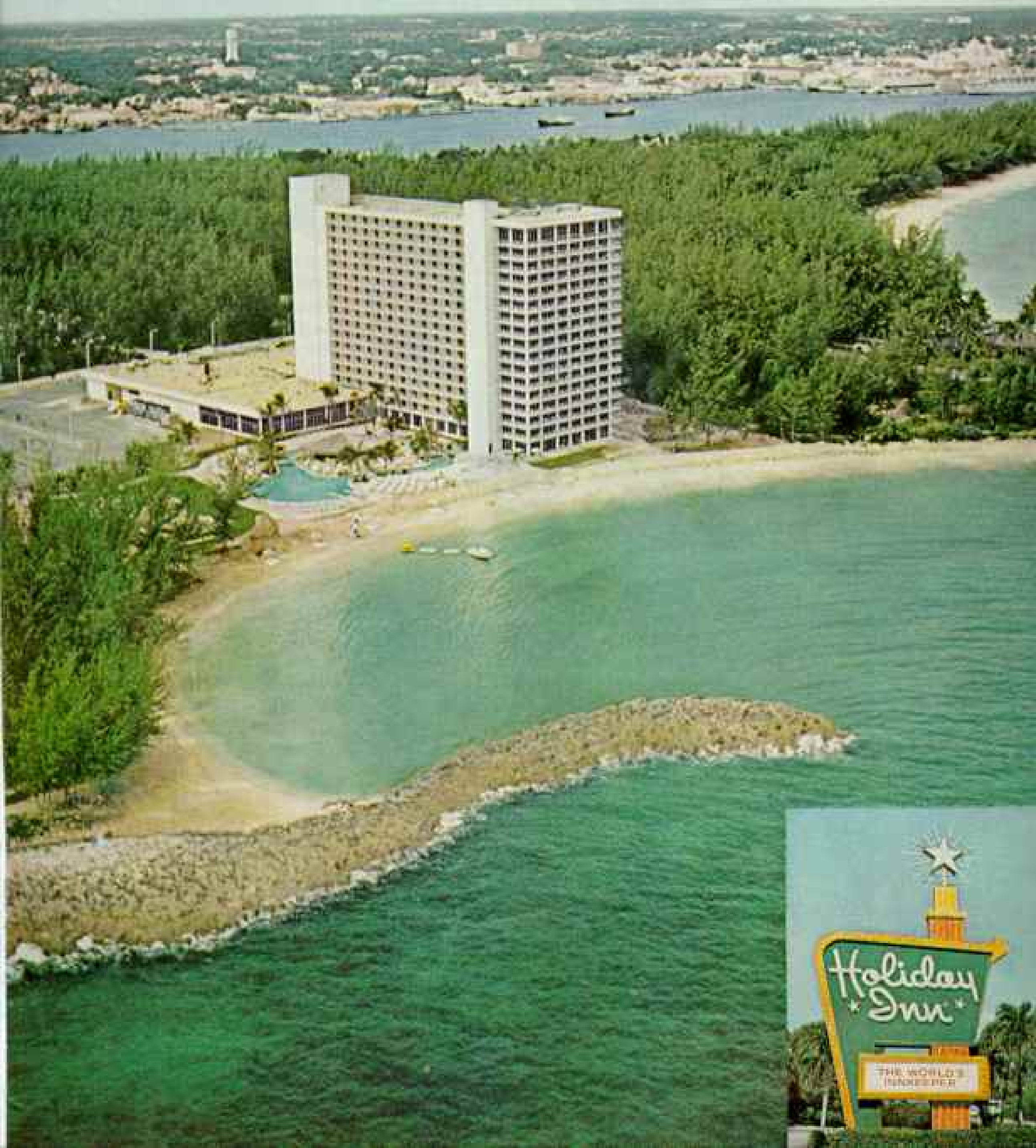
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So next time you plan a few days of the good life, ask your travel agent about our Holiday Inns. The ones that come with oceans.

Holiday Inn. The most accommodating people in the world.



This frail doll whispers of Peru's lost civilizations

Raggedy Andy of a forgotten time, he wears homespun cape and cap, with coarse wrappings for arms and legs. His rouged face is fashioned of wood, the hair of fiber.

