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NICHOLAS DEVORE III

Probing for pitfalls, an Eskimo guide feels his way across flooded ice ahead of author Colin Irwin and seven sled dogs. In a test of stamina and spirit, the young Englishman braved the Arctic's rigors to experience and record the harshness of traditional Eskimo life.

Trek Across Arctic America

ARTICLE AND PHOTOGRAPHS BY COLIN IRWIN*

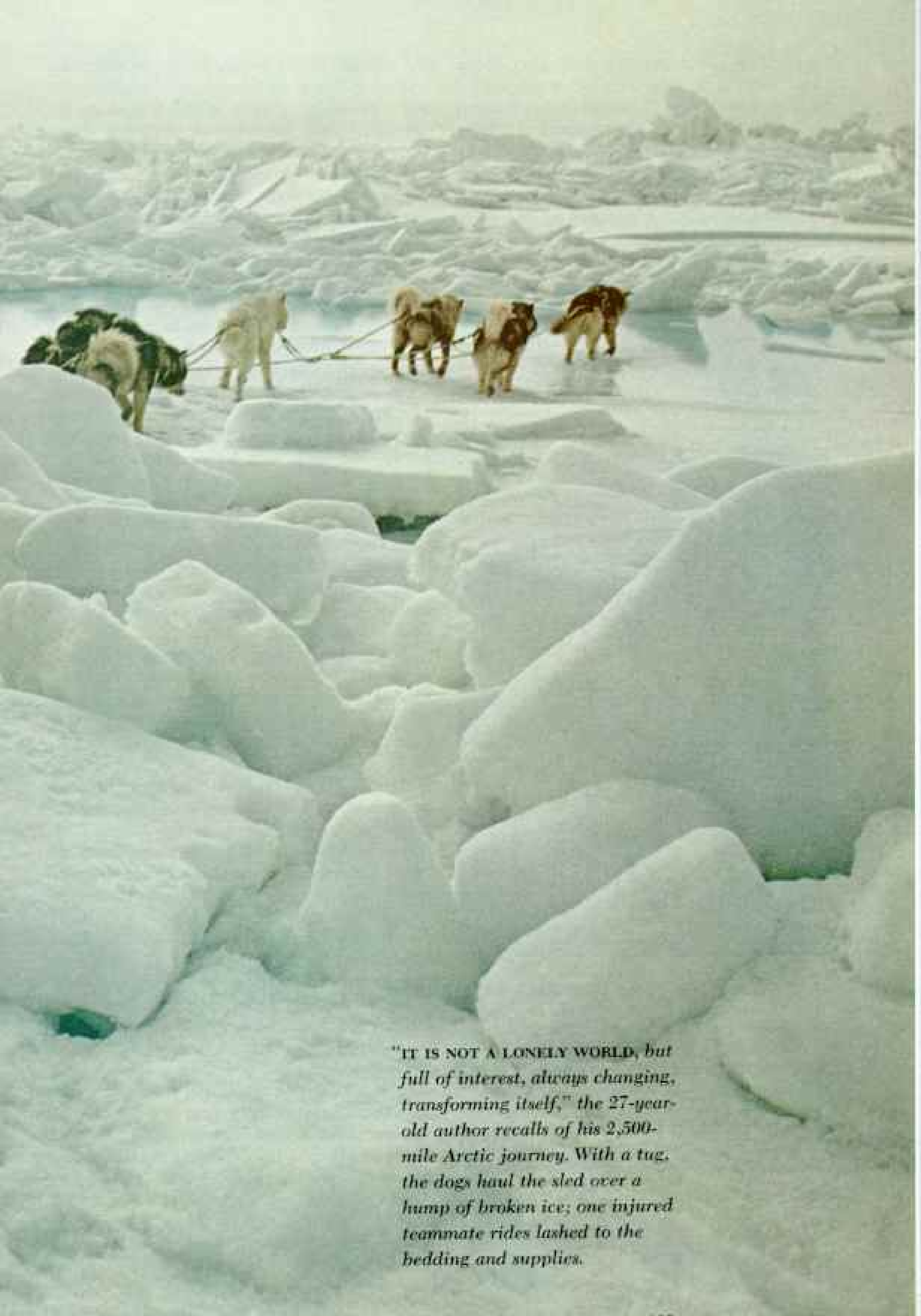
FORTY MILES to Pelly Bay. With every step my boots broke through the fragile crust of snow on the wind-swept tundra. Fatigue numbed the pain in my shoulder, wrenched many miles back—a week ago?—while wrestling our sled across the rough sea ice of the eastern Canadian Arctic. The sled itself we had abandoned early in the morning.

That day we had eaten only broth—water in which I had boiled a frozen caribou stomach left by wolves along our route. Our last solid food had gone a week earlier. I lagged now, and stumbled from time to time. John Etibloena, my Eskimo companion, tied the trace from our remaining dog around my waist. Nothing seemed to stop this dog, a black female I called Blossom. Each time she tugged me I was reminded that, like her, I must not give up.

Three weeks before, we had started from Repulse Bay, 150 miles to the southeast, with nine dogs. One by one they had played out after the food was gone, and we had left them, in the wan hope that some might survive.

Now we, too, trod close to the edge of

*Photographer Nicholas deVore III joined the author's expedition during its final month to make aerials and other supplementary pictures.



"IT IS NOT A LONELY WORLD, *but full of interest, always changing, transforming itself,*" *the 27-year-old author recalls of his 2,500-mile Arctic journey. With a tug, the dogs haul the sled over a hump of broken ice; one injured teammate rides lashed to the bedding and supplies.*

survival. We could not afford another of the bitter storms that had pinned us down for days on end. We had shed all our equipment save sleeping bags and a knife for cutting snow blocks to build shelter. We rested only two or three minutes at a time; longer stops threatened frostbite as perspiration froze. The effort of walking warmed us and made us thirsty. We ate snow.

At the end of eight hours, we came to a high ridge. From it John looked west toward a string of mountains braced against the sea ice around Pelly Bay. Then, turning to me, he said, *"Taavani qablunaat inuksuyat—*There's the white men's marker."

I knew what he meant. He could see the radar dome of the distant early warning station atop one of the mountains. I looked too; but without my glasses, which fogged up in the bitter cold, my view of anything more than a dozen yards away was a blur.

John estimated the dome to be 20 miles away. Another eight hours. As darkness fell, the flashing lights of the DEW line airstrip pulled us like a magnet, urging us on with a winking promise of food and shelter. We arrived shortly before midnight, having walked the 40 miles in 16 hours.

But that was scarcely the beginning. My final destination was Point Barrow, Alaska, 2,300 miles to the west (map, pages 300-301).

Now, reflecting on those early hardships of my Arctic trek, I view them simply as bad luck. There would be other agonizing setbacks, but never was I truly fearful for my survival. I was challenging the Arctic with ancient Eskimo skills, handed down from father to son for countless generations. But with the passing of the present older generation of Eskimo hunters, these skills are likely to be lost forever. Their sons prefer the snowmobile to the dog team, the prefabricated house to the igloo.

Thus my primary purpose in trekking across the Arctic was to share and record a vanishing way of life. Mine may well be the last such journey; I think few others, if any, now care enough to try.

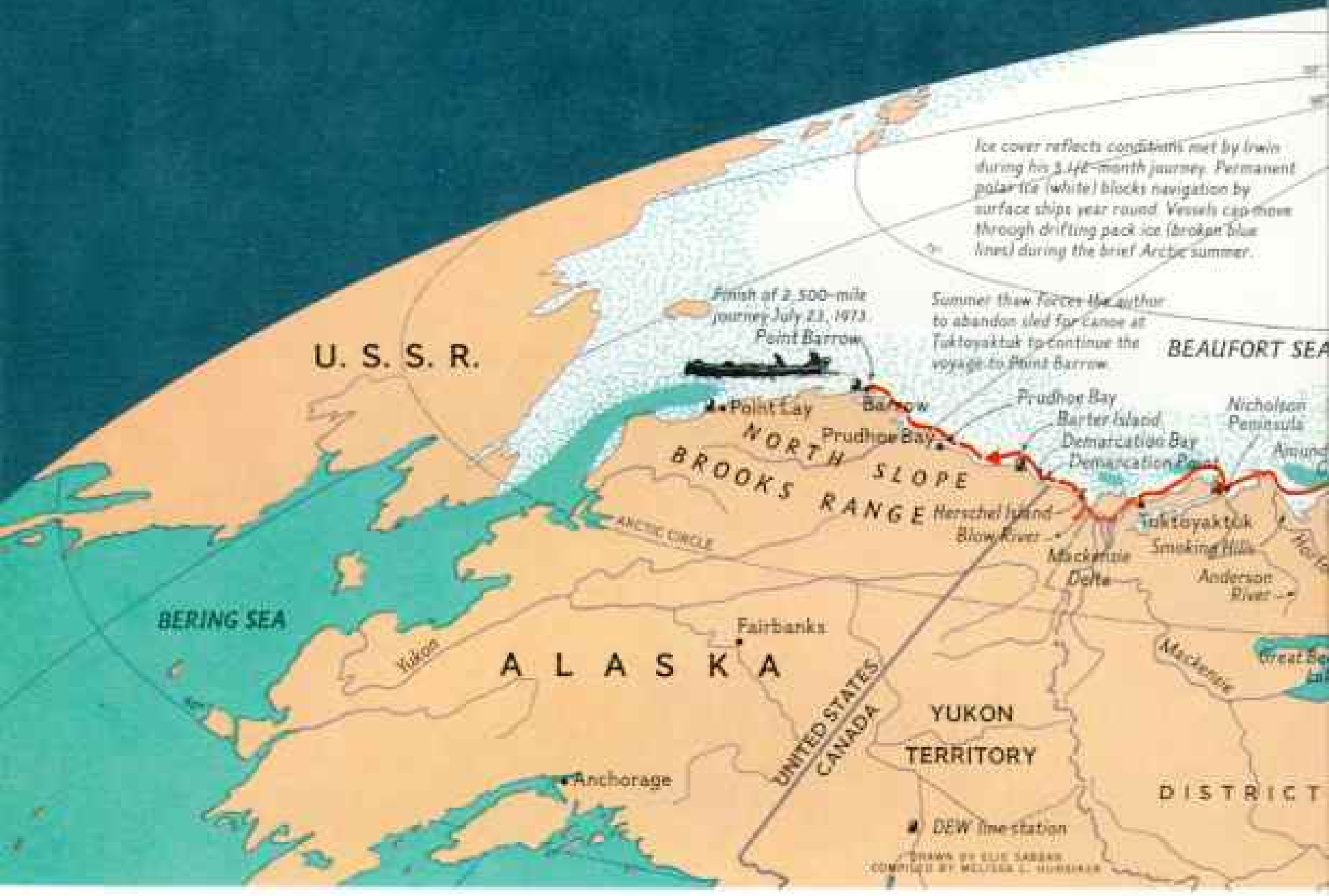
JOHN EISELEN

"The frostbite in my fingers is healing," Colin writes in an early letter, "but I have lost 12 pounds and my feet are swollen from the long walk." To store up calories against the cold, Colin digs out buttery-tasting caribou marrow (**above**). Eskimo guide Tipana (**facing page**) eases hunger pains with slices of rotten seal flipper. Colin was accompanied by three different guides on his trek, sharing their food and hardships.

I ARRIVED in the Canadian Arctic in the summer of 1971 and took a government clerical job in Cambridge Bay, about 600 miles northwest of Hudson Bay. There I spent the winter, living in an Eskimo house and making many Eskimo friends. I developed a deep admiration for the way they faced a hostile environment, always with optimism. I have seen a hunter return to his hungry family exhausted and empty-handed. They laughed, and simply talked of luckier hunts. And that, I knew, took courage.

In February 1973 I left Repulse Bay as an Eskimo would have done half a century ago —with a sled, dog team, and the basic tools for Arctic survival. My plan was to follow the frozen Northwest Passage, along much of the route taken by the explorer Knud Rasmussen, the famed Greenlander who crossed the Arctic with sled and dogs in 1923-24.

Nearly six months would pass before I reached Point Barrow. I would travel through a steely winter with temperatures ranging



Tackling the pathless Arctic without a compass, Colin relied for direction on the position of the sun and the imprint of prevailing winds on the snow. He set out from Repulse Bay in early February, reached the settlement of Tuktoyaktuk by dogsled on June 14, and covered the last 600 miles to Alaska's Point Barrow by motor-powered

down to −60° F., and a spring heralded by the percussions of cracking ice. I would finish in July, not by dogsled, but in a canoe on the flowing summer sea.

WHILE RESTING in Pelly Bay, I bought ten new dogs from local Eskimos. John retrieved our sled and equipment, and a few days later a plane flew him home to Cambridge Bay in less than three hours—a trip that would take me four weeks.

My companion for the next stage of the journey was another old friend, Tipana, who would trek with me as far as his home at Cambridge Bay, some 500 miles to the west. Like other seasoned hunters of his generation, Tipana, in his fifties, was wiry, weathered, and wise—possessing little formal education, but a vast knowledge of the Arctic. He fit my rule of thumb for a traveling companion in the Far North: If he speaks more than a few words of English, disqualify him.

Before leaving Pelly Bay, we replenished our supplies of sugar, tea, coffee, flour, and tobacco. We loaded our 18-foot sled with four rotten seals to be used for dog food; we also carried rifles for hunting caribou.

I hoped that we would have better luck in taking game than we'd had on the first leg of the trip. Certainly, I did not want to write another entry in my diary such as the one for March 2:

We both had a little caribou stomach halfway through the day as we have no meat left. I don't mind eating rancid seal, but I don't care at all for such leftovers as innards. If this carries on much longer, I'm afraid I'm going to eat one of the dogs. . . .

After traveling for two days out of Pelly Bay, we realized that we had missed our planned route through a high mountain pass. We came across a hunting party—two men and a boy—and they led us to a new course along a lake in a valley cut by glaciers of

canoe. Plagued by hunger, cold, and mind-blurring fatigue on the 5½-month trek, Colin retraced a route set by the pioneering Arctic explorer Knud Rasmussen 50 years before. Colin was first drawn to the Arctic by an urge to sail the Northwest Passage west to east—a feat he hopes to accomplish this summer in his boat *Endeavour*.

another age. As it was then late, we decided to put in for the night.

While I chained the dogs, Tipana and the hunters searched for suitable snow with which to build an igloo. As they walked, they listened for the deep, resounding squeak indicating a thick and firm drift. They probed with knives to determine the texture of layers laid down in successive storms.

Finding a site, the hunters cut a trench about 18 inches deep and three feet wide. They placed six-inch-thick blocks of snow in a circle around the trench, building upward in a spiral pattern until there was room at the apex for just one block (page 308). As they worked with knives to ensure proper fit, I pressed snow into the cracks, then shoveled more over the shelter.

The larger house was for the hunters and the boy. Tipana built a smaller one next to it, and when both were completed, we knocked out the wall between the two.

The ability to build a snowhouse quickly and well was without question the native skill most essential to our survival. Hunger, of course, is painful, especially in the Arctic cold when the body burns calories unceasingly; but life is sustained by the hope that tomorrow will find a seal or caribou in the rifle sights. If equipment fails or is lost, one can usually improvise.

But there is no substitute for shelter in the Arctic. Not when the wind is blowing to produce a chill factor of more than 100 degrees below zero; not when the snow swirls until sky and land fuse into a blinding wall of white; not when heavy breathing can freeze the tissues of your lungs.

