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African Wildlife: Man's Threatened Legacy

By ALLAN C. FISHER, JR.

SENIOR ASSISTANT EDITOR

Photographs by THOMAS NEBBIA

SURELY ONLY the most insensitive of men can look upon the Serengeti Plain of Tanzania without feeling some deep, atavistic emotion. You see a place of dream-like improbability: an ocean of grass, the light green of shallow tropic seas, endless in expanse, and flecked everywhere with the figures of wild animals—thousands upon uncountable, incredible thousands. This is a place remote from the 20th century, and you feel awed, small, and somehow close to the dawn era, time of man's genesis.

Serengeti. It is a singing name, one derived from the Masai word *siringet*, meaning "an extended area." Indeed, it taxes the sharpest vision, this extended place. Distant kopjes, or rocky outcrops, are strange ships sailing a flat inland sea. Between the kopjes flow huge herds of wildebeests, dark currents in the green (pages 152-3). Zebras and gazelles graze in a profusion the mind can hardly grasp. Jackals and hyenas skulk about the herds, and vultures inscribe effortless circles high in the benign blue.

Theodore Roosevelt, after experiencing similar scenes on an East Africa safari, wrote ebulliently in his diary, "A Pleistocene day!"

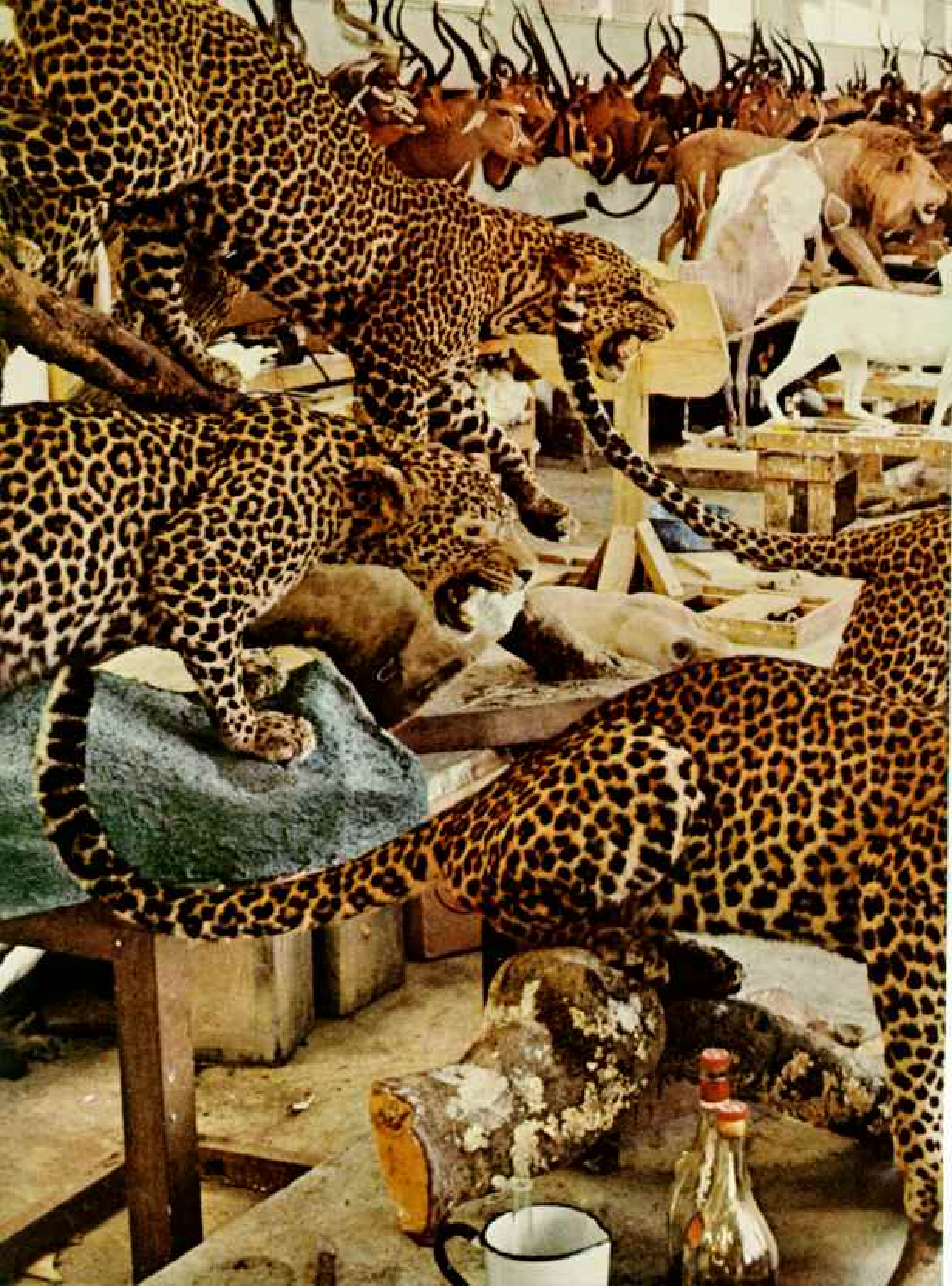
This was no mere flight of rhetoric. Africa, more than any other continent, preserves a fauna characteristic of the Pleistocene Epoch, which began two to three million years in the past and continued until some ten thousand years ago. Elephant, rhinoceros, giraffe, many magnificent antelopes—all these and more show their Pleistocene antecedents.

Trust Held for Tomorrow's World

Timeless, fecund Africa. In their wildlife the African countries hold in trust for all mankind a legacy of surpassing importance.

But it is also a temporal legacy, and clearly in mortal peril. Experts estimate that the African wildlife population has been reduced to a tenth that of fifty years ago. Only in the Serengeti and the little-known, little-developed northern reaches of Botswana can one see plains animals in the huge herds that once roamed much of Africa south of the Sahara (map, page 161).

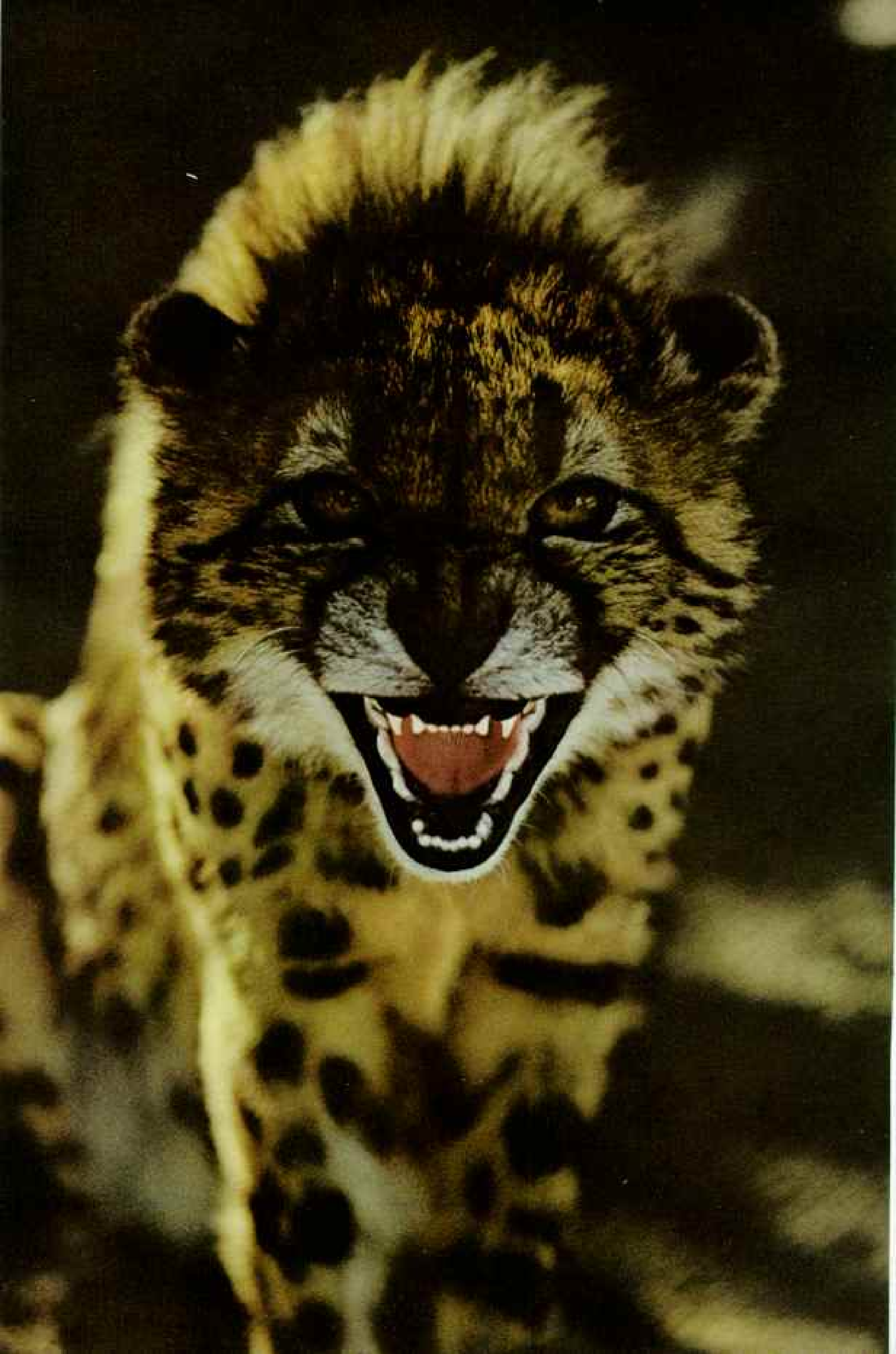
The explanation for this critical reduction is, of course, man, the most successful, the most cruel, the most profligate killer. Our attitude toward animals has not changed much through the millennia. Some scientists



Prey of the ultimate predator – man, Leopards mounted as trophies get final touches at a taxidermy shop outside Nairobi, Kenya. This stuffed menagerie fell to lawful hunters, whose license fees help finance conservation. But the animals steadily retreat before



civilization's advance. And poachers take a deadly toll. Foreign furriers still make up ladies' coats, using as many as 12 pelts for a full-length garment. Thus man the hunter, herdsman, farmer, and poacher threatens Africa's irreplaceable heritage of wildlife.



believe that primitive man, not just natural selection, was responsible for the disappearance of many Pleistocene birds and mammals in the Americas and Europe. Even in Africa, where so much survived (and, ironically, in the very cradle of the destructive human race), as many as fifty genera disappeared, and huntsmen with stone weapons may have exterminated a dozen or more of them.

Wildlife Vanishing at Perilous Rate

Since the year 1600 some 350 species and subspecies of birds and mammals have become extinct, largely because of human pressures. A listing of endangered fauna, maintained by the International Union for Conservation of Nature and Natural Resources (IUCN), currently contains 656 mammals and birds, including 123 in Africa. Many more, though not on the endangered list, have dwindled alarmingly in population.

In this increasingly serious picture, Africa is, to many, a matter of particular concern. There, with its unique and still-numerous wildlife, we have so much to lose—and so much to save (foldout, pages 164-7).*

Contrary to popular belief, wild animals continue to roam many areas outside Africa's parks and reserves. Can they survive there? Can they survive *inside* the parks and reserves in appreciable number? Or will they be reduced to small zoolike remnants, difficult to find and see, pitiful curiosities, a reproach to all mankind?

Asking just such questions, I recently traveled for three months through eastern and southern Africa, where most of the remaining wildlife roams. I visited 16 national parks and reserves, plus several large hunting concessions, and talked to some 300 people—government officials, park directors, scientists, veterinarians, rangers, game scouts, hunters, tribal elders. The nature of the threat soon became apparent. Basically it consists of three aspects:

- **POACHING**, the illegal killing of wild animals for their meat, hides, and horns. In much of Africa poaching is an acute problem, and in some areas it has become a well-organized commercial racket.

- **ENCROACHMENT**, the progressive, relentless pressure of an exploding human population on wildlife areas. Kenya, for example, now has more than 11,000,000 people—and expects to have twice that many within 25 years. Their needs, their land hunger, must come first. So each year more and more thousands of acres in Africa go under the plow or pass into private hands for ranching development. Increasingly the wild animals are being driven into parks and reserves, their migratory routes blocked by fences and farms.

- **LAND MISUSE**. For centuries nomadic pastoralists have grazed their cattle and sheep over vast areas of African rangeland, often sharing it with wild animals. But domesticated herds, sharply increasing in number, have virtually destroyed many areas by overgrazing. Some of the most abused land lies in key wildlife reserves, such as Kenya's Amboseli, a homeland of the Masai.

Lions and People Cannot Mix

Experts agree that, in the long term, encroachment must be regarded as the most important problem. Dr. George B. Schaller, who described in the April 1969 *NATIONAL GEOGRAPHIC* his research on Serengeti lions, commented to me, "You can't have lions co-existing with people. You can't have a patch of corn and entertain elephants."

Like Dr. Schaller, I find lions fascinating, and it saddens me to think that eventually they will be exterminated outside the parks and reserves. From Land-Rovers or observation posts, I have watched lions hour after

*This incomparable natural kingdom is also portrayed in a National Geographic Special Publication, *Animals of East Africa*, by famed scientist Dr. Louis S. B. Leakey. Copies may be ordered at \$4.25 each, plus postage, by writing the Society, Dept. 61, Washington, D. C. 20036.

Freedom lost but skin intact, a young cheetah—trapped while marauding livestock—snarls from an animal dealer's cage near Windhoek, South-West Africa. This African land encourages farmers not to kill troublesome animals but to catch them for zoos and national parks. Because furriers prize cheetahs and leopards for their pelts, poachers all across Africa take a grim toll of the spotted cats.

In a horde recalling Africa of old, wildebeests flow like a tide across the Serengeti Plain in their seasonal migration for pasture (following pages). The herd gives wide berth to a kill ringed by vultures. Such concentrations of hooved animals, once common across much of the continent, survive today only here in Tanzania's Serengeti National Park and in remote regions of Botswana.





hour, never tiring of them. In the sanctuaries their complete indifference toward people in cars has always seemed to me appropriately haughty and regal. Moreover, an experience in Tanzania's Lake Manyara National Park made me wonder if they don't amuse themselves occasionally at the expense of tourists.

Manyara is famous for lions that perch in trees—though no one knows why they do it—and my driver and I had found a big male and a number of cubs sprawled out on low limbs. We had driven almost beneath them and were shooting pictures when a minibus filled with German tourists became stuck in the sand nearby. Dutifully we drove up to pull it free with our Land-Rover.

Any lions in sight? No, so my driver got out with a towline. He hadn't taken more than a step when a lioness emerged leisurely from the bush, walked over to the bus, and lay down near its right rear wheel. Another lioness appeared and stretched out near the left rear wheel. Almost simultaneously a third lioness took a position near the front of the bus, very near our vehicle.

For a better view, I stood on the seat of the Land-Rover, my head and shoulders projecting out of its open top hatch. The Germans shouted at me from the bus with what I thought was rather raucous and undue alarm. My African driver, now back in the car,

glanced at me—and I swear his face seemed to pale. Instinctively I turned around. On a limb almost directly above me stood lioness number four, staring at me with considerable interest. I ducked down like a gopher into his hole. When finally I got the courage to peek out, the lioness was stretched out on the limb, regarding me with an expression I can only describe as amused.

We retreated and summoned rangers to free the minibus. By the time help arrived, the lions had tired of the game and had ambled back into the restful shade of the bush.

Most Urgent Problem: Poaching

The encroachment that menaces the majestic lion and many other animals is, I emphasize, a continuing, long-term problem. In time its effects may be lessened or blunted—there are hopeful developments to report. But how much time is there? Poaching has become such an acute problem in a number of countries that it threatens long-range planning for conservation and must be dealt with *now*.

Unfortunately, no one can be sure how many animals poachers kill. In the parks and reserves, estimates of game populations seem to hold up, but that may well be because of the large numbers of animals being forced into the sanctuaries. Certainly poaching, often on a massive commercial scale, occurs in the



parks. In the Serengeti, for example, 4,000 zebra hides were traced to just one big-time poacher. Outside the reserves, wardens report that animal herds have thinned out alarmingly in many areas.

Everyone agrees that leopards, in particular, have been heavily poached because of demand for their fur. Veteran hunter Syd Downey, one of the partners of Ker, Downey, and Selby, world's largest big-game-hunting safari company, thinks leopards may be virtually exterminated in East Africa if the carnage doesn't stop soon. "Conservatively estimated, poachers have taken 20,000 leopards out of East Africa, Ethiopia, and Somalia in just five years," he told me.

My own experiences and observations made me quite concerned about the poaching threat in a number of countries. How well I remember. . . .

Old, unchanging Africa—the remote bush country adjoining Mozambique's Save River. Massukutna, a tall, ascetically spare Shangaan elder, squats beside me in the dust and hot sun of the hunting camp. Together we stare wordlessly at a monstrous, obscene, evil thing. A glinting mound of wire snares—3,475 of them—instruments of agonizing death for wildlife and illegal throughout Africa. Game scouts have found and seized all these snares in only one month's time.

Massukutna turns and says quietly, "We used to be great hunters. Now we are great killers." His face remains expressionless, but nothing can hide the contempt in his voice.

Manguana, another elder, looks with rheumy eyes upon the tangle of snares. As if they are snakes, he pokes them with his walking stick, then says, "The young people never believe the game can be finished."

Steel Nooses Do Ghastly Work

Death by snare is death by slow torture. A poacher sets his snare, made of woven strands of steel wire, amid the brush along routes used by game. A loop in the wire catches the neck or a leg. Then the animal begins a frenzied struggle to escape. The harder it pulls, the deeper the noose sinks into its flesh. I have seen animals nearly decapitated by snares, or legs nearly torn from their bodies (next page).

Although the snare is an old technique, Africans began using steel wire, pliable yet unstretchable and unbreakable, only some twenty years ago. It proved devastatingly efficient. Unlike a hunter with gun or spear, the snare does not distinguish between male and female, young and old, or even between species. Poachers often set snares by the hundreds around paths to water, virtually exterminating the wildlife in sizable areas.

Massukutna and Manguana live in a region



Dropping by at dinner time, tourists watch cheetahs feed on a gazelle in Kenya's Nairobi National Park (left). Against park regulations, a gallery sprouts from a van roof (above). Only five miles from the center of the city, the small but game-rich refuge attracts such throngs of people that their intrusion threatens the natural habitat, increasingly the fate of African parks. —JOYCE L. SCHREIBER (LEFT)



Slaughter by slow torture: Mangled foot and leg stump bear witness to the agonizing, lingering death of a bushbuck, caught in two snares in Rwanda's Volcanoes National Park. Wire nooses, entangling the little antelope as it followed a game trail, bit ever deeper as the animal fought to escape.

Today every African nation outlaws wire snares, but the carnage continues. On a 7,800-square-mile Mozambique reserve,



ERIC CARPPELL (OPPOSITE) AND
SILBERN BENTZEL, NATIONAL GEOGRAPHIC STAFF

workers dispose of thousands of snares impounded in periodic sweeps (above).

Often working for syndicates, commercial poachers systematically plunder wildlife, despite strenuous efforts to control them. The traffic will end, conservationists believe, only when people around the world no longer buy coats made of skins of spotted cats, handbags of crocodile hide, and aphrodisiacs of pulverized rhino horn.

still rich in game: kudu, nyala, impala, eland, reedbuck, sable antelope. Both elders could remember hartebeest in their youth, but that animal is gone from the area, exterminated by hunters.

Until recently, many African hunters used bow and arrow. Massukutna, I was told, had few equals. To shoot an animal often required hours of patient stalking. The arrow seldom felled a large animal, and the enraged quarry sometimes charged. A hunter had to be brave and skillful.

But he was just as callous to animal suffering as the hunter or poacher who sets snares. Massukutna, like thousands of Africans still hunting with primitive weapons, used poison on his arrows, a concoction made from the seeds of the *Strophanthus* plant. Unless hit in a vital spot, a large animal might take as long as ten or eleven hours to die. The poison favored in East Africa, brewed from the wood or bark of the *Acokanthera*, is more potent. Yet hunters cut away only the flesh surrounding the arrowhead; the rest can be eaten.

Is the poison illegal? Of course—but so are wire snares.

War Against Poachers Never Ends

Twelve years ago the Mozambique Government set aside 7,800 square miles along the Save River, including Massukutna's homeland, as a hunting reserve. Safarilandia, a company catering to big-game trophy hunters, administers the huge area. It has sole responsibility for control of poaching, a job that never ends.

"Since 1959 we have impounded more than 90,000 snares," said Werner von Alvensleben, Safarilandia's field director. "I estimate that when we came here, 300 animals were being killed every day in wire snares. We have cut that down to a hundred a day. If we left now, not one animal would be alive in this region in ten years."

Von Alvensleben, a tall, powerful, bearded man with superb bush skills, is a hunter's hunter—and that's enough to damn him among some people. But I do not know a single conservation expert who decries controlled, licensed hunting. In many African countries hunting revenues are a principal support of conservation efforts, and professional hunters are among the most devoted conservationists. Werner, for example, had just talked Mozambique authorities into taking 1,700 square miles of his domain and making it a park.





Safarilandia's hunters and game scouts make frequent antipoaching forays into the bush. I went on one, a jolting, careening jeep ride along jungle tracks, up and down precipitous dry stream beds, through rank grass higher than a man's head. Frequently we struck out afoot to look for snares along game trails or around water holes, and by day's end we found 112—a poor day's take, Werner said. As for poachers, we caught not a one.

Usually no attempt had been made to conceal the vicious wire nooses. They gaped between bushes or across trails. None contained living animals, and only one held a carcass, a female impala, largely devoured by scavengers. That sight angered me, but not nearly so much as the discovery, by a water hole, of an animal that had somehow escaped from a snare, only to die an agonizing, slow death.

"A female waterbuck," said Werner. "Look at its left hind leg." He pointed to a deep circular indentation into the bone, the mark of a wire noose. This had caused deformation of the hoof, which was twisted at an odd angle, and a bone disease that had affected both leg and hip. The body was emaciated, a sack of sticks.

"It came to the water full of fever and died miserably," Werner added. "Look at that empty eye socket. A bateleur eagle has been here and picked out an eyeball. Natives call him *chimungu*, the boss bird. That's because he gets to the carcass first and leads in the vultures. The first thing he eats is an eyeball. Then for some reason he usually defecates on the carcass. See those droppings?"

I turned away from the sickening sight. Above us the vultures wheeled and waited.

Even Africa's Giants Fall Prey to Snares

Not even elephants are immune from such carnage. Wire of thick gauge, anchored to a heavy log or a big tree, will snare even a large bull. Elephants sometimes get their trunks caught and torn in the smaller snares. Werner told me of one old bull called the Whistler because of the noise it makes breathing through a mangled trunk. And he recalled seeing a young cow being fed by other elephants because the end of its trunk was severed and it could not forage for itself.

Fortunately each African country has men like Werner von Alvensleben, able, tough-minded men devoted to conservation. One of the most dedicated is Myles Turner, deputy chief warden of Serengeti National Park in Tanzania. Sitting in his office, I felt as if I had strayed into a war room. The walls held maps showing disposition of his forces—eight outposts, 72 men—and charts of the number of poaching arrests and convictions.

With a tender nudge under the chin, a cow elephant helps her 250-pound calf onto wobbly legs only half an hour after giving birth in Kenya's Amboseli Game Reserve. Steadily evicted from their natural ranges by encroaching farms and ranches, elephants seek refuge in parks, and today many reserves find themselves overrun by earth's largest land mammal. JULY 1988

Myles was pleased and cautiously optimistic. His latest annual figures showed 1,608 snares seized, as compared to 2,716 the previous year. Patrols were as frequent, but arrests and convictions were down. At least for that year, poaching had slackened. Myles attributed this to tough fines and sentences and stern antipoaching talks in the cells of socialist Tanzania's dominant party.

"We have smashed up a lot of motorized poaching on the western boundaries of the park," said Myles. "Many poachers believe they have a God-given right to kill the game. There is a Swahili phrase, *nyama ya mungu*, which literally means 'meat of God.' That sums up their attitude toward the animals."

I asked Myles if he had ever been wounded during one of his little wars, and he replied: "No, but a chap shot three arrows at me the other day. In very thick bush you can't see them coming, but this was scattered bush; fortunately I could see them and got down. Every one of those arrows was poisoned, and when that stuff is fresh, it will kill a wildebeest in 30 minutes."

On a previous occasion a poacher being chased by Myles's rangers was not so fortunate. He fell on a rough trail, driving an arrow smeared with fresh poison into his leg. As a wound, it was superficial, but the man took one horrified look at it and said to a ranger, "I'm a dead man." And he was, in 40 minutes. There is no antidote.

Wildlife Still Lacks African Friends

Concern for wild animals is not yet part of the ethic of the average African. Solomon Alexander ole Saibull, 36-year-old Masai and newly appointed director of Tanzania National Parks, emphasized that point to me:

"Here a poacher is not considered anti-social," he said. "His fellow villagers may believe he is being persecuted by fanatics. Elsewhere, the African public simply couldn't care less. It is not yet involved with conservation. If someone tried to jettison the park system, there would not be a loud public outcry. We hold the parks in trust for a public that is not yet conscious of its heritage."

Another well-educated, articulate African conservationist, Ngugi Nganga, made much the same point to me regarding the situation in Kenya. Ngugi, a graduate of Union College in Schenectady, New York, served as a divisional game warden at the time we met.

"We simply do not have an esthetic value here in relation to the animals," he told me.

"You can't sell wildlife to the ordinary man except by economic arguments. In your country leisure is an important consideration. Not here—food and shelter are my countrymen's primary considerations. But one day people here will have the need for parks."

Education in conservation ranks high on everyone's list of priorities. Rangers of the Animal Orphanage at Nairobi National Park were appalled to find that eight out of ten visiting African children could not tell a hyena from a leopard. But that will change. The African Wildlife Leadership Foundation (AWLF), supported by public donations and headquartered in Washington, D. C., built an excellent Wildlife Education Centre at Nairobi National Park. The East African Wildlife Society funded a mobile film unit that travels Kenya with a conservation message. Kenya's National Museums help sponsor the Wildlife Clubs of Kenya, a movement that enlists youngsters throughout the country.

College Trains Young Game Rangers

The AWLF provided the initiative in 1963 to launch the College of African Wildlife Management on the slopes of Kilimanjaro near Mweka, in Tanzania. Now brilliantly successful, the college trains young men from all over English-speaking Africa to be game wardens (opposite). When I visited the school, it had 64 students, and courses ranged from botany and taxidermy to ballistics and court procedures, from zoology and car repair to ecology and mapping.

What's more, "No student leaves here unless he personally has hunted and killed one elephant," said Tony Mence, the school's principal. "These men must be properly trained and competent in animal control. They must know how to track, to stalk, and to shoot."

Again with AWLF help, a similar wildlife management college opened in 1970 in Cameroon. It teaches French-speaking Africans.

John Owen, who recently retired as director of Tanzania National Parks, saw the need of public education for conservation years ago. He had several films made—including "A Masai Looks at Yellowstone"—that helped win acceptance for his programs. He also saw that his board of trustees visited Yellowstone and Yosemite National Parks.

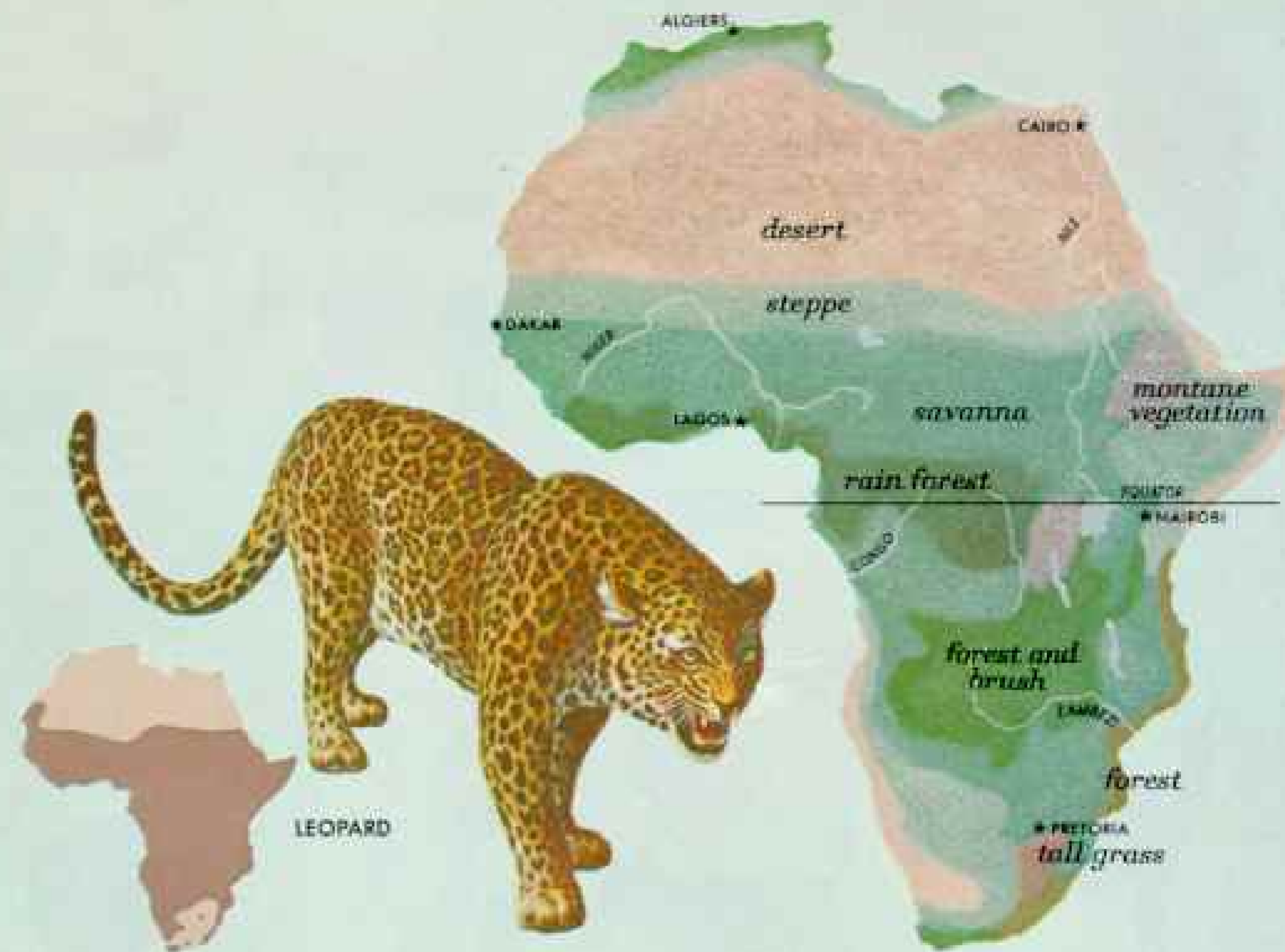
Tanzania gave pointed publicity to its recent crackdown on commercial poaching, some of which involved government employees. When reports of misconduct in game administration reached President Julius





Biting off more than it can chew, a cheetah learning to hunt struggles to wrestle a wildebeest calf to the ground in the Amboseli Game Reserve. Moments later the intended victim shook off its attacker and loped back to the herd. Only then did the cheetah's mother, watching motionless from a distance, approach her humbled offspring, as if to offer a parental critique of its performance.

Grazing Africa's bush and plains, wildebeests and other antelopes form an indispensable larder for the carnivores—lions, leopards, cheetahs, hyenas. But each year countless wildebeests fall to man's rapacity—snared by poachers who seek only their tails to sell as fly whisks.



A Continent's Living Treasure

FROM DAINY DIK-DIK to six-ton elephant, African animals come in shapes and sizes unsurpassed on any other continent. Here the artist, in consultation with Dr. Theodore H. Reed, Director of the National Zoological Park in Washington, D. C.,

portrays the wildlife a visitor would be most likely to encounter. Beside each animal, a map depicts its range, often rapidly receding before man's advance. Where a variety such as the zebra embraces several species, the map shows a composite of their habitats.

Comparison of the ranges with Africa's vegetation zones (above) reveals that many animals, such as the elusive okapi of Central Africa, dwell only in a specific habitat. But others, like the adaptable leopard, range from desert to dense forest.

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PAINTINGS BY STAFF ARTIST NED SEIDLER

RESEARCH BY JEAN R. MCCONVILLE, MAPS BY ELLI BARBAN





BAT-EARED FOX



SERVAL



BOHOR REEDBUCK



SPOTTED HYENA



IBEX



AARDVARK



BABOON



WATERBUCK



TOPI



WARTHOG



COLOBUS MONKEY



BLACK RHINOCEROS



GUENON



BUSHPIG



OKAPI



IMPALA



LOWLAND GORILLA



SITATUNGA



GREATER & LESSER KUDU



CROCODILE



HARTEBEEST



GIANT ELAND



DIK-DIK



MANGABEY



BLACK-BACKED JACKAL



BONGO



ZEBRA



BARBARY SHEEP



THOMSON'S & GRANT'S GAZELLE



CHIMPANZEE



OSTRICH



HIPPOTAMUS



SCIMITAR-HORNED ORYX



CARACAL



GERENUK



LION



DRILL & MANDRILL



CIVET



LECHWE



STRIPED HYENA



PYGMY HIPPOPOTAMUS



WILDEBEEST



BEISA ORYX



GOLDEN JACKAL



ELEPHANT



CHEETAH



GIRAFFE



DUIKER

"I don't play golf any more," Balson said wistfully. "I don't go out much at night. During the day I look after myself, but I have two chaps who keep an eye on me at night. Eventually I'll have to leave. I've made so many enemies here."

East African countries inherited from British colonial policy an awkward, dual system of wildlife administration. Parks are administered by boards of trustees composed of prominent citizens. Government game departments run the reserves.

In Kenya, both systems now come under the purview of J. L. M. Shako, the able Minister for Tourism and Wildlife, who has been conducting a quiet investigation of game administration. As a result, changes in both personnel and procedures have been made.

"When I came into this ministry, I soon discovered irregularities," Mr. Shako told me candidly. "Moreover, I found they had been going on a long time. But the government is fully aware of them and is taking action."

Rangers Not Even Safe in Planes

In Uganda, the third East African country, there has been some commercial poaching, particularly at Murchison Falls National Park, which has increasing settlement along its borders.* "They are even taking the rare white rhinos, introduced here ten years ago," said Augustine Bendebule, a senior game warden and a forceful, dedicated young man.

Out on the Victoria Nile in a ranger patrol boat, I marveled at the seemingly countless hippos and crocodiles (pages 182-3). The crocs basked on the sandbanks in somnolent indifference to our passing. Hippos surfaced and sank around us like fleets of submarines, and once, when our engine failed for a time, a group of hippos headed for us. Fortunately the swift current took us out of their reach.

"We usually patrol the river at night," said Augustine. "That's when the poachers come to kill the crocodiles. They shine lights in the eyes of the crocs, then spear them or shoot them. But you can't sell the skins anywhere in Uganda now—it's against the law."

Rangers patrol nearly all African parks by air, as well as by Land-Rover, foot, and boat. Light airplanes keep in radio contact with armed ground patrols. But not even pilots and aerial observers are safe. Iain Ross, warden of Uganda's Kidepo Valley National Park, told me, "In 1966 someone put a bullet

through my aircraft. The chap sitting next to me had half his jaw shot away."

Many thoughtless people around the globe must share the responsibility for poaching. These are the people who buy shoes and handbags made of crocodile skins, coats of leopard and cheetah fur, zebra hides, ostrich plumes, carved ivory. Without that rich market, commercial poaching would dry up.

Kenya has now banned both import and export of leopard and cheetah skins. The United States has long been the richest market for furs and hides, but in 1969 Congress passed a law that enabled the Secretary of the Interior to list animal species in danger of extinction and to ban importation of those creatures or any products made from them.

Unfortunately, the skins of some species are easily confused. For example, the hide of Africa's Nile crocodile, which is listed, looks identical to that of the American and salt-water crocs, not listed. Skins of various leopards look alike, but some leopards made the list, others did not. To plug that loophole, New York State, center of the fur and skin industry in this country, passed a law prohibiting the sale of *all* skins from big spotted cats and crocodiles. Challenged in the courts, the law was sustained.

Conservationists believe that, together, the federal and state laws will give solid protection to a number of endangered species.

Says Kai Curry-Lindahl, a U.N. zoologist working in Africa: "Only leopards and cheetahs need their own skins." In other words, movie starlets and dowagers don't need them.

Antipoaching forces clearly are in firm control in some African countries. South Africa and Rhodesia successfully protect game in private lands, as well as in their parks and reserves. Other countries exert control in their sanctuaries, although there are vast isolated areas throughout Africa that rarely see a game ranger.

In South Africa, protection came just in time to save several species from extermination by hunters. The Cape mountain zebra was reduced to fewer than 20 animals in one area. Now Mountain Zebra National Park maintains a herd of 124, and some 40 live elsewhere in South Africa. Bontebok dwindled to only 17. A national park set up specifically to protect that antelope now holds about

*See "Uganda, Africa's Uneasy Heartland," by Howard La Fay, NATIONAL GEOGRAPHIC, November 1971.

260, and a few herds exist outside the park.

But South Africa scored its most dramatic success with the white rhino. At one time that Pleistocene mammal roamed most of southern Africa, but finally it was exterminated, except for a small number in the Umfolozi Game Reserve in Zululand. Conservationists built up that remnant so successfully that they have been able to give more than 400 white rhinos to other African reserves and some 100 to zoos and parks around the world.

Botswana, a country larger than France, has one of the best conservation records of any newly independent African state. The U.N.'s Food and Agriculture Organization provided Botswana with a chief game warden and a biologist, and now the country has three national parks and five major reserves, comprising a seventh of Botswana's total area.

Tribesmen Introduced to Game Control

In Gaborone, the country's colorful little capital, I met Laurence D. Tennant, then on the eve of retirement as chief game warden, and we talked about the five-year program he had just completed.

"Traditionally the people have been able to live off the land by hunting," Tennant said. "The first thing we had to do was to try to control it on the tribal lands and state lands. The idea was to let them use the game, but to protect certain species. For example, they cannot hunt a cheetah unless it attacks their stock, and rhino and hippo get full protection. Also, they now cannot hunt without licenses. An exception is made for our 2,000 nomadic Bushmen. We let them hunt as they always have, with bow and arrow—yes, and poison. Without poison they couldn't kill enough to feed themselves and survive."

Botswana's Department of Wildlife and National Parks brings in an annual revenue of \$440,000, mostly from hunting fees, including stiff sums charged foreign trophy seekers. In Botswana, that's big money. "Our tourist development can be financed with what we make from hunting," said Tennant.

Part of Rhodesia's approach to conservation includes a unique experiment in education. School and park authorities designed a curriculum in which all subjects studied by four hundred 11- and 12-year-old children were ingeniously related to conservation for a period of 13 weeks. In arithmetic the children made graphs showing game density and

the rarity of various species; they figured out the number of revolutions made by the wheels of their school buses in bringing them to Wankie National Park, Rhodesia's largest sanctuary, for a week of field study. They wrote essays about conservation for English classes, studied the climate of Wankie for geography, erosion control for science.

At Wankie I spent two days with one group of 30 eager students. In their field work the



Begrimed but victorious, a lioness guards a wildebeest she felled at a muddy water hole in the Amboseli Reserve. Dragging a carcass heavier than she is onto dry ground leaves the cat puffing. Though the number of lions is decreasing outside reserves, protected animals adapt readily to park life, regally ignoring tourist vehicles.

children made plaster casts of the spoor, or tracks, of animals and learned to recognize them. They saw the kinds of animals that made the tracks, while rangers told them many things about each species. At one eroded place, teachers split the children into three groups, had one group decide what was wrong with the area, a second why and how the area had deteriorated, and a third what could be done to restore it. I was amazed at the sophisticated knowledge the children showed of erosion causes and control.