Carved and clothed by a Peruvian craftsman, probably about 800 years ago, the 23-inch doll and his small puppetlike companion survived the years in a bone-dry grave. Now he is carefully preserved in the Smithsonian Institution. No mere curio of some ancient toyland, he probably served as an offering to the dead. The pair were unearthed in Peru's desert, a virtually rainless ribbon of land along the coast. Here colorful textiles entombed for thousands of years preserve their brilliance; objects as delicate as feathers weather the centuries intact. Time has not dulled the doll's black hair or frayed his garments. Even the red paint on his face has not paled. In such frail images Peru whispers of ancient civilizations.

Inland, Peru shouts of past glories. High in the Andes, on a mountain saddle above the twisting Urubamba River, sun-worshipping Incas built the temple city of Machu Picchu. Hand-hewn granite blocks of the citadel lay hidden under dense jungle growth until 1911, when Yale professor Hiram Bingham "rounded a knoll and suddenly faced tier upon tier of Inca terraces rising like giant stairs." Supported by the National Geographic Society, Bingham explored and cleared the site. In the *GEOGRAPHIC* for February 1915, he reported his discoveries in detail.

Readers have since returned many times to Peru. Lured by tiny doll or mammoth ruin, they find lost civilizations vividly unveiled in the pages of *NATIONAL GEOGRAPHIC*.



How can your heart be warm when your toes are cold?

Every Winter day we face takes a little bit of warmth out of each of us.

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Prices apply until April 15 and don't include meals or local and departure taxes.

They do include a room for one person (based on double occupancy) in a selected hotel, plus many extras.

For more information, get in touch with your travel agent or Eastern.

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EASTERN The Wings of Man.





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See how long you
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Do you sometimes get the feeling that a beautiful life is being lived somewhere...and you're not there?

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Bermuda
Wish you were here.



1973 Oldsmobile Ninety-Eight.

United Air Lines' Senior VP for Maintenance Operations, Marvin Whitlock, thinks its engineering integrity makes it the best luxury car he's ever driven.

Maybe you'll agree. Maybe you won't.

But if you're going to invest \$5,000 or more in a luxury car, shouldn't you take the time to check it out for yourself?



"My life is devoted to reliability in aircraft, and I want the same thing in a car. So I'm oriented more to its engineering qualities than to anything else," observed Mr. Whitlock.

"What I feel in this Olds Ninety-Eight is, in one word, security. Everything about it—the engineering, the response, the handling and ride—added up to that. I've owned Oldsmobiles for years so I know their reliability, especially the engines. But this was more. It was a grand feeling of confidence."



At Oldsmobile, we believe a car priced \$5000 or more should be superior to an ordinary car. Not only in room, comfort and accouterments—but in its driving satisfactions as well. So we put as much care into engineering its Rocket 455 V8 and its suspension system, as we do in designing its body and upholstery.

There are other cars that might be considered in Ninety-Eight's class. Most are more expensive. But we don't think they're any more car, Oldsmobile. Always a step ahead.

**The 1973 Oldsmobile Ninety-Eight.
Drive it and draw your own conclusion.**

Scout introduces the 110 day vacation.

There are 52 weekends a year. That's 104 days.

Now add the six national holidays a year and you end up with 110 days — 110 days of potential vacation without really having to take time off from your job.

And if you have a SCOUT every one of those 110 days can be a new adventure. With four wheel drive the Scout takes you off the beaten path where ordinary cars can't go.

To places where it's quiet. And the fishing is good in clear, running brooks. And the skiing is through untracked snow. And you can pull your camper to places where you won't be surrounded by mobs of people.

And besides getting a vacation on wheels every weekend you also get a great weekday car in the bargain. The Scout rides and handles easily enough for women to love it.

And it's available with automatic transmission, power steering, power brakes, even air conditioning.

Test drive a Scout at your International dealer.

It could be the first day of your 110 day vacation this year.

Get 'em up, Scout.



 **International Scout**

In the image of Nikon...

Photograph by Joel F. Ziskin



There can be no mistake, it is a Nikon image. The distinctive imprint is there. The emotional impact, the memorable composition, the sheer optical superiority.

Wherever there are great photographs, there are Nikon images. For Nikon images are synonymous with great photographs. Even when made with other fine cameras. For such is the significance of this surpassing camera. It has literally reshaped the face of photography in the past decade. Its technical superiority is established. The variety and size of its optical system is unsurpassed. But, most of all, it is the one camera which has transcended the optical-mechanical mechanism and become an integral part of the photographer's eye.