And so it was on the morning after we made camp with the hunters. A storm had come up during the night, and by the time we awoke it was obvious that travel would be impossible that day. Rather, I had biscuits and tea, and then crawled back into my

sleeping bag, where I slept away most of the morning in the warmth of the igloo.

As we were setting out the following morning, one of the dogs started to misbehave. Unable to find the whip, I clouted him on the head with my hand. The result was a broken bone, and there are those, I know, who will be pleased to learn that the bone was in my hand.

I was taught to respect animals, to treat them with kindness and understanding. But in the Arctic, all of us—dogs and men—are in the same kettle. We have to put up with the same cold and hunger. There were times during my trek when I was so hungry that I ate rotten fish from a fox trap, and the remains of a seal left by a polar bear.

I became, in short, no less a scavenger than my dogs. My primary business was survival.

I did indeed hit the dogs on occasion, but only when it was necessary for all of us. For example, there was a time when a storm was about to overtake us. A cache of food lay some five miles ahead. If the storm caught us, we might have nothing to eat for three days or more; an Arctic blow often takes that long to subside.

The dogs, however, did not want to go on. I could not say to them, "Now look, my friends, if we go only five more miles we'll be safe." All I could do was strike them, forcing them on toward the cache. Thus I survived, and so did they.

As long as the dogs remained strong and well fed, Tipana and I often rode on the sled. At the beginning of the trip, layers of dark mud had been caked on the wooden runners, allowed to freeze, then planed smooth. Each day we smeared water over the mud with a scrap of polar bear skin; the water froze instantly. This coating of ice against ice made the Eskimo's time-honored means of travel remarkably efficient. The original mud cast on the runners held up until spring, when we switched to steel runners (left).

BY EARLY APRIL we were approaching Gjoa Haven. There Roald Amundsen—first to navigate the Northwest Passage—called with his stout sloop *Gjoa* in 1903. This fine, deep little harbor came into view on the day that I made this entry in my diary:

We set off a little late after a breakfast of coffee only. I had a cigarette made of tobacco wrapped in a page from this notebook. We are certainly on the right course now, but the

Stark domes and spires of an electronic cathedral—the distant early warning station at Lady Franklin Point—loom above the tundra. Napaseekadliak replaces the sled's mud runners with strips of steel (**facing page**). In extreme cold the wooden runners are smeared with mud, then slicked with ice to let them skate quickly over winter terrain. Melting snow and ice call for the more durable steel.

Feathers of frost partially mask Napaseekadliak's deep-seamed face as he gazes from an Eskimo home (**below**). Outside, 60-mile-an-hour winds blast snow into the coat of a curled-up sled dog (**bottom**).

dogs are slow, for they haven't eaten in several days. As for me, I am weaker than when I walked into Pelly Bay. I am afraid the reserves of my body are about used up. I get a little dizzy sometimes, and I can't keep warm even when I walk. I also have a little snow blindness in my left eye. I keep thinking of food. Huge slices of bread with gobs of jam. My body has reached its limit, but somehow I keep one foot going in front of the other.

All our friends were on the beach to meet us when we arrived in Gjoa Haven, a cluster of frame buildings including a Hudson's Bay Company store and a school. We stayed for three days, during which time I feasted with Eskimo friends and had my eye and the broken bone in my hand tended to at the government nursing station.

Before we left Gjoa Haven, the daughter of Hikitook, my host, refurbished my caribou-skin boots, split and worn from more than 400 miles of travel. She sewed coils of thongs to the bottoms, giving me nonskid soles that left my signature in rich print with every step.

My parka, mittens, and pants were all made of caribou skin—dried and scraped three times to make it pliable—as were my socks, worn with the fur inside. The fur around the hood of my parka was wolverine. When ice from my frozen breath collected in this strong, thick matting, I could easily beat it out with a stick. Well insulated by these garments, I was rarely bothered by the extreme cold, except after going hungry for several days.

THE CARIBOU sustained us in another way, too—as our major source of food. If we didn't wear it, we ate it. I learned to relish the marrow of caribou bone (the taste is similar to that of butter). Once we even used frozen caribou legs for tent pegs. Our sleeping skins were from the caribou. Little wonder, then, that we watched closely for tracks of this animal as we traveled.

We saw none for 400 miles after leaving Gjoa Haven. We traveled first in a southwest direction, moving along the coast of King William Island. The dogs were sluggish, and we made little progress before stopping for the night. The next day I had an accident, as recorded in my diary on April 8:

I did a silly thing today. I was eating a tin of corned beef with my snow knife, and while daydreaming I licked the bits of fat and meat off the knife. Of course the knife froze to my lip instantly, and I lost a large piece of skin when I pulled it away. The wound bled freely.

Passing the Irving Islands, we continued west over the sea ice until we came to the Royal Geographical Society Islands. As always, we used the drift patterns of the snow as our principal navigational aid; here the prevailing winds blow from the northwest.

"Cambridge Bay in three or four more sleeps," Tipana said cheerfully as we prepared camp. He would be glad to get home. It was a clear and beautiful evening, and the fields of rough ice all around blushed under the touch of soft and fading light—a scene of utter serenity. Yet this was polar bear country, and they are creatures of unpredictable humor. Fortunately none appeared to challenge our intrusion.

Nearing Cambridge Bay, we saw our first ptarmigan since starting the trip. They were lazy birds, refusing to fly away even when the dogs lunged toward them.

SENSING that food and rest awaited them, the dogs perked up, and we were carried into Cambridge Bay on a burst of speed. Tipana's children were there to meet us, scrambling onto the sled for the final hundred-yard ride into the settlement.

With its population of about 700, a DEW line station, three churches, and a Royal Canadian Mounted Police post, Cambridge Bay now seemed a virtual city spread across the empty Arctic landscape.

I made quickly for the familiar house of my good friend Kamaoyoak, a kind and extremely intelligent man who still believes an Eskimo must live off the land if he is to maintain his pride. He is probably the best hunter in Cambridge Bay, but to me he is much more than that. I had wintered and ranged afield with him the year before, and despite the gulf between our ages and cultures, he had treated me as a brother. It was Kamaoyoak who taught me almost all I know about Eskimo survival skills.

Kamaoyoak greeted me with little emotion. He stared at my face, now lined and weathered like his own, after more than two months on the trail. "You look old," he said.

Our relationship had changed somehow. He viewed me differently. I was saddened and puzzled. Not until several months later, after ending my trip, would I come to understand his attitude.

Napaseekadlak joined me at Cambridge

Faced by open water, Napaseekadlak eases a huge block of ice into position.

Yelping and whimpering at their uneasy footing, the dogs cross the gangplank.

Stepping gingerly, Napaseekadlak guides the heavily laden sled safely to the other side.

Bay for the 1,800-mile remainder of my journey. Round-faced, with jet-black hair despite his 60 years, he was short but had the strength and stamina of a man half his age.

Preparing for departure, we obtained steel runners for the sled, for we would soon have to change from mud. We also purchased a tent. It was now the end of April, and would shortly be mild enough for canvas shelter.

Leaving Cambridge Bay I jotted down:

We collected all our stuff and loaded the sled. Then all our friends helped us hitch the dogs up. As we were short one harness, one old man took the harness from the lead dog of his team and gave it to us. We left at 2 p.m. with ten dogs. Napaseekadlak and I rode all the way, traveled for eight hours before making camp.

Our route took us through the Richardson Islands, high and black against the late-night sun, then west, until a 60-mile-an-hour wind caught us. We struggled to get the tent up behind a snowbank, and when we did, the canvas snapped like a whip. The snow swirled until there was no visibility; our world seemed encased in an eggshell. We stayed in the tent for a day and a night, frustrated by the knowledge that there was a DEW line station only an hour's sled drive away.

We lost one dog in the storm, a small white female given to us in Gjoa Haven. With a team of nine, including Blossom, who had been with me from the start, we continued west. Suddenly the lead dog, having caught the scent of an animal, veered off the trail.

Then all the dogs were running for the nearby hills. I pushed down the sled anchor —a heavy metal hook—with all my weight. Snow sprayed us as the team raced forward.

Flushed from the hills by the noise of the dogs, two small caribou came into view. Napaseekadlak quickly dropped off the sled into a sitting position, the .243-caliber rifle in his hands. He squeezed the trigger, but the weapon misfired. Another squeeze, another click. "This gun is no good," he muttered, and reached for the .22-caliber rifle. Finally he brought down the nearer of the two caribou.

We butchered the animal quickly. Entrails, rib cage, and head were fed to the dogs. The skin became part of our sleeping gear. After packing the hindquarters on the sled, we dined on the tongue and the muscles of the legs. We boiled some ribs and some of the vertebrae, breaking the bones to extract the marrow and then drinking the broth.

For snacks while traveling, we froze fillets from the backbone. Eaten raw, they were crunchy and quite flavorful.

At other times, when coming upon herds of caribou, we were able to get surprisingly close to the animals. Kamaoyoak had taught me how to approach them slowly and quietly so that they would remain calm—regarding us, it seemed, as simply two other caribou. If the animal we shot fell dead, the others would run off; but if it was young, and only wounded, they might stay around.

STILL PUSHING WEST in early May, we began to see seals on the ice. Often we were fooled by shadows, and I found it difficult to judge distances, with so few visual references on the barren snowscape.

I recall Napaseekadlak stalking one seal that seemed to me to be about a hundred yards away. I had stopped the sled and stationed myself by the dogs to keep them quiet as he walked ahead with a rifle. Whenever the seal raised its head, he stopped in his tracks, motionless.

As long minutes passed, I realized that the animal was nearly a quarter of a mile away. Finally Napaseekadlak knelt and fired one shot. This was an anxious moment. We had no food for the dogs, and if the wounded seal fell back through its hole in the ice to die in the water, we would not be able to recover it.

I raised the sled anchor, and the dogs raced forward, barking with excitement. Napaseekadlak greeted me with a wide smile, and I knew that the dogs would be eating well. To my surprise, it wasn't the common ringed seal, but a huge *ugjuk*, or bearded seal, weighing more than Napaseekadlak and I combined (right).

Later in the trip, when many seals appeared on the ice to sun themselves, the dogs would race from hole to hole. We played the game, giving them their heads, hanging on to the sled as it zigzagged across the ice. Of course, each seal would escape back through its hole before the dogs got to it.

As we approached Amundsen Gulf, the ice on the southern shore became progressively rougher. And the weather grew warmer—so warm that at times it rained. We quickly took shelter in the tent, for if our fur clothing became wet, it would soon be caked with ice. When the rain stopped, we set out again, and with dampness still in the air, the sounds

we made were amplified. Before, all sounds had been absorbed by the dry powder snow, but now the dogs brought forth a tattoo of footsteps; the whip cracked as sharply as rifle fire, and the sled crashed over the rough ice with a thunderous noise.

The cliffs around us were festooned with streamers of ice, and everywhere there was the chaos of a sea frozen in upheaval. We were traveling in an eerie, frosted fairyland.

The ice at the mouths of some of the rivers had already started to break up, and the going became hazardous where river water washed over the still-frozen sea. Even so, travel on the ice was easier than on the disappearing snow inland.

Once, as we inched along the endless coast of the District of Mackenzie, we spotted a large black object in the distance. As we drew closer I realized that it was a shipwreck. Hard aground and locked in the ice, she was a 76-foot steel-hulled trading vessel named *Nechilik* (page 310).

I climbed aboard to find her in astonishingly good condition, even though she appeared to have been there for years. A plaque aboard told me she had been built in 1942 and registered in Saint John, New Brunswick.

Boats are my passion. While Napaseekadlak made tea, I fingered the wheel of the vessel and wondered. How had she come to be abandoned? Who sailed her, from where,

Bloody trail of a bearded seal marks a successful hunt. Creeping stealthily over the ice, Napaseekadlak caught this 550-pound *ugjuk* napping in the sun.

After another hunt he feeds the ever-hungry dogs (**right**), who dispatch their portions of seal meat in minutes.

1.

1. Construction time, 20 minutes—and no mortgage loan. First step in building a snowhouse is to find the proper snow: deep and hard. Having chosen his site, Tipana digs a rectangular pit; the surface around it will become a sleeping bench in the completed igloo.

2.

2. Snowhouse takes shape. Tipana rings the pit with the first layer of six-inch-thick snow blocks, shearing their tops in an upward spiral. Two-foot-high doorway will be cut out from inside the igloo.

3.

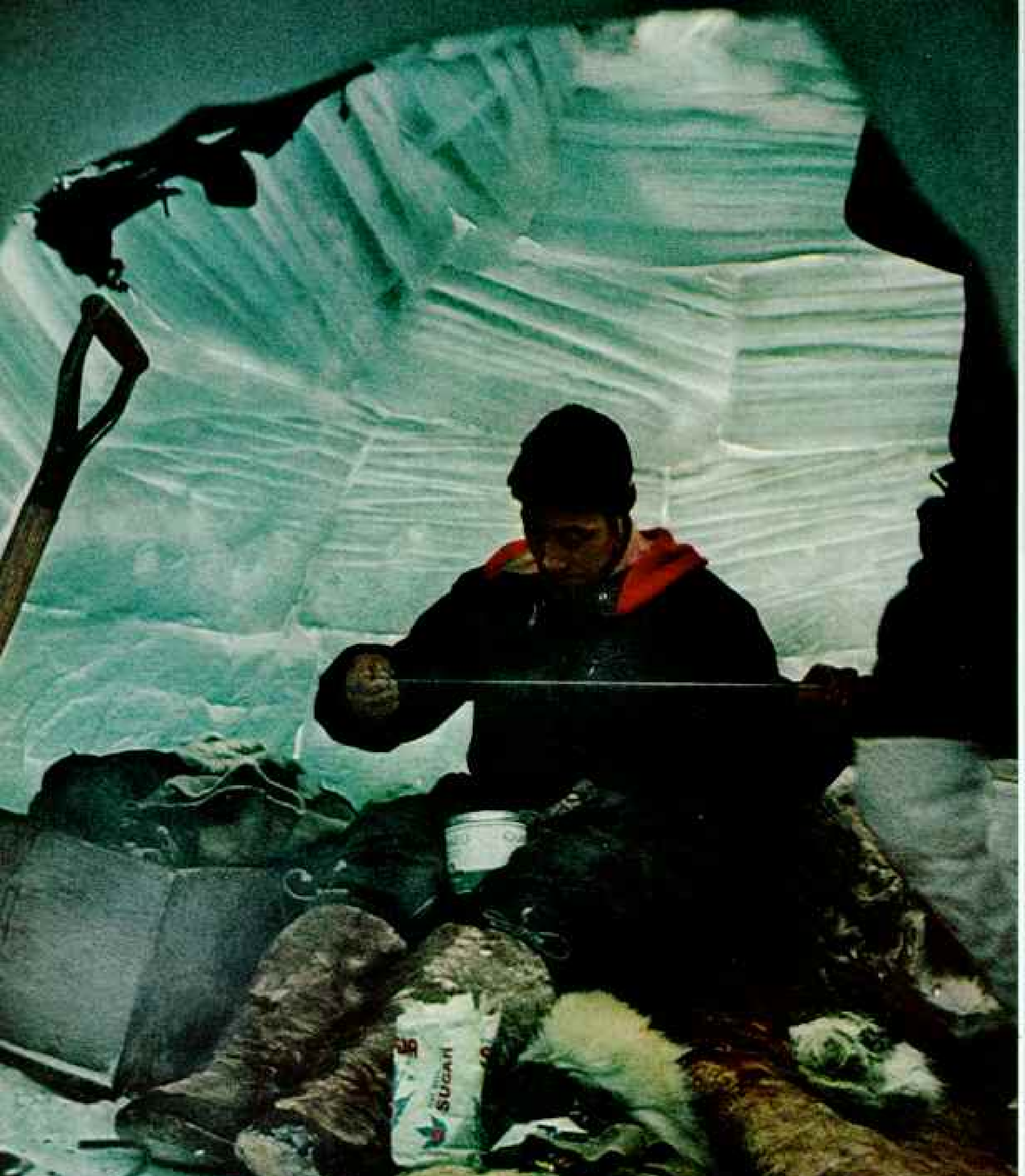
3. Carving and tapering the arching blocks, Tipana begins to tilt them inward for a windproof roof. Colin will provide unskilled labor by chinking cracks with loose snow.