I was even more surprised at the aplomb they displayed when they watched ranger Dave Rushworth dissect an impala. The park had more impalas than it could carry on its rangeland, and the animal had been shot in a control program. As Rushworth removed and explained the entrails, I expected some children to show squeamishness. But none did, and one little girl remarked thoughtfully,

"My aunt recently had six inches of her lower bowel removed."

Education, however, has a long-range payoff, and again one wonders how much time remains in Africa, not just to curb poaching but to mitigate the effects of encroachment—the remorseless, growing pressure of humans on wildlife habitat. Copper in Zambia, oil in Nigeria, diamonds in Botswana—intensive development of such mineral discoveries can create serious conservation problems. But the biggest squeeze comes from the extension of agriculture and cattle grazing, a problem in every African country.

Masai Lands Face Rapid Change

In East Africa the problem is particularly acute. Since 1920 Uganda has converted 75 percent of its wildlife ranges to agricultural development. That same tide now runs strongly in Kenya and Tanzania.



Kenya's Masailand, the country's most fecund wildlife area, totals ten million acres, much of it land too dry for farming. Traditionally it has belonged to the pastoral Masai, who move about with their herds, seeking water and forage. They measure their wealth in cattle and rarely poach for skins or hunt for food. In the past they have coexisted well with wild animals.*

But now the government has decided that by 1974 these lands will pass from collective tribal ownership into private hands—still Masai, but individuals and groups, for ranching. So land where cattle and wildlife alike once roamed freely will be cut up and fenced. The decision affects some eight and a half million acres, all the Masai rangeland not presently in parks and reserves.

In Tanzania a similar situation exists. Some years ago the government cut out of Serengeti National Park the magnificent

Ngorongoro Crater and declared it and surrounding lands the Ngorongoro Conservation Area, where Masai would be permitted to live in their traditional manner.

Since then the government has proposed that 95 percent of the conservation area be used for agricultural development. Only Ngorongoro Crater itself and the small Empakaai Crater, 17 miles away, would be spared.

At certain times of the year the hundred-square-mile floor of the larger crater supports a concentration of wildlife rivaling that of the Serengeti Plain. The floor, containing a large blue lake, lies 5,600 feet above sea level, and the crater walls rise precipitously 2,000 feet higher. Driving about among wildebeest and zebra, eland and gazelle, lion and jackal in Ngorongoro Conservation Area, I could see game trails cut by animals obeying

*See the author's "Kenya Says Harambee!" in the February 1969 GEOGRAPHIC.

threats at Albert National Park in Zaire, formerly the Democratic Republic of the Congo.

ELSPETH THOMPSON







Once the domain of antelope and lion, open Tanzanian rangeland now wears golden stripes of harvested wheat. Grain cascades from combine to wagon (below) in one of two harvests farmers reap in a 12-month growing season.

Confronted with exploding populations, most African nations face powerful pressures to open game lands to ranching and farming, even though the land may be only marginal for crops. Inevitably animal areas shrink, homesteaders war with marauding game, and fences block primeval migration routes. Most experts see in this encroachment the direst wildlife threat of all, portending a day when all animals will be forced into protected areas.

An answer, many believe, may lie in game ranching. Farmers can gain a lucrative income from meat and hides of wild animals managed on a self-sustaining basis, and from fees charged to hunters and camera buffs.



PHOTOGRAPHS BY ROBERT BARRINGTON, V&C

their age-old impulse to migrate, a tide that annually flows from far out in the Serengeti into Ngorongoro, and then, rhythmically, back again.

Will development cut those migratory routes? It seems likely. An Eden in peril.

Says Harry Selby, of the safari firm Ker, Downey, and Selby, "Animals need to migrate. Cutting off their routes may prove to be a very drastic mistake."

Sandy Field, former chief warden of Serengeti National Park, said to me: "The places where I used to hunt elephant twenty years ago now have roads and hotels. The bush is shrinking." He pointed out that development has now crept up to the very doorstep of the park. "Today you will see houses on the other side of the line," he said, "whereas five years ago you would have seen none."

Save a Mountain to Save a Park

Settlement has not been permitted in East Africa's national parks, although some reserves contain indigenous people, such as the Masai. Mozambique's Gorongosa National Park does contain subsistence farmers, an unsatisfactory situation for the farmers as well as for the animals.

Gorongosa offers some of the best wildlife viewing in Africa, and officials want not only to protect the park but to expand it. To direct their conservation efforts they hired Kenneth L. Tinley, a brilliant young South African ecologist. He soon found that the high Serra da Gorongosa, source of water for the park's animals and some 20,000 people in the area, lay just outside the park confines—and squatters were destroying the watershed.

Rising abruptly and alone from flat savanna country, the mountain mass towers to an altitude of 6,112 feet. Partly because of this sudden change in elevation, Gorongosa makes its own weather. Clouds wreath its head much of the time and dump their contents. On the mountain 100 inches of annual rain supports a verdant forest, but less than 20 miles away an average year brings only 35 inches.

Flying just above the mountain's humped

Avalanche of elephant thunders behind game warden Peter Stark, who tried to drive the broken-tusked rogue from farmers' fields into Etosha National Park, South-West Africa. Some parks employ helicopters to herd elephant escapees, whose trampling feet and daily diet of hundreds of pounds of vegetation ravage farms near reserves.







Airborne impala bounds through the bush at Kenya's Amboseli Game Reserve. Snow-maned Kilimanjaro, lord of African mountains at 19,340 feet, glistens in tropic sun twenty miles to the south in Tanzania. Ever alert for danger,

shoulders and up a high, hidden gorge, Ken Tinley and I took a searching look at this "key to life," as he calls Gorongosa. In many areas we could see plots of maize hewn from the precipitous forest, usually alongside streams, and many scabrous-looking, deserted clearings that had once held crops. Gullied erosion wrinkled those ugly scars.

"They are planting on slopes of 45 degrees or more," said Ken. "Often the fields are so steep they have to plant their corn behind rocks to keep it from washing away. And it's an acid soil that will yield crops only for a few years. If this destruction of the watershed continues, not enough moisture will be retained to assure a year-round runoff. The streams on which the park and all those people depend will dry up."

Another Eden in peril. But Mozambique authorities are prepared to put into effect at least a part of Tinley's proposed solution. Nine-tenths of the mountain will be included in the park, and about 16,000 people will be

relocated. The government will spend an initial \$324,000 to build new homes for those displaced and provide them with better land, technical help, schools, and health care.

Tinley has recommended that all people be removed from the park and has proposed a bold plan under which Gorongosa National Park would be extended to the sea. It would then be perhaps the only park in Africa that could be called an ecological entity, self-sufficient in water, forage, and space for its wild denizens. But that grand design would require years to bring about. Eduardo de Arantes e Oliveira, then Governor General of Mozambique, told me frankly: "It is a dream—but sometimes dreams come true."

Game Ranching May Be an Answer

Earlier I indicated the encroachment problem had hopeful aspects. All rest on the firm conviction of conservationists that wildlife can be made profitable to African farmers and ranchers—so profitable they will be willing



impalas react with instant, soaring jumps that carry them ten feet high and three times that distance. Hundreds of thousands of impalas thrive from Kenya to South Africa, but a black-faced variety of southwestern Africa faces extinction.

to coexist with wild animals, thus assuring their perpetuation outside the parks.

"We must show Africans that wildlife is important to them—in the pocket, in the stomach," says Frank Minot, Nairobi head of the African Wildlife Leadership Foundation.

How do you make wildlife pay off? You "crop" it; in controlled numbers you slaughter some of the animals on your property, just as you would cattle, and sell their meat and hides. Or, as a private landowner, you permit people to enter your property and shoot game or photograph it—all for a price.

Of course, the very thought of killing game repels some readers. But game ranching, as the experts call it, works. In large areas of both South Africa and Rhodesia, wild animals have paid off so well for farmers that they protect them.

Experts see no reason why it won't work just as well in the countries of East and Central Africa. Says Wendell Swank, a Food and Agriculture Organization representative in

Nairobi: "You can harp all you want to on tourist income, national prestige, or love of animals, but you must convince the little man here in Africa that he's getting something out of it."

Says hunter and conservationist Harry Selby, "Game can't live on charity."

Men planning game-ranching programs base much of their hope on a powerful ally, the African climate. Estimates vary, but some experts say 45 percent of the continent must be classified as pastoral land, with no farming potential except under irrigation. An additional 20 percent has inadequate water even for livestock.

But, through thousands of years of adaptation, wild animals can thrive on land that will not support cattle. Wildebeest, zebra, and topi eat the same grasses, but in different stages of growth. Other ungulates eat different grasses. The impala, eland, and Grant's gazelle eat not only grass but also herbs and woody plants. Together they utilize

Behind a leap-proof fence, an eland adapts to domestication on a game ranch in Rhodesia (below). Such experiments indicate that elands, oryxes, and other antelopes can be raised profitably for meat on land that cattle would denude.

Able to survive even in a desert, a graceful gerenuk (right) nibbles a thornbush. Getting moisture from vegetation instead of by drinking, these antelopes are believed to be



ROSLAND WERTZEL

spreading farther into arid areas, even as the ranges of most other animals grow smaller.

Scimitar horns arch from a giant sable antelope (opposite, upper). This endangered species today numbers fewer than 2,000, confined to grassy woodlands in Angola.

Less than two feet high, the demure dik-dik (lower) is prized by poachers for its tiny horns, which sell as key-chain ornaments.





RICHARD D. LEECE



WOLPER PRODUCTIONS

Citizen of two worlds: A Masai who became a park ranger returns to visit his village.

Living spires, giraffes browse the Serengeti (right, above).

Lion yields ground to four Masai armed with their ever-present spears (right).

Appetite for snakes marks the crowned crane; it kills them with its sharp, hooked beak.



PHILIP AND PEARL SCHLESIER

Warrior of Africa's animal lands

TALL AND SPEAR-STRAIGHT, the Masai of the Serengeti Plain epitomizes the fighter. For a century his fierce reputation slowed the advance of settlement in East Africa, as he grazed his cattle beside vast herds of wild animals. Now both man and wildlife are poignantly at bay.

Tear out this notice as a reminder to visit the proud Masai through CBS Television on February 22, when the National Geographic Society presents "Man of the Serengeti," third of its 1971-72 color documentaries. Traveling with a Masai warrior turned park ranger (left), you will share a homecoming to his village, join in age-old rites, and stalk the prowling lion and migrating wildebeest. Narrated by Leslie Nielsen, the program is produced in association with Wolper Productions, Inc.



WOLPER PRODUCTIONS AND (RIGHT) WOLPER PRODUCTIONS



vulnerable land," said one observer "Put too many cattle on it, and it can literally be beaten to pieces; it becomes fine dust and washes or blows away."

I have seen just such areas in countries as widely separated and diverse as Kenya and Rhodesia, Somalia and Botswana. Destruction of habitat affects wildlife as well as cattle. Indeed, some of the severest damage occurs in wildlife reserves, a number of which are also tribal homelands.

But wild animals themselves, if too numerous, can damage habitat. This is particularly true of elephants. Many of Africa's great sanctuaries have noted large increases in their elephant populations as family groups and herds retreat from human pressures.

Unfortunately, they can't all be protected by a stroke of the pen, as is the case with Ahmed, a famous old bull that roams in and about Marsabit National Reserve in northern Kenya. Ahmed may have the biggest tusks of any elephant alive; each is estimated to weigh 180 pounds or more. He is so huge and distinctive that he cannot be mistaken, and President Kenyatta issued a decree that Ahmed "may under no circumstances be hunted or harassed by any person."

Elephants Destroy Serengeti Woodland

Prior to 1955, elephants had not been recorded in the Serengeti since the days of the early ivory traders, nearly a century ago. The beasts seemed to prefer other areas. But they have returned, an estimated 2,500 in the wet season. And they are quite controversial.

You might say the elephant is a messy eater; he knocks over trees and nibbles them. In places along the Seronera River you would think tornadoes had cut swaths through the woodland. In one 3 $\frac{1}{4}$ -mile stretch, rangers counted 703 flattened trees.

Dr. Harvey Croze, a young scientist at the Serengeti Research Institute, studies elephants in order to save and protect them. He knows a lot about their habits, but not why they fell entire trees only to leave them, or eat merely a few leaves or twigs. One day Harvey drove me off into the bush to meet a friend of his, an old bull elephant named Max Planck. When we found him, Max had just shattered an acacia and was eating bits of it daintily and fussily.

"Trees seem to be a side dish," said Harvey. "Max is getting something particular

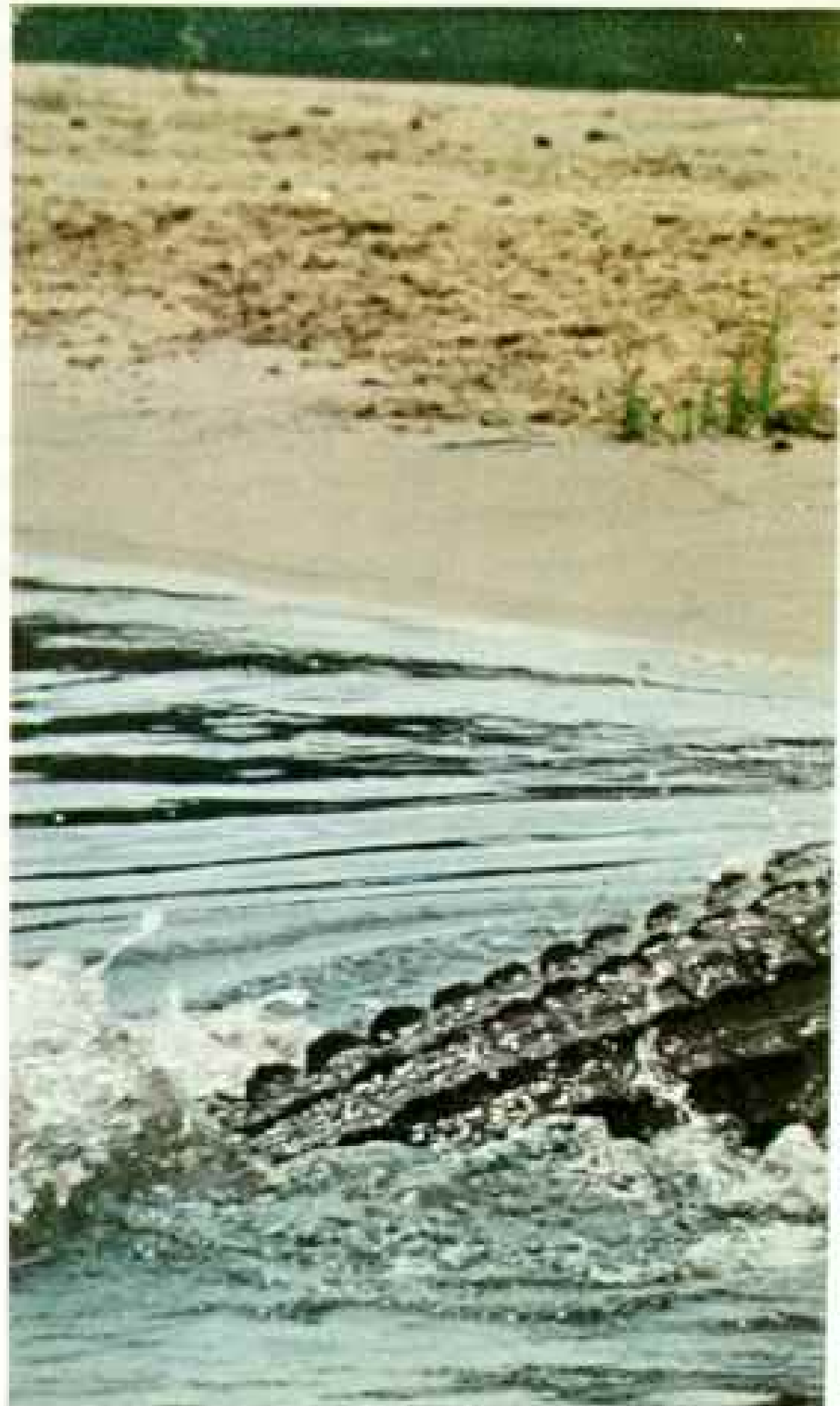


Killing a tree while feeding on its bark, an elephant in Tanzania's Lake Manyara National Park indulges in a habit that ravages African forests. The animals also bulldoze woodlands merely to sample twigs and roots. Before the Zambia Government began cropping herds, elephants nearly eradicated 24 species of trees.



Nature's balance—the savage law of eat and be eaten—operates endlessly in Africa, even as man's pressures increase. Here, knifing through gray waters of the Victoria Nile, a crocodile gains on a baby hippo that became separated from the herd. Terrified, the calf clambers onto a sandbar where it might find safety. In hot pursuit the croc moves in, sinking its teeth into the hippo's rump. Wheeling, the huge reptile bears its still-thrashing prey out into the river.

The savage drama took place at Uganda's Murchison Falls National Park, where the Victoria Nile explodes through a rock cleft. Crocodiles flourish along the river, luring nocturnal poachers who shine lights in their eyes and shoot or spear them for their hides. At Murchison, as in many parks, certain animals proliferate beyond the reserve's capacity to sustain them; the Uganda Government has recently thinned the herds of elephants and hippos.







out of that tree, but we don't yet know what."

Croze does not believe elephants should be killed to reduce the population. He favors more study of the problem. For example, he believes elephants may open up woodland areas for regeneration, since young trees will not grow under mature ones. Fire, which often sweeps African parks, is a bigger threat to woodland, says Croze, because it destroys young trees the elephants never touch.

Man Must Do the Protecting

Many scientists do not agree with these wait-and-see views. They point to Kenya's Tsavo National Park. In the past twenty years its elephant population, now a whopping 20,000, has changed much of Tsavo from bush to grassland. Since elephants are browsers as well as grass eaters, no one knows if they can survive the change.

Uganda in the past few years cropped 2,000 elephants and 4,000 hippos in just one locale, Murchison Falls. "People must realize that national parks are not natural areas," says Roger Wheeler, Uganda's director of national parks. "It is totally unrealistic to think

that mother nature will solve your problems."

Parks personnel in numerous countries say they find it imperative to reduce the numbers of many species, not just elephants or hippos.

Dr. U. de V. Pienaar, Conservator of Kruger National Park, made this point: "It is always a painful procedure for conservationists to kill animals protected in a park. But even the most ardent sentimentalist will admit that the fate of such animals is certainly much less cruel than if they were allowed to die miserably from starvation, thirst, or disease in overcrowded conditions."

Kruger shows the effects of human pressures perhaps more than any other African park. Mining, agriculture, and settlement outside the park have so reduced the flow of Kruger's rivers that they no longer provide enough water for the animals in the dry season. Now the park spends 500,000 rand (\$700,000) each year to build dams and weirs and to sink boreholes. But Kruger still carries a large wildlife population. Impala, for example, number 162,000 and zebra more than 20,000. Normally, none go thirsty.

As, increasingly, Africa's parks become



Watering places for the African ark invite a steady parade of wildlife. A giraffe displays its forelegs to drink in Rhodesia's Wankie National Park. Because the animal's neck is so long, valves in its two jugular veins check the downward rush of blood when the giraffe lowers its head, preventing rupture of blood vessels in the brain.

Predators haunt the water holes, and so do enthralled humans, coming to film the animals or simply to watch. Visitors at Bube Pan in South Africa's Mkuzi Game Reserve (opposite) find a blind built over the water where they can peer at creatures that come to drink. A nearby inn attracts capacity crowds, as do hotels in many African reserves.



PHOTOGRAPHS BY SOLEMAN HERTEL

The elegant and the grotesque patronize the water hole at Bube Pan. Burchell's zebras (left) display the handsome hide that tempts poachers. A South African relative, the quagga, is now extinct, and two other kinds of zebras are rare and endangered.

Thick upper tusks of a warthog (above) may help it to push through thornbush. Sharp lower tusks serve as chief defense against attacking leopards or cheetahs.

encircled by settlement, it will be more and more difficult for animals to migrate. Many people wonder what will happen when the herds can no longer follow their age-old instincts to move in search of forage and water. Yet for a decade such movements have been limited in Kruger. It lies within the so-called "red line" marking the perimeter of that part of South Africa where foot-and-mouth disease is prevalent. To keep the park's ungulates away from cattle, a fence follows Kruger's long western boundary. Only toward Mozambique, to the east, can game migrate freely. Though partially restricted, Kruger's game thrives.

Perhaps that may be the future pattern for all the great parks of Africa. They may be hemmed in, but with sound management and the devoted concern of conservationists all over the world, the parks and reserves can flourish. "It's going to be nothing more than a great big zoo," Harry Selby said to me, "but at least the game will survive." It will, indeed, and personally I think it can survive in large numbers.

If game ranching takes hold in East and Central Africa, wildlife also can survive in appreciable numbers outside the sanctuaries. On that point, too, I'm hopeful.

But the time of severest trial is at hand; the next ten years will determine the survival or virtual obliteration of that great Pleistocene display of mammals.

Tomorrow Depends Upon Us

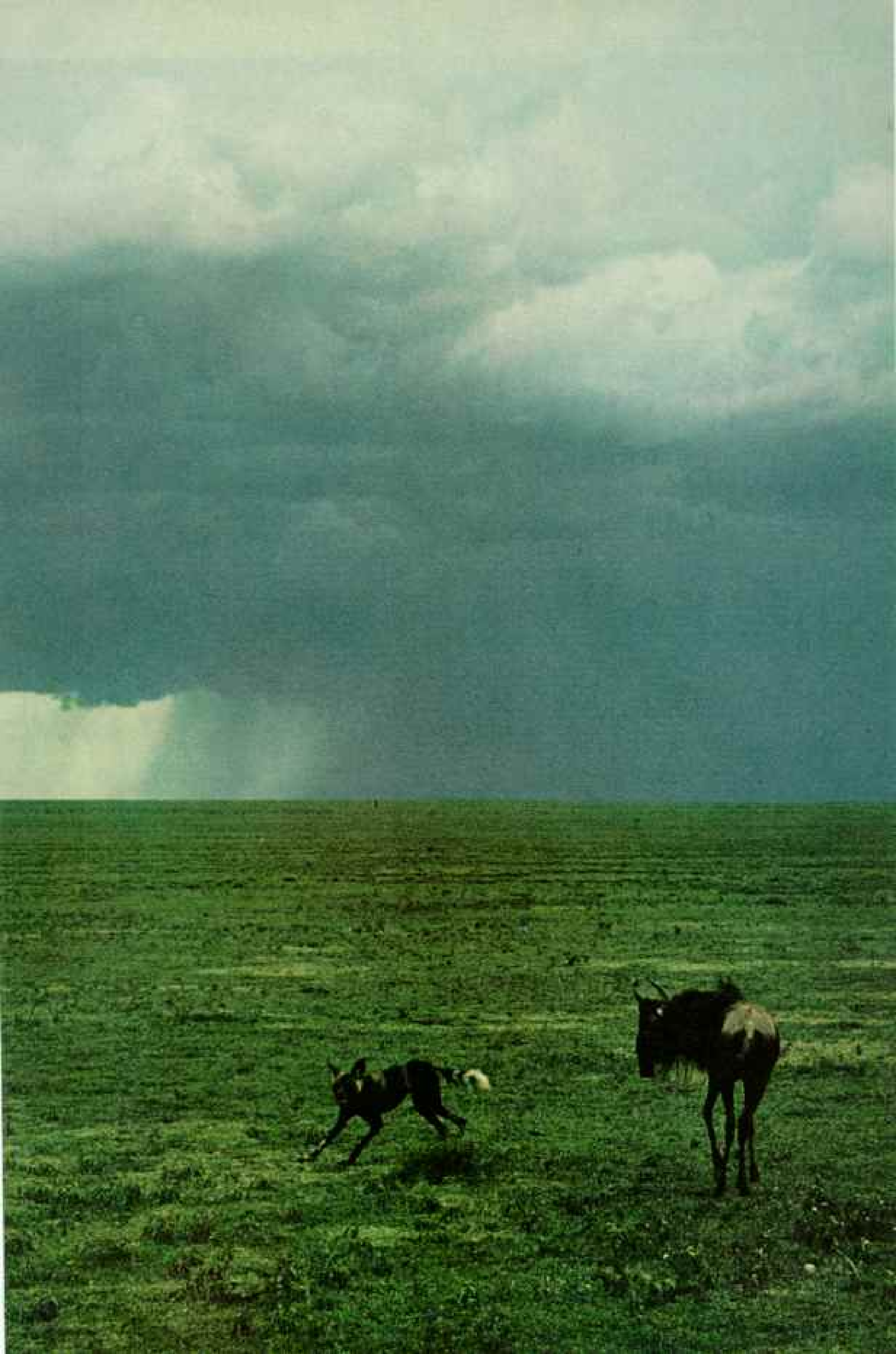
A compelling sense of what mankind could lose came to me many times during my African safaris, but perhaps most strongly one magic night at Harry Selby's Khwai River Lodge deep in the wilds of northern Botswana. Harry told me some of the sand for construction had been hauled 250 miles, the stone 400. Yet it's a comfortable, even luxurious place, and that memorable night I lounged on the porch of my cottage, looking out upon a dew-drenched meadow aglow with the brightest moonlight I had ever seen. There a herd of lechwe grazed and gamboled, the young antelopes as playful as otters.

Except for the remote lodge, human encroachment still was years in the offing for those animals. It had taken three different airplanes, and 12 hours of travel, just to get me to the Khwai from Botswana's capital, Gaborone. And I thought, how dreadful if my grandchildren could never see an African scene such as this, as lovely and unspoiled as it was thousands of years ago.

But our children's children can enjoy many magic moments in tomorrow's Africa—if we care enough today. □

Lonely duel between a wildebeest and a wild dog ends in a draw as storm clouds sweep the Serengeti Plain. In the brief scuffle, the dog seized the hind leg of the antelope, which then gored and drove off the attacker. Will wild creatures living by nature's rules survive? Or will man's inroads erase them forever? The next decade, experts agree, will decide.







MARYLAND ON THE HALF SHELL

By STUART E. JONES

Photographs by ROBERT W. MADDEN

SAILING ACROSS CHESAPEAKE BAY, we were overtaken and passed by a trim yawl with *Despot's Heel* lettered on her stern. Later, berthed in a marina at sundown, I met the owner and mentioned his boat's unusual name.

"You aren't going to ask what it means?" he said. "You must be a native Marylander."

For the benefit of non-Marylanders, the line "The despot's heel is on thy shore" appears in the state anthem, "Maryland, My Maryland." The yawl's owner, I learned, was noted for running his boat aground; it was frequently on somebody's shore.

"It's a bit subtle," he admitted.

Maryland, like the name *Despot's Heel*, deserves the adjective "subtle," meaning "delicate, elusive, obscure, hard to distinguish or describe." That's the Free State—crammed with charms as delicate and elusive as the iodine scent of tidewater marshes, obscure as Baltimore's reasons for covering honest red brick with imitation stone, indescribable as a Blue Ridge sunset.

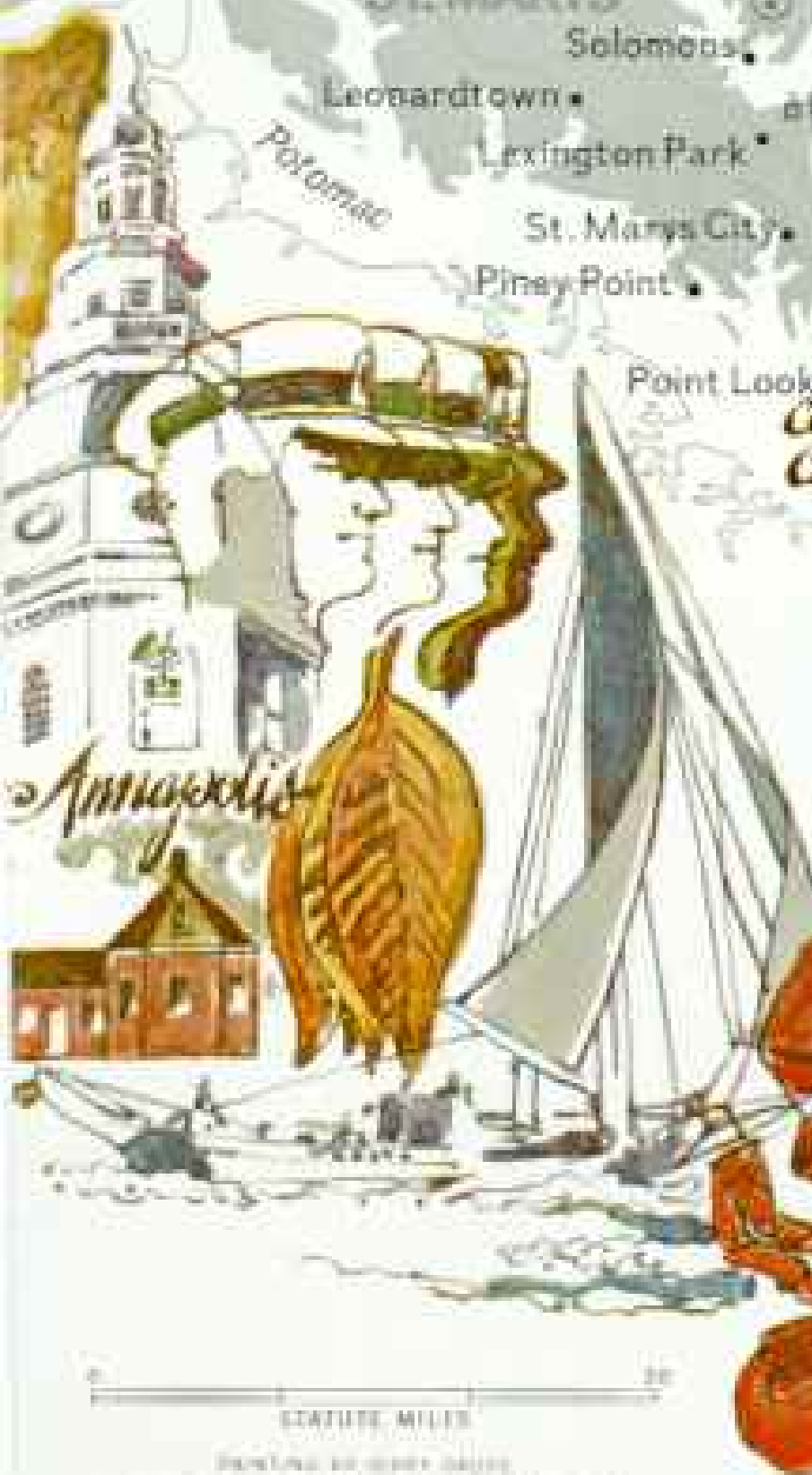
I know it fairly well, having been born and raised there, having gone away and returned several times. Recently I again became a resident—this time permanently, I hope, beside a quiet, lovely creek on the Eastern Shore.



PENNSYLVANIA

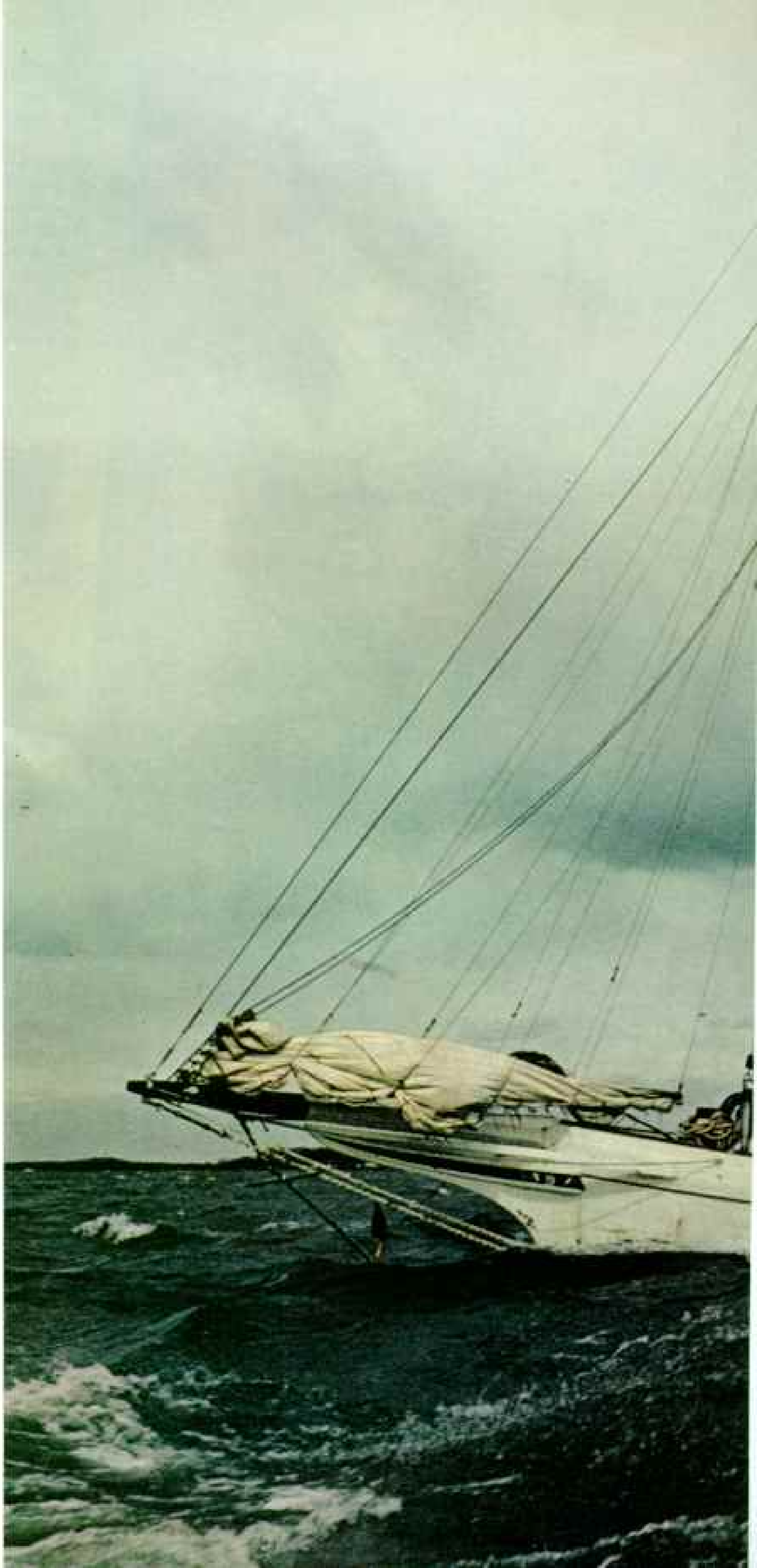


Star-spangled variety emblazons the face of Maryland. Settled in the 1630's under a royal grant to George and Cecil Calvert, Lords Baltimore, it spawned patriots such as Charles Carroll, a signer of the Declaration of Independence. Manors like Montpelier preserve the aristocratic air of colonial days. In Baltimore, Key dashed off the national anthem, Poe penned poetry and fiction, Mencken reigned as vitriolic critic, and the Babe learned the art of swat. Presidents find weekend refuge at Camp David.



Assateague Island National Seashore
ATLANTIC OCEAN

Running before
a squall, the
80-year-old
skipjack *Ruby G.
Ford*—one of the
Nation's last
working sailboats—
interrupts her
winter routine of
oyster dredging on
Chesapeake Bay.





Before settling there, I took a long look at Maryland in all its incredible variety, from thundering Atlantic surf in the east to forested mountains in the west, and southward from the Pennsylvania border to the Potomac River mouth, where southern Maryland ends and Virginia begins (map, pages 188-9).

But first I talked with Governor Marvin Mandel, a Baltimorean who succeeded a man whose name has become a household word—Vice President Spiro T. Agnew.

"I hardly think you can come up with a descriptive phrase any better than the one written by your late editor some years ago," said the Governor.

In a desk drawer he found a well-thumbed copy of *NATIONAL GEOGRAPHIC* for February 1927. He turned to "A Maryland Pilgrimage,"

in which Dr. Gilbert H. Grosvenor had described the state as "a delightful geographic miniature of America."

And so it is. Citizens like to boast that Maryland's 10,577 square miles include samplings of almost every physical feature of the United States.

I found that much had changed, especially in my native Baltimore. Not so long ago, that name might have evoked a response something like: "Oh, yes, that's the place you have to drive through to get from Washington to New York. Terrible traffic! And those monotonous white-marble steps!"

As if to oblige these critics, Baltimore had built a beltway-tunnel system that shunts traffic around its narrow streets and under its harbor. And the city, now 243 years old, had



begun the formidable task of bringing itself up to date.

As I gazed down from high windows of One Charles Center, architect Mies van der Rohe's magnificent office building, the immediate surroundings seemed much like the business sections of Houston, or Atlanta, or Boston. But beyond lay the familiar port, the Nation's third largest in foreign commerce, thrusting into the city's heart (pages 198-9) and reaching southeastward toward the Chesapeake. In the far distance a battery of belching chimneys marked Sparrows Point, where the Bethlehem Steel Corporation lights up the night sky with its vast furnaces and builds giant tankers and other vessels.

On a hilltop to the northeast I picked out the Johns Hopkins Hospital's 83-year-old

administration building, its Victorian brick mass and copper-ribbed dome dwarfed by several newer structures housing clinics, laboratories, and departments of the famous teaching and healing institution (page 195).

To the west, the smaller, older, and equally distinguished University of Maryland Hospital and the university's schools of medicine, dentistry, pharmacy, and nursing were in the throes of expansion. As I watched, a Maryland State Police helicopter landed an emergency patient beside a waiting ambulance atop a campus parking garage.

Later, as I revisited neighborhoods I once knew well, it became clear that Baltimore was experiencing a profound social, political, and economic upheaval. In what I had remembered as an unusually class-conscious



It's Saturday morning on Baltimore's Curley Street—time for row-house residents to scrub their famed white-marble steps, a trademark of the city. Quarries at nearby Cockeysville provided stone for the first steps. As demand grew—between 1905 and 1920—quarries in Vermont, Georgia, and Alabama were kept busy.

Shouts of "You're out!" still echo down city streets where early in the century young Babe Ruth, a native Baltimorean, may have blasted window-smashing home runs.



Painted window screens bring a touch of country charm to treeless city neighborhoods. Painter Richard Oktavec, whose father introduced the unusual craft to Baltimore, holds a newly finished work (above). The wire-mesh screen foils the prying stares of passersby, yet from within offers a clear view of the street.

community, many of the city's staid old clubs had eased their membership restrictions. The newest, the elegant Center Club, announced at birth a policy of ignoring race, religion, and nationality of prospective members.

More and more, the city's large and immensely varied ethnic groups—especially a black population now pushing toward 50 percent of the 900,000 total—were making their voices heard. In 1970, for the first time in its history, Baltimore elected a black Congressman—Parren J. Mitchell, former professor of sociology at Morgan State College and veteran fighter for civil rights.

Another Baltimore congressional district, containing both silk-stocking neighborhoods and inner-city slums, elected Paul S. Sarbanes, son of Greek immigrants, Rhodes scholar at Oxford, and brilliant lawyer.

Amid all the change, I found many Baltimoreans clinging to time-honored customs—like speaking their own “language.”

Baltimorese reaches its finest flower in East Baltimore, in blue-collar neighborhoods like Highlandtown and Canton, where rows of narrow flat-front brick houses with white-marble steps stretch for miles (preceding pages). These tidy, stable settlements are home to the machinists, carpenters, welders, shipwrights, tugboat crewmen, and others who do a busy seaport's hard work.

“Well, I guess I'll *washa* dishes,” a typical East Baltimore housewife might say after serving breakfast and getting her man off to work. After performing that chore in the kitchen *zinc*, she will go outside to sweep the *payment*, or sidewalk.