Nikon Inc., Garden City, N.Y. 11530.

Subsidiary of Ehrenreich

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Start with a new Evinrude. And you'll end up with a whole new lifestyle.

You can get away by yourself and really unwind. Or cut loose in an endless round of activity — fishing, skiing, cruising, exploring.

There's a lot of fun waiting on the water. And Evinrude delivers it all. The power to pull a gang of skiers. The stamina to move a big boat through big offshore swells. The finesse to pick through a stumpy backwater.

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And today's Evinrudes are quieter, stronger and cleaner than outboard power has ever been before.

Check out the 16 new motors from 135 hp to 2 hp at your Evinrude dealer today. The rest of your life begins tomorrow.

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How to Fly, Japanese Style.

Slip into a happi coat. Fast robe part-sport coat. The Japanese dress up even to relax.

JAL's flight kit includes slippers, fan, city guide, toothbrush, travel wallet - and eyeshades!

Beer, champagne, wine. And a platter of cheese to snack from in between.

Hot oshibori towels. Or, how to freshen up without getting up.

Kobe. The world's most luscious beef.

Pankekuchi. The delicious word for Japanese hors d'oeuvres.

Cuisine is Japanese. A perfect introduction to Japan.

Deluxe oyster. Lobster. Pate. When it's cocktail time on JAL, we treat you like a king.

Artichoke hearts. Carrots sizzle in butter. And the steak is cooked to order.

This photo features First Class service items.

We once asked some of our flight guests what they liked most about flying with us.

Surprisingly, it wasn't any of the comforts or delicacies above.

In fact, it wasn't what we did so much as how we did it. They spoke of being pampered. Of the way our hostesses in kimono smile.

Small things, of course. But in a world that worships the mammoth, the small has a way of making up in gleam what it lacks in size.

At JAL, we glory in the small

things of life. From our first hello to our last *sayonara*, we take the small attentions and courtesies so much for granted, they are our way of life.

It's a way of life practiced by us and our ancestors of generations beyond number.

In that sense, you could say we've been practicing how to fly for a thousand years and more.

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The Genius of Rembrandt

*Captured for all time in
an extraordinary series of
50 sterling silver art medals.*

*Available by advance subscription only.
Subscription rolls close February 28, 1973.*

Limit: One series per subscriber.

REMBRANDT. His name speaks of greatness. Of art that is immortal. Art that has beauty and meaning for everyone, in every age.

Because Rembrandt's subject was mankind. His people are real. They have lived, and their lives are written on their faces. Among great artists, only Rembrandt looked so deeply into the human soul.

More than three centuries have passed since Rembrandt created his masterpieces. Yet his art still communicates with undiminished power. Truly, this is art that transcends time.

How fitting, then, that the greatest works of this



owering genius will now be captured in a magnificent series of limited edition fine art medals minted in solid sterling silver—medals that will endure long after the centuries-old paint and canvas have cracked.

Medallic art in the great tradition

Fifty masterpieces have been chosen for this distinguished medallic series by a board of internationally renowned Rembrandt scholars headed by Dr. Peter Van Thiel of the Rijksmuseum—the National Museum of The Netherlands.

These important medals are being minted by The Franklin Mint, the world's foremost private mint and inheritor of the tradition of fine medallic art that was familiar to Rembrandt himself.

To capture the scope of the chosen works in the finest possible detail, the medals will be exceptionally large. Each will measure two inches in diameter and will contain 1000 grains of solid sterling silver.

Advance subscribers will receive one meticulously crafted medal each month for 50 months, beginning in March 1973. The cost will be \$17 for each medal.

Strictly limited edition

Now, for a very short time, you have the opportunity to acquire one of the most magnificent fine art series ever minted. There has been only one previous edition in the United States, and that was available only to established Franklin Mint collectors in a private offering. Subscription rolls for this public offering will close February 28, 1973. When this edition is complete, the dies will be destroyed and the series will never be offered again in this country. Its rarity will thus be assured forever.

Sumptuous collector's cabinet

To protect and display the collection, a hand-finished mahogany cabinet will be provided at no additional charge. This magnificent cabinet will con-

tain velvet-lined drawers to hold all 50 medals and will be personalized with a solid brass nameplate bearing the collector's name.

Art of enduring value

There are few joys to rival the possession of enduring art. The owner lives with beauty and has the satisfaction of knowing that the value of fine art is timeless, no matter how other values may change.