4. Eyebrows rimed by frozen breath, Tipana peers from his nearly finished igloo. The last block will be lifted on end from inside, then turned flat and settled in place on the projecting edges of the surrounding blocks.

4.

5. Inside the icy dwelling, walls of snow transmit light for a hunter repairing a torn caribou mitten (**right**). Body heat and a Primus stove can warm an igloo fifty degrees above the outside temperature, while caribou skins shield occupants from the icy floor. Most Eskimos, however, have now abandoned the traditional snowhouse for government-built dwellings and a settled life.

5.


Suzuki

Tortured by inner fires, the Smoking Hills send swirling vapor trails into the gloom. Napaseekadlak called this "the land where there is no snow in winter."

Other forces imprison the wreck of the trading ship *Nechilik*, gripped by landfast ice (**left**). On her way in September 1957 from Cambridge Bay to Tuktoyaktuk with supplies and a cargo of furs—fox, bear, and seal—she struck a submerged reef and was beached. The remoteness of the area discouraged the Hudson's Bay Company from trying to salvage its vessel.

with what cargo, on her final voyage? The answers I would learn much later, far from this lonely, frozen fastness (caption below). Now I felt a sadness, knowing she would never sail again. Still she would be well preserved in death.

There were many useful items aboard *Nechilik*—handsome brass lamps, for example—but the food on our loaded sled was more vital. So we left the ship as we found her, a mute, alien prisoner on that remote Arctic shore.

BY MID-MAY we had reached the DEW line site at Clinton Point. Though we usually stayed with Eskimo friends at our DEW line stops, we looked forward to the movie at the radar station. Films are rotated among the sites, and it happened that the schedule of one film—a Western made in Italy—coincided with our itinerary. Thus, we saw the same blazing gunfight again and again. Napaseekadlak never tired of it. "I wish I had that pistol," he said with a grin. "It never runs out of ammunition!"

We left Clinton Point on May 22, after waiting for the sun to burn off a heavy veil of fog. This day had a special meaning for me, because, as I recorded in my diary:

Today is my birthday. I'm 27. This is my third birthday since I left home, but I didn't think about that until this evening. The years go by, and if I wish to do all the things I plan, I must hurry.

We had to hurry, too, if we were to keep ahead of spring breakup. But it started to catch up with us several weeks later. We had passed the Smoking Hills (left), near the mouth of the Horton River, and observed —as had Rasmussen half a century earlier— the gray-blue smoke billowing from fissures in the slopes. The smoke is from smoldering layers of bituminous shale.

The ice was now covered with pools of water, and a screen of cold spray rose up in the wake of the dogs. At times I thought I could smell the sea through the ever-widening cracks. When the temperature dropped, the spray on the dogs froze, turning their coats into chilly armor.

In places open leads forced us inland, onto terrain etched and frozen into fields of crystal knives. Napaseekadlak fitted the dogs with little boots made from sealskin to protect their paws (page 315).

Our team leader at that time was a

nameless massive gray animal—part dog, part wolf. She was haughty and proud, possessed of great strength and character. She always seemed to know what was expected of her, and she did her job well. She would not allow us to pet her, but there had never been any need to discipline her.

Napaseekadlak had an amazing rapport with dogs, speaking to them with just the right inflections to keep the team working at top efficiency. But once, near the end of a long day as we raced a storm toward a DEW line station a dozen miles away, his urging failed. The big gray leader had simply gone as far as she wanted to go.

So he hit her. From that moment, she was driven by defiance. She continued on for a time, but her movements were full of spite. For example, when commanded to go right, she would make a sharp 90-degree turn, rather than the gradual swing in that direction.

We finally gave up and made camp. But the dog wasn't to forget the humiliation of having been struck. That night, as the storm bore down on us, that magnificent animal stood erect, with her face to the wind—stood like that until she could stand no longer. She fell only after the savage wind had sucked the last bit of life from her.

WE WOKE UP on the morning of June 11 to leave the land for the last time by dogsled. Here the sea ice and shore were separated by open water. Just the night before, we had scrambled to the beach on a floating bridge of ice, which was now a flimsy, half-melted honeycomb.

To get back over to our highway on the frozen sea, I attempted to pole-vault across with the long stick, which Eskimos call an *ayontak*, used to probe for holes under the meltwater on the ice. I fell short, and reached the sea ice wet and annoyed. I pulled the lead dog across by rope, and the others, being harnessed to the trace, had to swim across.

But Napaseekadlak was left stranded. He finally worked his way across on a narrow ice bridge, which collapsed. He, too, was soaking wet, but it could have been worse. Like most Eskimos, Napaseekadlak could not swim.

At Nicholson Peninsula photographer Nicholas deVore flew in to join us for the last leg of the sled journey. Our progress was good until we came to a place where a stream had poured its flood out onto the sea ice. Leading the dogs, we carefully waded

"**The sun revolved in a clear sky** as we threaded our way past pools of water atop the ice," wrote Colin after a ride through a sunlit night near Nicholson Peninsula.

NICHOLAS DEVORE III

across the narrowest spot and once again found firmer footing.

Farther west the great Mackenzie River too had broken, opening a 100-mile stretch of water across the delta where the 2,600-mile-long river finally meets the Beaufort Sea (map, page 300). It would now be impassable by sled and dogs, and we knew we would have to complete the trek in a canoe.

I gave all the dogs to friends in Tuktoyaktuk, a settlement of several hundred on a lake-strewn peninsula. Blossom was the only one to have stayed with the team from the start, and it grieved me to leave her. She had performed well, and, unlike most working dogs in the Arctic, she was a companion. She had made us laugh with her acts of mischief at times when we should have been crying with hunger and pain.

We purchased a 22-foot canoe and two 25-horsepower outboard motors. I thought it best that we carry a spare engine because my understanding of things mechanical is not as solid as my trust in dogs.

IN LATE JUNE we left Tuktoyaktuk. The trip across the delta was easy enough, but once on the other side, we were astonished to find sea ice solid to the shore. Suddenly I longed for the dogs and sled.

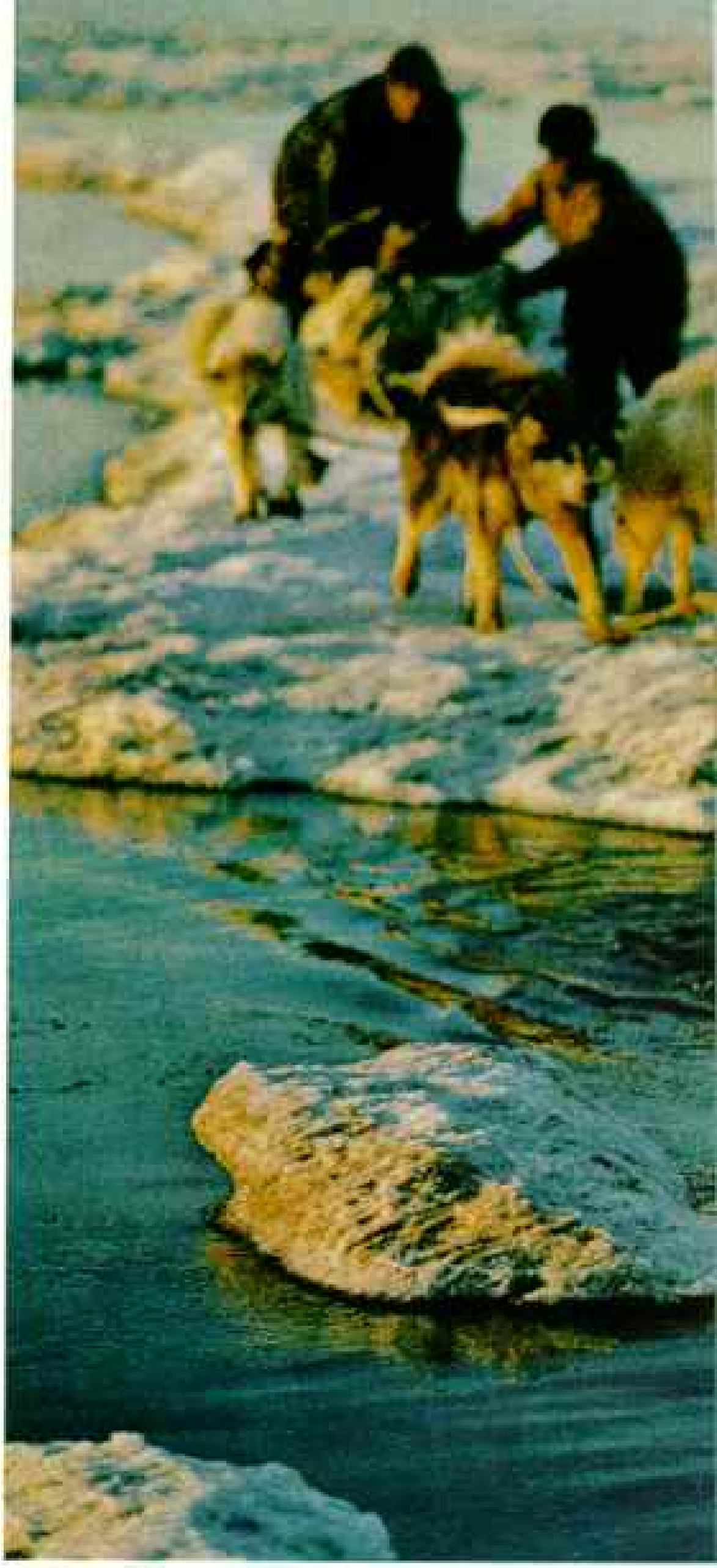
We could do nothing until the ice went out, so we took the canoe up the Blow River in Yukon Territory, where we camped for a week. Then we got as far as Herschel Island before the ice closed in once again.

Our food supply was in good shape, for there was an abundance of wildlife, including ducks and geese. Also, near Herschel Island, a stray caribou walked into our camp. Napaseekadlak was so startled that he missed with his first shot. We made the kill, however, and Napaseekadlak cut the meat into strips and hung it up to dry.

Even more exciting for Napaseekadlak was finding part of a whale rib near our camp on Herschel Island. Years ago he hunted whales out of Dorset Island in Hudson Strait, and Fort Ross on Somerset Island. But in the late 1960's he moved to Spence Bay, northwest of the Simpson Peninsula, where there are no whales.

As he looked at the whale bone, his mind must have been flooded with memories. Later he spent many evenings carving the bone—into a sculpture of a whale.

Favorable winds pushed back the ice, and



Bred to be tough, Colin's sled dogs wade through a pool of bone-chilling water; one takes to the dry toehold of an ice island. The dogs can splash across flooded ice without harm, but must have sealskin boots when faced with fields of ice needles (**right**).

ALL BY NICHOLAS DEVORE III

our canoe moved on toward the nearby Alaskan border. Traveling now was predictable and monotonous. Where an ice-free river mouth opened into the sea, we could use the motor. Otherwise we paddled or portaged. The ice still stretched to the western horizon, but we could usually push through the tidal cracks along the shore.

At long last we reached Alaska. Four-fifths of my journey was over.

We stopped briefly at Demarcation Point. The bronze border marker's wooden frame, I noticed, had been clawed by polar bears. Beyond Demarcation Bay, ice was no longer a problem. Now our only wish was for sunny days free of wind and rain.

At Barter Island we visited with Fred Gordon, a hunter and close friend. He told us that his wife had perished in a blizzard that winter. She was the third acquaintance of mine to have died in this manner during the three years I had been in the Arctic.

IT WAS JULY 15 when we reached Prudhoe Bay. Summer had rouged the North Slope with the fragile tints of wild flowers, and the sun was up around the clock. The darkness of Arctic winter, the ice, the cold, the uplifting solitude of the vast land—all this seemed far behind us now.

Charles Towill, an oil-company representative, arranged for me to call my mother in England from Prudhoe Bay. When I spoke to her, I learned for the first time that my sister had been married for several weeks.

Fitted with hard hats, Napaseekadlak and I were taken on a tour of the oil facilities at Prudhoe (page 321). My Eskimo companion marveled at the network of roads, built up above the surrounding tundra, that connected the complex of oil wells. The wells, Prudhoe's reason for existence, were all capped and awaiting construction of a pipeline—officially approved last November—to carry petroleum to the oil-thirsty south.*

We set out on the final leg of our long journey, but we were not to finish without another blow from the weather. Shortly after leaving Prudhoe, we beached our canoe for two days in the face of heavy winds and rains.

Warm, sunny days followed—so warm that Napaseekadlak spent much of the time in shirt sleeves. Still, the water along the coast was littered with *(Continued on page 321)*

*William S. Ellis discussed the pros and cons of the North Slope pipeline in the October 1971 GEOGRAPHIC.

Winter bows to spring, but survival remains a problem. Colin and Napaseekadlak empty boots and change clothes swiftly after a surprise dunking (**above**). Loss of the Primus stove forces them to convert a coffee tin—here sitting atop an empty gasoline can—into a seal-oil cooking range for pan-fried bread (**right**).

Camped on the banks of the Blow River, Colin

and Napaseekadlak pluck a brace of black brant for a late night's cookout (**above**); another gift of spring reaches the dinner table in the form of wild-goose eggs left deserted on the nest (**below**).