In her lexicon smoke comes out of *chimbleys*. Ice does not melt; it *milks*. If you have a lawn, you mow it with a *paramour*.

After trips to the zoo in *Drooodle* (Druid Hill) Park, East Baltimoreans tell of seeing *larns*, *luggers*, and *zeebers*. In their neighborhood bars they talk endlessly about their baseball, football, and basketball teams and rejoice that they live in *Bawlmer*, *Merlan*, city of champions.

On my strolls I noted, too, that many row-house dwellers still find privacy behind colorfully painted window screens, an art form for which the city is noted. The passerby can't see through the charming picture, but the window sitter in his darkened parlor enjoys a clear view of happenings in the street.

Pictorial screens were introduced to Baltimore more than fifty years ago by the late William Oktavec, an immigrant from Czechoslovakia. In a small art-restoration and framing shop, I found Richard, one of his four sons, painting the “cozy-cottage number” on a screen. It portrayed a red-roofed bungalow, with trees, ducks in a pond, and a curving lane (preceding page).

“This has always been the most popular subject,” said Mr. Oktavec. “Next come a Swiss mountain scene and a mill with a waterwheel. Some customers send pictures of their own to be reproduced on screens.”

IN EAST BALTIMORE I heard of a school-teacher who was surprised, and somewhat disturbed, to learn from her pupils that many parents knew little about the big city outside the painted screens. Deciding to remedy the lack, the teacher organized bus tours, and her invitations were accepted eagerly.

After several sight-seeing jaunts, she addressed a busload of parents one day:

“How many have seen Fort McHenry?”

All hands were raised. Similar responses came when she asked about the Star-Spangled Banner Flag House, the Baltimore and Ohio Transportation Museum, the U. S. Frigate *Constellation*, and other standard attractions.

Then she asked, “How many have been to Charles Center?” Three hands went up.

Thus it happened that these Baltimoreans traveled the few miles from their homes

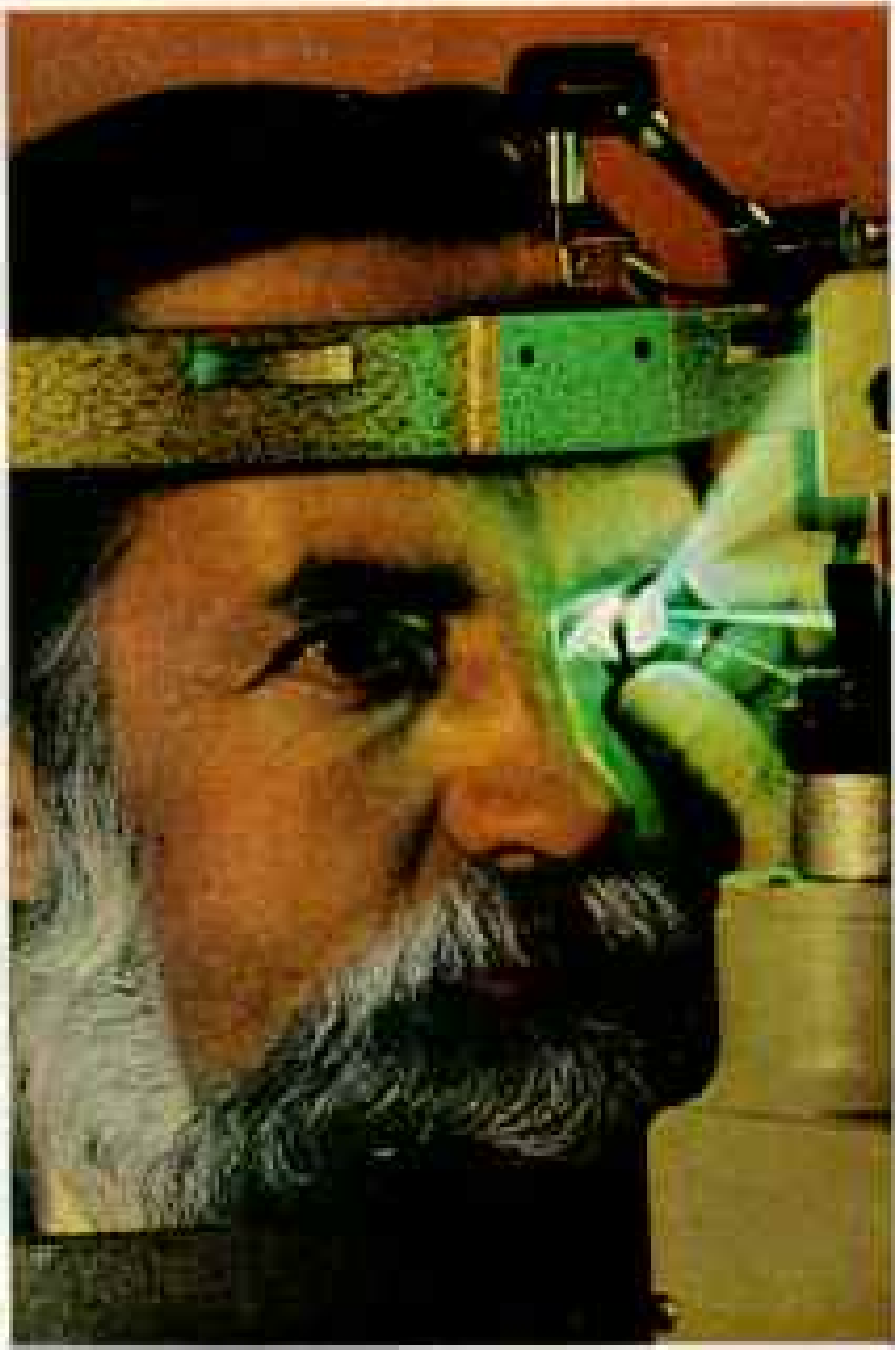
MARYLAND

AMERICA IN MINIATURE, Maryland packs kaleidoscopic variety into a small frame. Chesapeake Bay, the Eastern Seaboard's “inland sea,” provides a cornucopia for fishermen, a highway for maritime



commerce, and a wind-cuffed playground for weekend sailors. But increasing pollution and construction of a nuclear power plant create waves of controversy in the bay area. Heavy and light industry, fisheries, and agriculture give the state a diversified economy.

AREA: 10,577 sq. mi., ranks 42nd. **POPULATION:** 3,922,000, ranks 18th. **MAJOR CITIES:** Baltimore, pop. 900,000, metropolitan area 1,600,000; Annapolis, pop. 30,000, capital. **ADMISSION:** 1788, seventh of Thirteen Original States.



Medical breakthroughs are a tradition at the Johns Hopkins Hospital and School of Medicine in Baltimore. In a technique developed at the hospital's eye clinic, an argon laser seals tiny ruptured blood vessels on a patient's retina, helping to stop hemorrhaging and to prevent possible blindness.

to enjoy a closeup view of downtown Charles Center, one of the Nation's most spectacular urban-renewal achievements. In awed disbelief they trudged through the city's heart, where scores of shabby buildings had given way to a business-residential-entertainment complex that speaks of tomorrow rather than of the 19th century (following pages).

My own first brief view of Charles Center overwhelmed me. Driving into the city a few years ago after a long absence, I headed north on Charles Street and, as always, looked for the Sunpapers building where I once worked. It wasn't there. In its place, nearing completion, was the ultramodern Morris A. Mechanic Theatre, named for the show-business leader who endowed it. Nearby yawned great holes where familiar landmarks once stood. They would be replaced by office buildings, shops, high-rise apartments, shaded plazas, pedestrian malls on several levels, and underground parking garages.

By 1971 I found the mid-city project virtually complete and swarms of hard-hatted demolition and construction crews busy on

the second phase—a drastic face-lifting that will turn the seedy Inner Harbor area into another modern complex. It will include a slender, pentagonal World Trade Center designed by I. M. Pei.

AT 4:30 on a July morning I found myself about as far as one can get—in spirit if not in miles—from the Nation's seventh largest city. In pitch darkness I was standing on a rickety Eastern Shore pier, waiting to go crabbing with Raymond Eason.

Mr. Eason is a waterman. That means he is one of about 16,000 Marylanders who make their basic living from fruitful Chesapeake Bay and its myriad rivers, creeks, and coves.* It is a hard life, with modest financial rewards, but it offers independence—and that, say watermen, is a precious thing to have.

Watermen harvest crabs in summer, oysters in winter, soft-shell clams and many varieties of fish almost the year round. Some also farm a bit. Their wives keep house, tend truck gardens, work in seafood packing-houses, and drive school buses. Sons often follow their fathers' trade, and daughters become watermen's wives; so the cycle has gone since the 17th century, when the watermen's English forebears first settled along the shores of the bay.

Before dawn Mr. Eason arrived in a pickup truck with his grandsons John, 11, and Martin, 8. While Mr. Eason assembled his gear, I asked the boys if they expected to become watermen like their grandfather.

"No, sir," said John. "I'm going to be a backhoe driver."

"Me, too," said Martin.

Mr. Eason ruffled John's hair and chuckled. "They'll be watermen," he said.

We clambered aboard Mr. Eason's long, narrow workboat. He glanced at the sky, beginning to brighten in the east.

"Some people say crabbing's best when there's a full moon," he said. "No moon at all now, but we'll do all right. Been working these waters 26 years and never saw so many crabs."

Commercial crabbers use two basic techniques: potting and trotlining. The first employs baited pots, or traps, ingenious affairs of chicken wire and lath. Weights hold them on the bottom, and buoys mark their locations. Maryland law restricts commercial potting to the deeper waters of the bay and its

*See "Chesapeake Country," by Nathaniel T. Kenney, NATIONAL GEOGRAPHIC, September 1964.



Gusto city



Fun-loving, hard-driving Baltimore resounds year round with cheers for its perennially top-ranking professional teams—the baseball Orioles, the football Colts, the basketball Bullets. Oriole superstar Brooks Robinson (above) umpires a game with sons Brooks, Jr., at bat, and catcher Mike.

Another Baltimore institution, entertainer and nightclub owner Blaze Starr (left) reigns as queen of the "Block," a bawdy amusement district on East Baltimore Street. She symbolizes an era that may soon be ended by bulldozers.

Renewal already transforms the city's heart a few blocks away, where the towers of Charles Center (right) thrust skyward on the site of a once-deteriorating neighborhood. The camera looks through the frame of a geodesic dome temporarily erected for an art festival.





major estuaries: Mr. Eason prefers trotlining, the legal method in shallow waterways.

As he steered out of Haskins Cove into Irish Creek, Mr. Eason throttled down to a two-knot crawl and began laying out his first trotline. Anchored and buoyed at each end, it stretched about half a mile. Other crabbers passed us, headed toward the broad Choptank River. By unwritten law each had established rights to his own crabbing grounds.

Chunks of fragrant salted eel were tied to the trotline at four-foot intervals. The Chesapeake blue crab (*Callinectes sapidus*) will eat almost anything. But, said Mr. Eason, "Eel's the best bait. It's tough—a crab can't chew it off and swim away before you catch him."

When two trotlines were in place, Mr. Eason began the harvest. He slipped the end of the first line over a roller projecting from the starboard gunwale. The boat's slow forward movement pulled the line out of the water.

Almost every bait had a crab attached, hanging on with its two powerful claws and greedily chewing eel. With a long-handled net Mr. Eason deftly plucked them off the line and tossed them into bushel baskets. Many he rejected, letting them hit the roller and drop back into the water.

"See what I mean?" he said. "There's a powerful lot of crabs in this creek, but too many of them are under the legal five inches."

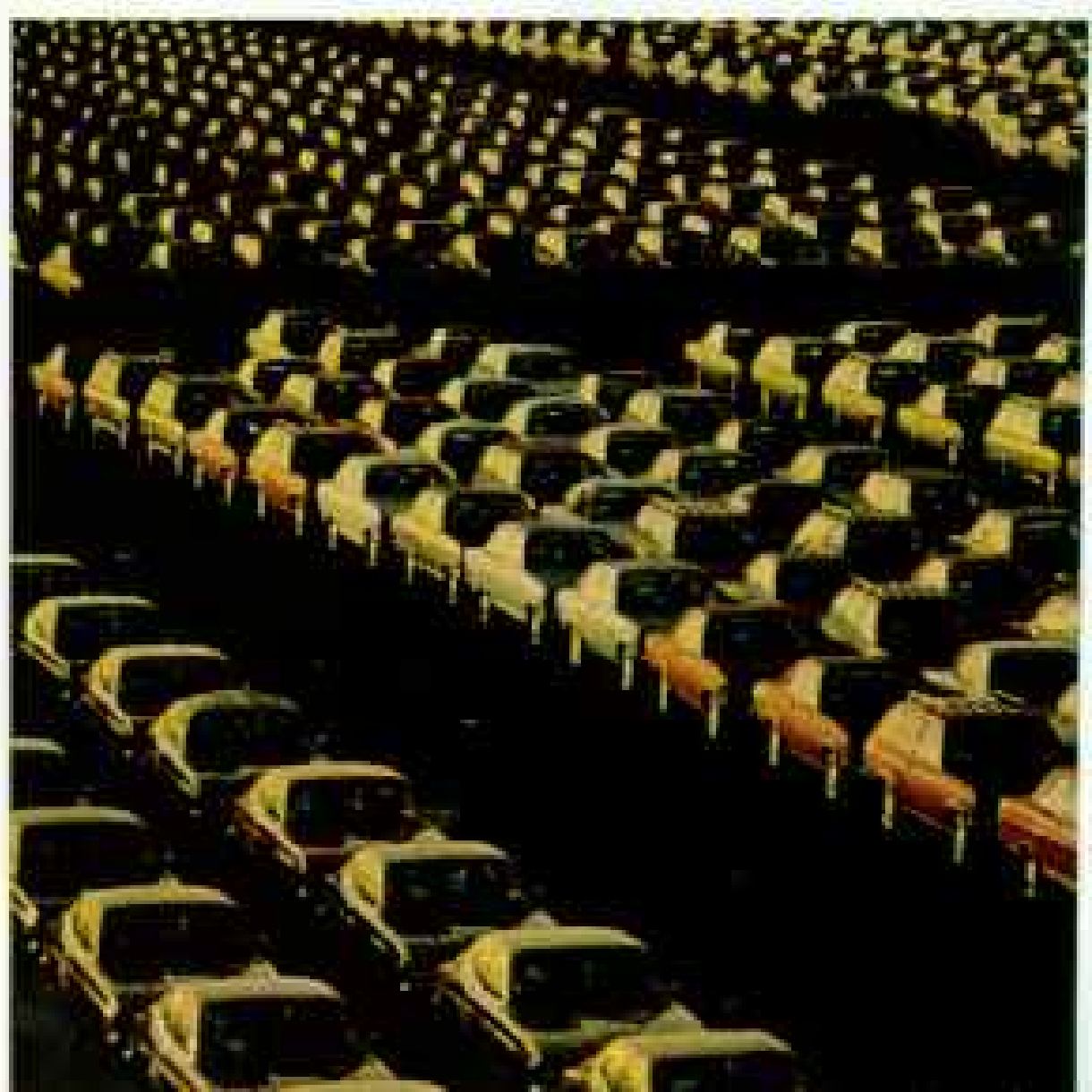
Still, after three or four hours we had four bushels of jumbos, measuring six inches or more between the points of the shell. They would fetch top prices from restaurants that steam them with spices to provide one of the bay country's finest feasts (pages 204-205).

OLD-TIMERS like Raymond Eason marvel at the new waves of settlers, mostly former city-dwellers like myself, who are advancing upon the Eastern Shore today. They come seeking quiet havens within shopping distance of such centers as Chestertown, Easton, St. Michaels, Cambridge, and Salisbury.

One real-estate broker told me of a New Yorker who called him not long ago. "About that Eastern Shore property you're advertising in today's *Times*," he said. "I'll take it, sight unseen."

"They come here looking for rural solitude," a neighbor of mine growled. "Well, if many more of 'em keep coming, there won't be much of that solitude left."

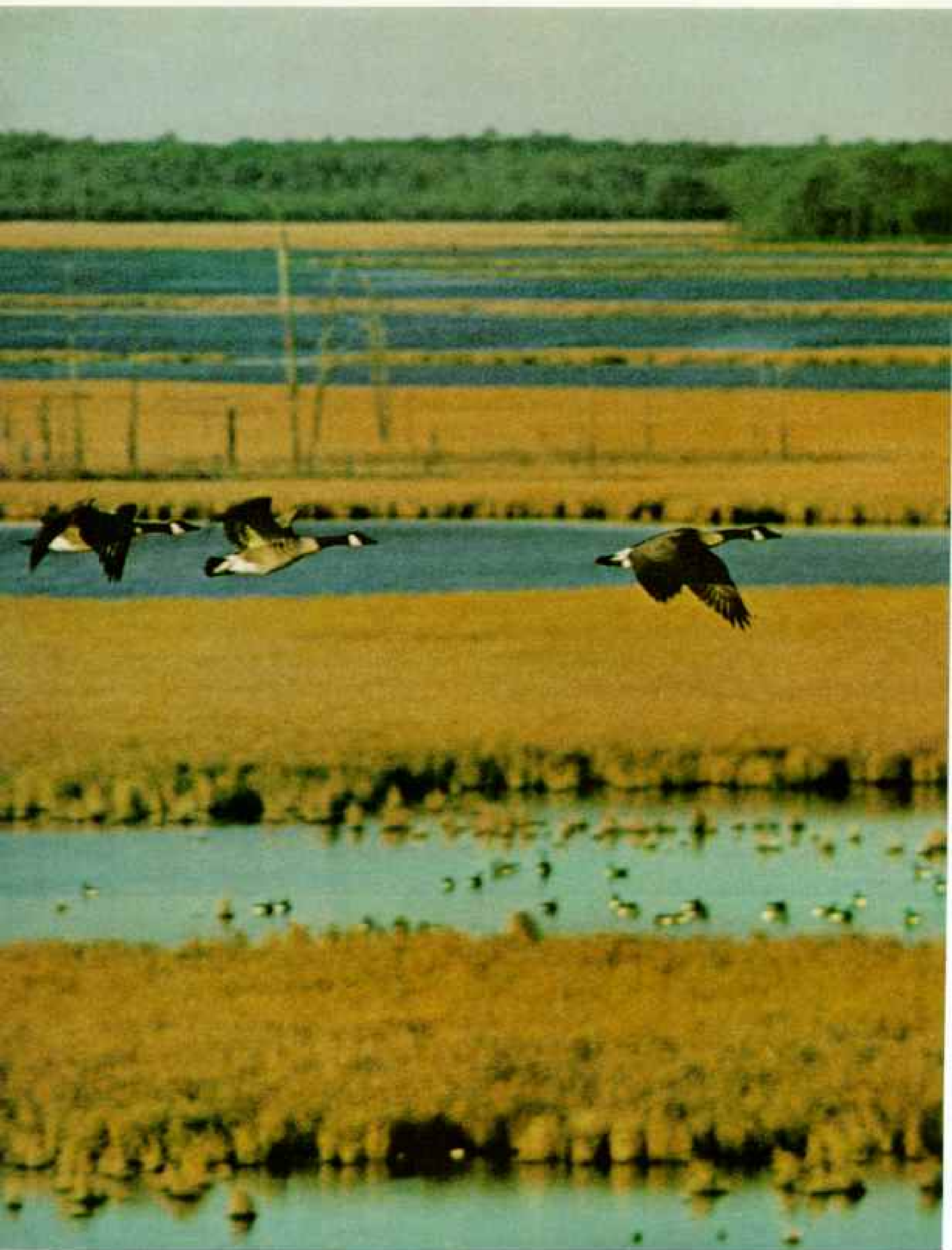
On summer weekends the migration from Baltimore, Washington, and other places to the Eastern Shore takes on lemming-like



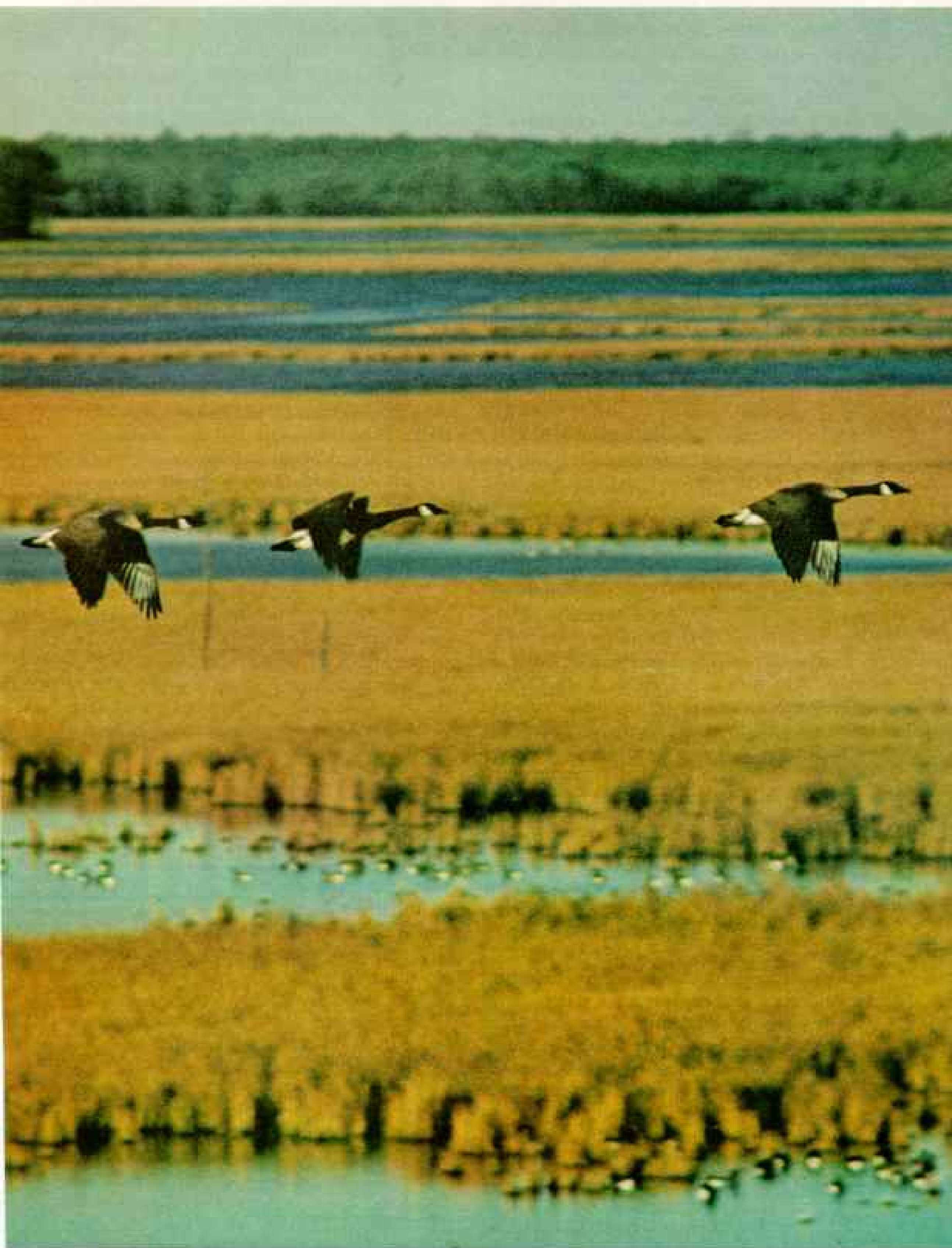


Port that built a city, Baltimore's harbor winds from the downtown business district toward the bay. A freighter leaves a wake on the Patapsco River, where Francis Scott Key watched "the rocket's red glare" as British ships cannonaded nearby Fort McHenry in 1814.

Founded in 1729, Baltimore at first boomed as a tobacco port, then flourished anew as an Atlantic gateway to the mushrooming Midwest. Today some 33,000 foreign cars a month, including these from West Germany (left), make it the world's leading auto importer and boost its total foreign tonnage to third in the Nation—after New York and Norfolk. Almost half the state's four million people cluster in and around the city.



A skein of Canada geese unwinds from Blackwater National Wildlife Refuge on the Eastern



Shore. In winter Maryland's brackish marshes shelter multitudes of ducks, geese, and swans.

proportions. Near Annapolis, cars back up for miles as they wait to squeeze onto the two-lane Bay Bridge, which spans four and a half miles from shore to shore.

Sunday evening, the tired, sunburned throngs head homeward and swelter through massive pileups of traffic at the bridge approach. While they wait, motorists climb out of cars and throw Frisbees. Some set up charcoal grills on the median strip. Children cry, dogs bark, radiators boil over, fathers snarl "Shut up!" A parallel three-lane bridge, expected to relieve all this, is scheduled to open in 1973.

Most weekend travelers head for Ocean City, Maryland, and other seashore resorts stretching northward along a broad, excellent beach into Delaware. Ocean City, a wind-swept, boarded-up town of about 1,500 half of the year, sees its population balloon to 200,000 in summer (pages 206-207). To the south, Assateague Island National Seashore, where wild ponies roam among the dunes (pages 228-9), draws capacity crowds of campers, picnickers, and fishermen.

For all its activity, the Eastern Shore remains a highly agreeable place, fully deserving of the compliment bestowed on the bay country by advertisements for a Baltimore brewery: "The Land of Pleasant Living." I like it best in autumn, when Canada geese and whistling swans fill the air with their wild clamor, fat oysters may be had for the gathering a few yards off the shore of my isolated creek, and nothing seems to have changed much since Capt. John Smith came this way in 1608.

FROM THIS WATERY, table-flat land a few hours by car can take you to a vastly different world of rounded, timeworn mountains, rocky gorges, and swift, sparkling streams.

To me, western Maryland shows its most beguiling face in the green, rolling dairy-farm country around the tidy whitewashed-stone town of Thurmont, in Frederick County. Here, on a Blue Ridge spur, I found one of our smallest and most unusual national parks.

Catoctin Mountain Park spearheads a program to get children out of urban areas and introduce them to woods and fields. Buses bring groups from Washington, D. C., and nearby Maryland counties to spend a week living together in lodges. In classrooms and on nature trails they learn about the environment, how early settlers made use of it, and

what its preservation means to them and to future generations.

Most of the 5,769 acres in Catoctin Park, with their dense hardwood forests, hiking trails, campgrounds, and trout streams, are open to the public the year round. But in their center lies a heavily guarded, stoutly fenced enclave seldom entered by anyone except the President of the United States, his family, and his guests.

Camp David has been the secluded mountain retreat of Presidents since Franklin Delano Roosevelt, who christened it Shangri-La. Thus, campers and hikers at Catoctin Mountain Park can congratulate themselves on enjoying the same air and scenery that refresh their leaders.

A national park may seem an unlikely place for a moonshine still, but I found one at Catoctin. What's more, it was producing whiskey. I learned about it from Park Superintendent Frank Mentzer as we set out on an automobile tour.

At the crest of a hill we paused to enjoy the view. We looked down upon a lush green valley, clean and placid beyond belief. In a grove of trees at its center stood a trim white farmhouse surrounded by red barns. Fat cattle grazed in fields divided by weathered stake-and-rider fences.

"Harbaugh Valley," said Frank. "This is the view that always lifts my spirits. You won't find it named on many maps. It's just a small valley where the Harbaugh family has lived for generations. This, to me, is a piece of what's left of the America that Thoreau and Whitman were talking about."

"How about that moonshine still?" I asked. "The Blue Blazes? OK, let's go see it."

Near the park's visitor center we turned off on a narrow trail that ran beside a purling brook. Soon we arrived at the still, a Rube Goldberg arrangement of copper cylinders, pipes, and coils atop a circular stone fireplace. Nearby stood seven barrels of quietly bubbling mash—fermenting corn and water—which the still would convert into clear, colorless, and highly potent white lightning.

"This isn't the real Blue Blazes still," Frank explained. "The original was one of dozens that operated in these hills. Prohibition agents destroyed it in 1929. People hereabouts still talk about the raid—a deputy sheriff was killed and several moonshiners were wounded. A few years ago we located the Blue Blazes site and decided to reproduce the operation, to show visitors to the park how



"I follow the water." So proclaim dogged watermen like Earl Daniels, who has just transferred a catch of oysters to a buy boat. Oystering in the R months, crabbing in summer,

clamming the year round, freighting odd cargoes, or guiding hunters, they make a go of it on their beloved bay, spurning the lure of better pay and easier lives ashore.

moonshining, even though illegal, was once an important factor in the mountain economy. The still you see was brought from Cades Cove in Tennessee.

"We make whiskey only on summer weekends," Frank said. "Sorry I can't offer you a sample. We add a bitter chemical to make sure it's undrinkable."

From Catoctin I drove southward over a couple of ridges and emerged in the Monocacy River Valley. Here, as noted by John Greenleaf Whittier in "Barbara Frietchie":

*The clustered spires of Frederick stand
Green-walled by the hills of Maryland.*

The clustered spires were in view as I made a wrong turn onto a road that seemed to lead nowhere. But the farms were green and beautiful in the sunlight (pages 212-13). At one, judging by the number of broodmares with foals in the pastures, the breeding season had been exceptionally productive.

Then a sign at the entrance, Yankeeland, rang a bell in my mind. I remembered having read that Charlie Keller, formerly of the New York Yankees, was raising harness-racing horses in Frederick County, where he had grown up on a dairy farm.

Minutes later, parked beside a trim brick house, I waited for the owner of Yankeeland to appear. When he walked toward me from a barn, I recognized immediately the stocky figure, the powerful arms and shoulders, that won Charlie Keller the nickname "King Kong" as he guarded the Yankee outfield with Joe DiMaggio and Tommy Henrich.

Obviously, at 55, he was not pining away in nostalgia for sweaty locker rooms and cries of "Ya bum!" from the bleachers. Like other ballplayers I had met, Charlie was cordial but taciturn. He did admit, however, that Keller-bred trotters were winning purses all over the country. Then, in a rare burst of eloquence, he said, "Nice thing about



horses—you don't have to milk 'em at 4 a.m."

In Frederick, you can stay at the Barbara Fritchie Motel, lunch at the Barbara Fritchie Candy Stick Restaurant, and munch on Barbara Fritchie chocolates. And in the old houses facing Court House Square, on the Hood College campus, or anywhere else in town, you can start an argument by mentioning Barbara's last name—or how to spell it.

Generations of Americans have learned from the New England poet Whittier that Mrs. Fritchie was a nonagenarian widow who defiantly flew a Union flag from her attic window as Confederate troops marched through Frederick on September 10, 1862, on their way to the carnage at Antietam Creek.

As Whittier described it in thirty couplets, Gen. Thomas Jonathan (Stonewall) Jackson halted his "famished rebel horde" and barked "Fire!" Dame Barbara then seized the

banner from its broken staff and waved it:

*"Shoot, if you must, this old gray head,
But spare your country's flag," she said.*

Whereupon, wrote Whittier, a "blush of shame" came over Jackson's face and "the nobler nature within him stirred":

*"Who touches a hair on you gray head
Dies like a dog! March on!" he said.*

So much for Whittier. Nobody knows what really happened, but even scoffers agree that if the melodrama did not occur, it should have.

Doubts about the story began surfacing soon after the poem was published in 1863. Most scholars believe Whittier exercised literary license after learning of a flag-waving incident in a letter from Mrs. E. D. E. N. Southworth, a novelist friend. The letter and other memorabilia are displayed in the

The makings of a Maryland feast

Find a table with a harbor view. Order a tray of peppery, steamed Miles River hard crabs, prized by gourmets for their size and meatiness. Arm yourself with a wooden mallet, a knife, and a generous supply of napkins. Surround your plate with side dishes of locally grown sugar corn, pungent pickles, and chunks of sharp cheese. Treat your thirst to a pitcherful of ice-cold beer. Then lay into the taste-honored, archetypal fare so dear to Maryland palates.

This red-checkered setting, at the Crab Claw restaurant (left), overlooks the harbor of the Eastern Shore town of St. Michaels. The rakish vessel at upper right, the *Edna E. Lockwood*, a restored 1889 hugeye, forms part of a superb exhibition of old bay vessels and memorabilia at the Chesapeake Bay Maritime Museum.

Canine confronts crustacean (right) in a face-off of bay natives

—a Chesapeake Bay retriever and a blue crab from the Miles River. Local sportsmen developed the hardy hunting dog for retrieving ducks and geese shot from blinds in icy bayside shallows.



Barbara Fritchie Home and Museum, built in 1926 to replace the long-vanished original.

Curator Margaret Clary told me of two very special visitors who came to the small museum during World War II.

"A long black car pulled up in front," she said, "and out popped Winston Churchill. President Roosevelt remained in the back seat while Mr. Churchill, holding a large cigar, saluted the flag, then recited from memory all sixty lines of 'Barbara Fritchie.' President and Prime Minister then resumed their trip from Washington to Shangri-La."

Long after Barbara Fritchie and the peace of Appomattox, Frederick found itself concerned with another echo of the Civil War. Shimmering on the horizon like a golden vision was the prospect of a princely deposit in the municipal treasury. Under a bill proposed by Senators Charles McC. Mathias, Jr., and J.

Glenn Beall, Jr., the Federal Government would hand the city as much as \$6,000,000 for its contribution to the Union cause.

In July 1864, the South's Lt. Gen. Jubal A. Early and 20,000 gray-clad troops quietly occupied Frederick, an important Union supply center. Early, threatening to burn the city, ordered Frederick to produce \$200,000 in cash or surrender the supplies.

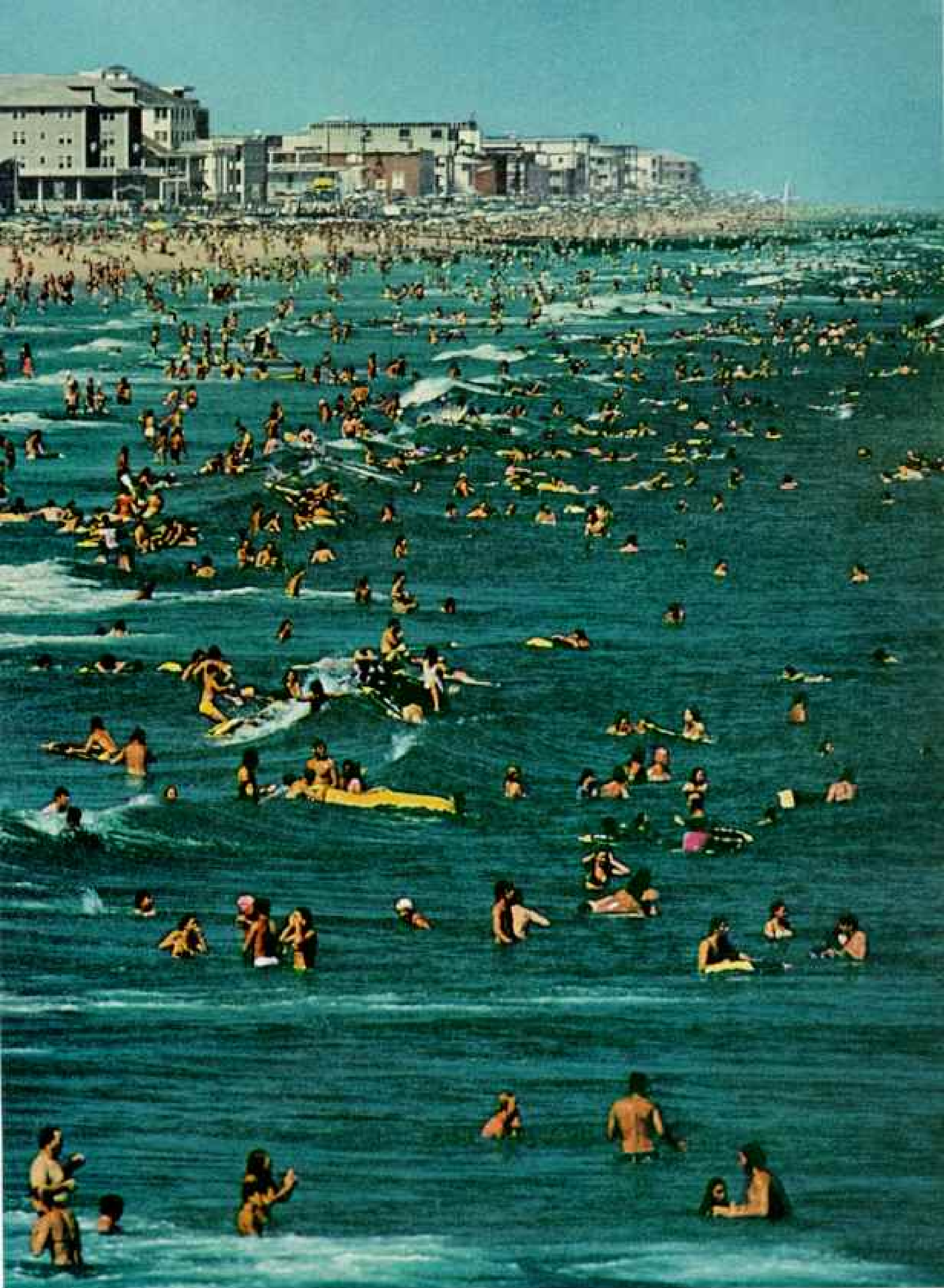
City officials took a full day to raise the cash from local banks and present it to Early in bushel baskets. The general packed the swag in his luggage and rode off to the southeast, bent on seizing the Capital.

At the Monocacy River, a few miles from Frederick, Early encountered Gen. Lew Wallace's small Union force, which fought a delaying action. When the Confederates reached the outskirts of Washington, one day behind

(Continued on page 210)



High tide of vacationists inundates Ocean City on a Labor Day weekend. In a bonanza for anglers, budget-fare party boats chug out each day for bottom fishing, and



convoys of sleek yachts and cruisers plow some 60 miles offshore to the Baltimore Canyon—a fishing hole that earns the resort its title, “White Marlin Capital of the World.”

Beyond the bustle

of Washington, D. C., more than a million Marylanders live in suburbs that spread ever outward on three sides of the Capital. Though still predominantly Washington commuters, a growing number now work for private firms and federal agencies that have sprung up outside the central city.

Some 1,200 employees share the National Geographic Society's graceful Membership Center Building (right) near Gaithersburg. Tailored to fit its parklike environment,

the center serves the needs of the Society's seven and a half million members.

Japanese cherry trees, grown from cuttings of those ringing Washington's Tidal Basin, blossom in fashionable Kenwood (below).

Developers of Columbia (below right)—a new city begun in the 1960's between Washington and Baltimore—plan for a population that could reach 100,000 by 1980. Here the Town Plaza, a "people place" at the center of the new city, glimmers beside the quiet waters of a man-made lake.







schedule, they met unexpectedly strong resistance and withdrew.

Not until 1951 did Frederick complete retirement of the loan through a series of bond issues. Now, say Senators Mathias and Beall, it is time to recognize that the ransom saved Union supplies and the delay in raising it may have helped save Washington.

I asked Mayor E. Paul Magaha how his city of 24,000 would use the money.

"Frederick will have no trouble putting that money to the best possible use," he said. "Schools, streets, sewers, parks, playgrounds—name it and we need it."

On the other side of historic South Mountain, Hagerstown was coping with another familiar problem. This city of skilled craftsmen had an unemployment rate of about twice the national average. Still, I found no hint of despair, and businessmen saw signs of an economic upturn.

Hagerstown's largest employer, Mack Trucks, Inc., had rehired hundreds laid off earlier and was operating at almost full capacity. Another leading Hagerstown firm, Fairchild Industries, Inc., had been dealt a heavy blow in March 1971, when Congress killed the supersonic-transport program. Fairchild, largest subcontractor for airframe parts in the SST prototype, saw \$34,500,000 worth of business go down the drain.

A broad diversification program, including advanced communications satellites, helped Fairchild cushion the shock. Its Hagerstown plant, where 200 had been laid off, was rebuilding its payroll back to the normal 1,200.