Thus, for many a collector, there could be no worthier goal than to possess this heirloom collection of fine art medals honoring one of the greatest artists of all time—a collection that combines great art, great rarity and the intrinsic value of solid sterling silver.

To take advantage of this unique opportunity, mail the Advance Subscription Application below by February 28. All applications postmarked after that date must be regretfully declined and will be returned.



The Genius of Rembrandt ADVANCE SUBSCRIPTION APPLICATION

The Franklin Mint
Franklin Center, Pennsylvania 19063

Please enter my subscription for a complete set of *The Genius of Rembrandt*. The set will consist of fifty 2" sterling silver medals, to be issued at the rate of one medal per month.

I enclose \$17.00* for the first medal, and agree to pay for each subsequent medal upon being invoiced in advance on a monthly basis.

*Plus state sales tax if applicable

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Valid only if postmarked by February 28, 1973.

Limit: One series per subscriber.

THE FRANKLIN MINT IS THE WORLD'S LARGEST PRIVATE MINT. IT IS NOT AFFILIATED WITH THE U.S. MINT OR ANY OTHER GOVERNMENT AGENCY.



Medals shown actual size

Top: Aristotle
Contemplating a
fruit of Homer

Bottom: Salsia

Overleaf:
The Sampling
Officials of The
Drapers' Guild
(The Symbols)

Do a little sight-seeing before you go on vacation.

We don't think of South Carolina as just another place to take a vacation.

So the book we wrote about it isn't just another one of those travel leaflets.

It's a 36-page, full-color, fact-filled book about places like the Wings and Wheels Museum, featuring the "Red Baron Special" and other signs of bygone eras.

It talks about beaches, from the one with the largest roller coaster in the world, to the ones with long and lonely stretches of sand in a Caribbean-like setting.

It talks about golf courses, from one of Sports Illustrated's "18 Best," to courses you can enjoy even if you don't break 100.

It talks about fishing, from mountain streams to piers on the Atlantic Ocean.

It talks about camping, from the most civilized campsites you'll find anywhere to backpacking in the Blue Ridge.

It talks about our gardens, from three of "the World's Thirty-Eight Great Gardens," to some less famous, but just as beautiful.

And it talks about a few hundred other things that we think will make you want to come here on your vacation.

Just send us this coupon and we'll send you our beautiful book. Free. Do it now.

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Princess Cruises

If nobody bothered to warn you, you'd be proud to send your kids to the Happy Clown Day Care Center.



Forget what you see.

The most important part of a day care center is the one part that can't be faked and glossed over with bright paint and papier-mâché.

That part is what's inside.

If it's a good day care center, inside it'll have qualified teachers. An adult volunteer staff, and a program for parent involvement.

It might have someone who knows what to feed kids to keep them healthy. And someone to care for them when they're not.

Inside it'll have affection, too. Kids seem to thrive on that.

Without at least a few of these

things, a day care center is only a hollow shell. Something that can do a kid more harm than good.

That's Metropolitan Life's concern. The children. So we've prepared a booklet for parents called "Day Care: What and Why?"

Right now in this country there are 5 million kids under age six whose mothers hold jobs. Quality day care would be good for all kinds of kids, including many of these 5 million. Yet only 700,000 spaces in licensed group care centers are currently available.

A word of caution, however.

Even worse than no day care centers at all would be lots of well-mean-

ing but inadequate ones. Those years a child spends in a day care center are few but vitally important to his future. More than half of everyone's learning ability is developed before school age.

If you're as concerned as we about day care centers being good ones, send for our free booklet. Write: Day Care, Metropolitan Life, One Madison Avenue, New York, N.Y. 10010. Or call your local Metropolitan office.

Don't put it off. It's something we think a lot of kids can't do without.



Metropolitan Life

We sell life insurance.
But our business is life.

Presenting Datsun 610. Considering the luxury, its economy is all the more remarkable.

The new Datsun 610 is something altogether new... a luxury economy car. A Datsun original.

Whether you choose the new 2-Door Hardtop, the new 4-Door Sedan or the new 5-Door Wagon, you get more power, more room, more quiet, just plain more car than any economy car has a right to be. But it comes with a Datsun price tag. And the kind of design sophistication you've come to expect from Datsun.

There's a new 1800 overhead cam engine and new power-assist front disc brakes for the perfect per-

formance combination. The 4-Door Sedan and 2-Door Hardtop have a new independent rear suspension, too.