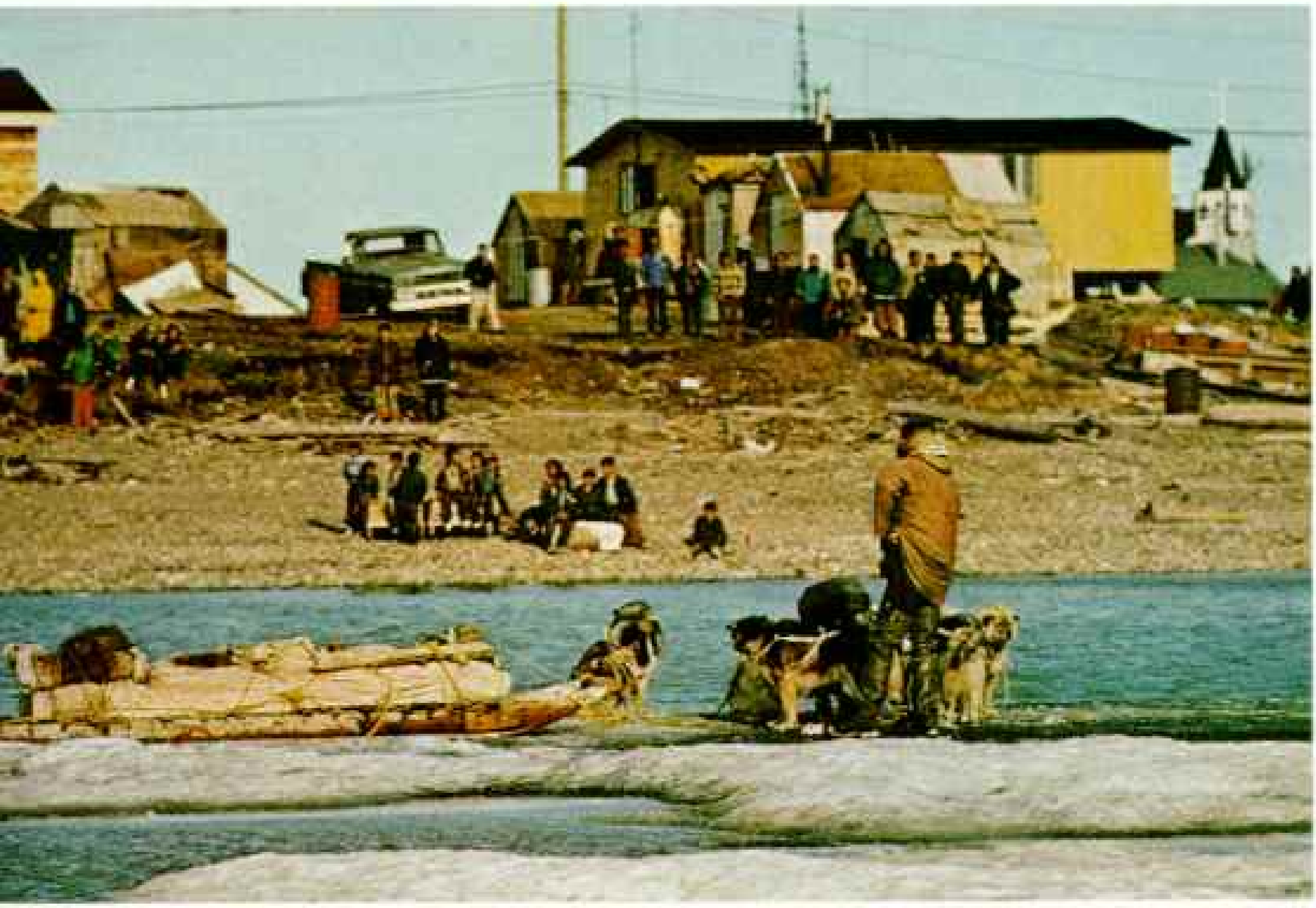
Though he carried some supplies—coffee, tea, flour, and sugar—Colin often depended for his existence on the whims of a harsh environment, each night's dinner a result of that day's hunting luck.

ALL BY NICHOLAS DEVORE III

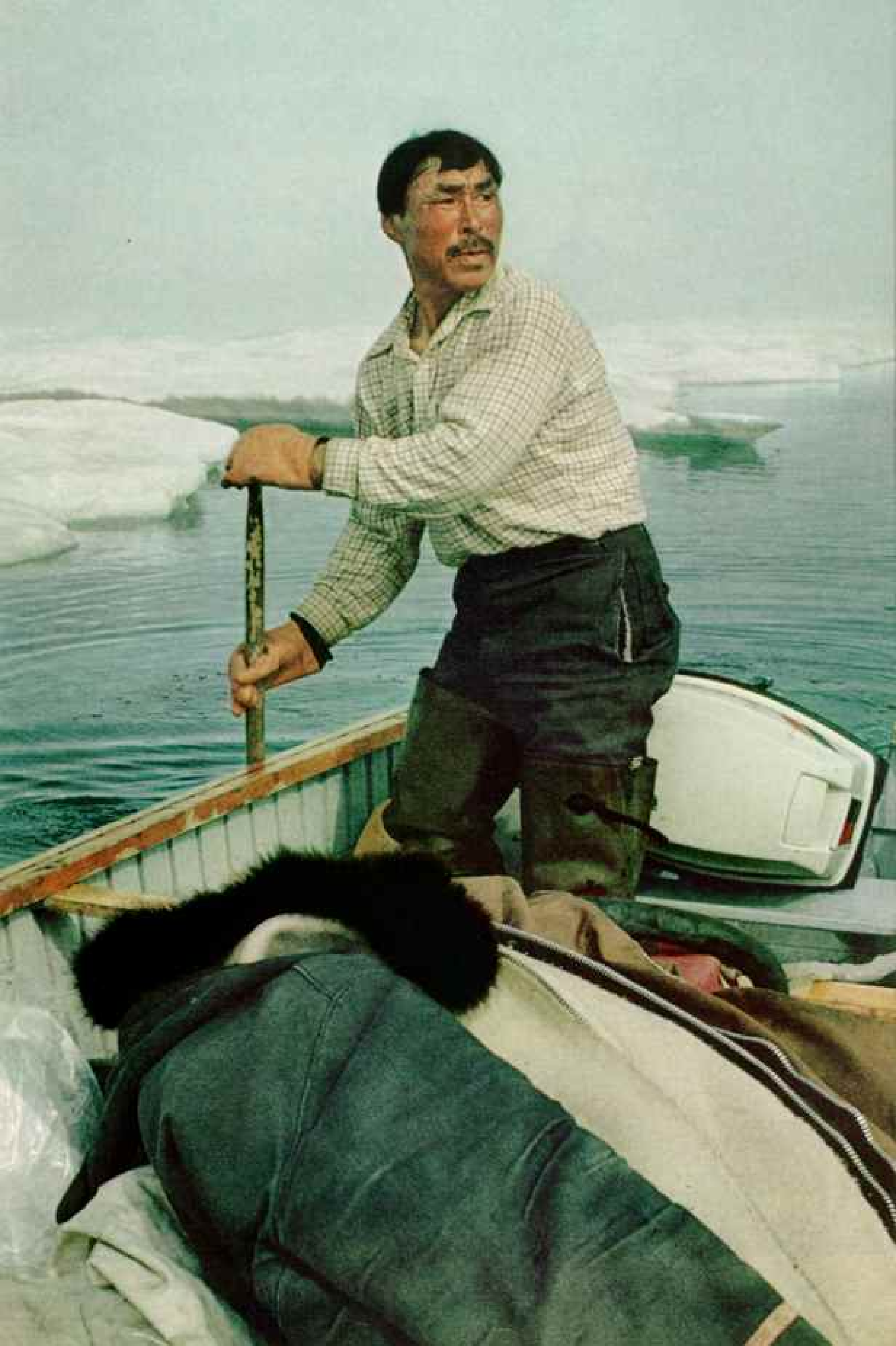
Seagoing sled carries Colin and his guide as the dogs strain toward the headland of Nicholson Peninsula (**above**). Waterproof canvas wrapped tight around some of the supplies gives added buoyancy to the wooden sled.

Enjoying the appearance of travelers from the sea, the townspeople of Tuktoyaktuk flock to the beach to greet them (**right**); even toddlers turn out for the occasion (**left**). A modern settlement near the wide Mackenzie Delta, Tuktoyaktuk serves as a supply port for the central Arctic.

Though Colin's adoption of Eskimo ways helped him deal with the Arctic's uncertain temper, it also created problems. "I used to live in one world," he writes. "Now I live in two, and my mind does not know where to settle."



ALL BY MICHOLAS MEADOW III



Far from home but still in his element, Napaseekadlak poles through a broken ice field in Alaska (**left**). Later he joins Colin for a hard-hat tour of the oil rigs at Prudhoe Bay (**right**). From here, the author radiotelephoned his family—the first time he had been in touch with them for nearly two years.

floes. On July 23, with the sun still glowing late at night, we pulled our canoe up on the shore at Point Barrow. Beyond, the sea ice again closed in solidly. This was our destination, and nature, it seemed, did not plan to let us go farther.

The 2,500-mile journey was over.

MY ESKIMO FRIENDS find it difficult to understand why I undertook so long and arduous a journey. I confess I find it equally difficult to explain to them.

My first winter in the Arctic, I used to look from the window of my office in Cambridge Bay and see the Eskimos of the settlement heading out on their snowmobiles to hunt caribou and other game. I felt restless and confined.

Although the government provided me with a house, I chose to live with Kamaoyoak, and he was forever telling me stories of great hunts, of storms survived, of sled dogs with noble character. It was he who inspired me to challenge the Arctic using only the skills of an ancient people—skills newly learned by me, and increasingly forgotten by them.

I started on the trip figuring that it would take four months. It took nearer to six. I would not want to repeat the adventure.

But I know now that I can burn seal blubber when I need a fire. I know I can find warmth in a snowhouse when the temperature is 60 below zero. I know that I can take nourishment from the marrow of a caribou bone when there is nothing else to eat.

I know too that, all things considered, the passing of the times when those practices were part of everyday Eskimo life is not to be mourned. That life had many fine qualities, however—a willingness to share all until there was nothing, for example. It will be a tragedy if this too is lost. Still, Kamaoyoak's stories fell short of telling all.

When I visited him in Cambridge Bay while making the trip, he must have sensed that I knew this. That would explain our changed relationship. It was now one of mutual understanding. A certain magic sprang from the gap that separated our generations and cultures, and that spell was now broken, to be replaced with an even deeper bond.

Now, we both knew that the great hunt consisted mostly of a long walk and an empty stomach. □

"**Grow, industry, grow, grow, grow!**" At the giant Matsushita color-television plant near Osaka, crisply uniformed employees begin each workday with a rousing rendition of the company song, followed by a respectful recitation of the company creed. Such fervent loyalty swells

dividends of business conglomerates whose success has lifted Japan from World War II's ashes to today's astounding but threatened prosperity.

Those Successful Japanese

By BART McDOWELL
ASSISTANT EDITOR

Photographs by FRED WARD
BLACK STAR

MADAM BUTTERFLY—or so we can call her—was age 37 and had been married 11 years. Just 14 months ago she became a career girl in Tokyo. Within six months she had suffered an unhappy love affair and considered suicide.

Butterfly's case history comes from the Tokyo Family Court. Her problems typify the human adjustments that 107 million modern Japanese are making in their crowded, prosperous kingdom. Butterfly went to work because of high prices, a labor shortage, and a new willingness in Japan to hire women.

"Her husband was a teacher," reports Mr. Mitsugu Hirayama, family counselor for the court. "They had no children and no parents living with them to give them wise advice. She entered the employment of a large trading company—and met worldly people."

At work Butterfly got involved with a man who soon tired of her. Feeling jilted and guilty, she sobbed out her story to court personnel. "She wanted to kill herself or to tell her husband," Mr. Hirayama recalls. "But we counseled her not to do either. Instead we advised her to devote more time and affection to her husband. Recently she visited us. She realizes that her mistake

Benefits beyond the fringe go to employees of Japan's mega-companies. Near Matsushita's Osaka plant, a wedding room in a workers' recreation center (**right**) welcomes a steady flow of couples, often introduced by matchmakers in the personnel department. Offspring, too, reap advantage from company paternalism. At Sony's Atsugi plant (**left**), an employee's daughter studies violin in the company day-care center.

Muscle-stretching exercises fill a break at one of Sony's Tokyo plants (**left**), where an employee leads women of the assembly line in an enthusiastic backbend. After work, a spectrum of activities helps cement the group spirit and a feeling of togetherness. Workers at Matsushita (**above, left**) practice judo in an after-hours class.

Even away from the job, the gentle tentacles of paternalism reach out. A young couple (**above**) survey construction of their new home in Yokohama, financed through Canon, the husband's employer. Big concerns often buy tracts of land, then sell lots to employees at bargain rates. Without company aid, many Japanese could never afford to own a home.

was caused by her ignorance of modern business society. She has now quit her job and helps her husband with his research. Both are happier."

This approach may not surprise Western marriage counselors, but the Japanese still find such problems unsettling as they try to adjust to their urban, industrial society.

Who Will Own the 21st Century?

For months I have followed the Japanese around their homeland and abroad, seeking the human story behind their statistics. I have asked them—and the people who do business with them—about the secrets of their success and what changes industrial prosperity has brought to their lives. How could a defeated country rise from the rubble of World War II and build itself so quickly into the world's third largest industrial power?

Since 1945 Japan's industrial output has increased 20-fold. Her favorable trade balance by early last year had built a 19-billion-dollar reserve of gold and foreign currency, the world's largest after West Germany. As the world's thriftiest savers (200 billion dollars in bank deposits), the Japanese reinvest heavily in their businesses. And in case anyone still calls them copycats, Japanese research investments are exceeded only by those of the United States and the Soviet Union. Japan's patent applications—half a million a year—have more than quintupled since 1952.

By one yardstick, how fast its gross national product is growing, Japan leads all industrial nations. On a per-capita basis, Japan has already surpassed the Soviet Union in GNP and could pass the U. S. by 1990.

On such projections, American scholar Herman Kahn, of the think-tank Hudson Institute, has predicted that the 21st century may be the century of Japan.

"Why not the 20th century?" asks a traveler in Paris's Orly Airport. He points to signs in Japanese characters and to coveys of kimono-clad Japanese on tours. "They are even negotiating to buy French vineyards."

In Tahiti the director of tourism is studying Japanese. And a Bolivian radio station airs a Japanese course three times a week.

"Consider our telephones," says a German in the Ruhr. "We can direct-dial Japan."

An educator in London has described Japan as the "first great empire without real estate. The sun never sets on the Rising Sun."

"Wanted—Japanese samurai swords," the ad of a New York dealer exhorts. "Paying top price!" And, indeed, souvenirs bought by GI's for a dollar or two have returned home, some to their original owners, at a $100 or even a $5,000 price.

With nearly seven billion dollars in foreign investments, the Japanese have paid their dues in the world club. Japanese expeditions have explored the upper Amazon River and climbed Mount Everest. Japanese largess has lately given a million dollars to each of ten American universities, ranging from Harvard to the University of Hawaii. The highly effective Japan Overseas Cooperation Volunteers—their peace corpsmen—are at work in 16 countries, planting gardens in Morocco, testing the soil of Nepal.

"We were building a highway near Tanzania," reports peace corpsman H. Yoshimitsu in Kenya. "Many lions there. At night our men could not go outside camp even to make water. But once, when lions killed a wildebeest and left the carcass for later, our men cut off some meat for themselves before lion returned to eat. Wild place." But not too wild for hungry Japanese to turn to gain.

Yet the worldwide Japanese adventure has not been universally welcomed. Brazilians and Indonesians have called the Japanese "economic animals." Students in Bangkok have boycotted their products and called them "yellow Yankees."

And some Yankees themselves—especially those in Hawaii—also grouse. "They are bombarding us with yen," says a Nisei Hawaiian. He jokes wryly about "more hostility toward Japan now than in December 1941."

Sad Days for Cherry Trees

But I found foreign complaints matched by those of the Japanese themselves.

"Our cherry trees are dying in Tokyo," one woman lamented. "And diseases of pollution are known by the names of our cities."

Venerated Fujiyama can now be seen from smoggy Tokyo only one day out of seven. And an electronics manufacturer in Osaka told me: "In areas with bad air, our television antennas sometimes last just one year."

Psychological pressures mount. An electric sign near the Ginza registers the noise level like the time and temperature in other cities. The government tobacco monopoly announces that more than a million Japanese started smoking in one year, bringing the total to an amazing 33,060,000—or 77.6 percent

of all men and 15.5 percent of all women.

More alarming are some of the news headlines: "Man Kills Himself Over Medical Bills." "Boy, 15, Fails Entrance Exam, Commits Suicide." After a decade of decline, suicide is again increasing in Japan. The rate is 27 percent higher than that of the U. S.

As the world's number-one importer of oil—85 percent of it from the Middle East—Japan stands chillingly vulnerable to world events. When the Arab states cut back exports last autumn, lights went out on the Ginza, TV stations curtailed broadcasts, and the cabinet changed both its policies and its personnel. Pessimists predicted ruin.

Skepticism by a Rip Van Winkle

Is success worth the suspense?