Browsing at a Hagerstown newsstand, I spotted a publication I had not seen in ages: J. Gruber's *Hagers-Town Town and Country Almanack*, a respected compendium and oracle in homes throughout the land for 175

(Continued on page 216)



DAVID S. LAMMAN (REUTERS)



"Nuts and Bolts in Contemporary Society," a course in applied science, teaches practical know-how (upper left) at Goucher College, a women's school of liberal arts near Baltimore.

Ears tuned to the slightest nuance, a "voicer" tests the timbre of organ pipes (above) at the M. P. Möller, Inc., organ factory in hill-girt Hagerstown. From its three acres of buildings come pipes ranging from pencil size to towering 35-footers.

Glow of a blast furnace illumines a steelworker (left) at Bethlehem Steel's Sparrows Point plant. One of the world's largest steelworks, it provides jobs for 27,000 Marylanders.

Deadly serious in his "play," a technician at the National Bureau of Standards in Gaithersburg uses a doll to dramatize the flammability of a child's pajamas. When tested,



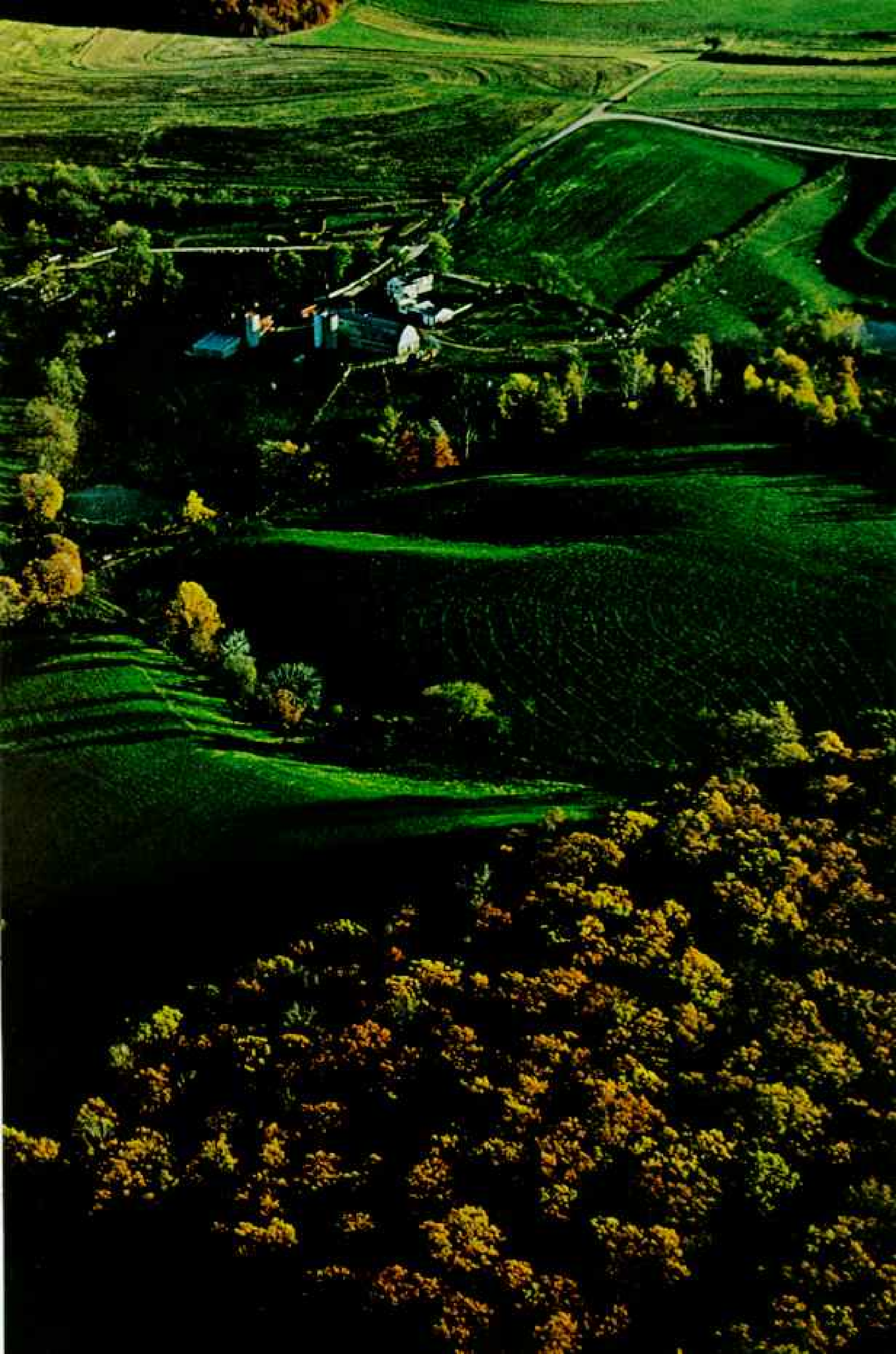
the material burned extensively after less than three seconds' exposure to an open flame, proving unacceptable under new federal standards.





Autumn gold chases summer green over rolling farm country near Frederick.

NATIONAL GEOGRAPHIC PHOTOGRAPHY © 2011 G. L. L. 10/11





Pious laborers of Pleasant Valley

Their faith as solid as the hills around them, an enclave of Amish folk in western Maryland pursue daily tasks with religious devotion, disavowing modern contrivances. Sparks fly as 79-year-old Simon Swartzentruber (left) forges a wheel rim for a neighbor's

buggy. John Yoder (below) sifts chaff from buckwheat. He left his father's thriving but crowded homestead in Pennsylvania to find land of his own. Despite today's emphasis on mechanized farming, the Amish prosper using simple, time-honored ways.



years. I sought out the Gruber Almanack Company's office, expecting to find something resembling a Norman Rockwell illustration, with rolltop desks and employees wearing sleeve garters.

Instead, the *Almanack* command post was the uncluttered glass-topped desk of John R. Hershey, Jr., brisk young regional vice president for a Washington-based brokerage firm. Mr. Hershey said he published the annual, as a sort of hobby, for heirs of J. Gruber, who launched it in 1797.

"You are looking at one-fourth of the staff," Mr. Hershey said. "My partner, Frank Leiter, and I handle the business end. Weather forecasts, astronomical tables, phases of the moon, and the like are taken care of by William E. O'Toole III, a mathematics instructor at Mount St. Mary's College in Emmitsburg. The editor, Mrs. C. W. Fisher of Wynnewood,

Pennsylvania, does the rest. In August she ships everything to the printer."

A month later, about 225,000 copies of the *Almanack*, complete with woodcut illustrations, advertisements for wallpaper remover and burial insurance, recipes for rhubarb crisp and sweet-potato soufflé, go out to newsstands in 35 states.

From Hagerstown I drove to Cumberland, starting point for the first federally funded highway in the United States. Begun in 1811, this National Road across the Alleghenies later became U. S. Route 40, stretching all the way from Atlantic City to San Francisco.

In this northwestern corner I felt that I had left Maryland behind. Signs everywhere proclaimed the businesses they advertised as the "Tri-State" this or the "Tri-State" that.

Residents of Cumberland, Oakland, and points in between look upon Pittsburgh as



MARTIN SCHLESER (RIGHT)

Cradle of champions. Maryland's pastures have nurtured countless blue bloods of the racing world. At Sagamore Farm near Glyndon (above), home of the immortal Native Dancer, a just-born foal tests legs that may one day pound the turf to victory and fame. Such was the reward for Kentucky-bred, Venezuelan-owned

Cañonero II last spring (right), when he won the Preakness Stakes at Baltimore's Pimlico. Jockey Gustavo Avila rises in triumph as his mount—already winner of 1971's Kentucky Derby—sweeps under the wire to take the second jewel in racing's Triple Crown. His bid for the third, the Belmont Stakes, failed.





their metropolis. Cumberland gets its water from Pennsylvania, and its municipal airport is in West Virginia.

A friend of mine, a transplanted native of Cumberland, went back there recently for a weekend visit. "The place looks pretty much as it did forty years ago," he reported.

When I went there, Mayor Thomas F. Conlon told me that the city's population had declined from about 40,000 at the end of World War II to less than 30,000. "Many people," said the mayor, "have moved across the river to new developments in West Virginia, where they get a break on real-estate taxes. Still, because Cumberland depends on basic industries, employment is stable."

Railroading remains the foundation of industrial Cumberland, as it has been since the pioneering Baltimore and Ohio sent the first train into the city in 1842. Metallic clangs

sound round the clock from vast B & O shops, and long freights rumble ceaselessly through this important division point. In a huge classification yard, trains are broken up and sorted out. Then they head for midwestern or eastern terminals of the B & O and its parent company, the Chesapeake and Ohio.

In my motel I found a folder proclaiming the 75th anniversary of the Kelly-Springfield Tire Company. I wondered how that could be, since there were few automobiles to use tires until around the turn of the century.

The answer was simple: Kelly-Springfield began making tires for carriages. The firm was born when Arthur W. Grant, a Springfield, Ohio, blacksmith, invented an improved solid-rubber tire and went into partnership with financier Edwin S. Kelly. The company has been in Cumberland since the 1920's.

When you get to Oakland, in Garrett



County, you have gone about as far west in Maryland as you can go. En route there, I visited Wisp, a handsome ski resort overlooking Deep Creek Lake, and walked trails in Swallow Falls and Savage River State Forests.

North of Oakland, I stopped to watch workmen quarrying limestone at Roman Nose Mountain. A foreman said, "A lot of it is hollow, you know. We've been digging stone out of it for years," and invited me to look.

Despite deafening jackhammers and clouds of limestone dust, I found it a strangely enchanting place of long, shadowy corridors and huge chambers, with tall pillars left standing to support the roof. When the quarrymen ended a day's work, I felt sure, trolls, gnomes, and perhaps a giant or two emerged from hiding places for nightly revels.

The foreman said civil-defense officials had estimated that the man-made cavern

Tobacco is king

Seated astride a two-row planter, field laborers put out tobacco near Lothian in southern Maryland. The farmer (above) chomps appreciatively on a local product—though most Maryland tobacco finds its way into cigarettes. A vital cash crop since colonial times, fine Maryland leaf—lower than average in nicotine—enjoys a rising popularity in today's health-conscious era.

Of the state's diverse regions, southern Maryland clings most closely to the conservative traditions and soft accents of the Deep South.



could shelter 60,000 persons, nearly three times the population of Garrett County.

In Oakland people were still talking about two strangers who turned up there recently. They identified themselves only as "Mr. Ed" and "Mr. Bob" and said they were scouting locations for an industrial plant, but refused to say whom they represented.

They were attracted to Oakland, said Mr. Ed and Mr. Bob, by the availability of labor in this part of Appalachia. Their company's product was very small and was shipped in large quantities, they revealed, and the factory site must be within four hours' trucking distance of major airports. Oakland qualified, being within four hours of Pittsburgh, Washington, and Baltimore.

There matters rested while Mr. Ed and Mr. Bob investigated highway, school, and sewer facilities and the quality of Garrett County

life in general. Then the scouts suddenly left town. Some shrewd detective work revealed they had gone to Rochester, New York.

With this clue, suspicion immediately fastened upon Eastman Kodak. Wasn't Eastman a large Rochester firm, and didn't it make small products, like cameras and rolls of film? The mystery was not solved until weeks later, with the announcement of Garrett County's new industry. It wasn't Eastman Kodak. The small product turned out to be Bausch & Lomb eyeglass lenses.

For a final abrupt change in environment, I jumped to the state's oldest and perhaps most picturesque region, southern Maryland—five counties embraced by the bay on the east and the Potomac on the southwest, with the Patuxent River curving down the middle.

Almost immediately today's realities swept away my fanciful visions of tobacco-rich



Human ballast keeps a frisky log canoe on her feet as crewmen teeter atop movable springboards. Unique to Chesapeake Bay, the fast vessels have hulls made from three or five logs, held together with wooden pegs and hewn to shape with adzes. Tall sails catch the gentlest breeze but make capsizing a constant hazard; crewmen often find themselves rudely flipped from a board at a sudden drop or shift of wind.

A century ago about 1,600 of these sprightly craft dotted the bay, many serving as workboats in the oystering and crabbing fleets. Today only a dozen or so remain in use. *Noddy's* crew sports whimsical turn-of-the-century bathing suits while competing in the 1971 Governor's Cup, the racing classic of log canoeing staged annually at St. Michaels.

cavaliers and their ladies stepping through minuets in gilded 18th-century ballrooms.

First I discovered "Pax River." That is what servicemen call the U. S. Naval Air Test Center, which sprawls over 6,800 acres at the mouth of the Patuxent. With its 5,000 Navy and 2,400 civilian personnel, Pax River provides about a third of the employment in St. Marys County.

On a section of runway marked off to simulate a carrier deck, I watched planes rocket aloft from a steam catapult whose machinery extended three stories underground.

Nearby, a big twin-engine jet, with odd protuberances under its belly, landed and taxied to a hangar. Out of it climbed tall, 27-year-old Lt. John Michael Luecke, test pilot.

"That," said Lieutenant Luecke, pointing to the jet, "is a Grumman EA-6B Intruder, an aircraft built solely for tactical electronics

warfare. It can carry about 15,000 pounds of gear designed to deceive or jam hostile radar or disrupt missile-guidance systems. We're about ready to give it the Pax River seal of approval."

Luecke said he returned from Viet Nam and entered the Naval Test Pilot School here, hoping to qualify as an astronaut. But NASA said no; six feet, four inches of Mike Luecke was too much to fit into a spacecraft.

Test pilots, he said, spend more time with slide rules and computers than in the air.

"While airborne, we tape-record personal observations. Beyond that, it's black boxes all the way. Sensors monitor the aircraft's equipment, and up to 200 telemetry channels transmit readings to a ground computer center. Doesn't sound like a movie test pilot with a white silk scarf, does it?"

With that, the lieutenant drove off to his

wife and three children in Lexington Park, the lively community of 9,000 that has sprung into being on former farmland since the base was established during World War II.

A FEW MILES NORTH of Pax River, southern Maryland comes face-to-face with both future and past at Calvert Cliffs, long known for extensive fossil deposits. In these bluffs, whose bright layers of sediment can be seen for miles up, down, and across the bay, lie the remains of whales, sharks, and other creatures dating back to the Miocene Epoch of about 20 million years ago. There I found swarms of yellow-helmeted workmen well along with construction of Maryland's first nuclear power plant.

As I sat in a trailer with the Baltimore Gas and Electric Company's Ray Brokamp, a typical Chesapeake squall hit the area, cutting off power and halting all work. After a few minutes of fierce winds and driving rain, we heard a voice booming from a battery-powered loud-hailer: "Is there an electrician in the house?"

Almost from the beginning the plant, expected to cost nearly \$400,000,000, has been under attack by conservationists who fear damage to the environment through accident, disposal of radioactive waste, or thermal pollution. A recent court decision resulted in new, more stringent regulations affecting not only Calvert Cliffs and a proposed plant near Aberdeen but, in fact, every nuclear power plant in the Nation.

When Calvert Cliffs' two reactors are "on line" in 1974, fueled by millions of tiny uranium dioxide pellets, the plant will feed about 1,700 megawatts into the company's system.

Near Piney Point on the Potomac, not far from St. Marys City, where English colonists established Maryland's first capital in 1634, a small forest of masts symbolized the region's seafaring tradition. The masts rose above the Harry Lundeberg School, run by the Seafarers International Union and the shipping companies with which it has contracts. Administrator Ken Conklin explained the school's mission: "To guide and encourage those seeking careers at sea, and to help those already in the profession to gain greater skills."

Each year, Mr. Conklin said, more than 1,000 young men graduate from Lundeberg. To train its students, the school has assembled an impressive fleet of vessels. Largest is the 258-foot steam yacht *Dawntless*, the former *Delphine*, commissioned by automobile maker



Pleasure-craft hub of Chesapeake country, Maryland's capital dresses up its waterfront for the 1971 U. S. Sailboat Show, largest exposition of its kind.

The graceful gray and white dome of the State House dominates Annapolis. Seat of the legislature since colonial times, the building served briefly as national capitol when the Continental Congress convened there from November 26, 1783, to June 3, 1784.

Home port of the United States Naval Academy, Annapolis keeps historic streets like Maryland Avenue (right) spick-and-span as a carrier deck.



JAMES L. ARNOLD (REDFER)





Horace Dodge, who died without ever seeing it. At the Lundeberg piers I also saw the yawl *Manitou*, often sailed by President John F. Kennedy, and many other craft, some fitted out as floating schoolhouses.

With all its 1970's bustle, southern Maryland remains a placid and somewhat drowsy region. Elegance survives in many a lovingly tended manor house, some occupied by descendants of the builders, others by newcomers who have bought, remodeled, restored. It matters not that a newcomer arrived decades ago; he may be accepted socially, but his lack of cavalier ancestry never will be forgotten.

To the cavaliers, tobacco was gold; at one time the leaf actually served as currency. It is still a hard-cash crop today (pages 218-19). Some decrease in acreage has been recorded recently, but planters told me this had been offset by new techniques producing higher yields per acre.

In a vast, aromatic warehouse at Lothian, I watched and listened for two hours as manager Bernie Doepkens and auctioneer Bob Cage sold about 100,000 pounds of Maryland's air-cured "Type 32," known for its low nicotine content.

Dry brown "hands" of tobacco were stacked in 150-pound "burdens." Followed by two tally clerks to record sales, Bernie and Bob moved between rows of burdens. Opposite them trooped seven or eight buyers, some of them representing Swiss and West German cigarette manufacturers.

Bernie drew a hand from each stack, appraised it quickly, and announced the opening price. At one he said, "Eighty," seeking bids beginning at \$80 per hundredweight.

Taking the cue, the auctioneer went into his rapid singsong: "Eighty, eighty, eighty, seventy-eight . . . seventy-nine . . . now eighty-one, a one, a one, how about two, two it is, now three, three, three, how about four, four, a four, now five, five, five . . . all done? Sold!"

Bidding was silent, signaled by a nod, a lifted finger, a raised eyebrow.

I asked Bernie why, when setting an opening price, he pulled a sample hand from the

middle of the burden rather than from the top.

"That's to protect the buyers," he said. "Ever buy a box of strawberries and find choice ones only on top? Same principle."

ANNAPOLIS, TOO, belongs to southern Maryland, and this venerable state capital ranks high among my favorite cities (pages 222-3). I liked it even before the dedicated preservationists of Historic Annapolis, Inc., inspired the "Incredible Change," when Annapolis was a rather shabby little city, notable chiefly as the seat of Maryland government and the site of the United States Naval Academy.

True, there was much of historic and architectural interest, such as the State House, built in 1772. It houses the Old Senate Chamber, where the Continental Congress, on December 23, 1783, received George Washington's resignation as commander in chief and less than a month later ratified the Treaty of Paris, bringing the Revolutionary War to an official end.

Best of all, there was the view from Church Circle down the gentle slope of Main Street to a harbor crowded with yachts, fishing vessels, and oyster-dredging skipjacks, last of our country's working sailboats.*

Beside the harbor, on Dock Street, I liked to inspect the displays of crab pots, tonging gear, bilge pumps, anchors, cordage, and other marine equipment, and perhaps buy a peppery crab cake from an elderly black lady who sold them from a basket.

All these attractions remain today—but with a difference, as I discovered on a stroll around the waterfront with Mrs. Barham R. Gary, president of Historic Annapolis, Inc.

"What you see in Annapolis," said Mrs. Gary as we left her office in Shiplap House, "is one of the few cities where the trend toward urban blight has been reversed. A good example of the many restorations here is our own headquarters. Shiplap House was built as a tavern about 1720. When Historic

*See "The Sailing Oystermen of Chesapeake Bay," by Luis Marden, *GEOGRAPHIC*, December 1967.

Hats aweigh! Naval Academy graduates fling "middle" caps skyward at the climax of June Week commencement exercises. Now they will wear the hats of officers.

Oh, for a ladder! Celebrating the end of their first year, plebes (following pages) engulf the Herndon Monument to knock off a cap put there by upperclassmen and replace it with one of their own. A liberal coating of grease makes the task a slippery one. They reached the top in 40 minutes—about average for the annual rite.





Annapolis bought it in 1955, it was a condemned slum tenement, falling apart, with 27 people living in its five apartments. We have restored the exterior to its original appearance, and we're gradually doing the interior."

We left the waterfront, walked up Prince George Street, and halted before a tall brick facade covered with scaffolding.

"This is our most ambitious restoration," Mrs. Gary said, "William Paca's house. When we are finished, it will be used as a reception and conference center."

Paca was one of Maryland's four signers

of the Declaration of Independence and the state's third governor. He built his 35-room mansion in 1765. Two centuries later the house was threatened with demolition. Historic Annapolis led a campaign to save the house, and the State of Maryland is now restoring Paca's magnificent garden.

"One of these days," said Mrs. Gary as I left her at her own Ireland House (built about 1800), "you will see a completely restored downtown area, a community with compatible buildings representing 300 years of architecture all in appropriate present-day use."



Lonely at land's end, wild ponies guard a solitary stretch of Assateague Island, a

ALTHOUGH COLONIAL CHARM draws thousands to Annapolis, the city's prime tourist attraction remains the United States Naval Academy. Joining a crowd in front of Bancroft Hall to watch the noon mess formation, I noticed that almost all these tourists were middle-aged or older.

I wondered how the antimilitary, anti-Establishment attitudes of today's youth affect a service school like the Naval Academy. I put the question to Vice Adm. James Calvert, a tall, distinguished submariner who has been the academy's superintendent since 1968.



sandy barrier off Maryland's Atlantic Coast.

"I might answer that," said the superintendent, "by telling you that the 7,300 candidates for the Annapolis class of 1975 were not only the most we've ever had, but the most for any service academy."

Under Admiral Calvert, striking curricular changes have created broad academic opportunities for the young men who come to Annapolis to be trained as officers.

"When I came aboard," the admiral said, "it was obvious that improvements had to continue and accelerate. Of particular concern was a rise in voluntary resignations.

"So what to do? Standards could not be relaxed. Our program had to remain tough—there is no easy path. Yet the curriculum had to be up-to-date and realistic to make sense to today's youth."

Ten years ago all midshipmen took the same 40 courses. That old "lockstep" curriculum was dropped, and midshipmen were given the choice of more than 24 majors. Annapolis now offers nearly 600 courses, including several in black studies.

"Sure," he continued, "we hear about youthful antipathy toward the military. However, a lot of young men are clearheaded enough to recognize the value in the kind of quality education and professional training offered at Annapolis.

"Expenses at a civilian college these days can run very high. At the Academy, of course, there's no tuition. And a midshipman has been paid nearly \$10,000 in salary by the time he has graduated. And he has a job.

"Something that worries me," he said as I was leaving, "is that there are not enough black midshipmen. We now have about 85, out of a total of roughly 4,200. These 85 are a fine group, making good records. But there should be more. The Navy is a place where young black men can really move swiftly."

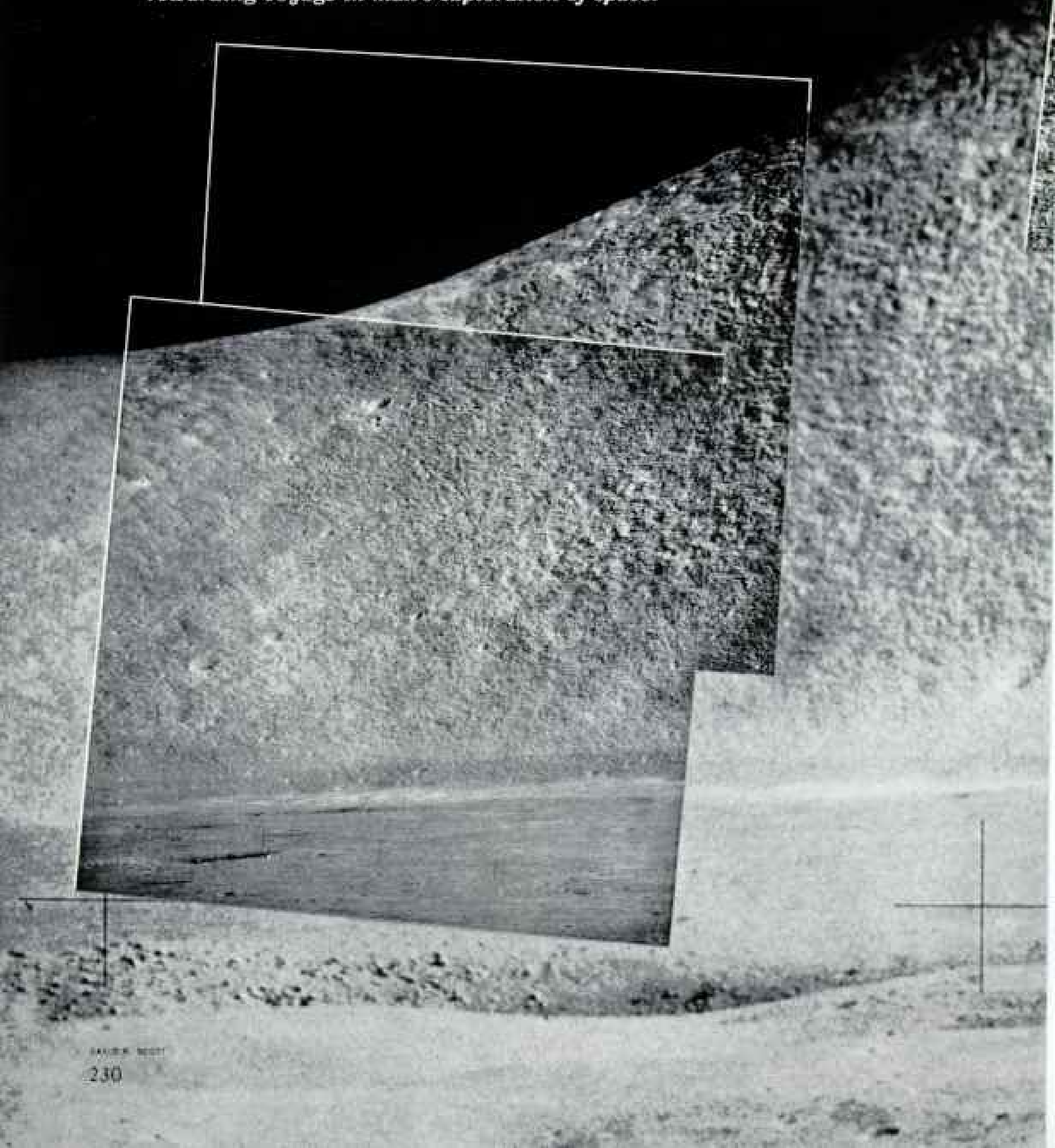
I left Annapolis with the feeling that both the colonial city and its Naval Academy were in good hands. Driving across the Bay Bridge, I watched a bright-blue helicopter delivering a load of concrete for a pier of the new parallel bridge's high central span.

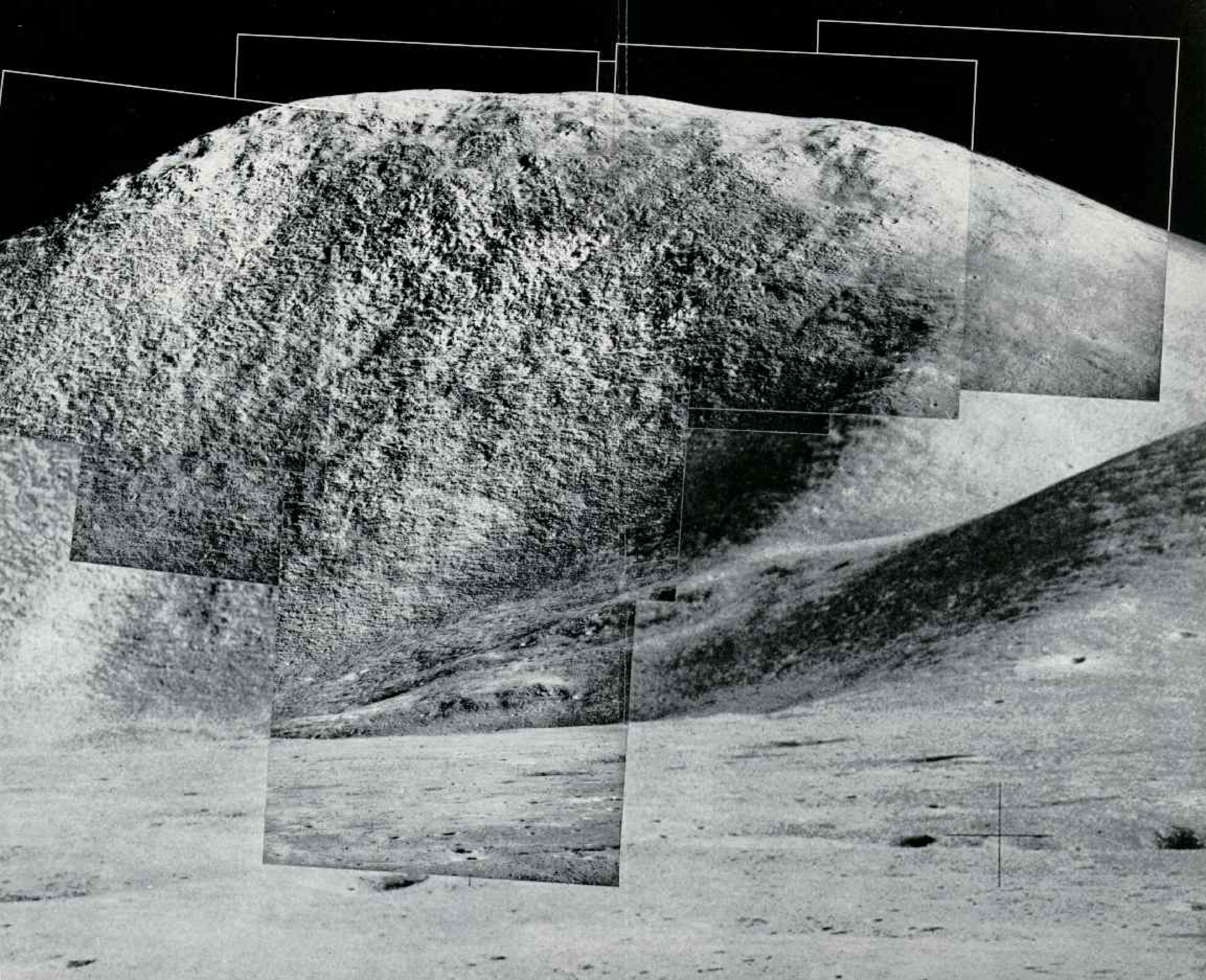
A few miles farther on, at Kent Island Narrows, skipjacks were drying their sails after a hard October rain. Against the sky to the east I saw great ragged V's of Canada geese, back on the Eastern Shore after summering in the Far North.

It felt good to be a Marylander. □

History written in rock

DECEPTIVELY DUNELIKE above the plain of Mare Imbrium, Mount Hadley rears to a height of 15,000 feet. Streaked with lines that suggest fracturing or layering, the mountain presents astonishingly legible clues to the violent past of earth's nearest neighbor, and perhaps of earth itself. This composite panorama forms part of an unparalleled harvest of photographs, samples, and data collected by Apollo 15, the most scientifically rewarding voyage in man's exploration of space.





To the Mountains of the Moon

By KENNETH F. WEAVER

ASSISTANT EDITOR

"FIFTEEN, does it look like you are going to clear the mountain range ahead?" asked the man on earth.

"We've all got our eyes closed; we're pulling our feet up," replied the three men above the moon.

The exchange was lighthearted, but edged with excitement. Only a short time before, on the moon's far side, the men of Apollo 15 had

fired their braking engine and dropped into an orbit that now skimmed only ten miles above the dark lunar "sea." Directly ahead, glowing in the early-morning sun, the long Apennine range thrust up sudden peaks as high as 15,000 feet.

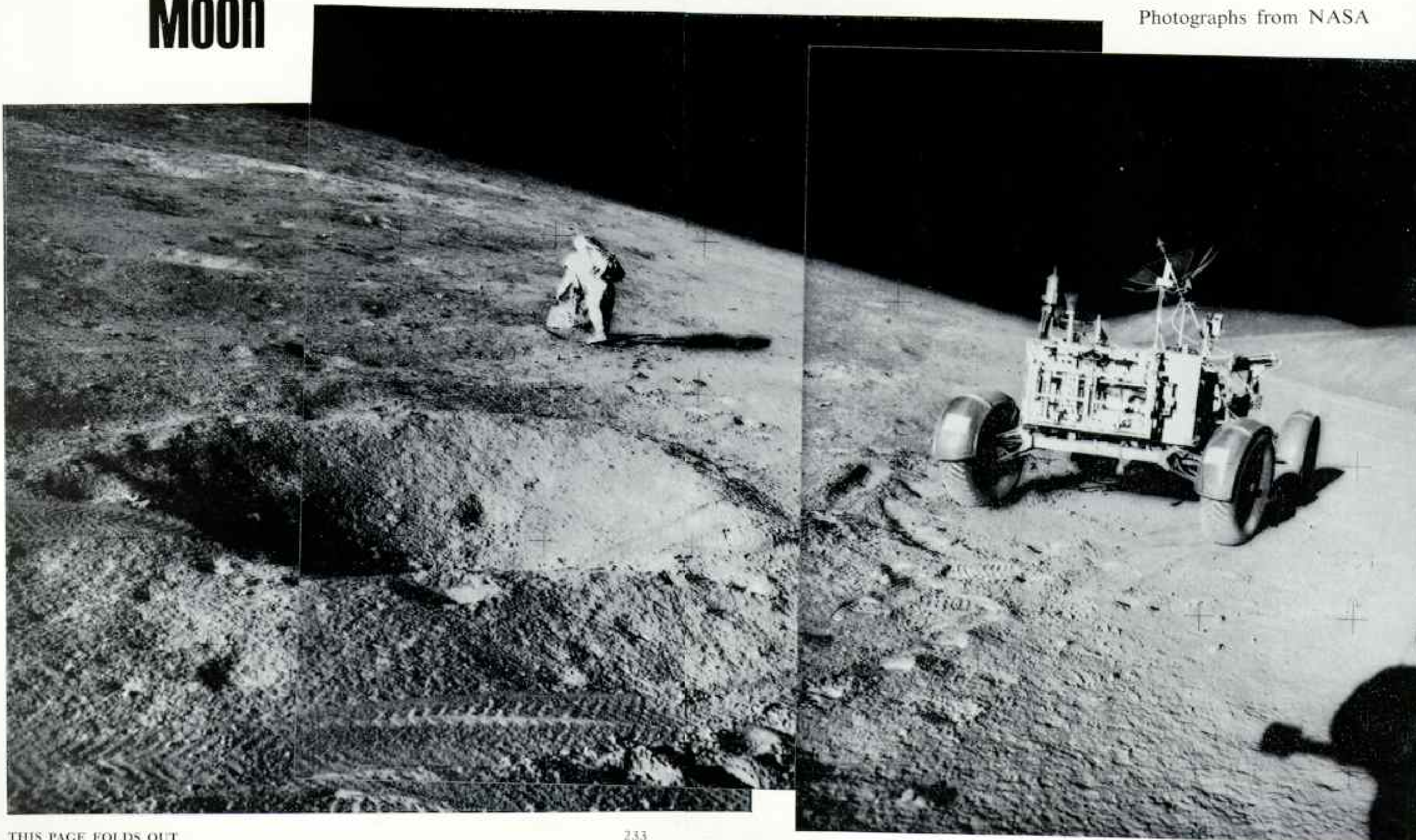
And just beyond lay the target, a little basin hemmed in on three sides by the mountains and on the fourth by a deep gorge, the Hadley Rille (page 249). There, within hours, Astronauts David R. Scott and James B. Irwin would undertake to land.

To reach their goal, Scott and Irwin would

have to separate from the command module, come in even lower over the peaks, brake quickly in a steep plunge to the surface, and bring their frail LM—the lunar module—to a stop just short of the rille. It would be man's first attempt to reach the lunar mountains—and the most difficult landing yet for Apollo.

More than difficulty, however, set Apollo 15 apart. This was the most ambitious, the most challenging, the most complex of all space missions. The twenty-fifth United States manned space flight was the most extensive effort yet to explore the moon.

Photographs from NASA



The flight had begun three days earlier, on July 26, 1971, with a perfect launch from Cape Kennedy. The moonward voyage, marvelously smooth, had turned up only a few small problems: a warning light indicating that a switch had shorted and thus the all-important service propulsion engine might not fire; a water leak inside the command module *Endeavour*; a shattered glass cover on a meter in the lunar module, the *Falcon*. But from Mission Control in the National Aeronautics and Space Administration's Manned Spacecraft Center in Houston had come solutions worked out on earth.

"There's always someone on the ground who knows what to do," the Apollo 15 commander, Dave Scott, remarked gratefully.

Falcon Touches Down in Rough Country

Now it is Friday afternoon, July 30, a hundred hours after lift-off. *Endeavour* and *Falcon* separate after a first attempt fails because of a loose electrical connection. The command module pilot, Alfred M. Worden, takes the mother ship into a higher orbit, where he will travel alone for the next three days. Scott and Irwin in the *Falcon* circle the moon twice again, then brake for the final run over the Apennines.

Irwin's voice chants the refrain of numbers—familiar from three previous lunar landings—that tell the constantly changing distance to the surface and the rate of descent. Then, at 104 hours, 42 minutes, 29 seconds, Scott's jubilant words ring in the control room: "OK, Houston. The *Falcon* is on the plain at Hadley."

Falcon has come to rest with one leg in a depression and tilts 11 degrees. But no problem. Neither the sharp drop over the mountains nor the extra ton and a quarter of weight carried in this LM have kept Scott from making a perfect landing—with more than 100 seconds of hover-time fuel left.

"It's very hummocky, and, as you know, in this kind of terrain you can hardly see over your eyebrows," Scott reports as he looks out his window. Then, a bit later, "Tell those geologists in the back room to get ready, because we've really got something for them."

In the "back room"—the science-support room in Mission Control—Professor Leon Silver, of the California Institute of Technology, is all smiles. For the past 14 months, with frequent field trips to mountain and desert, he has worked enthusiastically to train the Apollo 15 crew in the lore of rocks and minerals, mountains and volcanoes. The men have learned how to observe, how to report, how to take samples. Now the pupils are on their own.

Already appetites in the back room have been whetted by vivid descriptions from orbit of some of the moon's major features. Lava flows in Mare Serenitatis suggest an ocean with frozen shorelines. The smoothly rounded Apennine Mountains—"They're really something"—are unlike any terrestrial mountains the men have ever seen.

Mare Marginis—never overflowed by earlier astronauts—"looks like a great desert." "Swirls across the surface look like a great dust storm had been blowing." Mention of "swirls" causes ears to prick up. On a moon whose surface is airless and waterless, what could cause swirls?

The excited adjectives have come tumbling: "fantastic," "spectacular," "overwhelming," "mind-boggling," "striking," "unreal." But there have also been sound geological details about volcanic domes and wrinkle ridges, ejecta blankets and albedo (reflectivity).

And at one point Al Worden has said, "After the King's training, it's almost like I'd been here before." The King is the crew's nickname for one of their teachers, Egyptian-born Dr. Farouk El-Baz, who has pored over countless moon photographs with them.

"Stinking Swamp" Reveals Its Wonders

But now comes the real excitement, as Scott stands up in the LM's overhead hatch and begins a systematic description of the surroundings. For this site promises to be the most complex and significant yet visited.

In Dave Scott's words, "No place on earth holds such a concentration of features"—mountains taller than Mount Everest relative to their surroundings; a meandering gorge a mile across, a thousand feet deep, and 70 miles

After "a rocking and rolling ride" aboard the battery-powered lunar Rover, Apollo 15 commander David R. Scott collects soil from beneath a boulder at station 2 of the first traverse (page 240). Scientists will compare the sample with exposed soil taken nearby to determine effects of cosmic-ray bombardment. The moon car made possible five times the total surface exploration of the three previous Apollo landings.