As for the luxury, well, you've really got to drive it to believe it. The luxury touches—whitewalls, fully reclining bucket seats, tinted glass, full carpeting and custom vinyl interior—are just a beginning.

It's the new Datsun 610 series. Sporting performance, luxury accommodations and an economy car price. You've got to drive one to believe it. Drive a Datsun... then decide.



Own a Datsun Original.

From Nissan with Pride

Mazola® 100% golden Corn Oil- It dresses salads right!

Mazola is pure corn oil. From sun-ripened corn, full of natural goodness.

Which means that Mazola Corn Oil has more natural polyunsaturates, and is naturally lower in saturated fats, than most other oils. Because most other oils are not corn oil.

And there's nothing better than pure corn oil to bring out the flavor of all the summer vegetables in our Mediterranean salad dinner. Specially since you know that every bite will taste delicious.

After all, who knows more about corn oil than Mazola?



SALAD A LA NICOISE

- | | |
|---|---|
| 1 package (9 oz) frozen whole green beans | 1 medium tomato, cut in wedges |
| 1/4 cup Mazola corn oil | 1 can (1 1/2 oz) pitted ripe olives, drained |
| 1/4 cup red wine vinegar | 1 can (2 oz) anchovy fillets, drained and chopped |
| 1 teaspoon sugar | 1 can (7 oz) tuna, drained and broken in chunks |
| 1/2 teaspoon salt | 2 hard cooked eggs, sliced |
| 1/4 teaspoon pepper | |
| 1 medium red onion, thinly sliced | |
- Cook beans; drain and place in 1-quart bowl. Measure corn oil, vinegar, sugar, salt and pepper into jar. Cover tightly and shake well. Pour half of dressing over green beans; toss. Cover and chill 1 hour. To serve, place beans in salad bowl. Add onion, tomato, olives, anchovy, tuna and half of egg slices; toss. Garnish with remaining egg slices. Drizzle remaining dressing over salad. Serves 4.

Winnebago's 1973 D-18 Brave.

At \$6,900*, this is your best value in a low-cost motor home.



Before you buy any motor home, find out what the price includes. Many things that are standard equipment in a Winnebago are "optional at extra cost" or simply "not available" on other makes.



Winnebago gives you more.

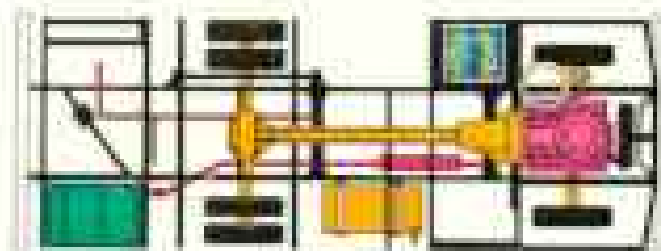
Forced-air furnace. Gas/electric refrigerator. Gas oven and range. Dual batteries. Twin 20-lb. LP bottles. Co-pilot swivel seat. Front bunk windows. Front bunk mattress. Choice of new Herculon® stainproof and flame retardant fabrics. Front privacy curtain. Water heater. Shower. Shower curtain. Mirror. Lavatory. They're all standard.

You get more space and more visibility.

We've added 3" right down the middle of every new Winnebago. Put in an escape window. And we've made the windshields 20% larger in all of our motor homes to give you a better view of the road.

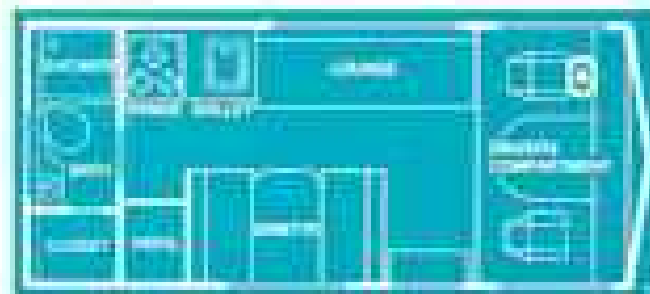
Patented Thermo-Panel® construction helps seal out heat and cold.