"A fictitious success!" hoots Hirotaro Ogura, who represents a Japanese airline. "Japanese militarism did not die after World War II. The loyalty merely changed from the Emperor to the employer."

"We are nominally rich," says a senior executive of Japan, Tetsuro Umegaki, of Dentsu Advertising Ltd. "But look at the way average people live: Perhaps the lowest living standard of all the developed countries."

A newsman particularizes the point: "Only 15 percent of Japanese homes are connected to sewers."

"It is harder to live today than before the war," Sgt. Shoichi Yokoi told me. The sergeant enjoys an unmatched vantage point: He held out for 28 years in the jungles of Guam, finally ending his personal state of siege in January 1972. So he compares the old and new, like Rip Van Winkle, without the clutter of daily transition, "Japan as a country has lost power. People have lost traditional beauty and the high quality of *yamato damashii*—Japanese spirit."

In large measure, though, the Japanese spirit explains current prosperity. "To understand Japanese business," an American Nisei friend had advised me, "you must start with Zen Buddhism. The values of Zen—diligence, self-denial, loyalty—shaped the knightly samurai character. These qualities make Japanese workers productive."

I tried my friend's ideas on a Zen Buddhist priest, the Venerable Zenshu Inoue, in the classic monastery gardens of old Engakuji Temple.

"Responsible for the economic success? No, we are its victims," the priest said. His gaze swept out beyond ponds covered with a skim of ice to an old plum tree, gnarled, propped with logs, but winking with a few early blossoms. "That tree is many centuries old," he added. "Those cedars are 400 years old, and dying from pollution."

High-density islands pack 107 million people into an area smaller than California, home of 21 million. Lack of minerals forces Japan to rely on human resources.

The Venerable Inoue spoke of traditions Zen had brought from China in the 12th century: flower arrangement, the tea ceremony, kendo (fencing with staves). "But that is not well said," he corrected. "Kendo *is* Zen. The tea ceremony *is* Zen. *Pursuing and devoting yourself to your own work*—that is Zen."

So work is worship in Japan.

Zen is only one of many imported ideas that the Japanese have embraced with both energy and alarm. Mainstream Buddhism, also from China, caused a great stir, and the Nipponese of the eighth century moved their capital from Nara to Kyoto to escape the influence of the Buddhist hierarchy. Christianity followed in the 16th century; the numbers of converts—some 300,000 by the early 17th century—so concerned the ethnocentric Japanese rulers that they turned the archipelago into a hermit kingdom. Any Japanese who tried to leave his homeland was summarily put to death. *(Continued on page 332)*

Doing things in multiples becomes a necessity in a land where space is at a premium. Triple-decker driving range in Tokyo (**left**) caters to thousands swept up by the Japanese craze for golf.

Flag raised high to show the way and keep her flock from mixing with others, a tour guide (**top**) shepherds young visitors through the grounds of the Imperial Palace in Tokyo. Inveterate tourists at home and abroad, Japanese join touring and hiking clubs by the millions—forgoing solo travel for the security, camaraderie, and preplanned itinerary of the group. Newlywed couples (**above**), instead of hiding out in a niche away from the world, join forces on a tour of Mount Kaimon in southern Kyushu.

Parboiled by heat rising from subterranean springs, vacationists simmer

blissfully in sand baths at the Ibusuki Kanko Hotel on southern Kyushu.

In the 1630's a decree forbade even the building of large ocean-worthy ships. Ironically, Japan now builds nearly half the world's tonnage: 11.9 million tons a year, or more than 20 times U. S. production.

Other ships—the steam-powered U. S. Navy vessels of Commodore Perry—ended Nipponese isolation in 1854. A new regime modernized the kingdom and armed it against foreign domination—and moved the capital again, from Kyoto to Tokyo.

Recently the *Japan Times* published a portentous headline: "Plan to Build New Capital." The construction minister had suggested a model city for a million people on an unspecified 30-square-mile site for the purpose of "alleviating the tremendous congestion in Tokyo." History seemed to be repeating.

The congestion becomes frenetic in department stores. Prices are stratospheric. And the temptations—mink jackets styled to wear over kimonos, dolls that sell for $1,000 each—press customers to get, do, and have.

The pursuit of happiness is fast. Violent television shows feature gory samurai sword fights. *Pachinko* (pinball) parlors mesmerize customers for hours. "My father spends his day off at pachinko shop," one youth told me. "He takes his lunch in a paper bag."

Japanese cinemas exhort the public with luridly pornographic posters. Pharmacies sell energy pills for all-night Mah-Jongg parties. And traditional Japanese bathhouses have gone flashily opulent, with fake mother-of-pearl tile and color TV. Japan has made it big.

Samurais of the stock market: As if flailing invisible swords, brokers on the tumultuous floor of the Tokyo Stock Exchange wave their hands to make a bid. Trailing only New York in money value, the Tokyo exchange reputedly ranks first in the world in sheer frenzy and decibel level.

Tokyo's Stock Exchange Becomes No. 2

The success story began in the rubble of World War II, when a third of all Japanese industry lay in ruins. With U. S. occupation, Japanese were again permitted to tune their radios to the long-forbidden foreign stations. Some enterprising engineers opened a shop to repair old radio sets. One day a foreigner brought in a recorder for adjustment, and the repairmen got ideas. Today their shop is called Sony.

Other giant industries—Honda, Panasonic, Canon—similarly rose from ashes. U. S. military purchases during the Korean conflict fattened the economy. Big conglomerates, broken up by the occupation authorities, again coalesced. The Tokyo Stock Exchange, once so speculative that a wit called its brokers croupiers, began to log a steady ascent.

Today, in money value, the noisy, teeming Tokyo exchange ranks second in the world, after New York. Ironically, Japanese racetracks post their odds on sophisticated electronic display panels; the stock exchange still uses 15 board boys armed with chalk.

The exchange stands on a street named Kabuto-cho, or "war-helmet district," where arms makers once outfitted fierce samurai. And though the neighborhood has long since beaten swords into stock shares, a samurai loyalty survives in Japanese business.

An archetype is the Mitsubishi conglomerate, a group of firms founded a century ago by a samurai of the Tosa clan. "Our motto," said one *sarariman* (salaryman, or white-collar worker) at Mitsubishi, "is organization."

Among its rival firms, the Sumitomo company is known as one of the hardest working. "To keep from wasting time at lunch," gossips joke, "they eat instant noodles at their desks." Each company enjoys its own clannish prestige; employees proudly wear company lapel pins.

In the Japanese business card, the *meishi*, I still detect overtones of feudal hierarchy. When strangers are introduced, each ritually studies the other's business affiliation and

titles. The deepest bows go to those identified with *torishimariyakukai* (board of directors) and *shachoshitsu* (office of the president). Shallower bows go to a *bucho* (head of a department).

"If I had to explain Japanese business in one word," a foreign businessman told me, "I'd say 'group-think.'" Decisions are made after long meetings, extensive memo-passing, and—*plunk, plunk*—the rubber stamping of company seals.

"Meetings are hard to take," an American businessman confessed. "People keep shouting *'hai,'* yes. At first I thought they meant, 'I agree.' Then I decided they just meant, 'I understand.' Now I'm convinced hai really means, 'I'm awake.'"

But once the group reaches a consensus, everyone moves quickly.

"The Japanese don't work harder than we do, but they work *together*—and that's enough to beat us all." That considered statement came from Father Robert J. Ballon, an economist and Belgian Jesuit who heads the Sophia University Socio-Economic Institute in Tokyo. "If the Japanese were individuals," Professor Ballon said, "this place would blow apart right now. Here, the group—the 'we'—is all-important. Even the language reflects this attitude." In conversational Japanese, for example, the pronoun *I* is rarely used.

Golf Suits an Action-oriented Culture

Professor Chie Nakane, social anthropologist at the University of Tokyo, tells a story about the office building planned by the Shell Oil Company. British and Dutch executives insisted on private offices—but Japanese employees objected. "It had a vital significance," says the woman professor. "The Japanese wanted a common room where everyone worked together. They didn't like to be alone. So Shell had to redesign the offices. Japanese would rather do anything than sit alone and think. It is an action-oriented culture."

For this active reason, the Japanese businessman turns to golf. "Of course we do business on the golf course," a Mitsubishi executive told me. "My wife says business is my hobby, and golf is my business."

Despite the Tokyo joke that "the Japanese tee off in order of their salaries," golf is a serious business.

"I worry about golf," a conservationist laments. "We have precious few square meters of level land per Japanese. We already have some 600 golf courses, and 550 others are planned, an area equal to that of our largest prefecture."

Investors speculate in golf-club memberships, and green fees can run as high as 8,000 yen, about $30. But, like other pleasures, golf often goes on the expense account. Japanese businessmen spend more than one and a quarter *trillion* yen a year on tax-exempt entertainment.

"I attend business dinners at least four nights a week," the executive vice-president of one trading company told me. His schedule is typical. The bill for drinks and dinner may run to $100 a head. Add a geisha to play the samisen, or a hostess to serve the meal, and the price leaps dramatically.

"And at what hour did *Gozensama* come home?" one housewife asks another. The word means "Mister Early Morning," and it encapsulates a common complaint.

Everyone Sings the Company Song

Professor Nakane explains long work hours in terms of anthropology. People make a village of the work place, she says. They do—and especially at the giant Matsushita plant near Osaka.

Founded 56 years ago by a home workshop inventor named Konosuke Matsushita, this firm floods the world with its radio and television sets, and its thousands of other electronic products. In sales, it ranks sixth among Japanese manufacturers; in profits, first.

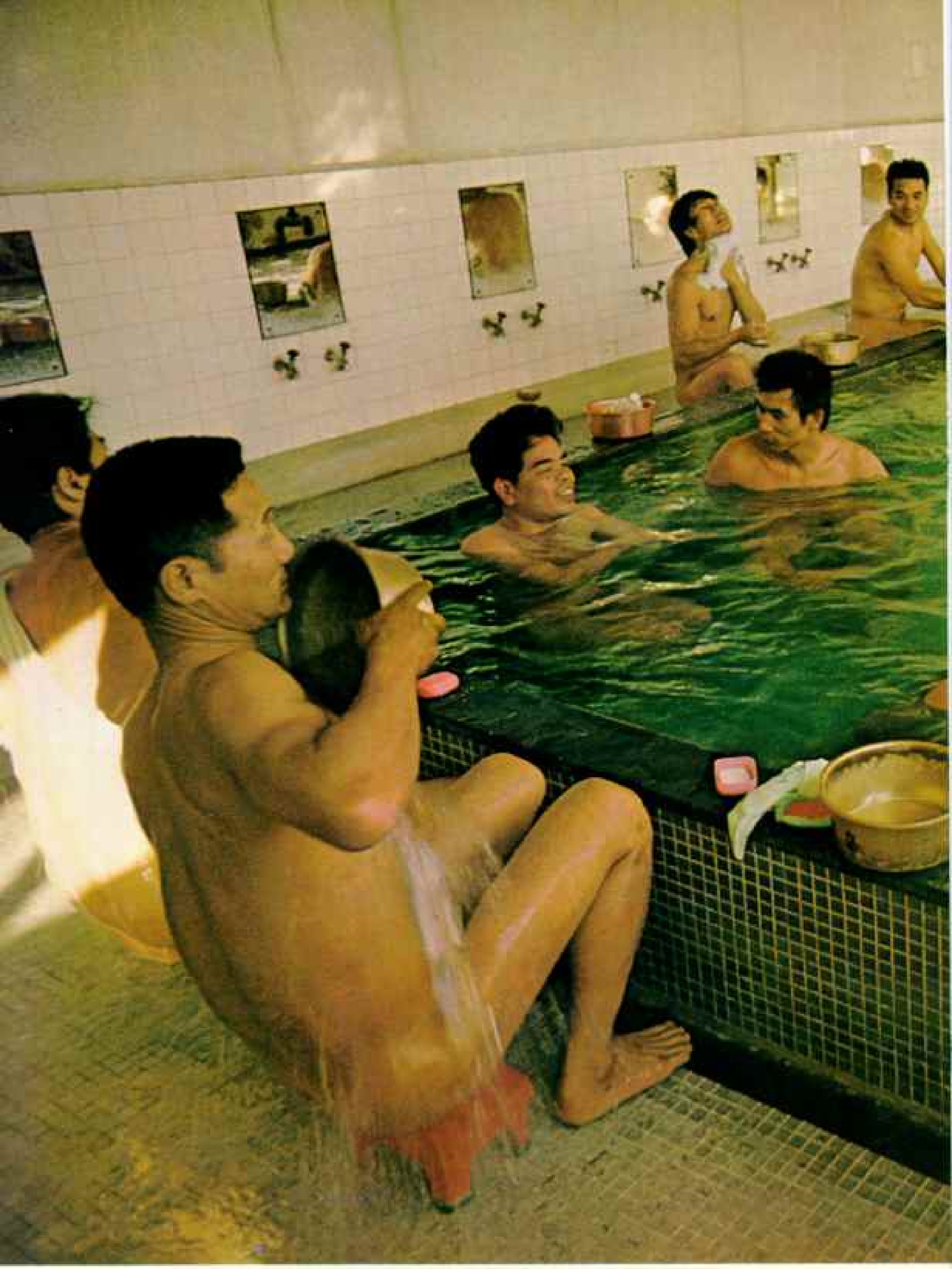
At 8 o'clock one morning I stood in the TV factory while foremen and workers gathered in rows. A moment later, on signal, the workers began to sing the company song:

For the building of a new Japan,
Let's put our strength and mind together,
Doing our best to promote production,
Sending our goods to the people of the world,
Endlessly and continuously,
Like water gushing from a fountain.
Grow, industry, grow, grow, grow!

Every factory employee sings this song at 8 a.m. "And at 8:30, when the offices open, all the executive personnel sing," explained Mr. K. Yamada of the public relations department. "Even scientists in the laboratories." If their ceremonies seem naive and square—somewhere between the Thoughts of Mao and Babbitt-*san*—Matsushita production does not. Highly sophisticated machines now *(Continued on page 340)*

The very model of a modern executive, Sony President Akio Morita (**left, top to bottom**) dictates messages to departments in his Tokyo office, catches up on paper work aboard his private jet, and inspects a machine in his firm's increasingly automated operations. Tied to a computer, the highly sophisticated device masterminds the assembly of hundreds of parts into electronic circuit boards.

Flamboyance is a way of life for many of Japan's new breed of self-made millionaires—a far cry from the typically shy, somber-suited, self-effacing Japanese businessmen of a decade or two ago. Here Saburo Akai, far right, who has reaped personal profits of more than $50,000,000 in the tape-recorder business, entertains guests in his palatial Tokyo home. Though the decor is Western, the amenities—including a standard offer of indoor footwear for guests—remain traditional Japanese.



Bucketing off a day's grime, then slipping into the communal tub for a nerve-soothing hot

soak, employees at a steel plant on Tokyo Bay revel in the luxury of the company bath.

Peaceable invasion

A VISIBLE PRESENCE around the globe, Japanese tourists, businessmen, teachers, and technicians ride a wave of internationalism that geographically far transcends the territorial dreams of Japanese militarists in World War II.

One soldier in Japan's economic foreign legion is Hidehiko (Dick) Tsuru, logging coordinator for the Japanese-owned Alaska Lumber & Pulp Company (**left**). The timber that he and American colleagues help harvest will be transformed into everything from homes to photographic film in wood-hungry Japan.

Halfway around the world in Africa (**top**), a member of Japan's peace corps teaches Kenyan girls how to sew.

Lest children of Japanese lumber executives in Alaska become "de-Japanized," a company-hired teacher in Sitka (**right center**) gives regular instruction in Japanese reading, writing, and culture.