"The *Falcon* is on the plain at Hadley," reported Scott after the team safely landed the instrument-laden lunar module between the towering Apennine range and the deep Hadley Rille (page 240). Amid boot-printed regolith—rock pulverized by meteorites—Irwin salutes the mission flag at the three-day base below Mount Hadley Delta. The powdery soil darkened



DAVID B. SCOTT

the astronauts' heat-reflective suits and frequently had to be brushed off. TV camera and umbrellalike antenna aboard the Rover beamed surface activities to earth.

long; abundant craters; lava flows; and rays of bright material ejected from distant craters.

Those imaginative scholars of another era who gave classical names to the lunar features called this region Palus Putredinis, Marsh of Decay. "The Latin might better be translated 'Stinking Swamp,'" Farouk El-Baz once told me. Palus Putredinis is at the eastern edge of Mare Imbrium, the dark circular sea that forms the right eye of the "man in the moon."

Explosion Uncovers Lunar History

Long ago, scientists believe, an enormous meteorite, perhaps 50 miles in diameter, blasted out the 650-mile-wide Imbrium basin. It was the largest and nearly the last of the giant collisions that shook the moon during its first half-billion years or so, creating the huge basins that form the prominent dark features on its face.*

The impact threw rocks and molten material hundreds of miles. It also pushed up the Apennines, the Juras, the Carpathians, and the other mountains ringing the basin.

Extensive lava flows long since have covered the floor of the Imbrium basin, but the scientists who recommended the Hadley site hoped that part of the early geological record would still be revealed at the Apennine Front and in ejecta from deep craters.

As Professor Silver pointed out, "At the Hadley-Apennine site, we may well get fundamental information on the origin of the moon and the possible early history of earth."

All this is in Dave Scott's mind as he surveys the Hadley site. Yet his first reaction is that of the enthusiastic tourist: "Oh, boy, what a view!" Then with map and sun compass he takes bearings on nearby landmarks and gives crisp, precise descriptions.

"All the features around here are very smooth," he tells the scientists on earth. "The tops of the mountains are rounded off. There are no sharp jagged peaks. . . . It's a gently rolling terrain completely around."

Then comes the blockbuster.

"To the east of Hadley Delta. . . I can see smooth surface; however, I can see lineaments. . . there are definite linear features."

Geologists in the back room are startled, especially when the astronauts later observe that the apparent layers in Mount Hadley number in the hundreds, in thin parallel patterns (foldout, pages 230-32). Nobody has anticipated striations this detailed, at least not

*See "That Orbed Maiden . . . the Moon," by Kenneth F. Weaver, NATIONAL GEOGRAPHIC, February 1969.

in the mountains, although Lunar Orbiter photographs show what appear to be a few strata in the wall of the rille. The moon has seemed to be chiefly a big rubble pile, from the evidence of earlier Apollo visits.

Since lunar scientists believe the moon has never had bodies of water, presumably the lines could not be deposits of ocean sediments such as are common on earth. Possibly they represent fractures, or very ancient lava flows, or ejecta blankets that accumulated before the time of the Imbrium impact. The question promises to occupy scientists for many months to come.

Excited as Scott and Irwin are, they know they must rest before their first long EVA

(extravehicular activity). So they eat a supper featuring cold tomato soup and cold hamburger, then crawl into their hammocks.

Sleep aboard the crowded LM is not easy at best. The spacecraft makes curious noises: fans circulating oxygen, the glycol pump forcing coolant to the electronic gear.

But the Apollo 15 crew has anticipated the problem. The men have practiced sleeping with a tape recorder playing the actual sounds made by a spacecraft while it was operating in an altitude chamber. So they fall asleep with little trouble in their "portable Leaning Tower of Pisa."

Nine hours later, refreshed and eager, the two explorers open their hatch and descend



DAVID R. SCOTT

Probing the lunar soil

ASTRONAUT James B. Irwin inserts a hollow tube (above), pushes and hammers it to a depth of two and a half feet, and leaves a hole when he withdraws the tube and its stratified cargo. Locked within the cylinder, the separate soil layers tell of periodic violence: Small meteorites smashing into the moon millions of years apart covered surrounding areas with successive blankets of debris and dust.

Scientists believe a Rhode Island-size projectile blasted out the Imbrium basin some four billion years ago. The shock pushed up the Apennines and opened cracks that later released molten rock from below. At the edge of Hadley Rille, Scott collects fragments hammered from a basalt block (right), a solidified remnant of the lava floods that formed the dark lunar "seas," or maria. The step-by-step schedule for each station is outlined on the wrist pad of the astronaut, whose visor reflects co-worker Irwin. Perched atop the rock, a tripod-mounted gnomon points straight up; from it, scientists can later determine scale and angle of slope.

for the first time to the surface. Radar signals beamed from earth and reflected back by the moon have already suggested that the Hadley site is covered with fairly deep dust. And that is exactly what the moon walkers find—a foot or more of powdery gray dust that clings to everything it touches. Boots sink in an inch, sometimes much deeper.

"Oh . . . it's dirty!" exclaims Scott. "Your boots are blacked over!" says Irwin. They liken the dust to soft powder snow; indeed, the mountain-rimmed basin reminds Irwin of Sun Valley, Idaho, where he has skied.

Throughout their stay on the surface the two men speak frequently of the dust kicked up by their feet or by the wheels of their

vehicle. It coats their cameras and gear and settles on their white space suits. The dust must be brushed off frequently; dark surfaces absorb the sun's heat, putting an extra strain on the circulating-water cooling mechanism in the portable life-support systems.

The PLSS backpacks, incidentally, are substantially improved models; the men can stay out of their spacecraft nearly twice as long as any previous Apollo team.

With the TV camera set up on its tripod so that earthbound scientists (and the world) can watch, the men turn to unloading the *pièce de résistance* of Apollo 15. It is a remarkable roving vehicle, an electric dune buggy to carry men and tools on excursions

JAMES H. HAYES



Mount Hadley Delta rises 17,700 feet above the lunar-landing plain. Astronomers use the Greek letter delta to distinguish the mountain from its higher sister peak, Mount Hadley, 20 miles to the north.

APENNINE FRONT



Rover carries men 17 miles

across the rocky crater-pocked lunar surface.

Lanyards are pulled, and from a storage bay in the LM, the folded-up Rover uncoils and flops out with the jerky motions of an insect emerging from its chrysalis. Scott and Irwin are ready for their first traverse.

The Apollo 15 Rover looks like a stripped-down jeep, but the appearance is deceiving, as I found when I examined it at the Boeing factory near Seattle, Washington, and when I drove a training model at Cape Kennedy.

Stripped down the Rover may be, but there's nothing simple about it. Tires of woven piano wire, faced with titanium chevrons to ride on top of the dust; sealed electric motors in each wheel hub, about the size of a handyman's electric drill; two 36-volt batteries; and a gyroscopic navigation system. To all this is added a suitcase-size radio unit so the astronauts can talk directly with earth.

And the Rover is crafted like a Stradivarius violin. At the Boeing plant I watched an engineer assembling the lunar vehicle for Apollo 16. With mallet and punch he was removing a misplaced rivet, working as slowly and carefully as a cabinetmaker repairing a fine

antique. Yet the Rover is sturdy. Weighing 455 pounds on earth but only 76 on the moon, this vehicle is designed to carry 2½ times its weight across the lunar surface.

The Rover is not, to be sure, the first wheeled vehicle on the moon. The Apollo 14 crew, in February 1971, pulled a handcart loaded with tools.* And even as Rover sets out, a tubby, eight-wheeled robot, Lunokhod 1, sits dormant in the lunar night on the other side of Mare Imbrium. As soon as the sun strikes its solar panels, it will again lumber over craters and ridges, sending pictures back to earth as it has done since landing in November 1970.

Explorers Drive Off Across the Moon

"OK, Dave, and buckle up for safety!" It is the CapCom speaking, the capsule communicator in Houston, the man in Mission Control who handles communications with the astronauts. During EVA's on the lunar surface the CapCom is Dr. Joseph Allen, a scientist-astronaut who has worked closely with the

*See "The Climb Up Cone Crater," by Alice J. Hall, NATIONAL GEOGRAPHIC, July 1971.



across the face of the moon

Apollo 15 crew and shared their training.

And so the first traverse begins, headed south for a close look at the rille and the base of the Apennine Front.

"OK, Jim, here we go," says Scott, driving the Rover from the left seat. "Whew! Hang on!" replies his passenger. And for a time much of their comment has to do with the excitement of maneuvering a new vehicle over strange, rough terrain with gravity only one-sixth that of earth.

The ride is bouncy and rolling, "a combination of a bucking bronco and rowboat in a rough sea," as Irwin puts it. But the vehicle's suspension is good and the steering responsive. It's "a rocking and rolling ride," "a great sport," "a super way to travel."

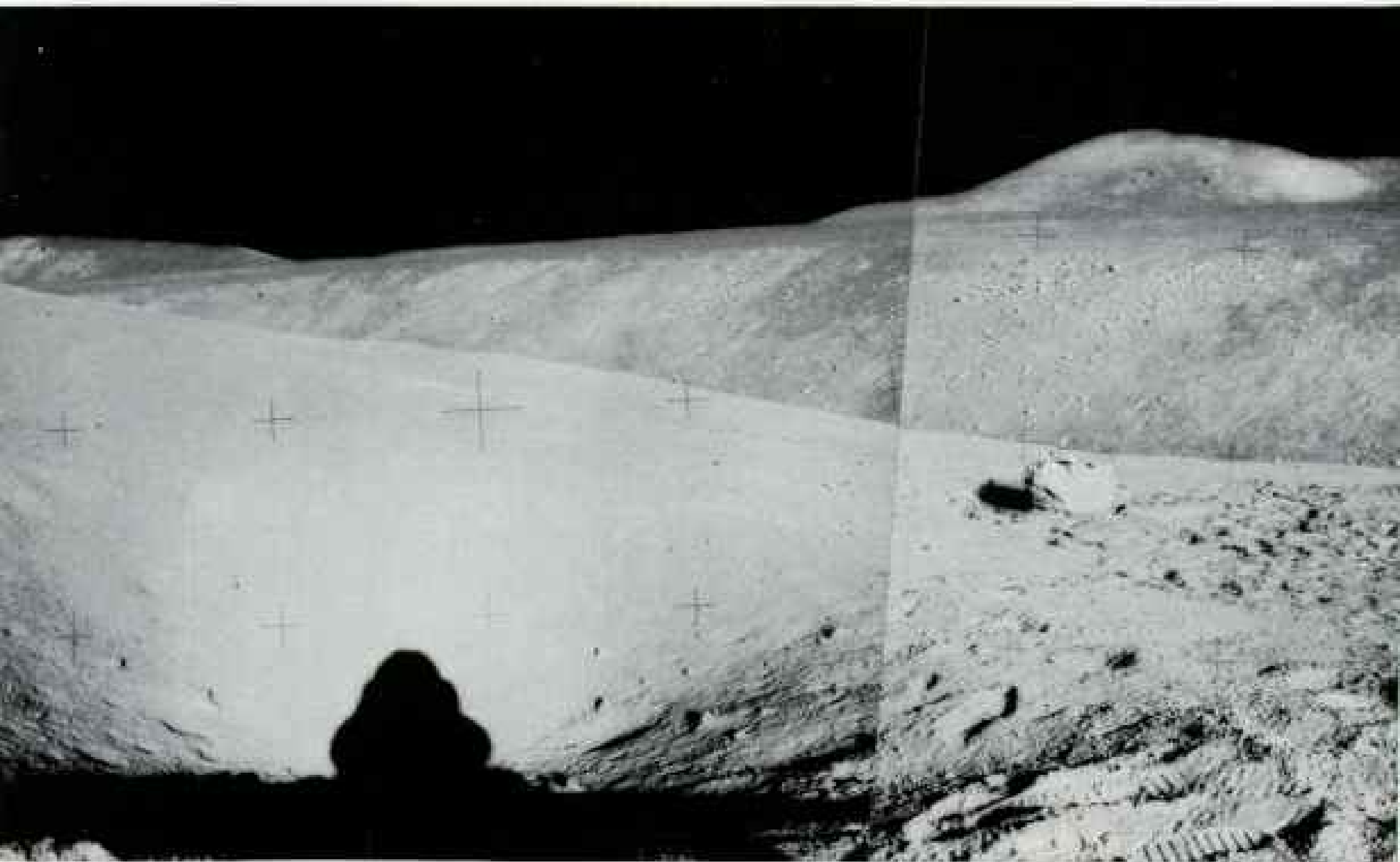
They find that they can push speed up to seven or eight miles an hour. But at one point they make a downhill turn too fast, the front wheels dig in, and the rear end breaks away in a 180-degree skid. Later the crew erupts with laughter, and Scott yells: "Whoop! Hang on! Oh, brother!" Then he explains: "Came up over the rise, Joe . . . there was a great big crater in our path. But we missed it."

My own experience driving the Rover training model was somewhat less lively. Earth gravity held it down more firmly, damping out the bumps. I found that it rode much like an electric golf cart, moving forward as I tilted the control arm forward, braking as I pulled it back, and turning as I moved the arm left or right. The vehicle can make a circle within its own ten-foot length.

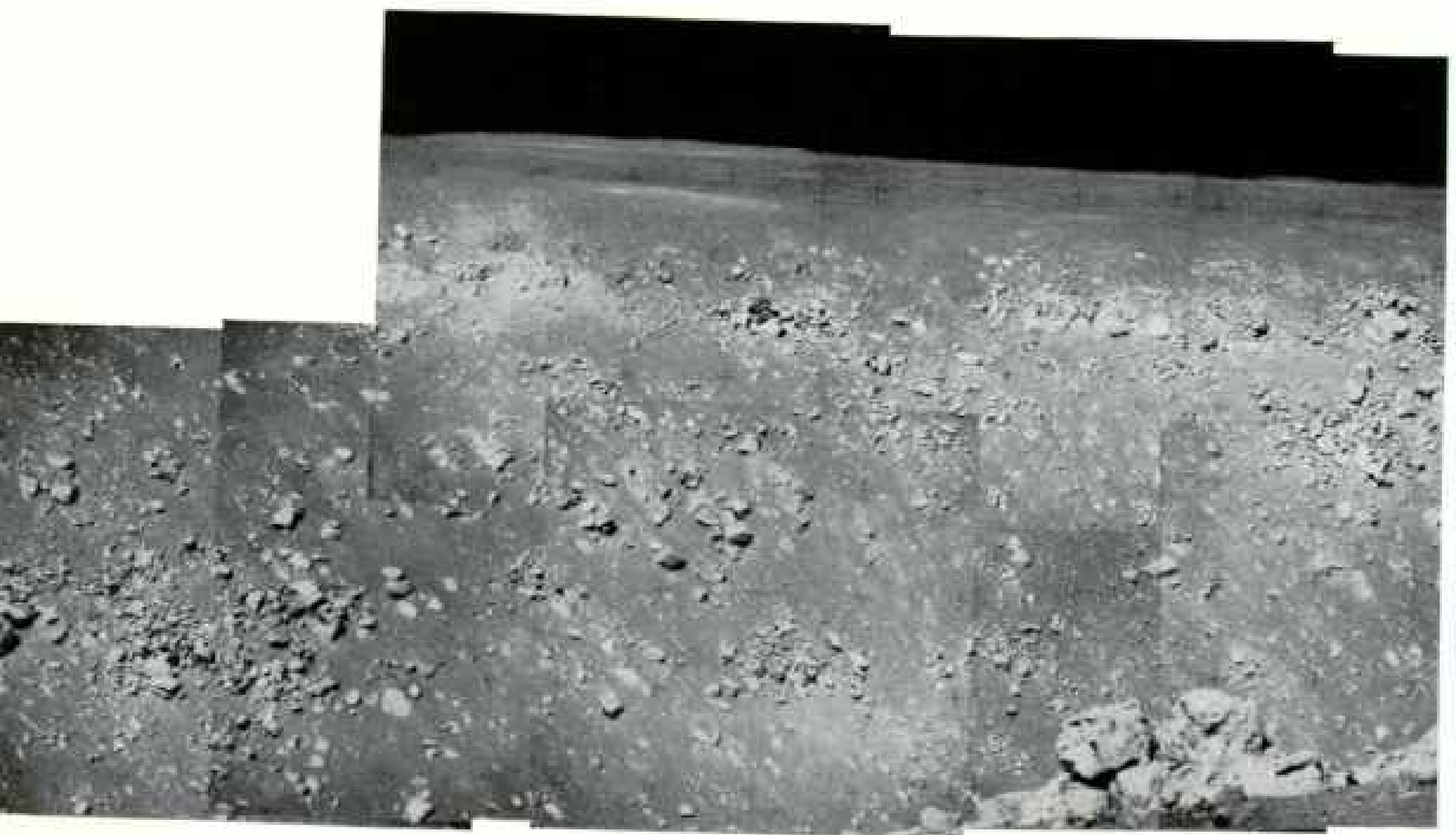
But for all the exuberance of the ride, the two men pay close attention to their geological tasks. They skirt the rille for a considerable distance, noting that it has a raised rim and contains many large blocks, that the bottom is irregular and perhaps 200 yards wide, and that indeed there seems to be layering in the rille wall (following pages).

Scott and Irwin decide the rille most likely is a fracture in the moon's crust. That will interest the scientists, most of whom think the moon's sinuous rilles are in some way volcanic—perhaps collapsed lava tubes, or the result of flows of volcanic material.

The astronauts stop now and again to take panoramic shots with their cameras, and to allow the television camera on the Rover to



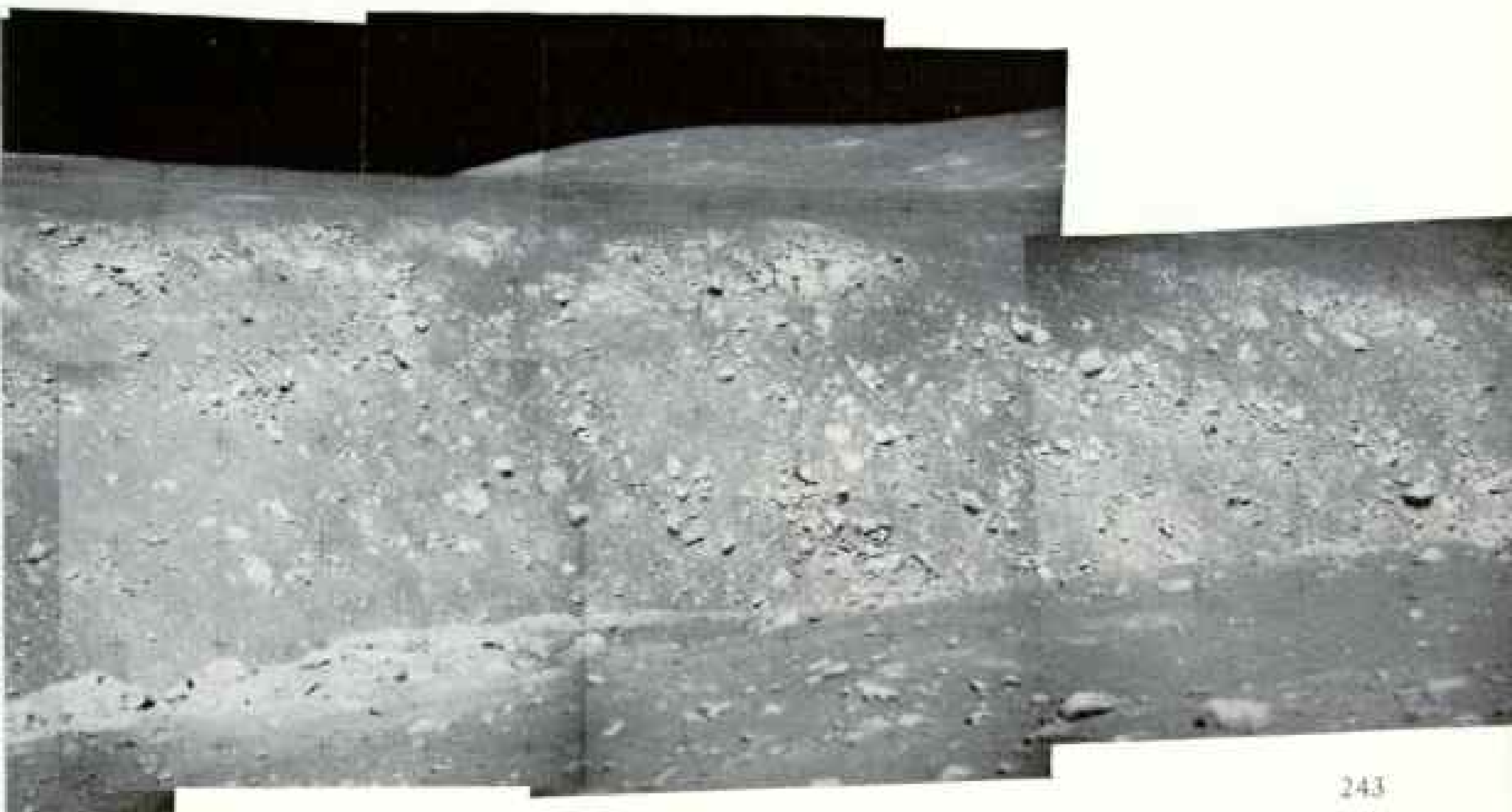
"That's beautiful . . . spectacular!" exclaimed Irwin as he stood at station 2, near the edge of the Hadley Rille (**above**), whose east wall is blackened by shadow. Exulting over scenery long characterized as barren and drab, the astronauts scanned this broad vertical cross section of geology for clues to the moon's early development. Studying Hadley Rille's far wall (**below**), they described the horizontal layering of lava flows and occasional slumps that suggest an unstable

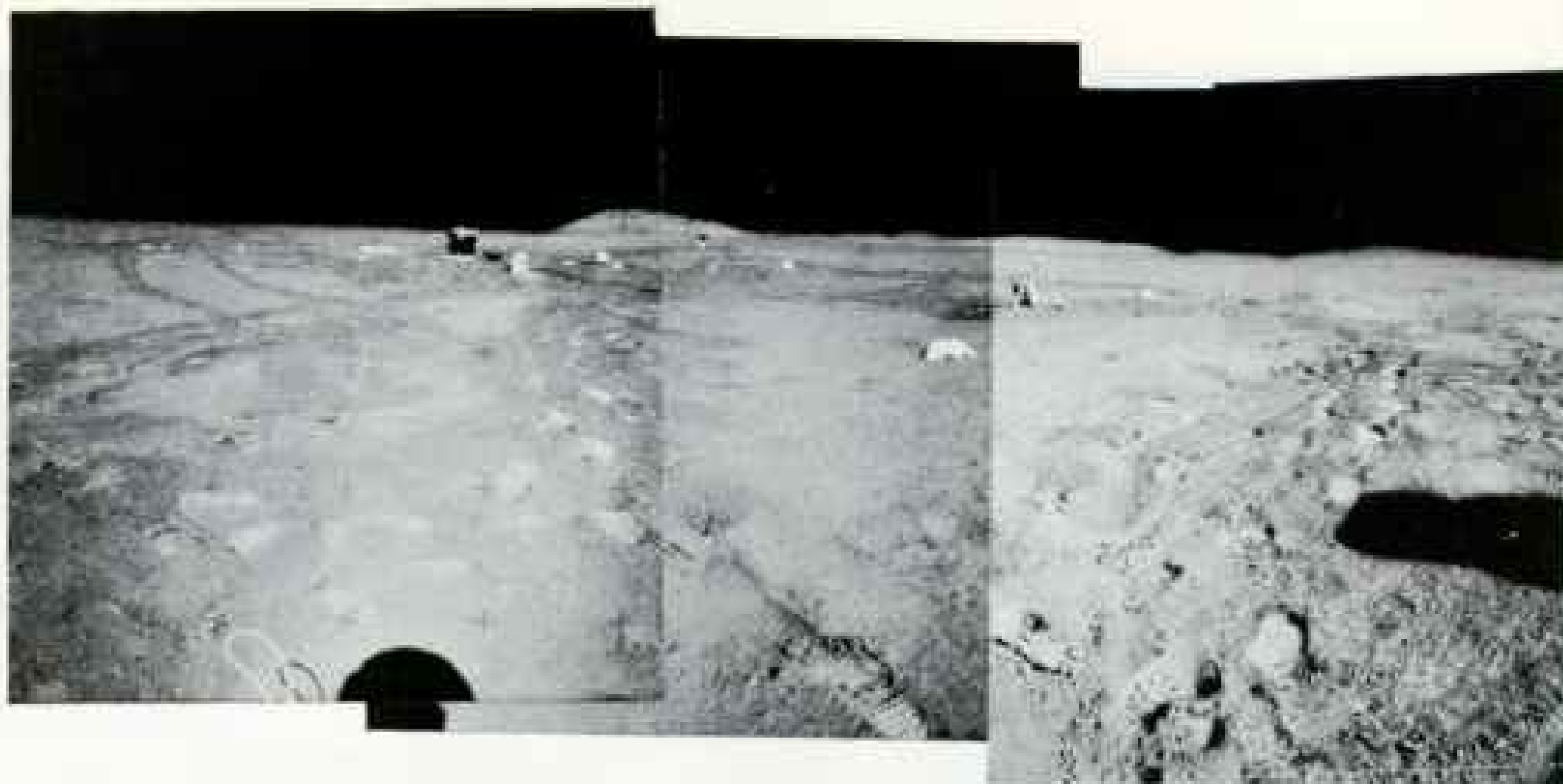




JAMES H. IRWIN AND DAVID R. SCOTT (BELOW)

surface. Scientists offer several explanations for the mysterious canyon that wanders through this waterless, windless environment: Flowing volcanic materials may have cut the gorge; gases erupting through cracks could have left the 70-mile-long fissure; by a third theory, the rille may have opened when the cooling Imbrium lava shrank. Photographed with a telephoto lens, the rille in the view below appears much narrower than its actual one-mile width.

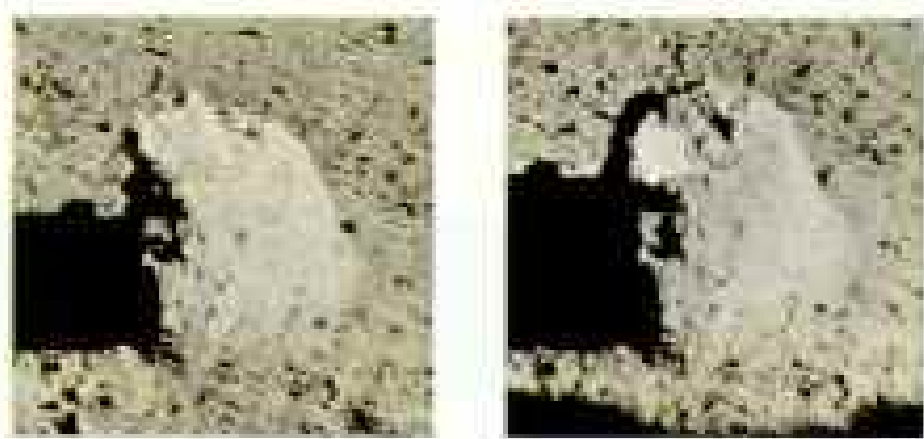




Gardening for science, Irwin digs a trench to test the cohesiveness of lunar soil. The Apollo lunar surface experiments package (ALSEP), deployed at upper left, teams with instruments placed hundreds of miles away by Apollos 12 and 14 to monitor quakes and the moon's extremely thin gases.

Stooping in the mission's new, more flexible space suit, Scott (right) puts down a battery-powered drill while boring a hole to measure heat escaping from the moon's interior. The rack beside him holds additional drill stems. Ribbonlike wires relay temperatures from the holes to a transmitter, which beams them to earth. The heat-flow readings suggest high levels of radioactivity, a likely cause of lunar volcanism.

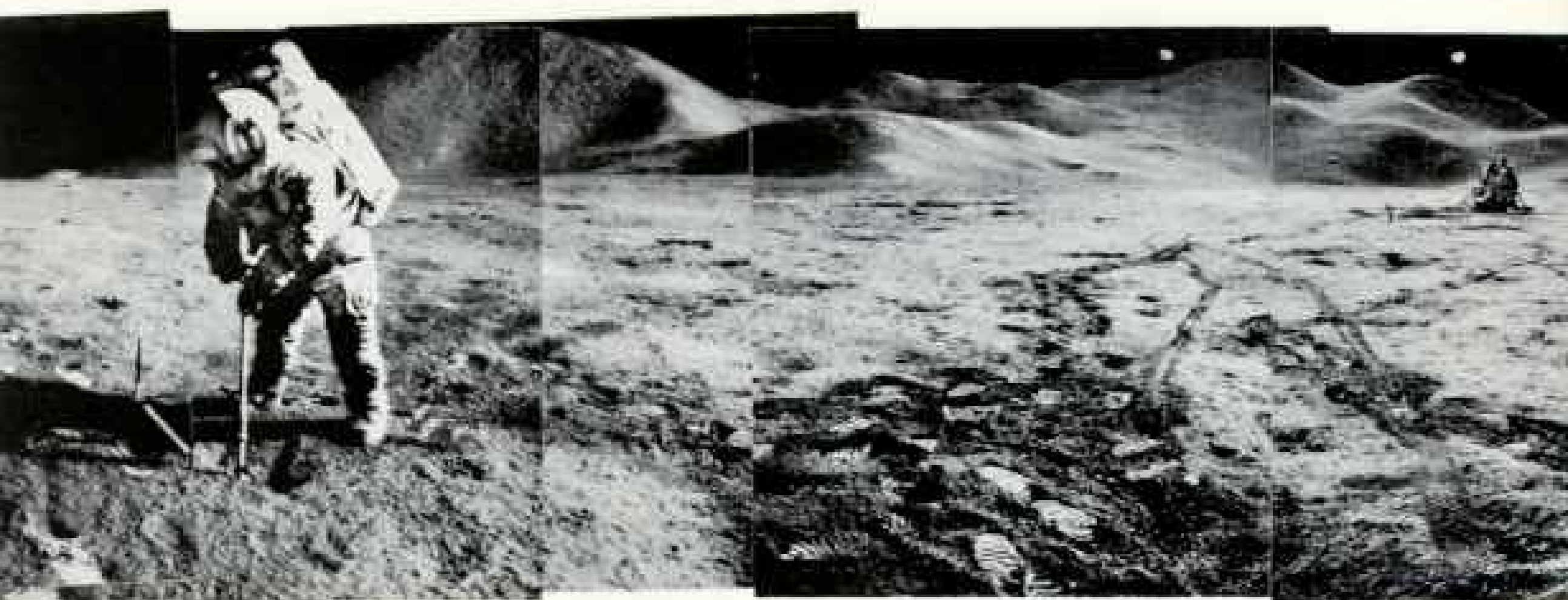
The Apollo 12 and 14 instruments have detected possible water vapor, stirring speculation that water exists within the moon. A spectrometer, foreground, measures the solar wind sweeping the moon's face.



DAVID R. SCOTT

Jewel for geologists: A chunk of anorthosite at least four billion years old perches atop a pedestal of soil (left); the rock has been removed in picture at right. Aluminum-rich crystals within the fragment (shown actual size on page 265) may have come from the original moon crust.

JAMES S. IRWIN



DAVID H. SCOTT

portray their activities. The TV operates only when the Rover is parked, because its inverted-parasol antenna must be pointed very accurately toward earth. The men note geological features, such as craters with much glassy debris. They gather samples. They identify such rock and mineral types as basalt and breccia, olivine and plagioclase. Their descriptions and identifications are found to be impressively accurate when their samples are studied later in the Lunar Receiving Laboratory in Houston.⁸

At one point, the men examine a large "fresh" boulder on a slope, and ponder how long it may have been resting there. As I listened to their discussions, I recalled a comment made by Dr. Robin Brett, chief of the Geochemistry Branch of NASA's Planetary and Earth Sciences Division at Houston.

"When I look at a rock in my backyard," said Dr. Brett, "I know that in a few thousand years it will be worn away by wind and rain. But when I look at some lunar rocks, I know that they have been sitting within a meter of the surface of the moon for the past 500 million years. During that time, on earth, the Rocky Mountains have formed, the Appalachians have formed, the Alps have formed, fishes have evolved, land plants have evolved—really the bulk of earth history as we know it has taken place. And all the while that little rock has just been sitting there on the moon, and nothing much has happened to it at all."

On the return trip, the men come across their outward-bound tracks. "Somebody else has been here," says Irwin with a straight face.

The two explorers return to home base after logging more than six miles on their first traverse. They have been out on the surface

for a full four hours. But before they can rest, they must deploy a battery of scientific instruments known as ALSEP—the Apollo lunar surface experiments package.

These devices include a series of thermometers to measure the flow of heat from inside the moon to the surface; a seismometer to record moonquakes and meteorite impacts (similar instruments left by Apollos 12 and 14 are still operating); a magnetometer to measure the moon's magnetic field (a twin to one left by Apollo 12); a spectrometer to measure the solar wind—electrified particles that constantly blow at high speed from the sun; two devices to detect the moon's tenuous gases (yes, the moon does have an atmosphere, albeit an exceedingly thin one); and a sensor to measure accumulating dust.

Instruments Take the Moon's Pulse

Irwin opens doors in the LM to take out the two pallets holding the instruments. "Boy, it's going to be hard to keep the dust off the ALSEP," he says.

He carries the two packages, together weighing 296 pounds on earth, 350 feet from the LM, well away from exhaust gases and debris when the LM takes off from the moon. The men set out the instruments, plus a radio transmitter that will send telemetered data to earth, and a radioisotope thermoelectric generator producing nearly 75 watts of power from pellets of radioactive plutonium-238. The power should last for at least five years.

While setting out the ALSEP, Scott says to the CapCom: "I'll give you a demonstration here, Joe. Got the TV on this pallet?"

⁸The author described "What the Moon Rocks Tell Us" in NATIONAL GEOGRAPHIC, December 1969.



BERNIE SAJOCIA, COURTESY ESI

Popgun lift-off of the LM was seen in living rooms on earth via the TV camera on the abandoned Rover. As the exhaust sent dust and debris flying, Alfred M. Worden in the orbiting command module played the tape-recorded Air Force song, "Off we go, into the wild blue yonder. . . ." Rocketing to a height of 70 miles, Scott and Irwin rendezvoused with Worden. They circled the moon for 50 more hours, then headed homeward.

When Joe Allen assures him that the TV is watching, Scott winds up like a Frisbee thrower and hurls the small platform. To everyone's surprise, he is unable to check his own momentum in the moon's light gravity, spins around, and almost falls headlong.

"What was that a demonstration of, by the way?" asks Allen as Scott regains his balance with a desperate, lunging dance. "It started out to be of gravity and wound up being of centrifugal force, I think!" Allen adds.

After the mission, I asked Dave Scott why he had not yielded to the urge every man and boy would feel to throw rocks into the rille. "I had fully intended to," he told me, "but we literally ran out of time."

The Big Question: Hot or Cold?

The most troublesome experiment to set up proves to be the heat-flow probes, two series of ultrasensitive thermometers to be inserted into holes in the lunar surface.

Scientists have long debated the question of a hot versus a cold moon. Some specialists have scoffed at the idea that the moon was ever hot enough to melt rock, except perhaps in local areas. A few scientists even doubted that there was any volcanic activity. Others have believed that the moon, like the earth, was at one time at least partly molten, and that at some depth beneath the surface much of this heat remains.

Intensive examination of igneous particles from moon soil brought back by Apollo teams has led to an imaginative hypothesis about the moon's evolution by Dr. John A. Wood of the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts.

Together with many other scientists, Dr. Wood believes that the moon, like the planets and the sun, was formed out of a vast cloud of gas and dust about 4.6 billion years ago. At first the velocity of incoming particles was relatively low, but as the moonlet grew, and therefore exerted stronger and stronger gravitational attraction, chunks of matter struck it with greater velocity and greater force.

Much of the energy of motion of these mighty collisions was converted to heat, so that the outer layer of the moon—perhaps to a depth of 50 to 100 miles—eventually melted. Certain substances—notably the aluminum-rich mineral called plagioclase—crystallized from the liquid and floated to the top, according to Dr. Wood's belief.

The supply of material in the original solar-system cloud could not last for more than a

few hundred million years. By then most of it had been swept up by the gravitational attraction of the sun and the planets.

So, lacking new additions of energy, the moon began to cool on the surface. A crust formed—a crust predominantly made of anorthosite, a rock consisting chiefly of plagioclase crystals. Small meteorites peppering the top-most layer slowly ground it into fragments and powder, forming an insulating layer for the heat below, while larger meteorites left the few large basins and the wealth of craters so visible today.

Meanwhile, scientists believe, radioactive elements inside the moon—uranium, potassium, and thorium—were disintegrating with a gradual release of heat. Thus, for an unknown length of time, the moon became hotter and hotter, at deeper and deeper levels. The temperature at some depth became high enough (about 2,400° F.) to melt rock. The great circular basins—the maria, or seas, on the front of the moon—show evidence of such melting, for, as in the case of Imbrium, they are filled with successive lava flows.

A test of this picture of the moon is provided by the heat-flow experiment. If Dave Scott can drill holes deep enough, the heat-flow probes may begin to give lunar scientists some answers.

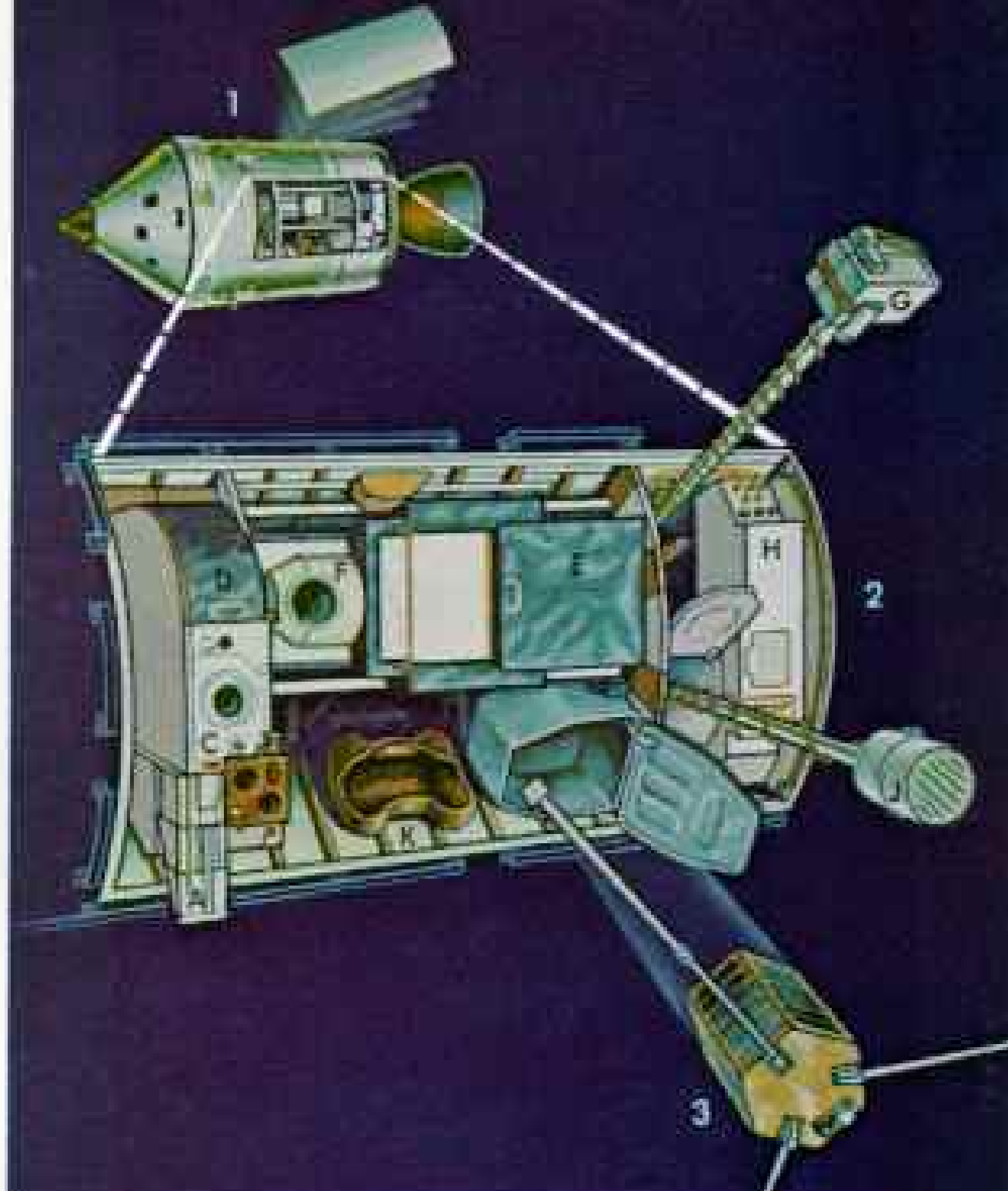
Dave takes out a small-scale jackhammer drill. Battery powered, weighing only 30 pounds, it makes 2,270 hammer strokes a minute, eight for each turn of the drill. It needs neither lubrication of the drill bit nor coolant. On earth it can chew through three to five inches of basaltic rock or five feet of simulated lunar soil in one minute.