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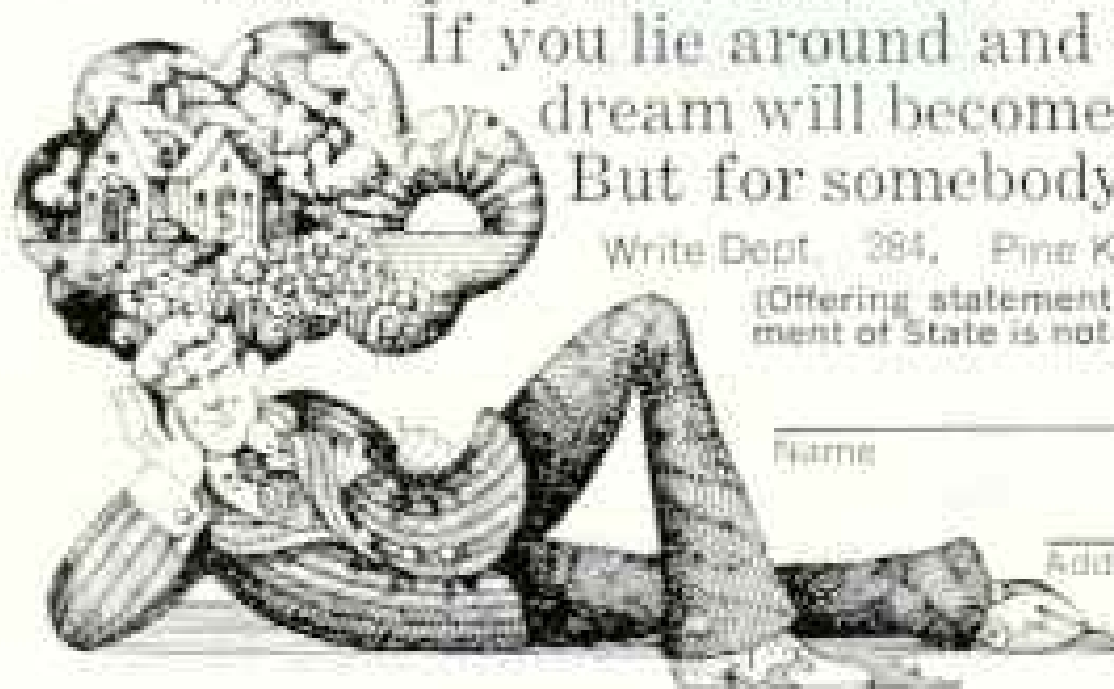
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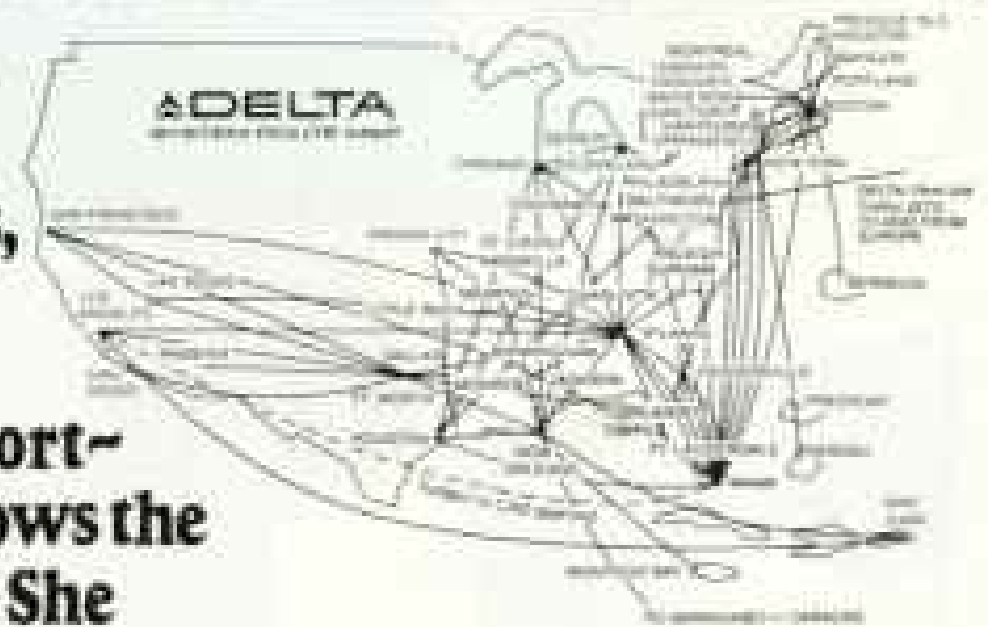
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