A Japanese maritime cadet (**right**) poses for a snapshot with a grass-skirted Hawaiian lass in Honolulu, whose Waikiki area has been nicknamed "Little Tokyo" because so many of its hotels are now Japanese-owned.

Blessed silence reigns as grade-school students in Tateyama assault only their own ears while practicing on Yamaha electric organs. The teacher tunes in selectively to monitor each student's progress—or the lack of it. When necessary, she can issue verbal knuckle-rappings heard only in the headset of the embarrassed offender.

replace human hands in the TV factory.

"Labor is scarce and expensive," complains one export executive. And for this reason, many firms are now expanding their factories in cheap-labor areas like South Korea, Taiwan, and Thailand. "With that machine," Mr. Yamada pointed to a device inspecting TV sets for quality, "we try to eliminate even human brains."

But until the company succeeds, rewards—as high as 150,000 yen ($535)—go to employees whose ideas boost output. Training programs abound, though not all are job-centered. Workers may learn the tea ceremony, calligraphy, kendo, judo, and *ikebana*—traditional flower arranging.

Want a Wife? Ask Personnel

Photographer Fred Ward and I observed the ultimate in Matsushita togetherness one afternoon at a company chapel in a recreation center. A 28-year-old personnel man named Hidetsugu Kikukawa (basic salary 78,000 yen, about $285 a month) took as his bride a pretty 26-year-old office worker from the gas appliance department, Tomiko Ikuta (basic salary 59,000 yen a month). "Yes, a love match!" beamed the groom. "We met three years ago. The company has some hiking groups, and we met on the hiking trails."

The official go-between, a personnel man named Mr. Itahashi, showed us to the company Shinto chapel. There 28 relatives, a priest, and two acolytes gathered before an altar. The Shinto ceremony proceeded solemnly. Then, to the cadence of recorded Japanese music, the party filed downstairs to a dining room. Now the recorded wedding march from *Lohengrin* swelled over Matsushita amplifiers as the couple entered. At banquet tables sat 52 guests. Office dignitaries made speeches:

"Personnel is the office that keeps office secrets; the groom has kept secret all his own romances. . . ."

"We have so many union members here it reminds me of collective bargaining. . . ."

Even if a boss has used his quip before, he deserves loyal laughter. A jolly day.

The Mitsubishi people even employ a computer in the traditional role of go-between for company marriages.

"Other matchmaking agencies got a bad name," said Takeo Nagatani, my interpreter. "Some young male applicants did not have pure purposes."

So in 1971 Mitsubishi set up its own agency, with an imported IBM computer and the economic clout to keep all purposes pure. Now unmarried Mitsubishi employees (the Tokyo area alone has thousands of them) and their relatives can pay an 8,000-yen registration fee and fill out the necessary forms.

"One special case just now," says Hiroyuki Ito, general director of the marriage service. "The young man works in our New York office, and the girl here in Tokyo. Their parents have examined the records and have become ardent. So the couple may meet in Hawaii for the first time—at their wedding!"

I discussed this electronic love story with my interpreter, who is 23. "Today, among my friends, the *o-miai*, or arranged introduction, is growing more popular," he said. "People feel it's romantic." And statistics bear him out: Perhaps a fifth of Japanese marriages are now arranged by parents. "On her wedding day," said Nagatani-san, "my mother had never before seen my father. She was pleased to find him so tall."

But Takeo Nagatani did not want the o-miai for himself. And as to the Mitsubishi project, he cast an appreciative, slanted eye

upon the Mitsubishi miniskirts—and asked, "Why do they need a computer?"

Marriage customs somehow resemble the practice of lifetime employment. One man confided to me, "Because I had already worked for two employers, I feared no trading company would hire me. Like marrying too many times."

Parting is an unsweet sorrow, for it connotes a lack of loyalty. A young man fresh from school does not "get a job." He "enters a company." The word choice hints at monastic vows. He stays on, riding the seniority ladder without fear of layoffs. His salary doubles every few years so long as he conforms. A maxim warns: "Protruding nails will be hammered."

A salaryman officially retires at 55 or 60. He then gets severance pay (about three years' salary) or a small pension. Often a retiree must start a second career. Top executives, of course, stay on as long as they please.

Things may be changing, however. Employers now mutter about "my-home-ism" —a tendency of young employees to leave work early and spend more time at home. And a tight labor market now nibbles at habits of loyalty and lifetime employment.

"We need to learn how to live," remarks a young sugar broker. "When the company sent me to London, I suffered from the fog; and with short days I often thought my watch was wrong. England is also not so modern. But then I learned their way of life is very deep. They enjoy their life. When retired, it would be good to live in London. But I do not want to live there while young. *Because in London there is no tension.*"

Bastion of the Six-day Week

Many men in Japan work a tense six-day week. Their labors are gradually improving the way they live. Homes are still cramped by Western standards. But families that can afford it are "getting up off the floor," replacing the traditional tatami mats with Western furniture in at least a main room.

Electrical appliances are nearly universal. About 92 percent of Japanese households have refrigerators and 96 percent washing machines. Clothes dryers are rare. Electric dishwashers are found in fewer than one percent of the homes. "After all, only the women use them," one husband snickered.

Most Japanese households own television sets, according to government figures. Yet the old kerosene stove heats rooms in 85 percent of the homes.

For consumers, progress seems spotty. In fact, the Prime Minister's office took a poll recently and found that almost 60 percent of the people said their way of life had not improved and another 12 percent reported that life had gotten worse.

Progress, like space, is relative. "Japanese society is like a dictatorship," a foreign correspondent remarked. "Everything not forbidden is compulsory."

Mental Hospitals Need No Locks

A U. S. psychiatrist who traveled in Japan in the late 1940's, Dr. James Clark Moloney, has discussed the early development of *ko*, or respect for the father as head of the family. "The mother pushes the head of the suckling into a bow as the father enters the room." Such precognitive attitudes broaden with time into a great respect for authority.

Dr. Moloney was surprised by Japanese insane asylums, since even the most violent patients "lived together in rooms that were separated by unsecured rice-paper partitions. . . . The windows were unscreened glass. . . ." Dr. Moloney concluded that the Japanese, "even when insane, conform to authority."

Sane ones, though, are sometimes less tractable. At rush hour, for example, Tokyo subways must rank as the world's most vexing. I watched in pain as uniformed attendants pushed passengers onto trains, cramming them bodily into cars so doors could close.

"Aren't you afraid of hurting old ladies?" I asked a former people pusher, who is now stationmaster at Shinjuku.

"Not so dangerous," he smiled mildly. "We push men mostly, since they are the ones who try to get onto fully packed cars. It is useful work. We can add 30 more passengers to a car by pushing."

People politely endure such usefulness every morning. But in the course of a union slowdown of commuter trains, headlines blazed out one morning, "Angry Commuters Storm Ageo Station." More than 10,000 rush-hour commuters had mobbed the operations room, smashed windows, and vandalized the platform. So, in the same plural way that they tour, play, and work, the Japanese can also have a mass tantrum.

"They exclude foreigners from their group," asserted a Pakistani at Tokyo's Waseda University. "The very word for foreigner, *gaijin*,

means 'outsider.' And one of their expressions —*hennagaijin* [oddball outsider]—I regard as an insult. Strangers have sometimes called me that when I am walking with a Japanese girl. They are honest people. And diligent. But they do not like foreigners."

Foreign businessmen in Tokyo often attribute their commercial frustrations to the same insularity. "Do you know how many of your Chevrolet Corvettes were sold in Japan in 1972?" a German asked me. "Exactly 18. Why? Well, your price in the U.S.A. was $5,300—and here it was $17,000."

Import duties have played a part in such restraint of trade, but so have cozy agreements and price-fixing associations—all completely legal in group-conscious Japan.

Silence on Women's Lib

As more Japanese work and travel abroad, (some two million in 1973), their attitudes may alter. Already Japanese home life is changing, with signs that the father's authoritarian role is diminishing.

Japan is still no place for women's lib. "Nobody even mentions it here," says the first woman faculty member of the University of Tokyo. "I have never discussed women's lib with any Japanese. Only foreign correspondents ask. Our women will never want or need to fight against men."

I found her view reinforced in a theme on "the liberated woman," written last year by the wife of a Japanese executive living in Germany. Here is a paragraph:

"It's said that after World War II, women and stockings became strong. . . . But I am satisfied. Usually the man goes to the parties without the wife. Once I asked my husband with whom I should spend a nice evening, and he answered, 'With your daughter. She is your nicest doll.'"

But there are real changes, for instance the coeducational schools introduced in the MacArthur era. "Before the war, a boy feared to be seen on the street with any girl—even his sister," a middle-aged executive told me.

"For girls, boys were mysterious," says a woman teacher. "They seemed to have much power and respect. After coeducation, the illusion was gone. Women got confidence."

And after confidence, jobs.

"Working mothers are responsible for our 'key children,'" says Haruo Kitazawa, chief investigative counselor for the Tokyo Family Court. "The children have the key to the home. Some get into trouble. Then there is the *arubaito*, the part-time job a youth of 15 can easily find today, perhaps making 2,000 yen a day doing odd jobs. The youth is economically mature but socially immature."

The English expression "generation gap" has lately entered Japanese usage. (So has the word "privacy," since Japanese lacks an equivalent.)

And communities are starting to provide homes for abandoned old people. "I was an unwelcome guest in the house of my niece's daughter," 85-year-old Sotokichi Katzuizumi told me when I met him and 90 other oldsters in Keiraku-en, or Favored Comfortable Garden, in Kawasaki, near Tokyo. "This place is a paradise on earth," he said with a grateful smile.

Heretofore, old folks' homes, like pensions and unemployment payments and medical treatment, have always been handled privately by families and companies. The shift toward public welfare—or none at all—leaves Japanese traditionalists aghast.

One of them is that most-talked-about folk hero in the realm, the Imperial Army Sgt. Shoichi Yokoi, who held out 28 years in the jungles of Guam. I called on him in the house he and his new bride now share in Nagoya. I expected to see a haggard man like the pictures from just months before: bearded, gaunt, clad in a jute-fiber suit he had woven for himself. He had lived on wild nuts, breadfruit, mangoes, papayas, shrimps, snails, rats, and frogs. His first question as he emerged from the jungle in 1972 was, "Is Roosevelt dead?"

Toll to Spiritual Values Seen

He has now caught up with the times. The 58-year-old sergeant greeted me jauntily, a trim figure in sports jacket and turtleneck. "These gentlemen are television producers," he explained of some other guests. "An interview on tape."

A tailor by trade, he admires the looks of man-made textiles, but says, "They fit too tightly—the body can't feel comfortable." He deplores high prices: "Both husband and wife must work, and they neglect the children's education." Some 22 million automobiles cause some 55 deaths a day, and "some families have more than one car. Though people tell me to own a car, I don't want trouble. I use taxis."

The sergeant watches little television, though he regularly appears on interview

shows; and he has seen exactly two movies since his return. He sighs over strikes and student demonstrations: "We did not know them before the war. We have gained material things and lost the spiritual!"

Sergeant Yokoi has made a nimble adjustment. So has another traditionalist: Fujigiku Ebina, age 77, and the oldest working geisha in Japan. She squints suspiciously at younger Japanese: "This generation is different. They prefer nightclubs to geisha houses. And they offer me chairs to sit in, but I always sit thus." She knelt neatly on the tatami mat.

As the dean of geishas in the Gion district of old Kyoto, Fujigiku Ebina is a spry, durable authority on applied anthropology. She produced her scrapbook with photographs of the old days.

"Here: I was 14 when I became a geisha." The photograph showed a beautiful girl. "Our training was strict—*military!* In winter we had *kan-geiko,* cold-practicing, out on the balcony. We sang. They told us cold was very good for the voice. And in the summer heat, we had to wear the traditional kimono and the hair done so. Hot! I carried the *sensu,* the fan, but I could not use it for myself. I had to sit behind the client and fan *him.* Military!"

She reminisced. During World War II most geisha houses closed. Ebina-san got a job sewing military uniforms for 60 yen a month. "My work was relaxing, but the food very bad. I traded my *bachi,* the ivory pick for playing the samisen, for food." She rambled on, speaking of university students and cabinet ministers she had entertained.

"I'd guess there were 800 geishas here in the old days. Now we have about 190—and only 18 new *maiko*—young dancers—so I am pessimistic. And the girls! Many have Western clothes for use after hours. They even wear panties. I have no Western clothes at all. And certainly no panties!"

Some anthropological standards endure.

"I felt ashamed to come home alive," recalls Shoichi Yokoi, the Japanese soldier who hid in the jungles of Guam for 28 years rather than suffer the dishonor of surrender after World War II. Now married and living in Nagoya, he confesses to visitors a growing disenchantment with the modern world.

Pollution's Price: Maiming and Death

Living in what has been called the most heavily polluted country on earth, the Japanese are fast becoming its most environment-conscious people. Survival demands it.

Minamata was once a charming fishing port on the southern isle of Kyushu; now newspaper readers worldwide know it as the name of a painful, paralyzing, blinding illness. Industrial mercury there went into the sea and its fish and poisoned the folk who ate the catch, killing scores and crippling hundreds.*

Cadmium in the Toyama area makes bones weak and brittle; a flip nickname, *itai-itai,* or "ouch-ouch," belies the intensity of its pain.

I paid a visit to the city of Yokkaichi, near Nagoya, famous for oil refineries, among its varied industries—and for an affliction called Yokkaichi asthma.

"It's better in the last six months," a traffic policeman told me. "People aren't moving out the way they did."

Beside a wharf Tadashi Nagata warmed his hands at a bonfire with his fellow fishermen. "No one wants to buy any fish from here," he said.

"And people go to the hospital every few days for asthma," said Nagata-san. "Bad. In rainy weather, we can't sleep. Some years ago we demonstrated to make companies put up higher smokestacks. And it's better now."