Drill Sticks in Dense Moon Soil

I tried the drill once with a slab of basaltic material much like moon rock. With no pressure on my part, the tungsten-carbide bit moved down through the rock as though it were so much wood. Astronaut Alan Bean, in a demonstration, unwittingly put the drill through a rock and on into the floor.

But Scott does not find drilling on the moon so easy. Below a foot or two the soil is denser than anything he has encountered on earth. As he works, he presses harder and harder. He comments: "Takes a little bit of force. . . . In fact, it's getting a lot stiffer. . . . I tell you one thing, the base at Hadley is firm. . . . Boy, that's really tough rock."

By now, Scott is putting all his weight on the drill just to keep it from turning him

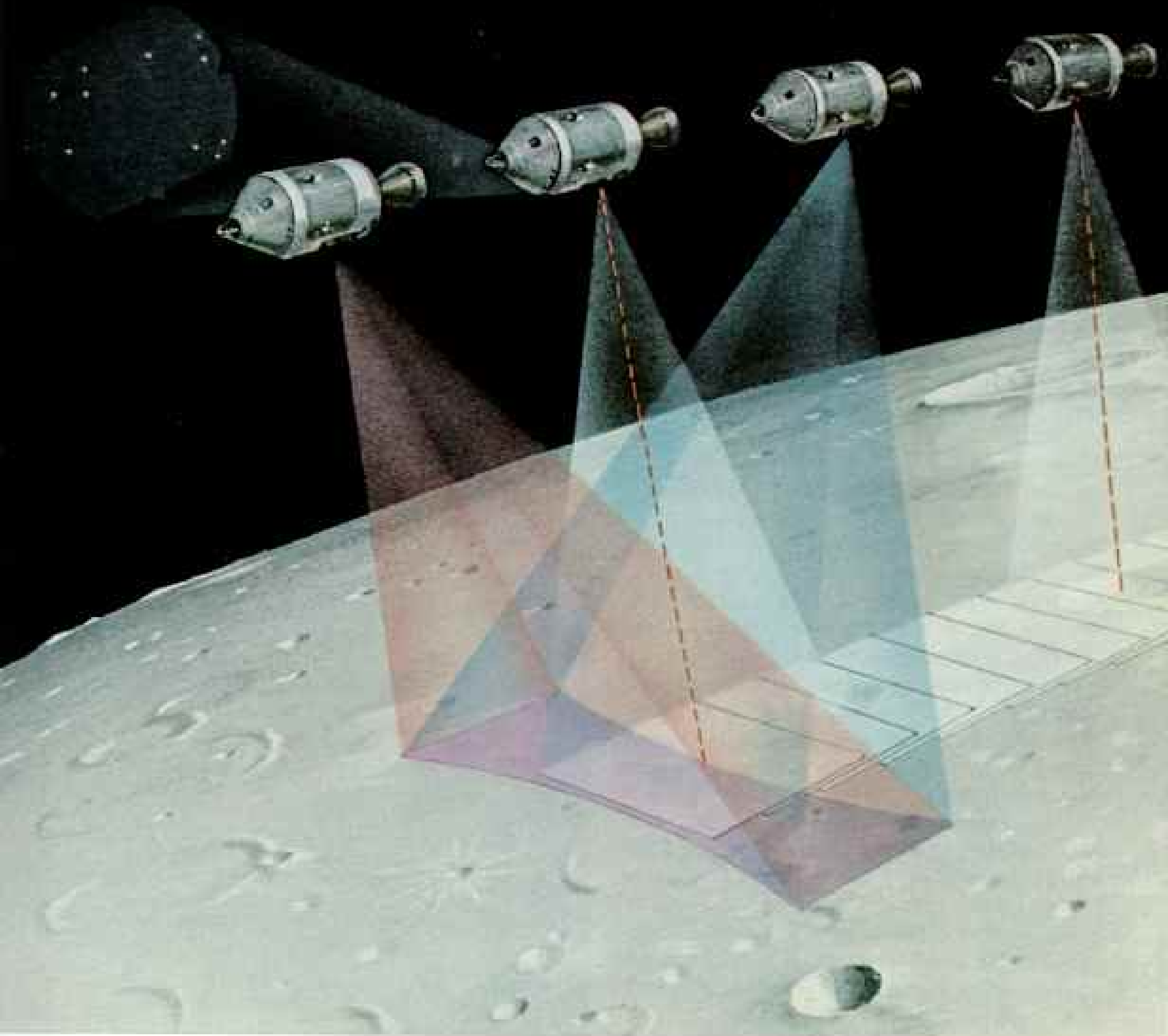


Research in orbit

WHILE his companions explore the moon's craggy face, Al Worden circles 70 miles above with Apollo 15's "flying laboratory." In the command ship (1), he activates the SIM—scientific instrument module (2)—for a unique program of lunar research. A subsatellite (3) later is ejected into orbit to measure solar bombardment and lunar gravity.

- A** Stellar camera shoots series of star fields to determine spacecraft attitude.
- B** Laser altimeter measures distance to the ground to record lunar topography.
- C** Mapping camera photographs one-eighth of the moon's surface with geometric accuracy.
- D, E** Film cassettes were retrieved by Worden during homeward flight.
- F** Panoramic camera takes high-resolution stereo pictures of the moon (following pages).
- G** Mass spectrometer on 24-foot boom records the lunar atmosphere.
- H, J** Spectrometers detecting X rays, alpha particles, and gamma rays determine chemical composition of the surface.
- K** Boot stirrup steadied Worden while he worked outside the command ship.

ILLUSTRATION BY DAVID ALLISTAR ROBERT W. FORTMANN



around. Finally, at a depth of five and a half feet, he is forced to stop. He inserts the heat probe as far as he can. He fares no better on a second hole and gives up for the moment; time is running out for this EVA.

Before returning to the LM, Scott sets out a fancy kind of mirror, a laser ranging retro-reflector (known commonly as LR⁰), and aims it toward earth. To the southeast, about 600 miles away, stands a similar mirror left by the Apollo 11 crew; some 670 miles to the southwest is a third, set up by the men of Apollo 14. The three serve a common purpose: to bounce laser signals back to earth. The round-trip time tells scientists the precise distance between earth and moon at any given moment (233,850 miles on average,

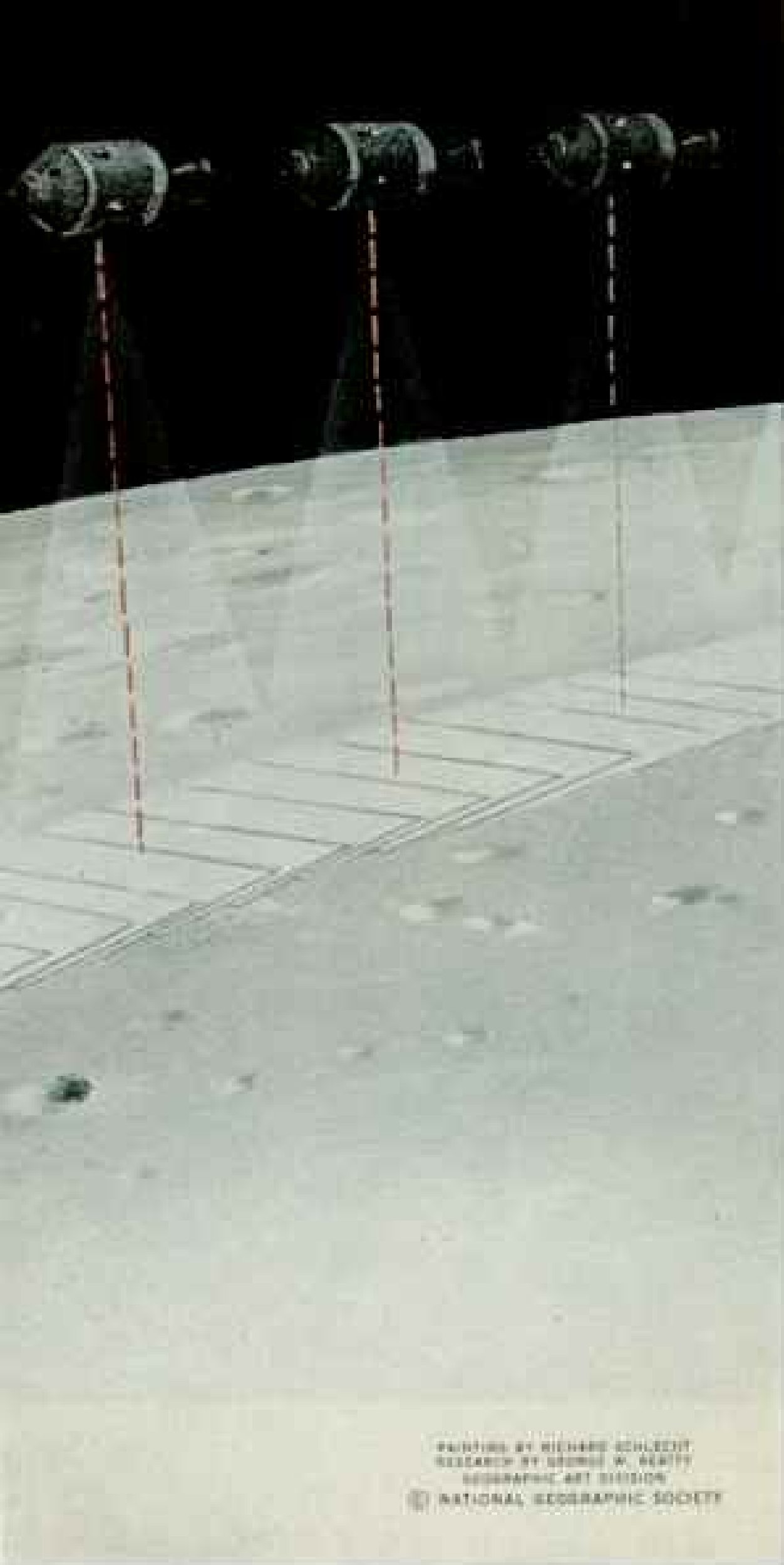
surface to surface) to an accuracy of a few inches. By triangulation, it will also make possible measurements on earth itself accurate within ten inches or so.*

But the Hadley device offers a huge advantage over the others; instead of 100 fused-silica reflectors, it presents 300, and thus can bounce back three times as much light.

Safely back in the LM, after more than six hours on the surface, the men take off their suits and helmets and notice an odd odor like gunpowder, which they attribute to the lunar soil they have tracked into the cabin.

And they complain that their fingers are

*See "The Flight of Apollo 11: 'One Giant Leap for Mankind,'" by Kenneth F. Weaver, NATIONAL GEOGRAPHIC, December 1969.



JAMES B. IRWIN

Alone in *Endeavour*, Astronaut Worden pitches the command ship nose down toward the moon so that Scott and Irwin in the LM can inspect the exposed SIM bay.

The SIM's mapping camera shoots overlapping pictures (left, light squares), while a laser altimeter measures distance to the moon's surface (dashed red lines). Simultaneously a stellar camera photographs a star field to determine the attitude of the spacecraft.

Another camera takes panoramic exposures (dark area). By photographing the same 210-mile-wide swath from successive positions, a stereoscopic view is obtained.

One frame from the mapping camera (below) reveals the LM's landing site (x) between the jutting bend of the rille and the Apennines. Mounts Hadley (H) and Hadley Delta (Hδ) flank the landing plain. Arrow shows direction of view of the traverse map on pages 240-41.



sore. Scott, in fact, has broken blood vessels under several fingernails because his glove tips are too tight. The nails will have turned black by the time he returns to earth.

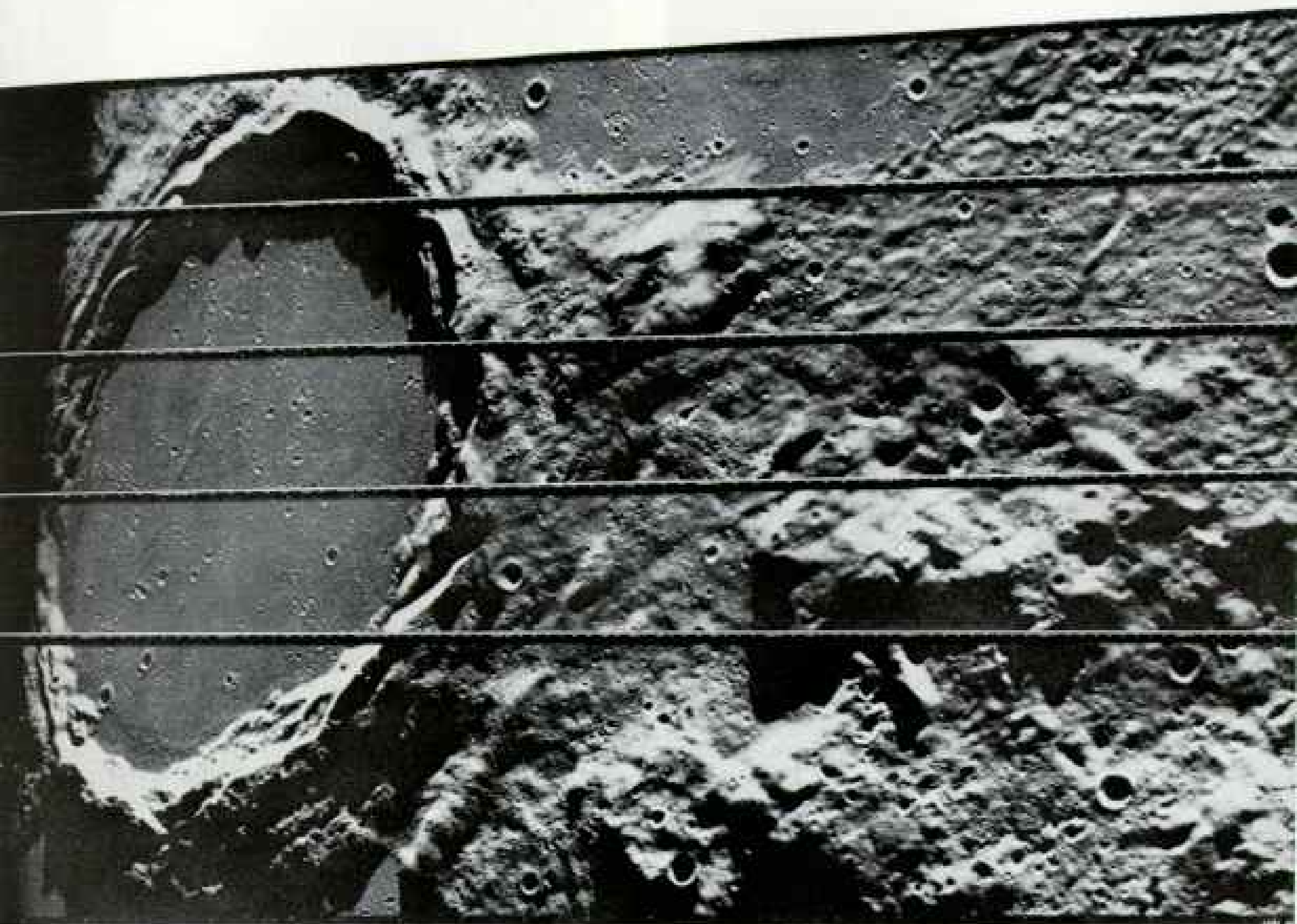
"Real fine day's work up there, guys!" Joe Allen calls. "Why don't you take the rest of the day off?"

Three Busy Days Aboard *Endeavour*

While Scott and Irwin have been making lunar history, their comrade aloft has been equally busy in the command module. Worden has been so occupied, in fact, that he has had no time to be lonely. He is seeing more of the moon than any man before him.

"I'm living the life of Riley up here," he tells his colleagues.

Five ribbons of film from the panoramic camera show 50-mile-wide Archimedes crater and jumbled terrain to the south. With such high-resolution film, investigators can identify the high, broad hills as ejecta thrown out by a meteorite's impact; with magnification, they can detect objects as small as a desk.



Among other things, Worden has been making detailed geological observations of the surface some 70 miles below, observations so skilled as to bring enthusiastic approval from the scientists back on earth. Around Littrow crater, at the southeastern corner of Mare Serenitatis, he has spotted something of more than ordinary importance:

"I'm looking right down on Littrow now and a very interesting thing. I see . . . a whole series of small, almost irregular-shaped cones . . . like a whole field of small cinder cones . . . and they have very dark halos."

The scientists prick up their ears. This is evidence of recent volcanism, taking place even after the lava flowed out into the mare basins. And it is evidence, too, of gases coming from the moon's interior; since cinder cones are formed by eruptions of volcanic ash and gas.

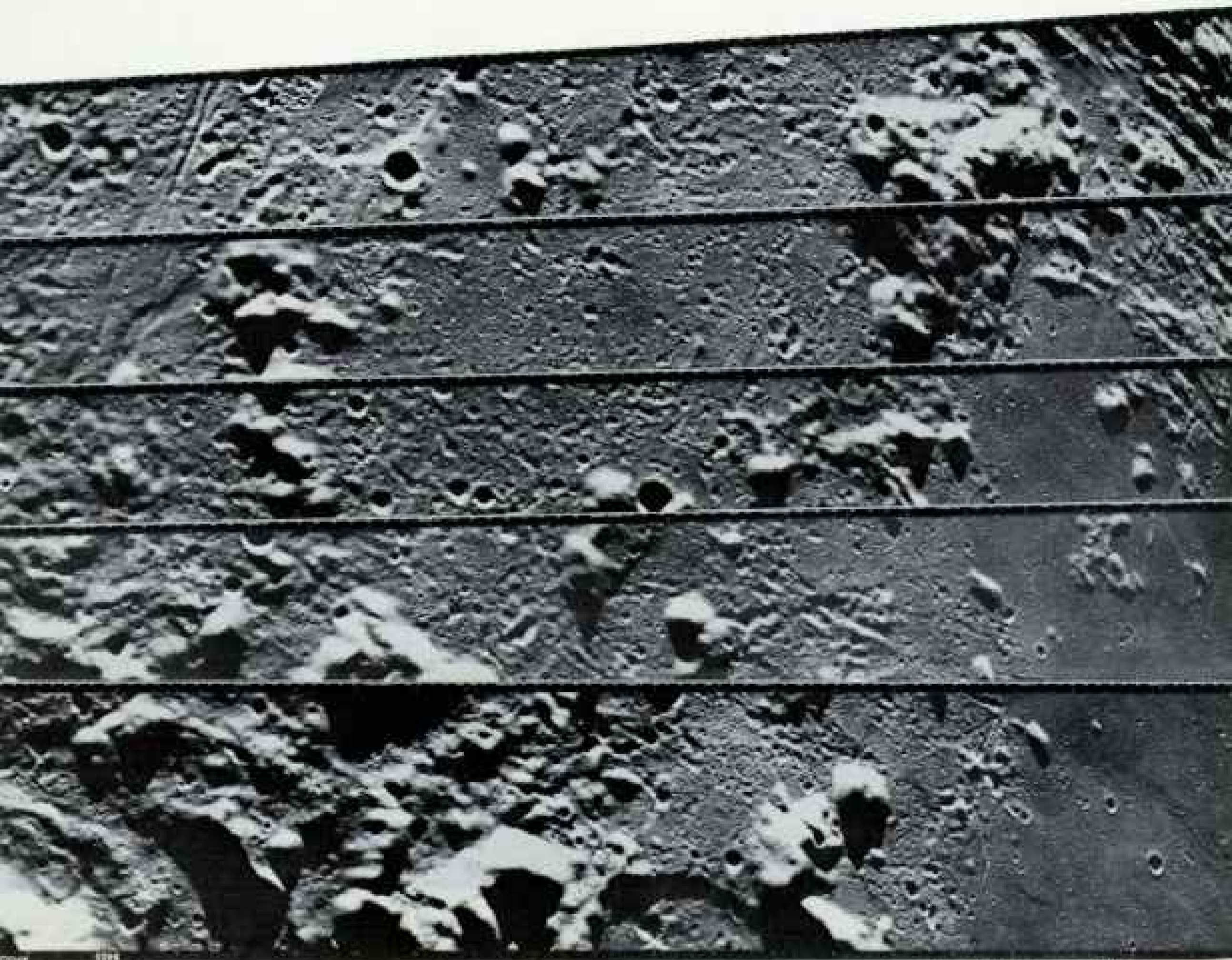
As Dr. Stanley H. Zisk of the Massachusetts Institute of Technology's Haystack Observatory puts it, "These cones were the dying belches of the volcanic moon."

Besides making geological observations, Worden has put into action an important set of cameras and instruments. These are housed in a compartment of the spacecraft known as the SIM—scientific instrument module—bay (page 247). Earlier, when the crew blew off the SIM-bay door, Joe Allen called it "the world's largest lens cap."

Cameras Scan Moon From Above

The tightly packed SIM bay turns two cameras toward the moon's surface:

- A panoramic camera with 24-inch lens, similar to those used in aerial reconnaissance, which sweeps its eye across the path of the spacecraft (above). The resulting panorama



NASA, COURTESY Itek CORPORATION

covers an area as wide as the distance from Washington, D. C., to New York City. This camera will photograph nearly two million square miles of the moon, revealing objects as small as five feet across.

- A mapping camera with three-inch lens that produces overlapping pictures along the path of the orbiting vehicle (diagram, pages 248-9). Each picture covers a square about 100 miles on a side with such precision that heights in the photographs can be determined within 50 feet, compared to 250 feet in the very best Lunar Orbiter photographs.

In addition the SIM bay carries:

- A laser altimeter that can measure the altitude of the spacecraft, and hence surface elevations, to an accuracy of about $1\frac{1}{2}$ feet.
- A mass spectrometer to measure the ultra-thin atmosphere of the moon and to detect any gases escaping from the interior.

- Three experiments to determine the chemical composition of the lunar surface by measuring the emission of gamma rays, X rays, and alpha particles.

How to Run While Weightless

Unlike his fellow astronauts on the moon's surface, who experience a sixth of the gravity they are used to, Worden floats in the weightlessness of space. To combat the effects on bones and circulatory system that have been recorded for earlier space travelers, he exercises each day.

After the mission I asked Worden what exercises he used. "I just ran in place," he said.

And how, I wanted to know, do you run in place in a spacecraft?

"Easy," he answered. "You just kind of freewheel your legs!"

(Continued on page 258)



Science and scenery

A POLLO 15's photographs offer not only priceless portfolios for scientific study, but vistas of stark beauty as well. Tsiolkovsky crater, most distinctive feature on the moon's far side, displays mare material (above) that appears as a dark sea surrounding a sunlit island. Rebound of the moon's crust thrust up the central peak after a huge meteorite blasted a hole some 125 miles wide and several miles deep.

Aristarchus (right), brightest large crater on the earth face of the moon, probably owes its high reflectivity to boulders littering its terraced sides and hummocky floor. Astronomers have reported telescopic sightings of unexplained "haze clouds" and color flashes in and around this crater.

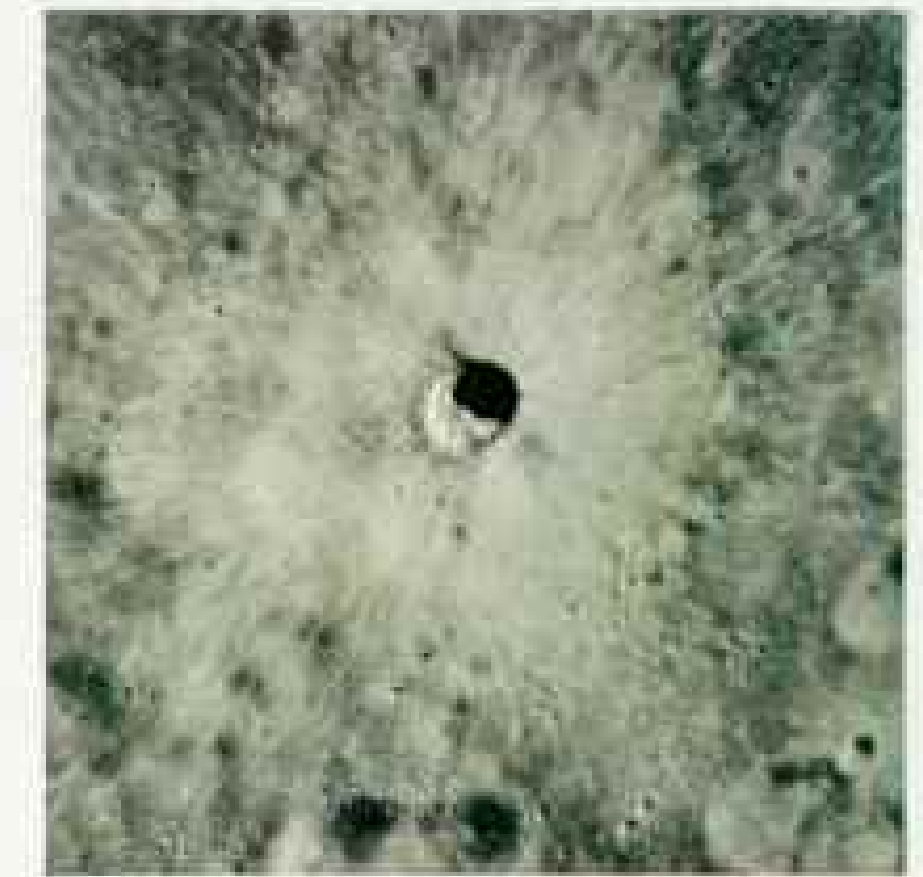
A unique feature—the series of elongated depressions (left, top) along a ridge in Oceanus Procellarum—has long puzzled scientists. A fracture in the moon's crust may have released viscous lava to form the ridge, which later slumped in places, leaving the craters.

OPPOSITE PAGE FOLDS OUT



Spider-web rilles of the 150-mile-wide Humboldt crater may have cracked open during elevation of the crater floor, long after lava covered it. Only a few lunar craters underwent such upward bulging, an intriguing riddle for lunar scientists.

Land of sharp shadows: Low sun angle near the terminator between light and dark dramatizes the ruggedness of the Aristarchus Plateau (below), with its mounds, hills, craters, and depressions. Shadows from small peaks appear like dunce caps at right. To the left, flat lava surrounds the elevated plateau and a long, jagged spine of mountains. Ranks of little ridges scar the mare surface, and sinuous rilles cut it on both sides of the spine.



Meteorite's splash, clearly visible (above), leaves a pattern often repeated on a surface pocked by space projectiles over billions of years. The largest meteorites probably struck in the first half-billion years of the moon's 4.6-billion-year history. A solid blanket of ejecta covers an area one crater diameter out from the circle and thins to scattered rays beyond that distance. Bombardment by small space particles will gradually blend the light material with its darker surroundings.





A crescent earth hangs in space

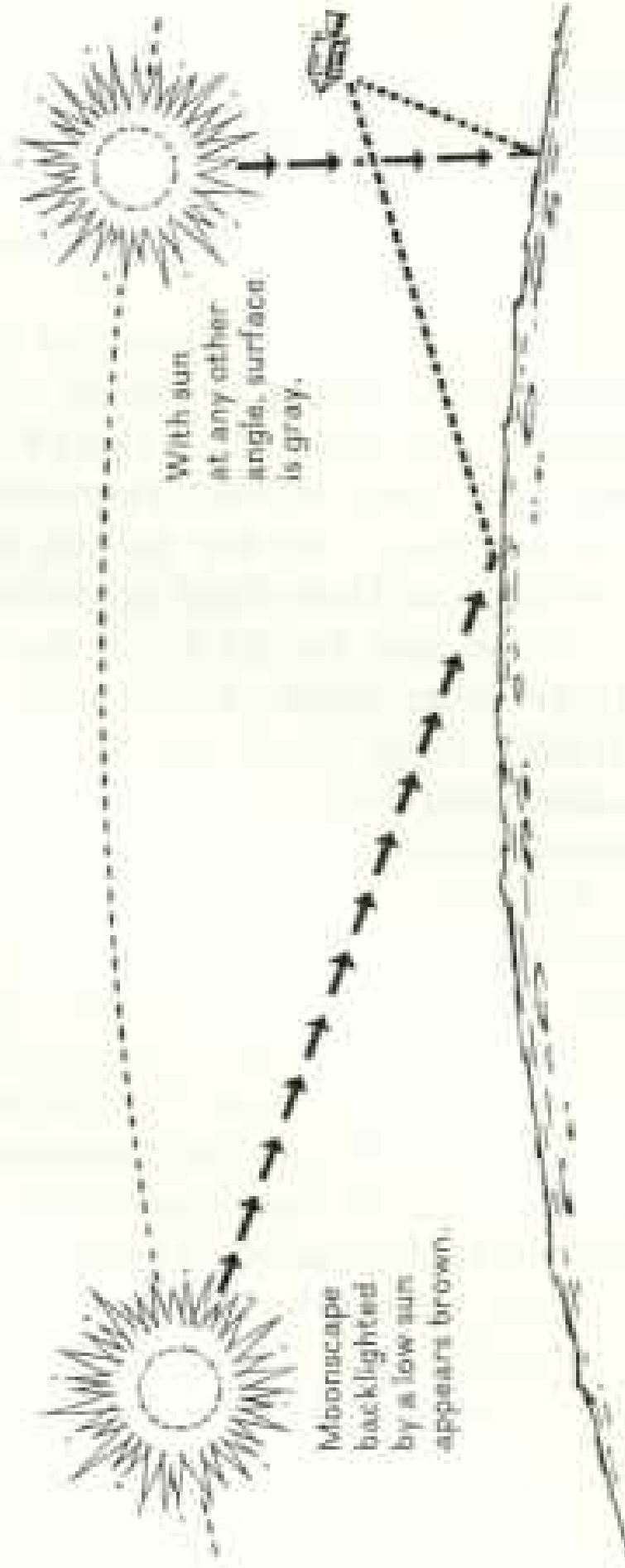
AS WORDEN streaks 70 miles above the moon's far side, a gleaming white sliver of earth rises above the horizon (foldout, above).

The moon's rumpled and cratered surface here appears chocolate in hue. A combination of the low slant of sunlight, the angle of view, and the reflective quality of the lunar surface gives the warm brown tone. The true color of the moon, as reported by all Apollo astronauts, is gray (diagram, below).

The far side appears smoother and more subdued than the front, as if covered by a uniform blanket of dust. Because few far-side craters have been filled with lava, most scientists believe the crust there may be thicker—too

thick to be easily cracked by meteorite impact. With not as many mare flows to create new and younger surface, the primordial face has had a longer exposure to the rain of meteorites.

In Mare Ingenit (left), fractures and slumps and the rain of particles have chopped the mountainous rim of the huge crater into a series of hogback ridges. An unexplained fracture winds along the basin floor. Recovery of samples from such an area, rimmed possibly by original lunar crust, would be invaluable. But the inability to communicate with earth from the back of the moon would make a manned exploration mission there dangerous, unless moon satellites were placed in orbit to relay messages.



Back on the surface, next day, Worden's colleagues continue their exploration. "Down the ladder to the plains of Hadley," Scott says cheerily as the two men leave the LM to set off in the "trusty old Rover" for EVA 2.

The crew has given informal names to the craters around Hadley site, and today's traverse takes them by some of the more whimsical (pages 240-41). There's Index, their major landmark, on a line with Matthew, Mark, and Luke. And there's Salyut, named for the Russian space station; Domingo, Spanish for Sunday, because that's the day for this traverse; and Fifty-four, for the year Dave Scott graduated from West Point.

Prime goal for EVA 2 is the Apennine Front, about three miles south of the LM. At the base of Mount Hadley Delta, Scott marvels at the huge barren sweep above him and exclaims: "My, oh my! This is as big a mountain as I ever looked up."

Presently he calls the CapCom. "Joe, this Rover is remarkable. I'm telling you, we have climbed a steep hill and we didn't even really realize it."

They find themselves half a mile up the mountainside, on a 15-degree slope. With a magnificent view of the basin, the LM, and the surrounding peaks, they stop to make intensive examinations of the geology and to relay detailed information to earth.

They also collect all-important samples of mountain material. They document each sample with descriptions and photographs showing exactly how it looked.

Partly Green—but No Cheese

Two kinds of rock arouse particular interest. Irwin calls, "Come and look at this. . . This is the first green rock I've seen!"

A bit later, after finding another green rock, they debate whether it could really be green. Could it be simply the way light reflects from it? Could it be the gold-coated visors they use to cut the sun's glare?

Irwin concludes, "It's a good story. I hope it is green when we get it home."

And it is! The samples consist of bright-green glass beads in a matrix of grayish material—the first big pieces of green stuff yet seen on the moon (page 263).

Shortly after this discovery comes an excited cry from Scott: "Guess what we just found! I think we found what we came for!" He is holding a piece of milky-white rock about the size of a fist, weighing about half a pound.

"Crystalline rock!" Irwin exclaims.

"Yes, sir! You better believe it! . . . I think we might have found ourselves something close to anorthosite!"

Scott believes they may have spotted a very ancient fragment of the moon. Later examination on earth proves him right: The rock *is* anorthosite, and it is at least four billion years old (pages 244 and 265).

The possible significance of this rock becomes clear when one recalls Dr. John Wood's hypothesis about the moon's evolution. Scott may indeed have found a piece of the pre-Imbrium lunar crust.



Meandering rilles near Prinz crater may have been formed by flowing lava or jets of gases from the interior.



ALFRED W. WOODS

Pool-shaped depressions at the ends of rilles could be where the flow originated or was greatest. The paper-clip-shaped trough at left formed either by collapse of a lava tube or subsidence between parallel faults.

All in all it is a rich day for the scientists—perhaps even “the greatest day in the history of scientific exploration,” as one jubilant official calls it.

And it seems to justify the astronauts’ name for the spacecraft that took them to the moon. Inspired in part by a 1927 article in NATIONAL GEOGRAPHIC, they have named their command module *Endeavour* in honor of the vessel Capt. James Cook commanded on his first voyage just two centuries ago.*

“Cook made the first purely scientific expedition in history,” says Scott, “and ours is the first extensive scientific expedition to go to the moon.”

Appropriately, Apollo 15 is carrying a Cook memento—a small block of wood—in a compartment of the command module. It is a piece of the sternpost of Cook’s *Endeavour*, courtesy of the Marine Museum of the Newport Historical Society in Rhode Island.

Feather and Hammer Confirm a Law

Now the tempo of the expedition speeds up; the astronauts are a bit behind their flight plan. EVA 3 next day is highlighted by a strenuous effort to pull up a core of lunar material more than 90 inches in length; a trip to the rille, where samples of bedrock are hammered free; and the placing of a memorial to the American astronauts and Soviet cosmonauts who have lost their lives.

In addition, Scott repeats a famous experiment in gravity (often attributed to Galileo, but actually performed by a Flemish predecessor, Simon Stevin). Simultaneously Scott drops a hammer and a falcon feather (from a U. S. Air Force Academy mascot, since the Apollo 15 men are all Air Force officers) to prove a law of physics: that in a vacuum all objects fall with equal speed. And they do, hitting the surface together in $1\frac{1}{8}$ seconds.

Then, in the first launch from the moon to be viewed on TV (page 246), the ascent stage lifts abruptly, toylike, in a flurry of debris, carrying the crew to a safe rendezvous with Al Worden and the orbiting *Endeavour*.

Several scientific tasks remain. A small satellite, a 31-inch hexagonal craft sprouting three booms (page 247), is ejected into an orbit about the moon, where it should stay for at least a year. It carries three experiments:

- A gravity experiment, using a radio transponder to measure fluctuations in the satellite’s orbital path caused by the mysterious “mascons.” These are a few well-defined areas on the moon called “mass concentrations” because they exert extra-strong gravitational pull. Since the mascons all seem to lie in the circular mare basins, some scientists think the extra mass may simply be the layers of heavy basaltic lava that have filled the basins.
- An instrument to measure charged particles in the vicinity of the moon.
- A magnetometer to measure the moon’s magnetic field at orbital altitude.

On the way back to earth, the men take X-ray observations of the galaxy, and ultraviolet photographs of the moon and earth. And Al Worden performs a space walk to recover film cassettes from the SIM bay.

Despite the collapse of one of three parachutes, the command module splashes down safely just over 295 hours after launch.

The Apollo 15 men have spent three exciting days at the mountains of the moon. They have found earth’s bright satellite not barren or desolate, but “dynamic and beautiful.” They have spent more than 18 hours outside their LM on the moon’s surface, and have traversed 17 miles in the Rover.

And they have brought back rich scientific booty: more than 10,000 photographs, of which 1,143 were taken on the lunar surface, and some 100 documented samples of rock and soil, weighing 170 pounds, including an eight-foot core tube. When X-rayed, it showed 58 layers of lunar soil, representing perhaps a billion years of the moon’s history.

Since bombardment by solar particles, fluctuating over the millennia, has left its record

*See “The Columbus of the Pacific,” by J. R. Hildebrand, January 1927; also “The Man Who Mapped the Pacific,” by Alan Villiers, September 1971.

“Jim, you look absolutely fantastic,” exclaimed Worden, as Irwin stood framed by the huge lunar orb while handling his teammate’s lifeline at the hatch. Television and movie cameras, far left, recorded Worden’s walk in space—reflected in Irwin’s visor—to retrieve SIM-bay film before it burned up in reentry. Artist Pierre Mion’s precise painting of the spectacular view, based on interviews with the astronauts, includes such details as paint blisters on the module’s shell, raised by the blast of attitude-control rockets.



Pieces in a geologic jigsaw puzzle, rocks from Apollo 15's 170-pound payload aid in the yet-to-be-completed picture of the evolution of the moon. To the expert eye each rock, shown here in actual size, tells a story of chemical processes and violent cataclysms that shaped the heavenly body. Hundreds of scientists in the United States and 15 other nations have received small samples of the moon rocks. The Soviet Union has also shared its mechanically collected samples from Luna 16.




SHOCK OF A NEARBY METEORITE IMPACT FUSED SOIL AND ROCK INTO MOLTEN MATERIAL THAT SPLASHED OVER THIS CHUNK OF BRECCIA—AN AGGLOMERATE OF ROCK AND SOIL—COATING IT WITH BLACK GLASS.




ROCK FROM SPUR CRATER CONTAINS WHITE NORITE SURROUNDED BY BLACK BRECCIA, PROBABLY WELDED TOGETHER BY METEORITE IMPACT.






THE 21-POUND "GREAT SCOTT" ROCK IS A BASALT FROM HADLEY RILLE. LARGEST SINGLE MOON SPECIMEN, IT HAS BEEN DATED AS 3.3 BILLION YEARS OLD. MICROMETEORITE CRATER IN ITS CENTER DEMONSTRATES THE PROCESS OF MOON EROSION.



TINY GLASS SPHERES PERMEATE THESE "HUBBLE ROCKS" FROM SPIN CRATER, FORMED AS LUNAR SOIL WAS COMPRESSED BY METEORITE IMPACT.



MORE THAN HALF OF THIS VESICULAR BASALT IS PORE SPACE CAUSED BY BUBBLING AND FROTHING DURING VOLCANISM. THE PORES INDICATE HIGH GAS ACTIVITY AT ONE TIME ON THE MOON.

in these layers, they may reveal a billion years of the sun's history as well.

For a long time to come, scientists will be wresting valuable knowledge about the moon, the sun, and the earth from the splendid achievements of Apollo 15 and its predecessors. Already some preliminary results have intrigued the scientific world.

The network of three seismometers is recording about one seismic event a day, according to Dr. Gary V. Latham of the Lamont-Doherty Geological Observatory; half are

meteorite impacts, the others are moonquakes.

Dr. Latham has found that 80 percent of the seismic energy comes from a single zone nearly 500 miles beneath the surface. This is startling news; the deepest quakes on earth—and they are extremely rare—occur at only 450 miles. The implications? The structure of the moon must be rigid at substantial depths.

The seismometers also show evidence of marked layering of the moon about 15 and 40 miles down, somewhat akin to earth's crust. When downward-ranging seismic



waves reach those depths, they speed up dramatically, indicating that the material below differs from the rock above. Thus the instruments have proved that the moon has a crust, which means that in its early history the outer layer was molten, at least partially, to depths of several hundred miles.

The two heat-flow probes left at Hadley show surface temperatures fluctuating from about -280° F. during the lunar night to 225° at noon, a difference of more than 500 degrees. At a depth of one foot the temperature varies only from about -13° to near zero. Readings become steady about three feet down (at -6° and -9° F. in the two holes), rising about 1° per foot downward from that point.

Dr. Marcus Langseth, of Lamont-Doherty, calculates that the flow of heat from within the moon at the Hadley site is about half the average heat flow through earth's crust. Since the moon has only a fiftieth earth's volume, it may hold a significantly higher proportion of heat-producing radioactive substances. Thus end the theories of a cold moon.

Not only is the moon hot, and not only has it had extensive volcanism in eons past, but it may even produce burps of water vapor to this day. That, at least, is the interpretation drawn from data sent by instruments left on the moon during Apollos 12 and 14.

Last March, instruments at the two sites recorded the presence of ions (electrified atomic particles) that cannot easily be explained except as water vapor. Clouds of these particles apparently erupted over a period of 14 hours, coinciding with a swarm of small moonquakes. The vapor quickly dissipated in the moon's vacuum.

According to Dr. John W. Freeman, Jr., of Rice University, the vapor does not appear

to have come from a burst water tank in equipment left or crash-landed on the moon, and must therefore have come from the lunar interior. Thus, deep beneath the totally waterless surface of the moon, there may be pockets of water.

The laser in the SIM bay operated only part of the time, but it confirmed that the moon's face, which always looks toward earth, is one to three miles low (in earth terms, below sea level) and that the far side of the moon is equally high.

Voyage Will Fire Men's Minds for Years

The X-ray experiment in the SIM bay—one of the most precise and carefully designed experiments ever attempted in space—has measured relative concentrations of certain important chemical elements—aluminum, magnesium, and silicon—over a large swath of the moon. It shows very high aluminum concentrations in the highlands as compared to the lunar seas, and helps confirm the picture of a primordial moon with a molten outer layer in which light substances separated out and rose to the surface.

These are but highlights of the results of Apollo 15. Further details will be months and years in the coming. Even then, we may never fully realize what stimulus this spectacular expedition has given to science.

As Dave Scott said at his first public appearance after returning to earth: "We went to the moon as trained observers in order to gather data, not only with our instruments on board, but also with our minds. And I'd like to quote a favorite statement, which I think expresses our feelings since we've come back: 'The mind is not a vessel to be filled, but a fire to be lighted.'" □

Mission completed. Astronaut Dave Scott, arms folded, describes discovery of a basalt sample for two geologists at NASA's Lunar Receiving Laboratory. Years of study of precious fragments such as this extremely ancient chunk of anorthosite (right) lie ahead in the search for the moon's origins.

"We can read earth's history back only some 3.5 billion years," says NASA scientist Dr. Paul W. Gast. "Within the moon may lie a complete record of the beginnings of a planet in our solar system."





Spirits of Change Capture the Karens

ARTICLE AND PHOTOGRAPHS BY
PETER KUNSTADTER, Ph.D.



AN APRIL SUN burned in a cloudless Thailand sky as the family, relatives, and friends of Chaw Wah Hay marched up and down the hillsides. The men stabbed the earth with iron-tipped bamboo sticks while the women and children followed, dropping a few rice seeds in each hole.

It was time for Chaw Wah Hay to speak to the spirits of hills and streams. Without their help there would be no rain, and no protection from the ants and termites, the boars and bears, the rats and ricebirds that would imperil the new crop.

With dignity becoming a patriarch, he held his hands, palms together, before his face and spoke a solemn invocation: "Water Lord, Country Lord, Hill Lord, Mountain Lord, come down! Lord of Laykawkey village, Lord of Laykawkey stream, send us down good rice, send us sparse weeds. . ."

The old man then sacrificed a chicken and daubed blood and a few feathers on the poles supporting a tiny bamboo hut—the spirit

house (left). After the chicken was cooked over a wood fire at the field's edge, Chaw Wah Hay placed some of its meat, some rice, and a little drink of rice liquor in the small house. He lit a beeswax candle and invited the spirits to come and eat. Once they were served, the rest of us could have lunch.

I shared the ceremonial meal and, when the work was done, walked back to Laykawkey, a Karen village of 34 bamboo houses perched on a hillside in the northwest corner of Thailand (map, above). As an anthropologist from the University of Washington, I was studying the way of life of the Karen (kah-wREN) people and the many social changes confronting them. My wife Sally and I planned to remain here for a year.

Despite his piratical look, Chaw Wah Hay proved a friendly neighbor and generous source of information. His was a large family, whose daily problems reflected those of the whole Karen community—depleted soil and declining crop yields, overpopulation, opium

"On this day of good sun and brilliant moon, we leave this for you to eat."
To appease a host of harvest spirits, Karen tribesman Chaw Wah Hay prays over an offering of chicken, rice, and liquor at a spirit house in his rice field.

Man of many talents, Ah Poo repairs the barrel of a muzzle-loader on his porch in Laykawkey, a Karen village where the author and his wife lived for a year. As Ah Poo pumps down on the crosspiece, the string unwinds and spins his drill. Blacksmith, carpenter, handyman, farmer, Ah Poo accepts payment in rice or cash.



Women of Laykawkey, old and young, share family chores. Pipe-puffing weaver (above) wears the traditional white gown of unmarried Karen women. Making light of her burden (right), a young girl returns home from a walk to the village spring, her bamboo water tubes filled. Chopping tobacco with razor-sharp knives, an older Karen and her neighbors' child prepare leaves for curing (left). Karens are avid smokers, says the author, beginning "as soon as they're old enough to grab a parent's pipe."



addiction, increasing poverty, and erosion of traditional values in a world whose change is beyond control. Yet we found our Karen neighbors bore their troubles in a cheery, resilient, and generally relaxed way.

Northeast of Laykawkey, about a 90-minute walk away, lay the village of Pa Pae, where we had lived, off and on, for more than two years while studying another group of hill people, the Lua.* Sally and I knew that a handful of Karens had moved into these hills about 125 years ago and now far outnumbered the native Lua. While living in the same area and using the same agricultural methods, these neighbors continued to differ markedly in speech and dress, as well as in spiritual and social outlook. We decided to explore these

*The author told of "Living With Thailand's Gentle Lua" in the July 1966 *GEOGRAPHIC*. See also "Mosaic of Cultures," by Peter T. White, and the supplement map, *Peoples of Mainland Southeast Asia*, March 1971.

differences and to learn how the Karens came to predominate in the land of the Lua.

"Why do you want to live in a Karen village?" our Lua friends asked. "You'll find it dirty and probably unpleasant. There's only a tiny creek in Laykawkey—those people never bathe! Besides, you don't know the language, and we will miss you when you go."

Later, when we were settled in Laykawkey, it amused us to hear our new neighbors castigate the Lua as unclean and much too serious.

Mats Roof "Bird With Two Heads"

We were lucky to have Benny Gyaw with us when we moved. Ben was a refugee from Burma, where more than a million Karens dwell in the eastern hills and feel the impact of the long political struggle in that country. In Thailand, he joined more than 100,000 other Karens—the most numerous minority group except for the Chinese and Malays.



Although often labeled as a "hill tribe," Thailand's Karens occupy both upland and lowland villages.

In Laykawkey our friends called the bamboo house on stilts they built for us a "bird with two heads," because it was double; Benny Gyaw had his own room and porch back to back with ours. Ladders led up to both porches. We moved in before the roof was thatched, but fortunately it was the dry season. At night we found it pleasant to look at the moon and stars through cracks in the temporary roofing of threshing mats.

Karen homes have square fireplaces recessed into the floor, where wood burns on a bed of clay. But Sally cooked in comparative luxury—on a propane stove. The 50-pound tanks of gas (one lasted for a couple of months) came on porters' backs 18 miles uphill from the market town of Mae Sariang.

(Continued on page 276)

Chanting as they plant, villagers dot irrigated terraces with rice seedlings (left). Thatch-rooted hut serves as field shelter and temporary barn after the harvest.

Rice production—the toil and the ritual—dominates the lives of most of Thailand's upland Karens. In recent years depleted soil and overpopulation have caused shortages of the staple. To prevent starvation, many families have to borrow rice, sometimes at 100 percent interest. The people of Laykawkey now have their own rice bank, which lends at a more reasonable 30-percent rate.

Their prayers rewarded, Karens fill baskets with rice threshed by beating it against mats on the ground.

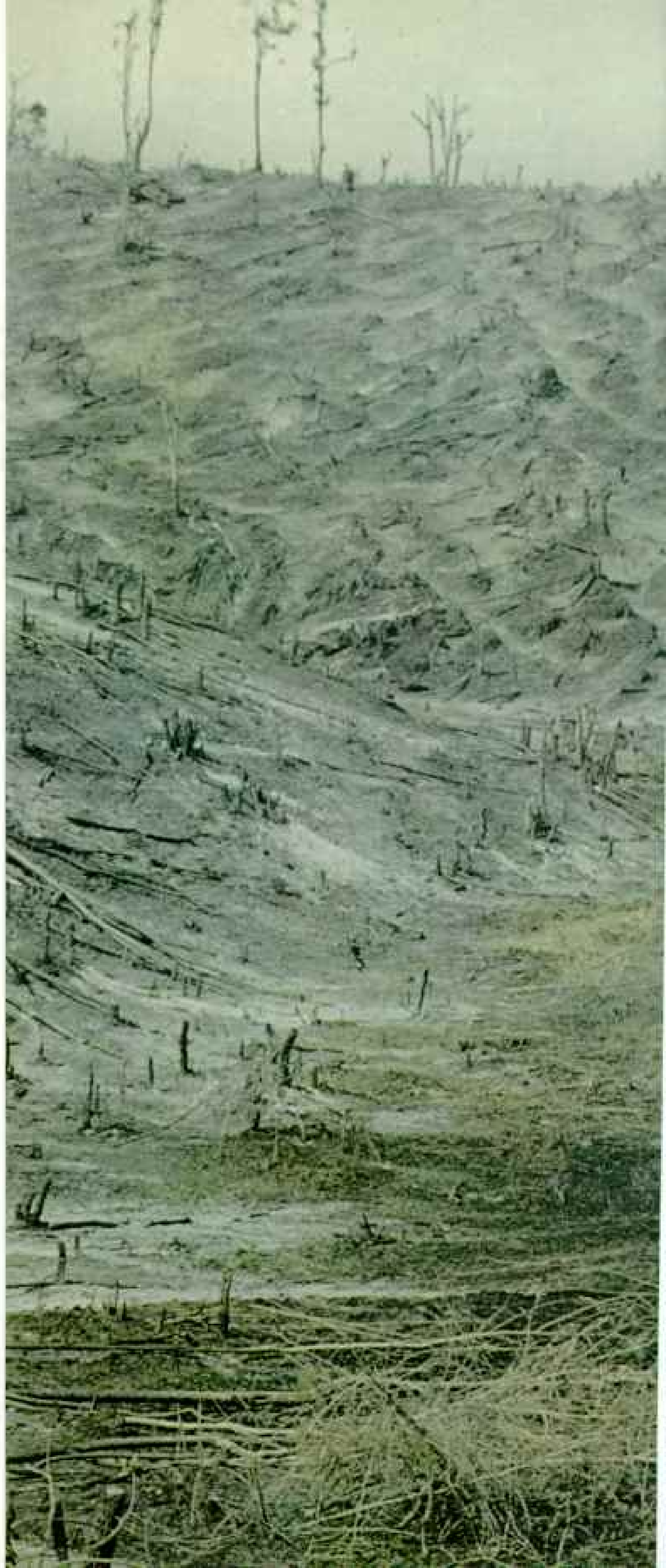
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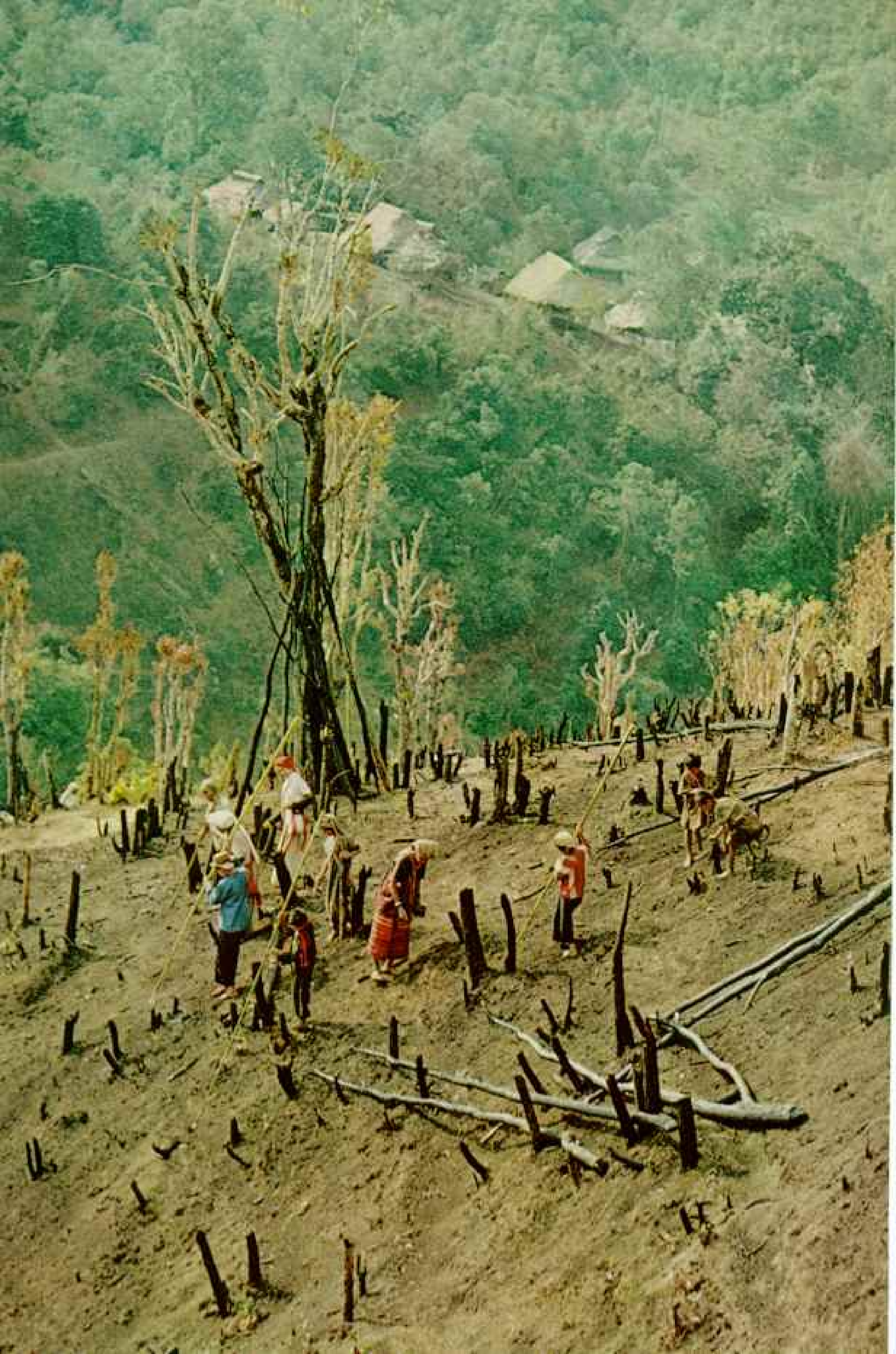
To still-smoldering slopes trudge girls of Laykawkey, carrying seed corn and cuttings of taro, yams, and manioc to plant in newly exposed soil. A few weeks later, after clearing and burning the remaining logs, they will return to plant upland rice. Like many other Southeast Asians, Karens practice both irrigated and slash-and-burn agriculture. Formerly, upland fields like this could lie fallow as long as ten years; now the demand for food accelerates the rotation cycle, and the exhausted soil yields less.



Amid the charred remnants of a forest sprouts the fresh green of corn and rice. Paths, made by buffaloes that grazed the fallow fields, zigzag the hill.







Helping their headman, villagers of Laykawkey get together to plant his upland field. He will labor on theirs in return. Working quickly, men with iron-tipped bamboo poles poke shallow holes; women and children follow, dropping a few rice seeds in each. Third from right on the slope behind them stands the Kunstatters' house.

Flower of false tranquillity, an opium poppy blooms beside a drying seedpod. Raw opium oozes from slits in the pod.

The plant grows in a field owned by members of the Meo tribe, whose poppy cultivation steadily encroaches on Karen lands. Soon Meo harvesters will scrape off the sticky sap, boil it, and sell the crude narcotic for at least \$25 a pound. With easy access to the drug, many Karens have become addicted.



Opium addict Pah Dee Hay lies on the floor of his empty rice barn. Heating a ball of opium on the end of a small metal rod, he will insert it in the opium pipe lying between his arms. Pipe at upper right contains tobacco that he smokes alternately with the narcotic. Pah Dee Hay's habit forced him to sell everything he owned, including his rice, to pay for the drug. Finally, after consulting a Buddhist priest in Mae Sariang, who predicted a dreadful death for him if he continued, he stopped smoking opium and regained his health.



Without a fireplace, we had more sitting space for guests. The villagers quickly learned they were welcome, and any evening a dozen or more might show up. We offered them tea, and tobacco for their pipes; we had a waiting list for empty cans. The Karens grow tobacco (page 268), but prefer the store-bought kind.

In turn we called on our new neighbors, starting our work with a census. This gave the villagers a chance to size up the strangers in their midst and allowed us to judge their reactions to us. Who would best tolerate all our silly questions and the inevitable misunderstandings with a foreigner? Who could shrug off inadvertently embarrassing queries?

Our house looked out on the porch of Naw Serdah (her name, a common one, means "youngest daughter"). She lived with her widowed mother, Naw Kah Ay ("bitter feces," a name deliberately chosen to be so repulsive that bad spirits would leave her alone). Naw Serdah at 18 was single and eligible, so she always had a lot of friends around.

Downhill from us lived Pah Dee Hay with his pregnant wife and six children. His adolescent son Pah Ay Wah was never around to help his parents, whom we had hired to haul water from a small spring under the mango trees below the village.

The house of Chaw Wah Hay and the eight in his family stood at the top of the hill. His youngest son, recently married to a girl from a distant village, kept coming home at least once a week. This earned reproof from those who said he should be staying at his father-in-law's house, according to Karen custom, to help in his fields. Sometimes his wife came to haul him away.

It was Chaw Wah Hay who made us aware of the power of the myriad spirits that populate the Karens' animistic world.

"When I moved here 40 years ago, people died easily, the spirits were very strong, and the place was violent. One day two brothers went digging for a meal of beetles on the hill east of the village," he related. "We found one brother dead, between two branches of a tree, and the other in the hollow of a tree, his

eyes dug out. This was the work of spirits.

"Death is very close to us in these hills," Chaw Wah Hay continued. "A snake or tiger may bite you, or you might fall off a cliff or drown in a stream. If men do not behave, disaster always follows—disease, death of chickens, pigs, and water buffaloes, or poor crops.

"We hill Karens have no medicine or doctors like the Thais and the foreigners, so we must rely on the spirits. When something goes wrong, we divine with the aid of chicken bones. If the divination says that the spirits must be fed a pig, we sacrifice a pig—a chicken won't do. When you do sacrifice a pig, though, the patient gets well pretty fast."

Karens believe that the spirits cause pain



Peeling cloves of garlic, Karen girls prepare for a Buddhist ceremony in the lowland village of Paykoh. Many valley Karens have embraced Buddhism, but most upland dwellers retain their allegiance to the spirits.

or illness in order to let people know they are feeling neglected or offended (page 280). One day during harvest I went to the fields with Chaw Wah Hay, and he was stung by a wasp.

"I think," he said, "the spirits are angry at me for telling you so much about them." But he recovered so rapidly that he concluded it must have been just an ordinary wasp sting and not a message from a resentful spirit.

Early Marriages Boost Population

As Sally and I began to assemble our census of Karens in this upland area, we found that the median age was only 16. To make sure their daughters get suitable husbands, parents often arrange early marriages, which result in

large families. Married women, on the average, have seven children. Even though almost 40 percent of the infants die before maturity, the population more than doubles in a generation. By contrast, Lua grooms, who must have a sizable bride-price, marry when they are older. As a result, the Lua population increases more slowly than that of the Karens.

Rapid population growth has led to strife. Laykawkey, for example, was founded only about four generations ago but is already running out of land.

Said Poo Loo Kay, an elder with many children and grandchildren:

"They help me clear a large field, and I will be well fed in my old age."



Another friend, Ah Poo, found fault with their attitude.

"Poo Loo Kay and his sons and sons-in-law just take what they want," he complained. "Last year they pushed widow Naw Chee and her daughter and grandson off a field her husband used to cultivate. It's hard to get back a field unless you are strong or have lots of relatives to stick up for you.

"In the old days, when we quarreled like this, we could always go off and form a new village," he added. "But now there is no space for a new village."

Renting Land Is a Risky Business

When we could take time from our Laykawkey routine, Sally, Benny Gyaw, and I walked to the lands bordering on Lua holdings and found the Karens gradually pushing into their neighbors' fields. Our old friends in Pa Pae have learned from bitter experience that land once rented to a Karen is lost forever. Piece by piece the Laykawkey folk are gaining land from the Lua of Pa Pae.

On one of our walks we visited the valley village of Paykoh, nine miles to the southwest. Its headman told me that the Karens once were masters and rulers of all races.

"We used to govern and collect dues from everyone," he said with good humor. "The taxes we imposed were so heavy that when the people were bringing them in, the pack straps of their carrying baskets sang like guitar strings. We were such oppressive rulers that the people got disgusted and chased us out. Now we pay taxes to the Thais, just like everyone else."

Back home in Laykawkey, we were caught up in the easygoing village life. Tranquillity lay on the hillsides like a spell. Old women on porches would look up from their weaving to talk with us. Amid the house pilings pigs snuffled and roosters scratched and crowed. Metronome for the passing hours was the "thunk-thunk" of wooden mortars as women pounded rice, husking it for the evening meal.

Yet we knew that under the placid appearance of things, a crisis of authority seethed. The young wife of an old man was carrying on with her sister's husband. The spirits of

the earth were offended. People feared for the reputation of their village and worried that the spirits might take revenge by bringing on an epidemic or crop failure.

To cool the temper of the spirits, a buffalo had to be sacrificed and its blood allowed to run into the ground. But the villagers could not decide who should pay for the animal and, by becoming involved, expose himself to the anger of the spirits.

Pah Chay Too, one of the village leaders, finally agreed to take the risk. But the oldest woman in the village, still vigorous and proud, carped to me: "That Pah Chay Too is not a proper leader. He's an upstart. His father wasn't anything—he didn't have the right ancestors. If he were a real leader, the spirits would favor him with good fortune and bountiful harvests, but he is just as poor as anyone in this village. Now that my father is dead, my son should be the one."

But neither the old lady nor her son dared to summon the earth spirits, so the job was done by Pah Chay Too. Tension continued for months, even after the sacrifice, through endless discussions by the village elders. Harmony was not restored until the old husband found another hamlet that would accept him and his straying wife.

Spirits Can Demand Too Much

The difficulty of coping with the omnipresent spirits has caused some Karens to accept other faiths. The Karens associate various religions with ethnic groups—Buddhism with the Burmese and the Thais, Islam with the Pakistani merchants, and Christianity with Westerners. They share spirit feeding with the Lua and other hill people.

Feeding the ancestral spirits, which cause illness when hungry or neglected, is essential to good health. To escape this onerous obligation, many in the Mae Sariang hills have adopted a complex ritual, first learned in Burma, that supposedly confuses the spirits and gets rid of their demands. Other Karens have become Christian, while many in the valley practice Buddhism. A few at Laykawkey consider themselves Buddhists as well as feeders of spirits. A village woman told me

Grown-up job as an elephant driver delights a Laykawkey youngster. Villagers will load the animals' carrying cradles with rice to trade in Mae Sariang, the nearest lowland market, 18 miles away. The few Karens in Laykawkey who can afford to buy baby elephants train them, then rent them out to lumbermen or sell them for a profit.



she still fed the spirits of her parents for her health, "but I try to make merit the Buddhist way so I will prosper."

In general, Laykawkey is not prospering, however. Crop yields decline as pressure on the land increases. The villagers have less to sell, while they are increasingly dazzled by the goods they see in the Mae Sariang market.

Hiring out elephants to lowland lumber firms is a major source of cash income, but only the richest Laykawkey families own elephants or even share in the ownership of one (pages 279 and 282-3).

Some Karen men have worked at the tin mines, but landslides killed several, and many now regard that labor as too dangerous.

The village's economic problems are aggravated by a growing social illness. Our neighbor Pah Dee Hay was an opium addict. And so were his younger brother and several other men in the village.

Opium-poppy cultivation and opium smoking are illegal in Thailand, and everyone knows it. Yet we learned that more than 15 percent of the older men in our village were

opium smokers, and we saw younger men beginning to experiment with the narcotic.

The drug has become readily available since poppy growers of the Meo tribe moved into the hills near Laykawkey about ten years ago. Addicts work for lower wages, and the Meos encourage Lua and Karen workers in their fields to take at least part of their wages in opium rather than in cash.

Scary Prediction Reforms an Addict

Pah Dee Hay invited me to photograph him smoking opium in his empty rice barn (page 275). He was always pleasant and agreeable and quite willing to discuss his habit. But despite the pleas of his family and our urgings, he sank deeper and deeper into debt and sold or mortgaged everything he could get his hands on to support his addiction. His children were in rags, and his barn was empty long before the next harvest was due.

About eight months after we came to Laykawkey, Pah Dee Hay stopped smoking, at least temporarily, after consulting a Buddhist priest in Mae Sariang.



"He gave me holy water and frightened me," Pah Dee Hay told me. "He said I might be gored by an elephant or a buffalo, or be eaten by a tiger. I would die horribly." Pah Dee Hay managed to recover his strength in time to work on his harvest.

For him, as for all others in Laykawkey, life moves in rhythm with the rice crop. From planting in April, through the tedious weeding of the rainy season, to the harvest of October or November, rice culture sets the pace of the people's days.

The villagers plant rice in irrigated fields wherever they can build level terraces and water them from creeks. But most of the harvest is dry rice, grown on hillsides by slash-and-burn agriculture. The Karens farm each field for one year, then let it lie fallow. New trees sprout and send down roots to bring essential chemicals up again in leaves, stems, and branches. When these are burned, their ashes fertilize the new crops in the sunlight of the fire-cleared slopes.

In past generations there has been enough land to support permanent villages within

walking distance of the fields. Given the present rate of population growth, this will not be true much longer. The pressure to grow more rice to feed more people now has reduced the fallow interval in some villages like Laykawkey to only six or seven years—too short a time for fertility to be fully restored. The older farmers of Laykawkey already notice the declining yields.

In late January I climbed with the village men to a forest area chosen for the next season's rice field. Everyone strong enough to wield a two-foot knife helped fell the trees and clear the brush, leaving them to bake dry in the sun. Cutting the trees in the dry season conserves soil moisture. When the felled trees are burned in March, the dampness keeps the ground cool and later nurtures the rice seedlings before the rains arrive.

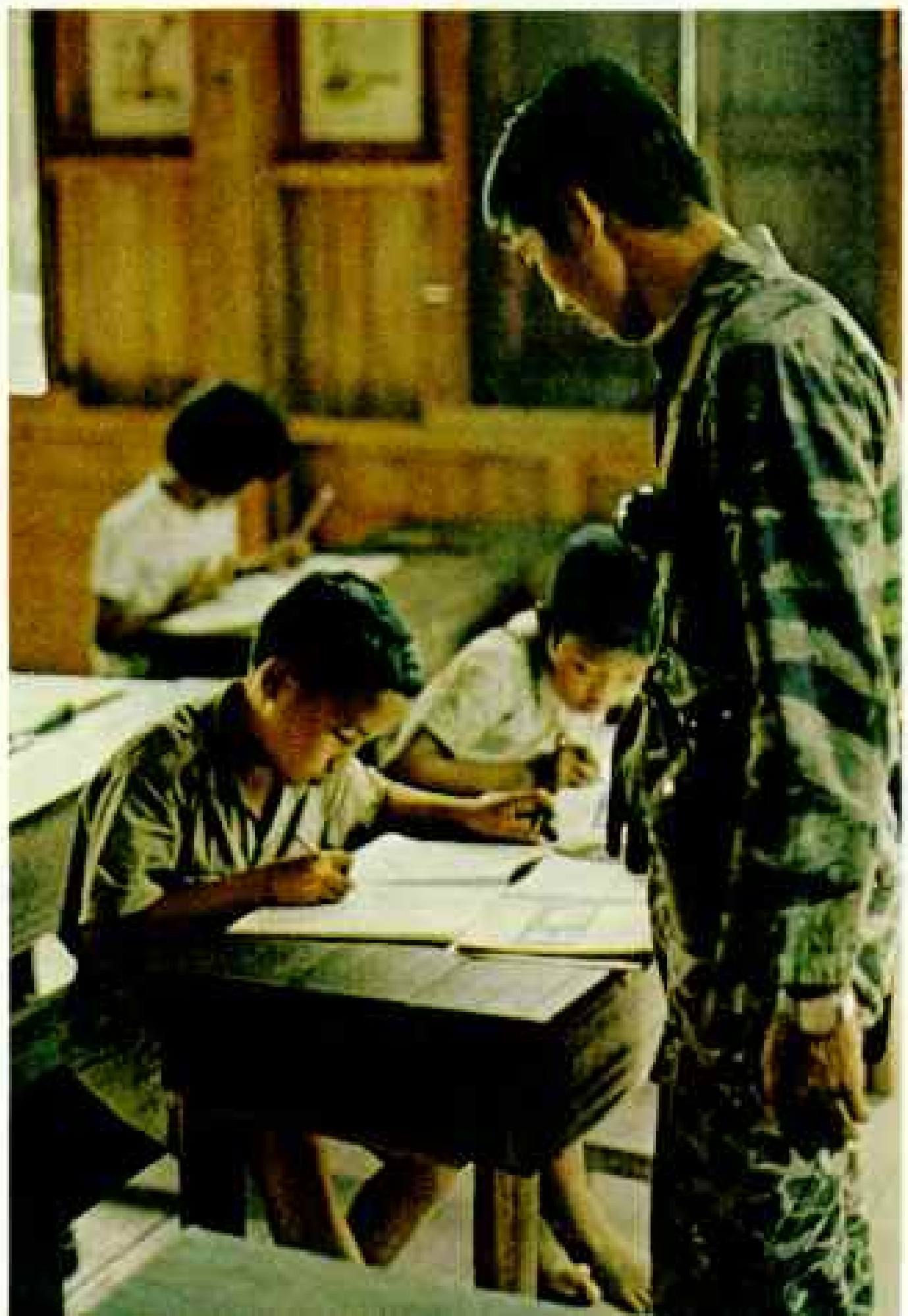
Excitement and danger attend the burning of the slash. On the appointed day we watched the young men prepare their torches of split bamboo. The early sun burned the dew off the tinder-dry vegetation, and the men set fire to it. We stood at the highest point in the

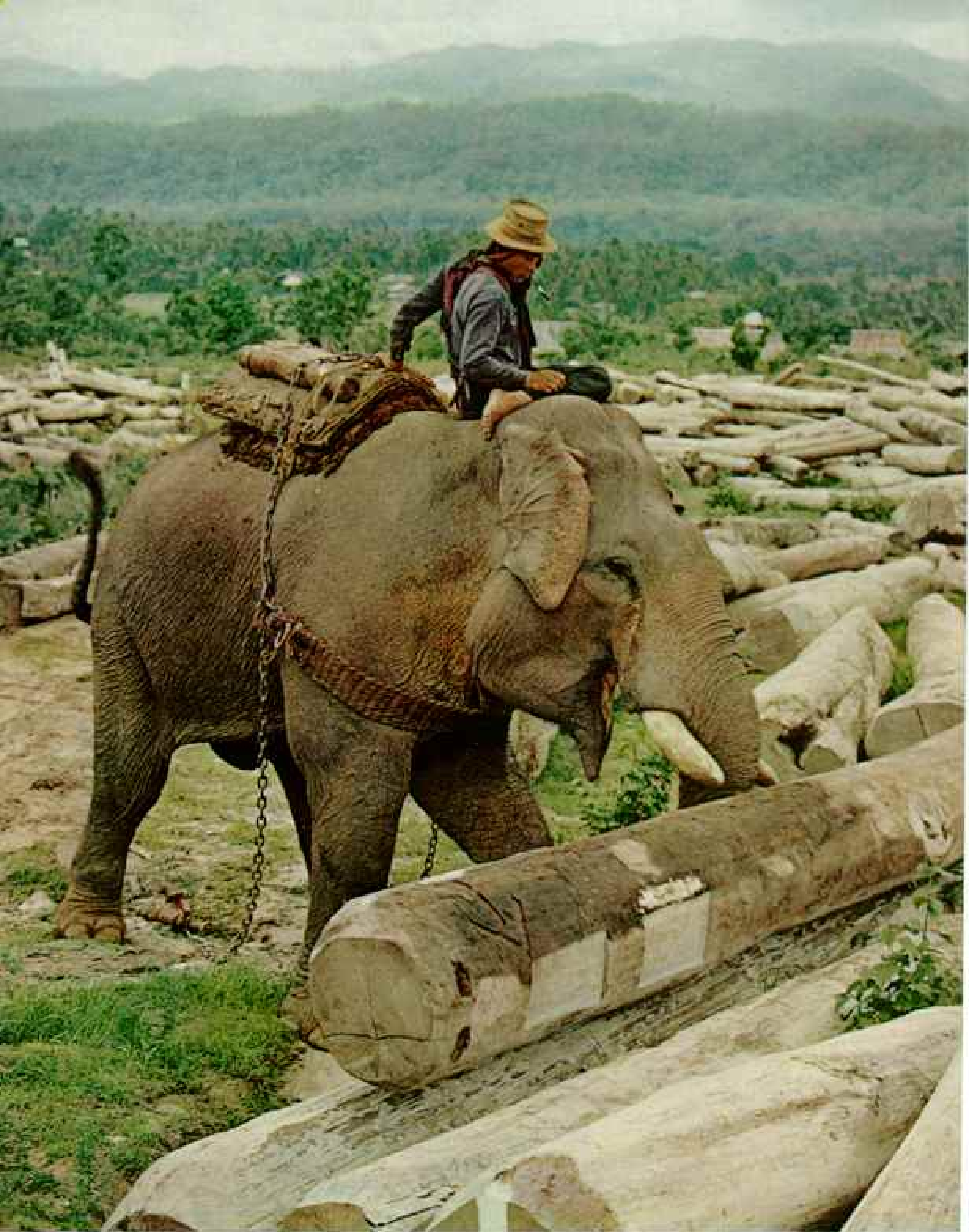
Spirit specialist on house call, venerable Kah Too places a food offering between himself and a stricken youth (left) to entice the evil spirit believed to have caused the illness. Kah Too also urged the spirit into a basket that was then taken to the woods. Finally, he placed thorny plants on the porch ladder to prevent the spirit from re-entering.

Dr. Kunstadter, at the father's request, treated the lad for suspected malaria. "He recovered," notes the author, "but I wouldn't say which of us cured him."

Magic words tattooed on the boy's arms supposedly protect him from injury.

Playing a dual role, a camouflage-clad frontier guard teaches Karen children in a remote southwestern village. In addition to their security-keeping duties, Thailand's Border Patrol Police build and staff schools, run health clinics, and help improve agricultural practices.





Jockeying a forest forklift, a Karen piles teak at Mae Sariang. Arrow on log in foreground points to a stamped permit number, signifying that the timber was cut legally and not poached from Thailand's government-controlled teak forests. The mahout steers his charge by poking



his toes against its ears. Elephants are more efficient than machines for dragging logs along narrow forest trails and arranging them for loading on trucks.

village to watch the fields as they burned—and to make sure our own house wasn't consumed in the process!

The men lit the first fires at the tops of the fields, helping create an updraft to assure a quick, complete burn. Firebreaks that had been cleared previously kept the flames from spreading over the ridgetops. With the upper parts of the fields lighted, the men raced down to touch off the brush at the bottoms of the fields, running as fast as they could to outpace the flames.

A few people stayed home to guard the village houses. Ah Poo climbed to the ridgepole of his house carrying water-filled bamboo tubes. Taking big mouthfuls of the water, he sprayed the thatch to keep it damp and cool.

Children joined the fun, squirting the roofs with water guns made of bamboo cylinders. Even the old ladies stood between their houses and the flames. They tossed salt in their winnowing trays as magic to make the wind blow away from the village.

The fire was awesome to watch. Tremendous clouds of smoke and flame billowed hundreds of feet in the air. The inferno roared, and exploding bamboo stems sounded like cannon fire. In about an hour more than a hundred acres were reduced to bare hillsides strewn with smoldering logs (pages 272-3).

Ritual Duties Greeted With Boredom

To the Karens, the ritual of agriculture is as important as farming methods. With only the simplest tools, and with an unpredictable water supply, they feel at the mercy of spirits.

Each Karen field in this area has both a legal and a ritual owner. The latter is responsible for all necessary ceremonies throughout the growing year. Often a young child is selected as ritual owner, because the Karens think that children have not lived long enough to offend the spirits. By this participation the children learn the rituals and prayers.

Pah Dee Hay chose his son as ritual field owner during our year in the village. Far from feeling honored, Pah Ay Wah was utterly bored. His father had to keep chasing after him whenever a chicken had to be sacrificed or a prayer said.

In the middle of the growing season, after the first weeding, Sally and I walked over the ridge and across a valley to Pah Dee Hay's field to see a chicken sacrificed and hear a prayer at the feeding of the rice spirits:

"Rice, O! Come back good again. Return white again. Come back thick and swaying

dark. Come back green and spreading. Return and fill last year's field. Return and fill this year's field. Come back with your stalks thick as wild bananas. Come back with grains as big as melons. Be restored, you who have been eaten by tiny red ants. Come back and eat chicken blood, O Rice Lord!"