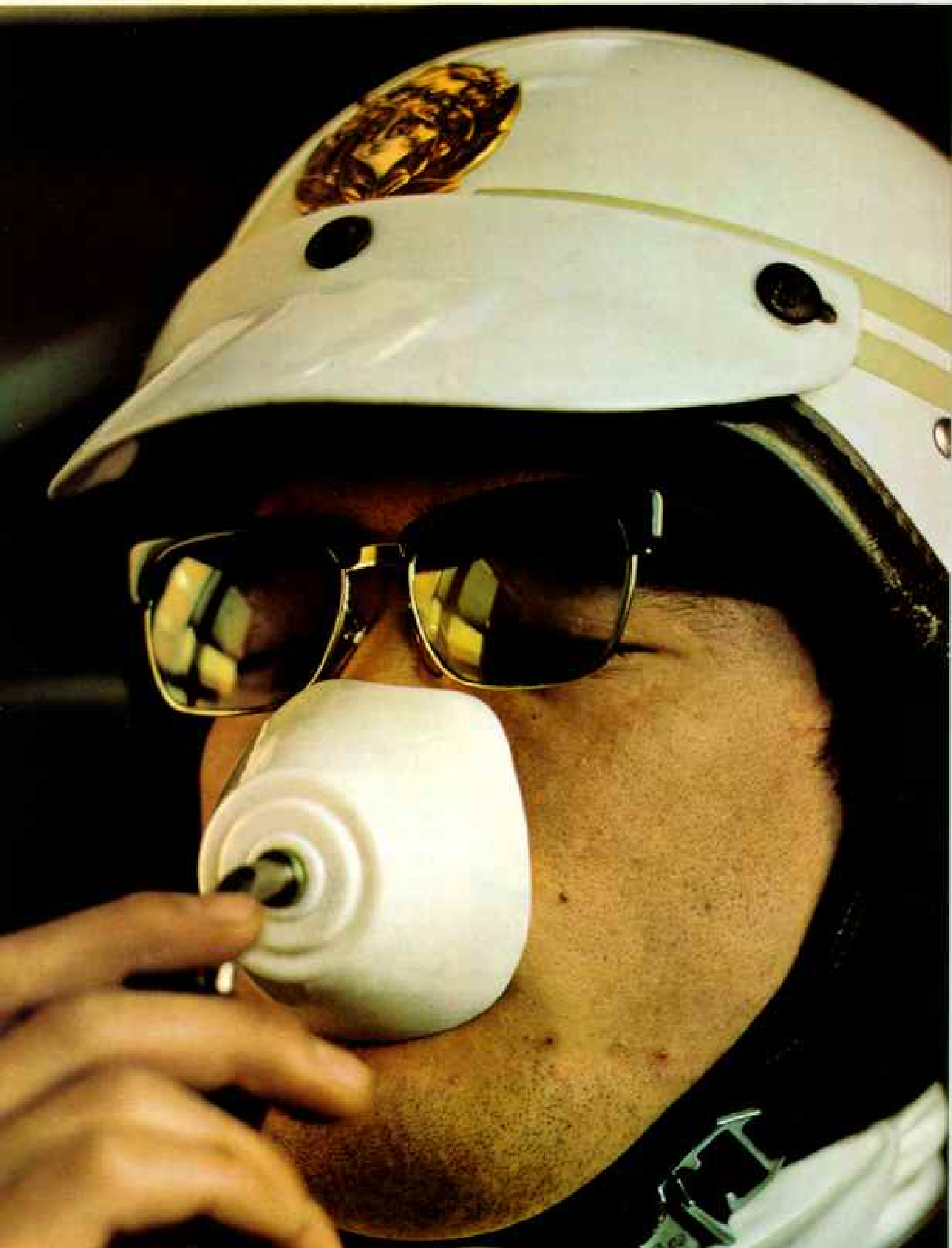
A Yokkaichi restaurant owner confirms the fishermen's complaints. "You saw the vacant buildings?" he asked. I had; whole apartment buildings stood empty, their walls stained black by bad air (page 346). "The fishermen demonstrated. But not the people who worked for the factories and refinery—they

*The October 1972 GEOGRAPHIC reported the tragic story in "Quicksilver and Slow Death."

Breathing can be a hazard in Tokyo (**right**), where fumes of rush-hour traffic drive a patrolman (**facing page**) to a waiting oxygen tank for a few restorative drafts—mint-scented, no less.

Electronic sign near the Ginza in Tokyo's entertainment district (**below**) gives air-pollution readings for sulphur dioxide and carbon monoxide in parts per million; bottom figure registers the sound level in decibels.

During a 25-mile annual march, members of a travel club (**bottom**) wear masks to dramatize the plight of those who, perforce, must breathe.



JAMES STANFIELD (LOWER)

What price progress? Pollution-grimed apartments (**top**) have been largely abandoned in Yokkaichi, where exhalations spewed by industry caused hundreds of townsfolk to suffer an affliction called Yokkaichi asthma. Therapist (**above**) helps a lad paralyzed by Minamata disease, a form of mercury poisoning named after a fishing port hard hit by the man-made scourge.

do not make demands of their own company. Loyalty? Perhaps it is the Oriental way."

In 1971 Japanese courts began awarding damages to the first of more than 9,000 officially certified victims of pollution. A judge sternly announced that any factory unable to protect the environment "should promptly cease operations."

"We Work, Work, All the Time"

Away from the industrial cities, an older, more serene Japan survives. One cold day my friend Kunio Kadowaki and I put chains on our tires and drove to Lake Biwa, where Siberian winds bring heavy weather through Honshu's western mountains. The whole white world called up memories from Nobel laureate Yasunari Kawabata's novel *Snow Country*. In the lakeside village of Oura, the only sound was the dripping of melt from snowy roofs.

"But Oura has also changed," remarked Mr. T. Matsuda, impresario of the local cottage industry, the making of electric plugs. "Twenty years ago we had only two cars here. Now I have eight for my business alone. Ten years ago people wore straw sandals. Now they have warm shoes and money and stores.

"On a day with snow like this, everyone used to relax, play cards, have folk dancing. Now we are accessible—roads are scraped, traffic moves. We work, work, all the time. There is no fun in Japan anymore."

A political leader of Oura, town assemblyman Matsutaro Tanaka, told us about a new fast train route that will open soon. "It will make Kyoto only 50 minutes away," he said. "Perhaps we could develop this area as a leisure center. . . ."

With new railroads and development, can places like Oura be saved?

"They must be!" insist growing groups of Japanese conservationists. A new and highly promising environment agency has been established. Prime Minister Kakuei Tanaka has even suggested rearranging all the industry and resettling the population.

But until those ambitious plans get results, I see greater hope among businessmen who have a financial stake in a clean Japan. Take, for example, Yohachiro Iwasaki, the 70-year-old head of 73 companies, and the largest individual landowner in Japan. I met Mr. Iwasaki in his handsome new Ibusuki Kanko Hotel, on Kyushu's southern tip.

Mr. Iwasaki and his staff always walk in

V-formation, the boss center front and all others following in order of corporate rank. Mr. Iwasaki is a short oaken figure with a boyish, conspiratorial grin and gestures suggesting perpetual motion.

"We'll dine in the Jungle Park theater-restaurant," he said. Our V-shaped squadron swept into a building that resembled an airplane hangar. Here royal palms and an understory of tropical plants and flowers reached for the skylight roof. Some 2,000 people, mostly clad in blue hotel kimonos, were eating dinner at tables here. One wedding party had 300 guests.

"This idea?" The benign conspirator grinned. "I did it to save man power. In traditional Japanese inns guests are always served in their own rooms. Many waiters."

Mr. Iwasaki started with a grade-school education and made his first few million yen in timber. Today his investments dot the map all the way to Australia. ("I want to introduce the raising of Kobe beef there.") He builds resort hotels in Japan and toll roads through his forests. He builds retirement communities and botanical gardens and mineral baths. He has even branched into transportation with a ferryboat line and his own jetport. The public flocks to Iwasaki attractions.

"Now we are doing botanical and marine research," he adds. "And the clean waters of Kagoshima produce excellent oysters for my pearl farm. Of course"—the smile recedes—"heavy industry and pollution could ruin all this: resorts, fishing, forests, pearls. We must keep out pollution."

Mr. Iwasaki's billions of yen prove that he has often been right about the future. And he is now betting the same fortune that his countrymen will follow a clean course.

National Image Abroad Needs Work

As men like Mr. Iwasaki invest their yen abroad, Japanese businessmen and diplomats follow the investments. Not all of them have been culturally prepared for their travels.

"The Japanese have had problems in Indonesia and Thailand," notes an anthropologist. "No one listened when experts warned Japanese businessmen about Southeast Asia—not until trouble started in Thailand. There the culture is soft and vulnerable."

Some 5,000 to 7,000 Japanese live and work in Bangkok, Thailand's capital. Some Thais feel that is too many—among them, Tirayuth Boonmi, a senior at Chulalongkorn University. He has led a series of noisy anti-Japanese student demonstrations.

"It is their nature to group together," he told me when I visited Bangkok. "Like sardines swimming: One turns, all turn. They try to control all business, and keep it for other Japanese."

Young Tirayuth's demonstrations startled the Japanese in Bangkok and at home. They promptly began to improve their image. Representing the number-one foreign investor in Thailand (Taiwan is second, the U.S. third), the Japanese now stress reciprocity, with trade exhibits of Thai silk and tropical fruits in the Japanese home market.

Short on Talent for Mingling

The Japanese are making an effort to mingle in Thailand, but they admit it is difficult. Yasuyuki Matsuo, President of the Japan Trade Center in Bangkok, told me, "The Japanese are not trained as international personalities. Your American civilians number about the same as we do here, but you are very frank people; Japanese people are rather closed."

Any cultural gap, of course, has two sides. At Matsushita's Bangkok plant I asked a management official whether his 550 Thai employees sing the company song each day. He laughed. He kept on laughing. "Different—different culture!" he managed to say. "No song. No, no."

The visitor notes other differences from the Osaka factory. Tropical Thailand is the land of the quick smile and the slow assembly line. But Matsushita is moving fast. Suvit Khlaisang, a young Thai engineer, now heads an 82-man factory making dry batteries. He trained for two months in Matsushita's Osaka plant ("Cold—I saw snow first time"). Now he sets an example for other Thais to emulate the Japanese work spirit ("Sunrise to sunset"). More Thai employees go to Japan each year for training; to prepare them, Matsushita offers language classes so they can converse in Osaka—classes in English, however, not Japanese.

"How do you say?" one Japanese asked me. "Low profile?"

The profile is even lower in Africa. Japanese businessmen and technical experts have moved in at the invitation of Africans. So far the arrangement is happy. In Ethiopia technicians are vaccinating villagers against smallpox; in Zaire *(Continued on page 358)*

Marriage of old ways and new

HEADDRESS AS DAZZLING as a crystal chandelier crowns bride Yukiko Toyama (**left**) on the day of her wedding to Mamoru Yokoyama. After the ceremony, families of the young couple pose for a stiffly formal group portrait (**top right**).

Assuming her role as homemaker, the new Mrs. Yokoyama (**below**) totes garbage from her house in a Tokyo suburb. Between domestic chores, she crafts a doll (**center right**) to be given to another couple as a wedding gift.

Her husband, a fish wholesaler, spends the predawn and morning hours at the Tokyo fish market (**center left**), then returns home, bringing an assistant to share a hurried meal (**bottom**) with his wife and the dog that keeps her company when he's away.

Women on the go-go. Hot pants and the promise of a feather dusting lure customers to one of Tokyo's highly competitive gas stations (**left**).

Young women who might once have contented themselves with lessons on the samisen, a classical stringed instrument often played by geishas, now seek more modern modes of expression and livelihood. A member of a folk group (**top**) plays an electric organ at a concert in Osaka. Musumi Tonaka (**above**) unleashes a song at Tokyo's Meiji Youth Center. Dancers on a television show for young people (**right**) rehearse at a Tokyo station.

ATTENTIVE AS WORSHIPERS, *residents of an old folks' home in Kawasaki keep eyes riveted to the TV set—sometimes called the "new Japanese altar." Breakdown of traditional family patterns since World War II has made social castoffs of increasing numbers of senior citizens—once the most honored members of the household.*

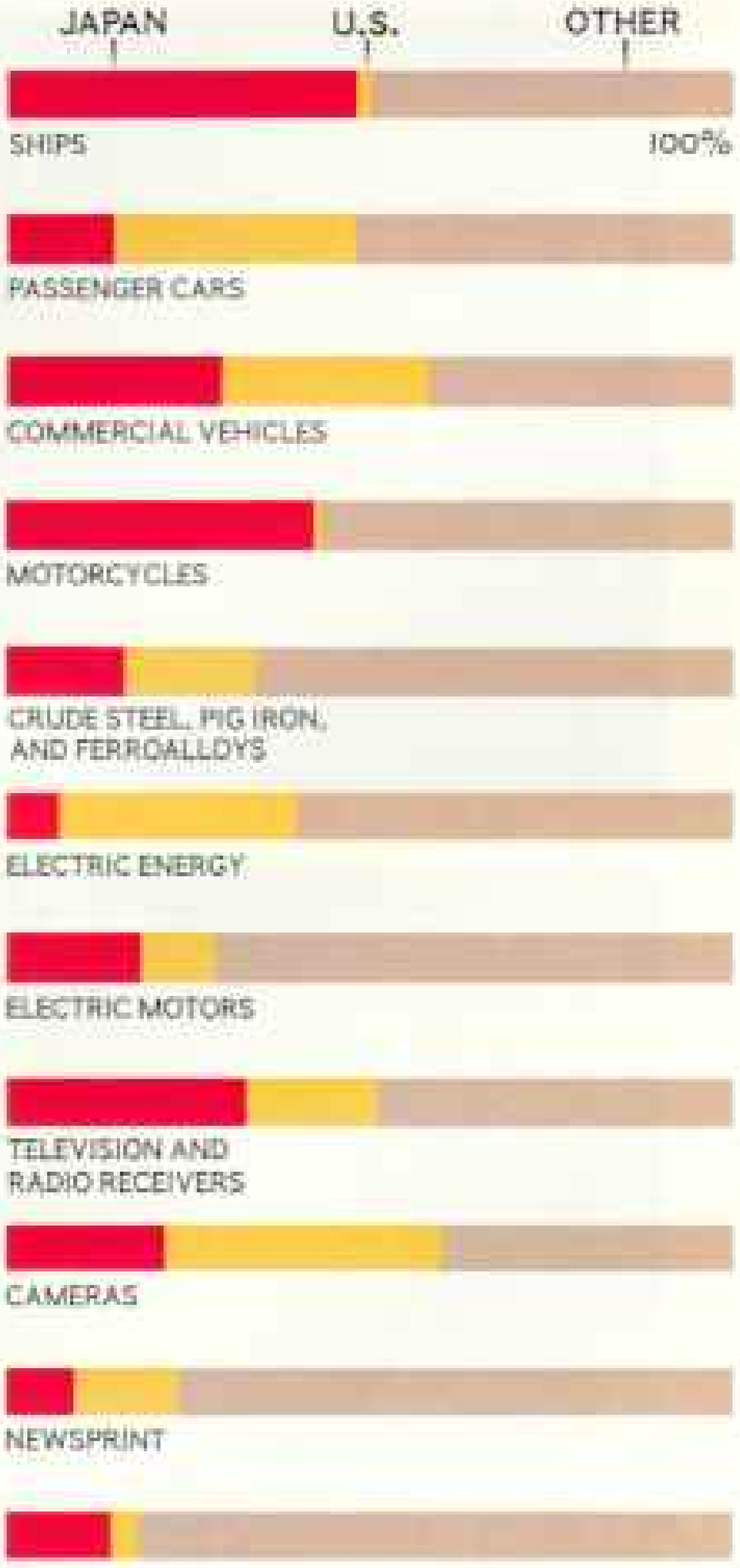
Lunching on the run

EATING IN PUBLIC, in former times a shocking breach of Japanese etiquette, has become commonplace in today's fast, frenzied Tokyo. A new McDonald's brings American-style meals-to-go to hurried passersby (**below**).

In the employee cafeteria at Matsushita's Osaka television plant (**below right**), assembly-line dishes keep lunch lines moving. Despite soaring food costs, employees pay only about 45 cents for a nutritious company-subsidized meal.

Faddish young miss munching a take-out treat (**facing page**) peeks out from her new panda hat—symptomatic of the craze that has swept Japan since China gave two pandas to the Japanese people in 1972.

Sweet scent of tradition lingers on the spring air, making every man a poet and luring workers out of factories and offices. On southern Kyushu (**left**) a couple improvises a dance during a cherry-blossom celebration. In a smog-plagued Tokyo park, a passerby draws a plum blossom close to sniff the remembered fragrance. Honeymooners at the Ibusuki Kanko Hotel on Kyushu (**above**) plant a camphor tree as a living testament to their vows; in later years the hotel will send them essence from the bark and wood of the very tree they planted.



Japan's huge industrial output, here compared to the United States and the rest of the world, stands on an uncertain base of imported raw materials, including Mideast oil. Such dependence, underlined by the world energy crisis, ominously shadows Japan's current—and future—prosperity.

mining engineers are digging for copper ore.