Wild boars and bears sneak out of the forest to raid the ripening fields by night. No fence is strong enough to keep them and the village elephants out. The men make all sorts of wind- and water-powered gongs and clackers to scare them away, but the animals soon become accustomed to the pleasant clunking sounds and ignore them.

Fears Darken the Joy of Harvesttime

Harvest is a joyful time of hard work. In October, when the rice had ripened, we watched the villagers cut it with sickles and carefully lay it on top of the stubble to dry.

To ensure that the supply lasts from one harvest to the next, the field owner must summon the straying soul of the rice. On the day of threshing, I followed Chaw Wah Hay around his field as he called softly:

"Proo! Rice soul! Return to the top of the rice fields. Come back inside the rice fields. . . . If you have gone where the sun sets, if you have gone where the sun rises, come back from near and far. Return to fill the fields and granaries."

Always there is hope that the rice soul will not allow the grain to diminish. Always there is fear that rice will vanish or be stolen. Each evening the owner marks his rice with twisted straw or woven bamboo signs to notify the spirits that this rice belongs to him.

More and more, Laykawkey people realize that they can no longer afford the sacrifices required by their animistic traditions. More and more, they seek to share in the benefits of modern life.

Education is one path to greater income for the hill people, but Laykawkey has no school, and few parents feel they can do without the help of their children in the fields. Most educated Karens have gone to school through the assistance of missionaries, or because they

lived in one of the villages that have government schools (page 281).

But the overriding problem is finding enough to eat. Rice yields are declining and debts are growing. The usual interest rate on borrowed rice is between 50 and 100 percent. But the Karens of Laykawkey and their neighbors, the Lua of Pa Pae, have received a grant from the King of Thailand to allow them to build and stock local rice banks.

Prince Bhisadej Rachanee, the King's assistant for hill-tribe development, flew up by helicopter to lend the authority of his presence at the program's inauguration. The villagers named their own committee to build a rice barn, to set the annual interest rate (only 30 percent), and to administer the loans of rice. The village committee used the King's money to buy rice, which they lent to their neediest neighbors. The bank was successful in its first year. Almost all the loans were repaid with interest, and there was more rice in the bank than when it started.

New Techniques Bring Hope for Future

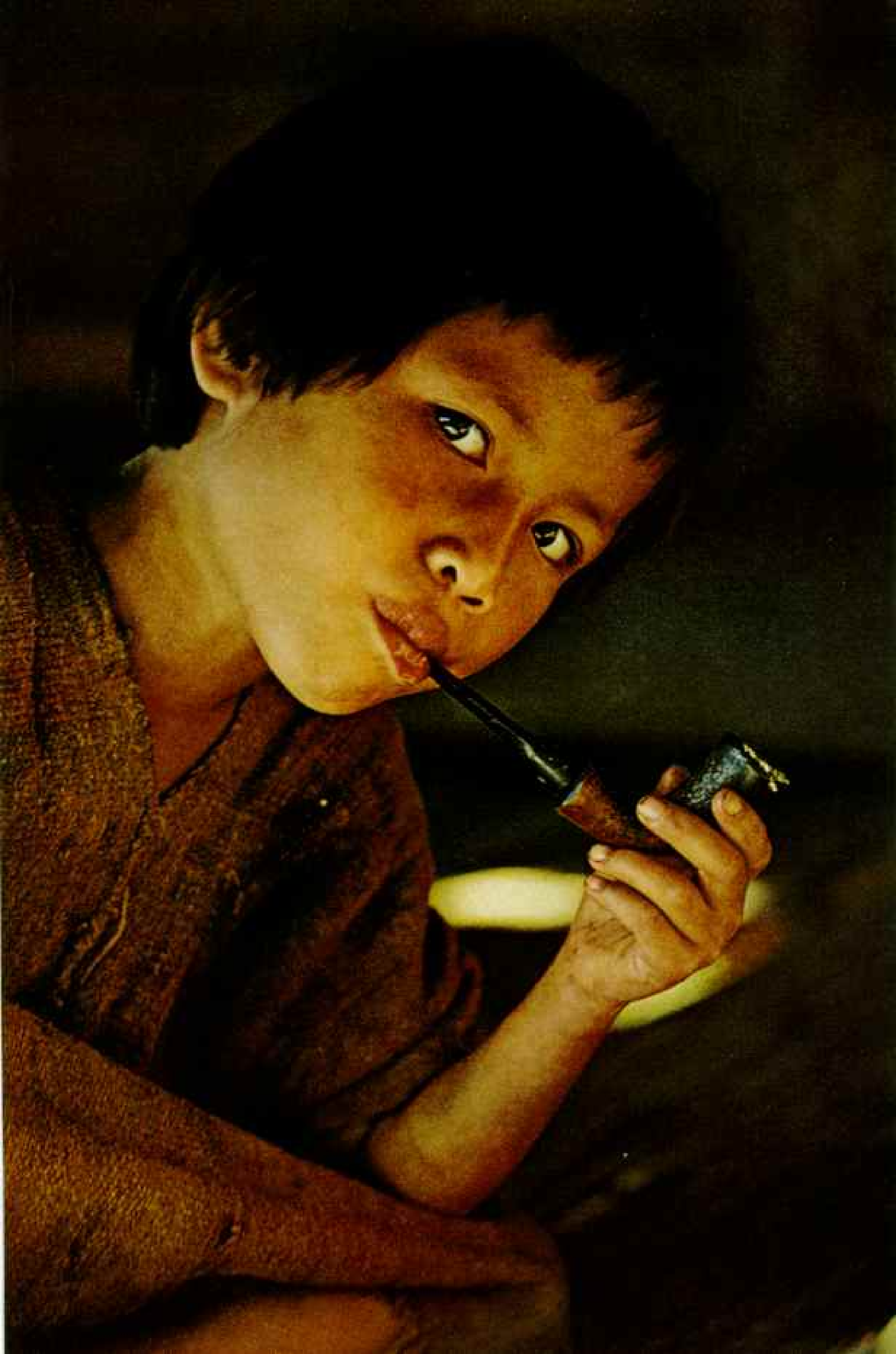
New varieties of rice, brought to Laykawkey and Pa Pae by Dr. Sanga Sabhasri of Kasetsart University, may improve crop yields. Certainly innovations in farming practices will help the food situation.

Though nonagricultural sources of income—elephant contracting and mining—help support a few Karen families, the rice harvest remains the basis of Karen life.

Our own harvest was in as well—a year's notes and photographs of land and people. Regretfully, we walked along the ridge for the last time and heard for the last time Laykawkey's elephant bells in the early morning.

We wonder what will happen to our friends. Their world is changing rapidly, and they are only beginning to recognize the changes. There is no more empty land, but there are ever-increasing demands on meager incomes. We can only hope that, with the new source of credit and with new varieties of rice, the villagers will be able to buy enough time to learn to cope with the quickly changing conditions of the modern world. □

"Good-natured, relaxed, and resilient, despite their troubles." Thus the author describes the Karens. In a pensive moment, impish Naw Ee Ber smokes her father's pipe. Today her people face problems of overpopulation, decline of the natural environment, and drug addiction, even as they yearn for the manufactured goods their own resources cannot supply.



BELOW ME the hill stretches away how far? A quarter of a mile? Could be. Pretty steep. Down there the thousand-tongued crowd stands around cars and chatters and buzzes and waits to see me break my fool neck.

"It doesn't matter which way you run," says my young friend Taras, "but keep the nose pointed into the wind."

This thing is trying to get away from me. I wrestle with the bamboo poles, and above me 256 square feet of plastic rustles and flutters. To its strength and to the aeronautical savvy of three high-school boys, I—a licensed pilot of 25 years' experience—am about to entrust my mortal body.

The place is a hill above Newport Beach, California. We are celebrating, on this May 23rd, the birthday of German glider pioneer Otto Lilienthal by staging a hang-glider meet.

A note on terminology: A "hang glider" is a glider from which the pilot hangs. OK?

Four young aeronauts from John Muir High School in Pasadena have been the heroes of the day. Taras Kleeniuk, Jr., 17, his sister Katherine, 15, Tom Dickinson, 17, and Steve Elliott, 17, have each stayed aloft in free flight for a quarter of a minute and covered distances of 300 feet or more; that's about 200 feet farther than Orville Wright's first successful flight under power. And to get off the ground at all in a hang glider is something of an achievement.

It has been proposed that I fly this glider of theirs. Nobody rejects the idea, so events march onward. Tom Dickinson wraps the green nylon tow cord three times around the left arm pole. "Put your thumb on this," he says. "Rest your arms on the poles, then slide back as far as you can."

A pilot standing nearby adds, "When you're high

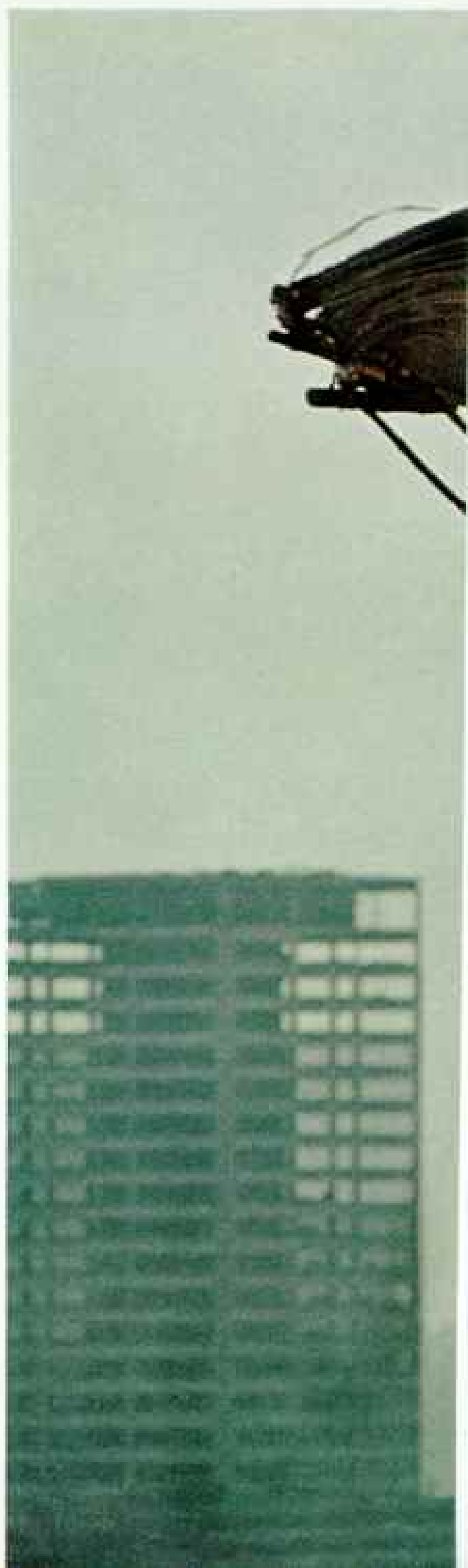
Happy

By RUSSELL HAWKES



© W. WOOD, FROM THE MUSEUM OF NATURAL GEOGRAPHY

To fly like a bird: The eternal dream of earthbound man captivated Otto Lilienthal in the 1890's (above). The German engineer's glider flights inspired the Wright brothers. Reviving the art, enthusiastic Californians meet near Newport Beach to fly home-built gliders (right) on Otto's 123rd birthday. Who knows? There might be another genius among them!



Birthday, Otto Lilienthal!

Photographs by JAMES COLLISON





Ingenious flying wing (top, foreground) was built by Richard Miller, a retired book dealer. With it, he ran a few strides, stepped off the hill, and glided for 280 feet in 12 seconds, the longest flight that day without help of a towing team. Like many hang-glider fans, Miller combines meticulous engineering and "trash technology." Anyone who spends more than \$100 on materials loses status.

Floating free, 17-year-old Tom Dickinson (upper right) steers by shifting his weight to right or left to turn as desired. Wide-angle lens of a camera mounted on the bamboo rigging curves the horizon.

Heavy home-designed glider with elaborate bracing (above) never got off the ground.

Leg power propels David Actor, a 22-year-old college student (right), to lift-off. His glider carries a yellow-and-green jib for greater stability.





enough or scared enough, just lift your thumb." Everybody chuckles.

Taras advises, "When you let go of the line, slide forward to pick up speed and to set your glide angle. Just before you land, swing your body aft to flare out your glide and touch down easy. Watch that. Some people swing their feet forward to take the impact. That makes the nose drop, and you pick up speed. You can really slam into the ground."

I nod, and he steps away from the big, black, diamond-shaped wing. Thirty feet downhill, Tom and Steve are waiting to run with the line. There is still time to change my mind, still time to lay this plastic-and-bamboo contraption down and walk away.

Taras says, "When you're ready to go, yell."

If the only alternative is to look like a fool, I'd as lief break my head. "Let's go!" We run three strides, and I rise into the air.

What can I tell you about this first step that encounters nothing solid? There's nothing to it. This upward stride causes the jaw to drop and the mind to cease its disciplined churning.

The people around me sink out of sight. Their voices thin away behind the rumbling of the sail-like wing. I look down the tow-line at Tom and Steve. They are running down the hillside, bounding over rocks and thistles as they go.

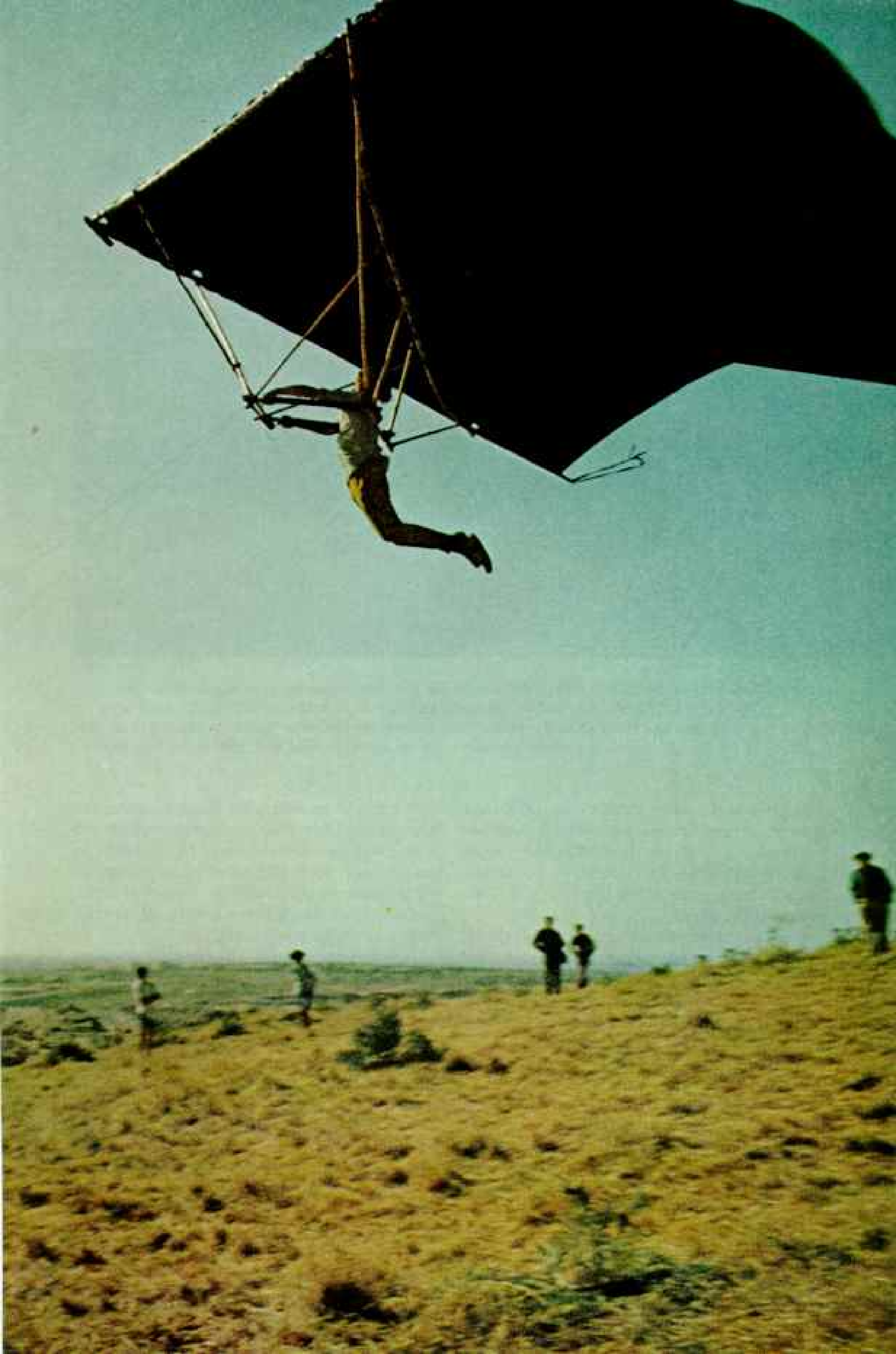
They look winded, I think. So I lift my thumb, and the green cord disappears. I become a pendulum, swinging under the wing.

LAUNCHING A BIRDMAN,
*friends tow Taras Kiceniuk, Jr.,
while he swings his legs
back to make the wing climb.
At 30 feet he will drop the
towline and pull himself
forward, bringing the
nose down and picking up
speed to stay aloft. The
craft covered the greatest
free-flight distance of the
day—some 320 feet.*

*Unlike sailplanes, hang
gliders must shun strong
updrafts that might carry them
too high. Number one rule of
the sport is "Never go higher
than you are willing to fall."*

290







TARAS KULENIN

Into the realm of sea gulls, Taras soars for five minutes along windswept bluffs near Torrance, California. Inspired by the meet, he designed this biplane, dubbed *Icarus*, with a sling seat and hand controls connected to rudders on the wing tips. Like other serious fans of the fledgling sport, he spends months studying aerodynamics and making practice flights.

The ground shoots upward, downward, then steadies. I am neither comfortable nor uncomfortable; I'm just there, like the people standing below me. I feel no fright. For roller-coaster thrills, go to an amusement park. This is something else.

I am supposed to be the pilot of this thing, but it seems to have little requirement for my services. We slide into a stratum of air where a crosswind turns us slowly to the right. I swing my legs to the left. Not as easy as it looks. Try to get some weight off the right pole. The turn stops. The earth is rising faster. Faster. Fascinating. WHACK!

The rocky hillside smites the soles of my boots, and a gout of gravel flies away. I sit down immediately and lay the bamboo frame on the ground. A spatter of applause dies away; Taras ducks under the wing and sits.

"You forgot to flare out," he says.

I jab an irritated glance at him. Of course I forgot to flare out; I know I forgot to flare out. I wiggle my toes, and the smarting in my

feet starts to go away. My flight, counting the tow, lasted 15 seconds and covered about 200 feet. Nothing earthshaking, but I begin to understand what this sport is all about: To fly without awareness of the means of flight.

Days later I'm still pondering. What does Otto's birthday party signify?

Is it one more rash of the endemic madness that periodically breaks out in California? Or the birth of a genuine national leisure-time mania, like drag racing and surfing? Hang gliding, like those sports, involves calculable hazard to life and limb. Flying a frail contraption of bamboo and bailing wire cannot be undertaken casually.

A dozen and a half gliders, fifty pilots, a thousand spectators at the birthday party don't constitute a ground swell of mass enthusiasm. But for all of them to come together at one time and place, with almost no organization, suggests that larger numbers must be lurking in the hinterlands, leaping off hillsides when no one is looking. □

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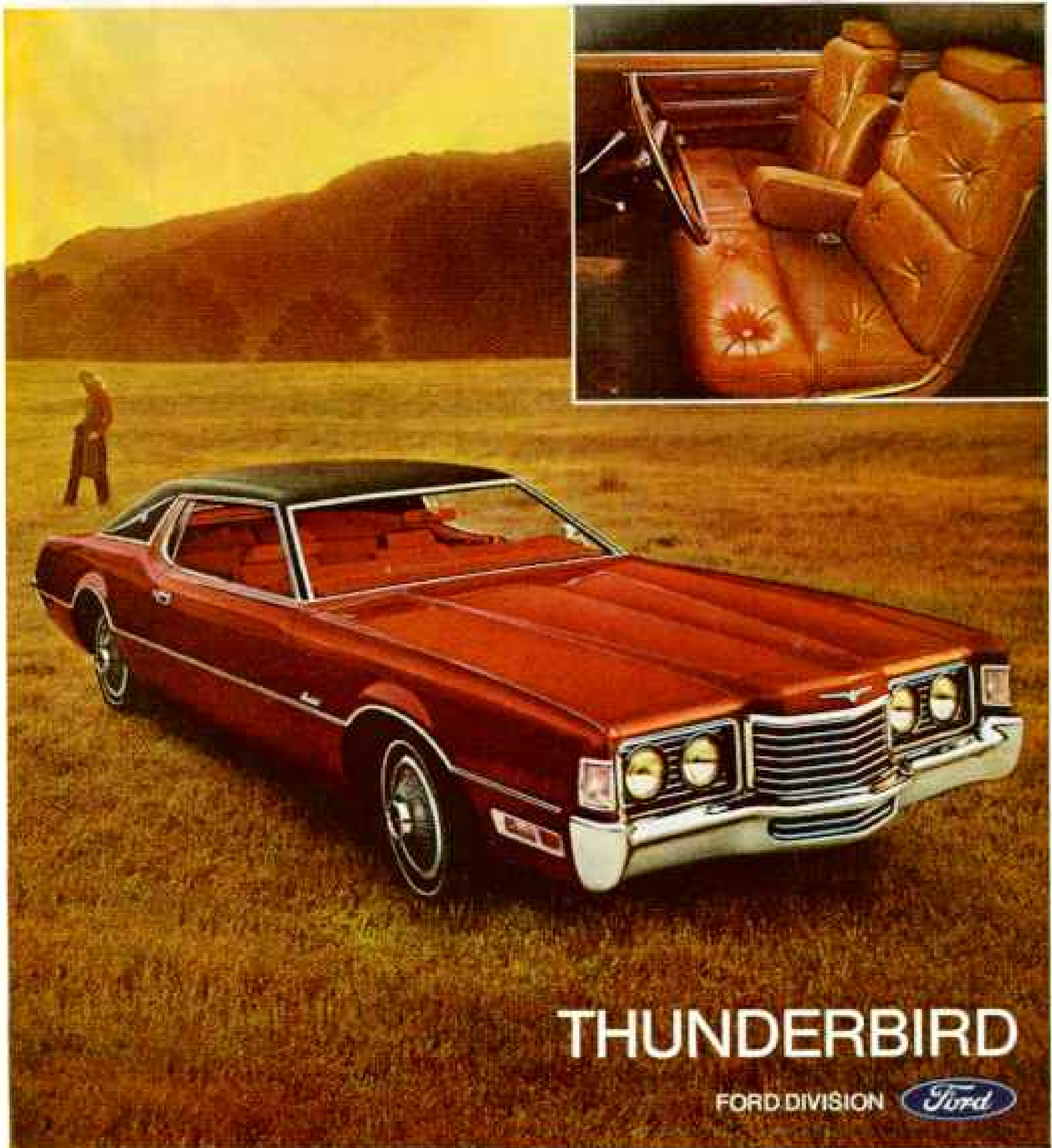
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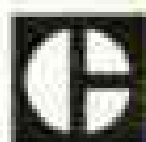
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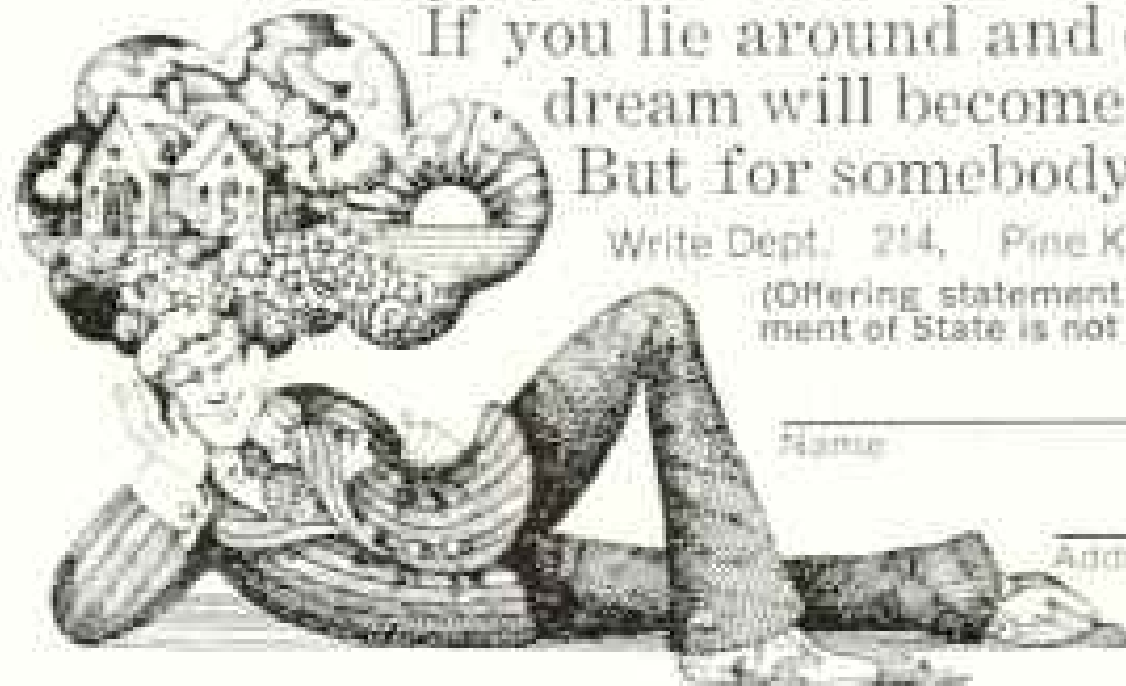
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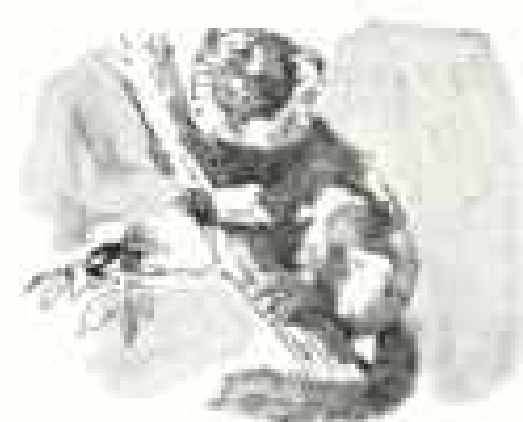
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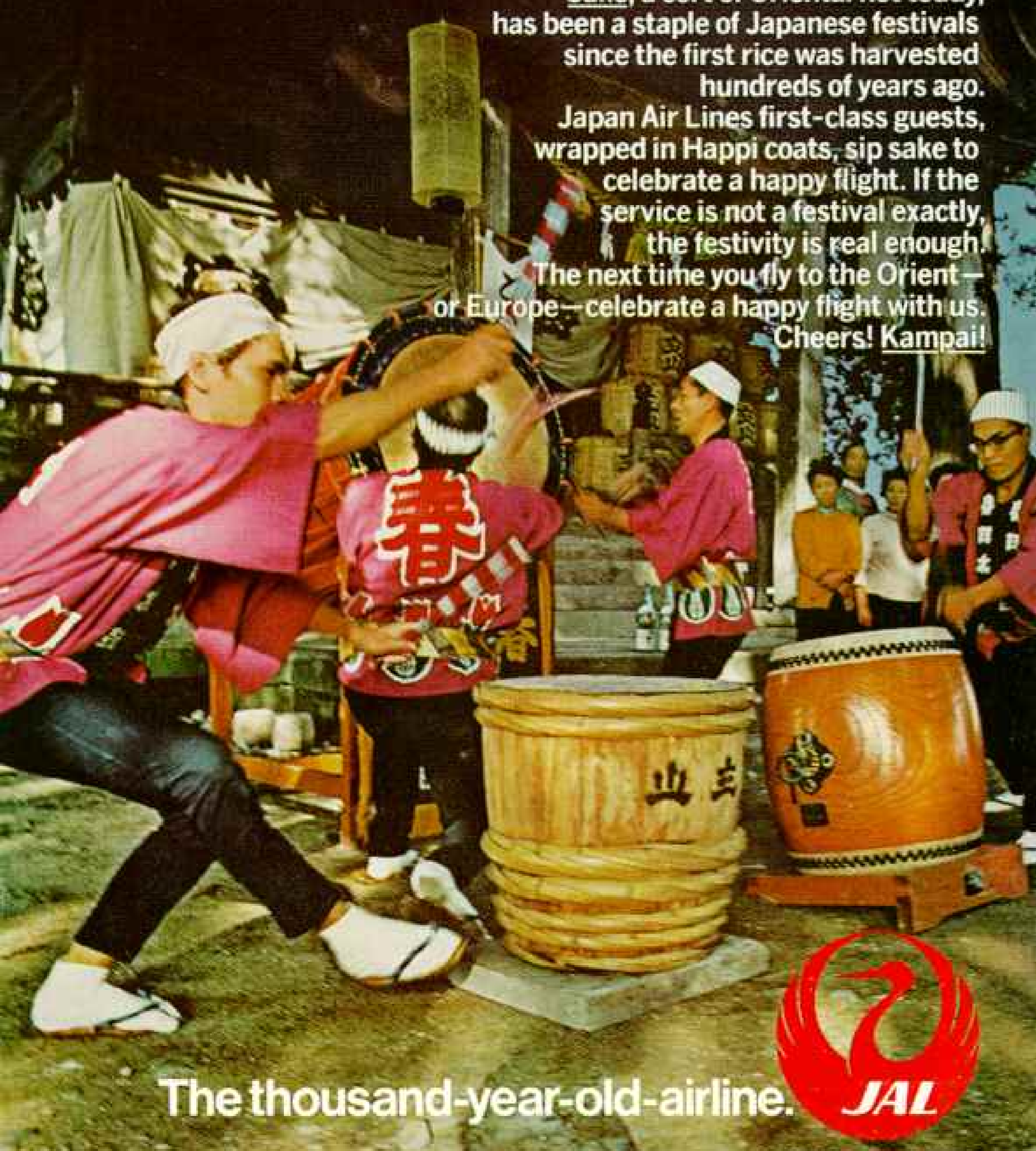
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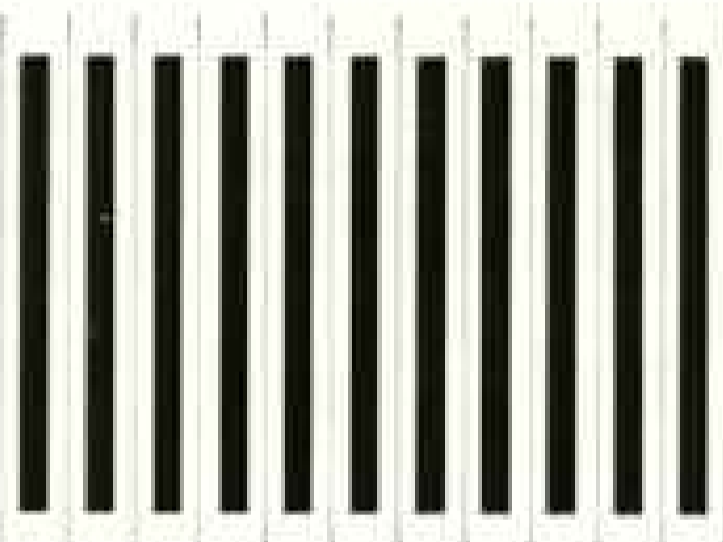


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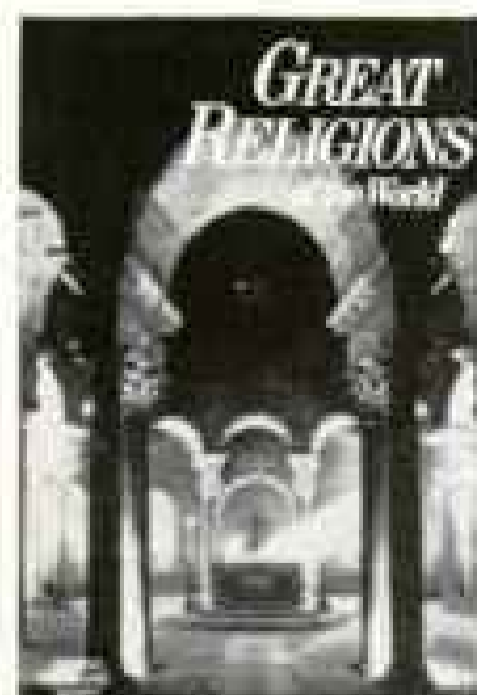
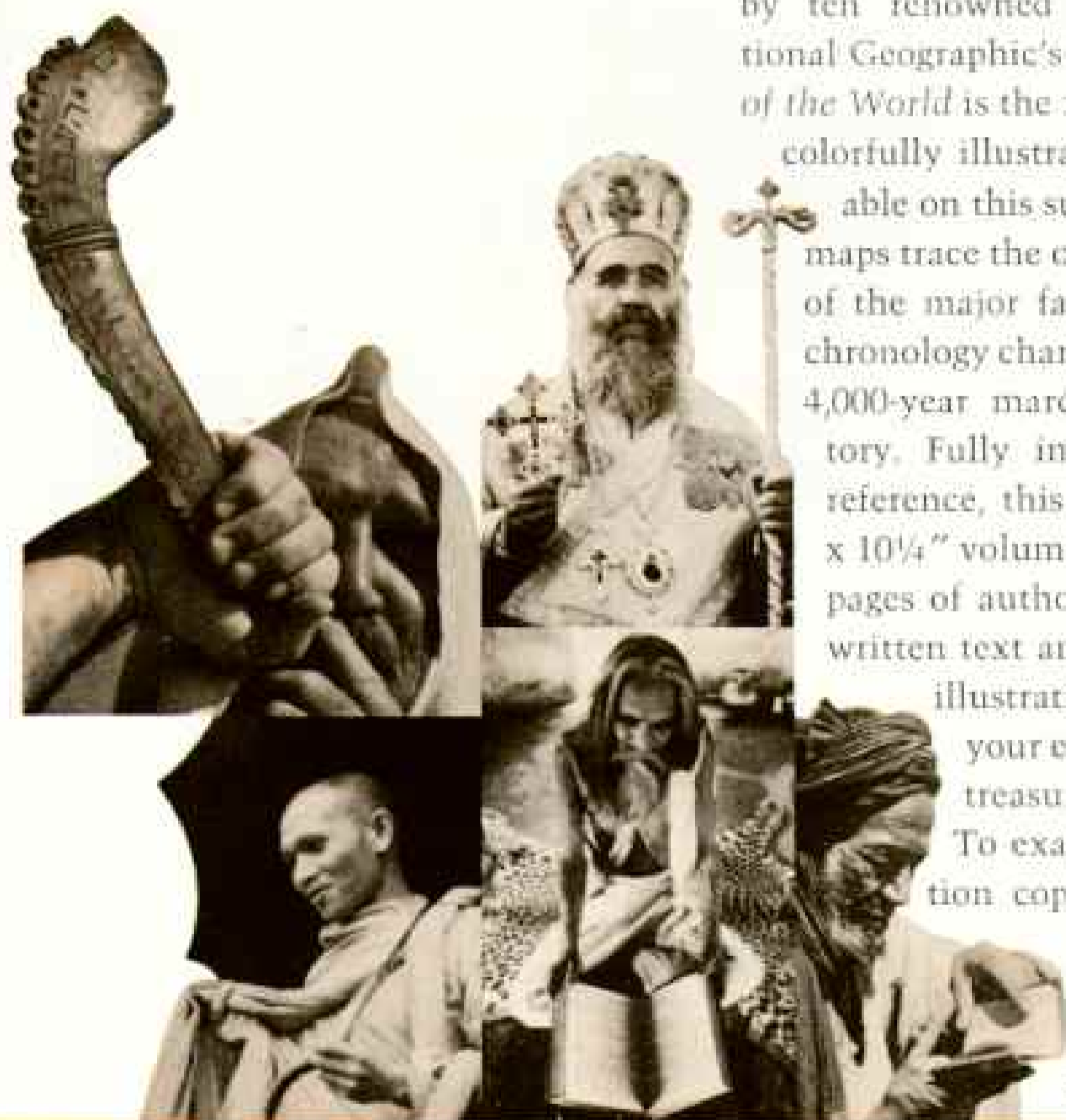
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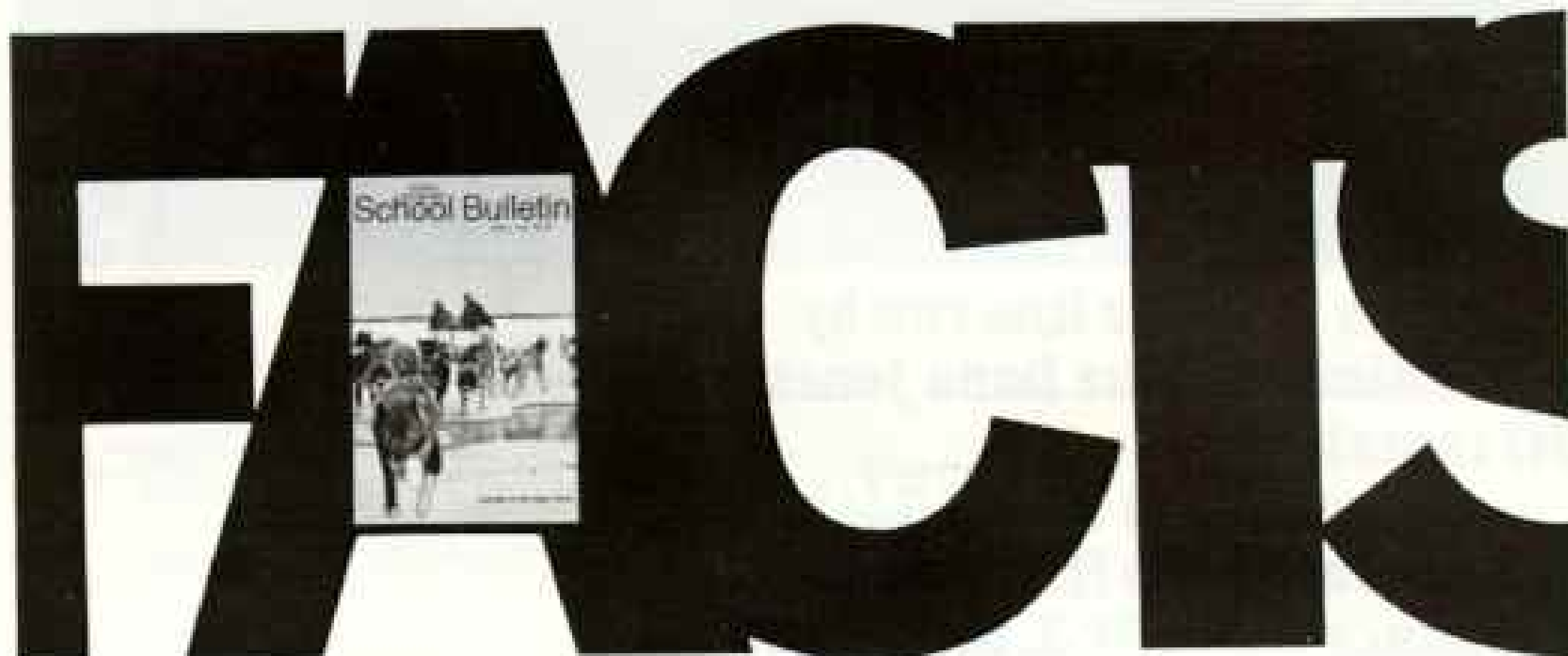
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