"Very good people, the Japanese," an official assured me in Nairobi.

"I want to live in Kenya longer," said a Japanese hooked on the tropical highlands.

I had already heard about the enthusiasm of young Japanese from Shoichi Ban, director of the Japan Overseas Cooperation Volunteers, or peace corps. "We have achieved our main target—the economic phase," he said. "Now some—especially the young people—want to help the developing nations. They want to get in touch with different cultures."

About 50 of Mr. Ban's 1,200 volunteers work in Kenya. One, an auto mechanic named T. Kabasawa, was assigned to the Nairobi-Addis Ababa highway construction project near the Ethiopian border.

"At our Turbi camp, we had to bring water many miles," he says. "No water there. Only sand and stone and dry bushes. I was working under a car one midday and flies came, seeking moisture from my lips. My hands had grease so I could not wipe them away. My friend saw me and laughed—and the flies entered into his open mouth! Very dry."

Idleness an Unwanted Commodity

A few action-oriented Japanese collide, culturally, with the ways of Africa. Engineer Takaji Suzuki, for example, loves Kenya but not big-game watching. "To see animals, you must *wait* so long."

Welding instructor A. Nishimoto once had a collision of another sort. Driving with a friend near Kajiado, his car struck and killed a cow belonging to the Masai. The tall tribesmen surrounded the car and angrily pounded on the door with their spears. Nishimoto-san rolled up the windows and waited. The Masai grew angrier. He waited an entire hour before an English-speaking African came by, translated the tribal demands, and arranged an indemnity.

Yet Nishimoto's only complaint is not danger, but idleness: "If no work to do, the Japanese is crazy. Too much time."

Kenya counts 300 Japanese residents, including 90 children. Many big trading companies have representatives in Nairobi, and business is growing. ("Kenya now exports Japanese-style green tea!") Families employ African servants and live well in houses far larger than they had at home.

But I met one man who was actively unhappy, Hirotaro Ogura, representative of a Japanese airline and dean of the Nairobi Nipponese community. He told me the story of his last nine years, a story of exile away from Japan—Karachi, Teheran, Nairobi—and largely away from his family. "Because of school, my wife must now live in Japan with our children. They grow up fatherless."

Mr. Ogura's trophies show the way he has spent his lonely years in Kenya: tusks, skins, antlers. What was the score, I asked, for the Great Yellow Hunter? He smiled wanly: "Well, 12 elephants, six buffalo, and one lion only. . . . They may have been sacrifices for my loneliness."

Until Japan can solve the problem of schools for overseas families, the nation's new world role will be a bitter hardship.

"My daughter, Nozomi, was attending German schools until last year," said Mr. Akira Fujii, in Düsseldorf. "Then we moved her to the new Japanese school here. But her mentality had already begun to change. For example, the morning tram got her to school late one morning. When her teacher complained, Nozomi blamed the tram and said, 'It's not my responsibility.' So her teacher called me and said, 'Nozomi is so *German*.'"

Nozomi now attends a handsome new school beside the Rhine at Oberkassel, the first official Japanese school in Europe. The school is a major reason why more than 160 Nipponese firms—from the one-man office of Kawasaki shipping line to the bustling operations of the Fuji Bank and Nippon Steel—maintain their European offices at Düsseldorf—or "Japandorf," as it was called by the French magazine *Réalités*. Some 2,600 Japanese live in this German city of 650,000 people, a concentration that supports three Japanese groceries and three restaurants.

How do German and Japanese ways differ when doing business? I asked this question of a Fuji Bank executive, who said, "Germans want very specific written contract. . . . Japanese work harder and longer hours."

"I was surprised," another Japanese remarked, trying for tact, "at German punctuality . . . to quit work at night."

Mixed Marriage Finally Wins Acceptance

But Hirohiko Tsuda, deputy general manager of Nippon Steel, has this observation: "The times are changing, and also the mentality of the Japanese."

He offers personal proof. In 1957 he went to Frankfurt with a trading company and fell in love with a lovely blond German. The idea of an international marriage scandalized Mr. Tsuda's company and both families. He returned to Japan to press his case. "My father refused. My younger brother supported me, and after eight months I succeeded in obtaining the agreement from my mother. It was the lightning moment of my life! My father then gave his reluctant approval."

Mr. Tsuda changed employers, and returned to Germany for his marriage. Thirteen years later, I called on the Tsudas, now the parents of three beautiful children, in their Oberkassel home.

And how has Mrs. Tsuda bridged the cultural chasm of East and West? "At first it wasn't easy," she admitted with a smile. But superficial differences fall away quickly in a crisis. Recently, she told me, a car struck their 11-year-old son, Akihiko, severely injuring his skull. Mr. Tsuda was on his way to London, so while surgeons debated a craniotomy, Mrs. Tsuda called the only person who could help, the chief of the Nippon Steel office, Saburo Iwai.

"For the first time, I spoke fluent Japanese on the telephone," Mrs. Tsuda recalls. "It was strange. I had never felt close to Mr. Iwai before." Mr. Iwai arrived, instantly took charge, called London to bring Mr. Tsuda home, and firmly poured Mrs. Tsuda a cognac. "He very sternly ordered me to leave the hospital," she says. "That's what I needed. No sympathy." He personally drove her home and attended to all details while Akihiko recovered.

"Now Mr. Iwai appears unexpectedly," Mrs. Tsuda laughs, "to photograph the children." Thus the office chief as father figure and protector.

Counting on a World at Peace

When a Japanese designer plans a house and garden, he tries for a long vista of hills and mountains, an effect called *shakkei*, or "the borrowed view." Today, as they sort out their new world role, some Japanese are searching for a national shakkei.

To some, the view is troubling: A future fraught with environmental problems, a younger generation that might lean toward Marxism, a boom that may run out of fuel.

But the president of the Mitsubishi Corporation, Chujiro Fujino, finds a cheerful shakkei:

"In the past few years the world economy has been expanding by about 5 percent each year. Long-range, instead of repeating the panic of the 1930's, the world economy will go up. We can share in it."

But beyond the world economy, Mr. Tsuda makes some observations from his Oberkassel parlor:

"Japan buys her raw products abroad and sells her manufactured products abroad. So Japan needs permanent peace in the world."

He smiles at his pretty German wife. "I like to think that my happy international marriage offers an example for people everywhere." □

Algae: the Life-givers

By PAUL A. ZAHL, Ph.D.
NATIONAL GEOGRAPHIC SENIOR SCIENTIST

IT WAS AN UNLIKELY fishing party, for we sought a catch too small to see.

All three of us—two Fordham University students and I—were dressed for polar weather. Loading our toboggan at the edge of an ice-covered lake near Armonk, New York, 30 miles north of Manhattan, we dragged it to a point about 150 yards offshore. There, with a sharp hand auger, we drilled through 18 inches of ice to live water and lowered the end of a plastic tube into the lake (page 363).

We pumped up water into a collecting jar from just beneath the ice, checking temperature, oxygen content, and acidity. Farther down we took another sample, then down once more. In all we "fished" a dozen layers of the lake, down to its 20-foot bottom.

Half an hour later, in the comfortable warmth of a lakeside laboratory, I peered into a microscope at a drop of water to see what we had caught. There, magnified 1,000 times, danced and jostled bright green *Chlamydomonas*, lively micro-organisms, each with two long, swishing "tails" called flagella.

Were they plants or animals? Among life at this microscopic level, the distinction begins to blur. But, although they were swimming, these were true plants; their greenness indicated the presence of chlorophyll.

Plants That Endure the Planet's Extremes

They were algae—among the most widespread of living things, and among the hardiest. Algae grow in the perpetual ice and snow of polar regions, in near-boiling hot springs, and in brine lakes ten times saltier than the sea. They even live in deserts, where they can survive indefinitely on traces of dew and spring into new growth when raindrops fall.

Algae. The word often evokes a sniff of distaste. This is the stuff that thrives on pollutants in our lakes and rivers, and reeks to high heaven on a hot summer day.

But consider this. Without algae, it is doubtful that man could have evolved and survived. Indeed, many biologists believe that one-celled algae may have been the remote ancestors of all multicellular organisms. Perhaps as much as 90 percent of all photosynthesis is accomplished by algae. And in the sea, as the vegetable part of plankton, they are the food upon which all life depends.

There are about 30,000 species of algae, ranging from tiny one-celled organisms to such seaweeds as giant kelp, which grows

1,650 TIMES LIFE-SIZE (FACING PAGE); 400 TIMES LIFE-SIZE (ABOVE); BOTH BY J. ROBERT WAGLAND

With bristles for outriggers, four cells drift along as a single raft of life (**above**). They comprise a type of freshwater algae called *Scenedesmus*. What might be a giant vault of stars to steer by (**facing page**) is itself part of another alga, spherical *Volvox*, made up of as many as 60,000 cells. It carries its own offspring, one seen here as an indistinct blob.

Algaelike cells were the first to change inorganic substances to living matter and release oxygen by the miracle of photosynthesis. Thus the fundamental link in the world's food chain was forged, allowing for the development of all higher life. Present-day algae range in size from the microscopic to 200-foot strands of giant kelp.

strands 200 feet long. Quite a few have been pressed into the service of man. When you take antibiotics, eat ice cream, or paint your house, algae may have helped make it possible. They are used in hand lotions and chocolate milk, photographic film and puddings, rubber tires and beer. They are used to purify sewage—and, some day, may help astronauts survive on long voyages to deep space.

Small wonder, then, that scientists probe so intently for new facts about algae. At the laboratory beside Calder Lake where I peered into my microscope, one part of the search goes on. It is run by Fordham University's Calder Conservation and Ecology Study Center. A research and teaching program, headed by Professor John J. A. McLaughlin, focuses on algae's life cycles, habits, and activities in all seasons of the year, hence our midwinter expedition onto the ice-covered lake.

Looking Back Billions of Years

The algae under my microscope were doing the same job that their ancestors learned perhaps three billion years ago: photosynthesis. And so they were the ultimate source of our oxygen, food, clothing, and shelter. Algal bodies were also a major ingredient of the petroleum so vital to our mechanized world.

Scientists believe that, in a habitat of misting, gathering waters during earth's primeval days, a combining of organic molecules produced something with the characteristics we call life. It had an internal metabolism and the ability to reproduce. It would learn to use the sun's energy and attain a sort of mobility, letting it seek out the most favorable environment for survival.

Almost certainly it was a time of exciting change: continual mutation, experimentation, scrapping of old ways for new.

We have clues to that ancient, complex process, for some algae are "living fossils" that have descended from the early primitives almost unaltered. Their survival with a minimum of change is a tribute to their adaptibility to varying environments.

I stared down at one-celled *Chlamydomonas* on my microscope slide. It was with a feeling of awe that I reminded myself I was looking so far back into the past.

Nature has an inexorable way of moving from simplicity to complexity, and that, in essence, is the basis of organic evolution. One-celled algae like *Chlamydomonas* came first. Later came *Pandorina*, which usually has 16 cells, then *Eudorina* with 32, and *Volvox* with up to 60,000 cells (page 360).

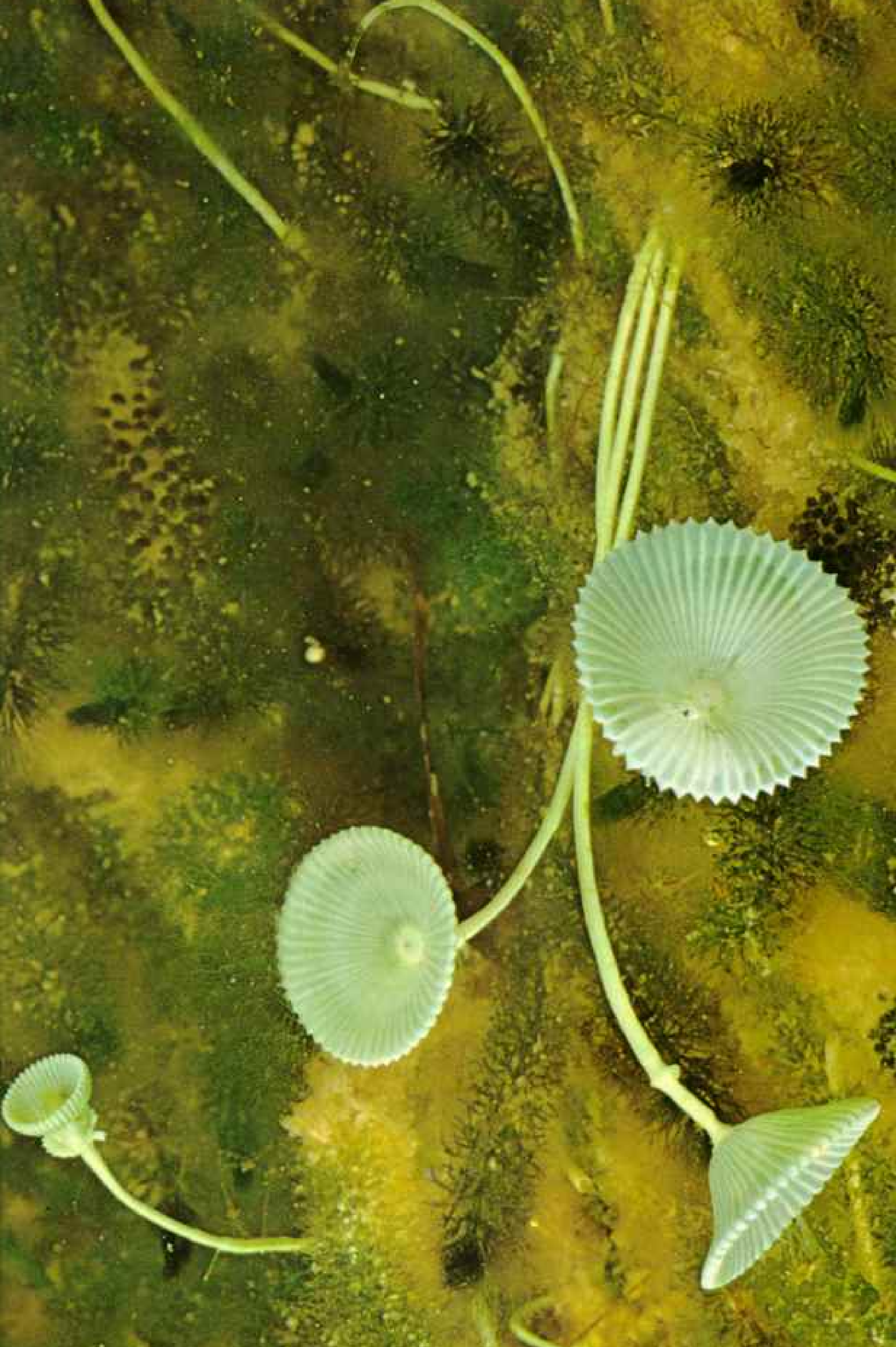
When a *Volvox* squirmed on my microscope slide, I could see one of the characteristics of life at an early stage—the ability to reproduce

(Continued on page 368)

Some like it hot. Algae thrive in nearly all environments: salt water and fresh; tropics and tundra; in soil and as the "moss" that prefers the north sides of tree trunks. Near Yellowstone's steaming geysers, primitive blue-green algae grow in hot springs, enduring water temperatures as high as 160° F. (**left**). Thermometer readings help Dr. Robert Nuzzi of Fordham University's Calder Conservation and Ecology Study Center determine the heat tolerances of various species.

W. E. GARRETT (LEFT) AND PAUL A. ZAHL, BOTH NATIONAL GEOGRAPHIC STAFF

Some like it cold. *Chlamydomonas*, normally green, displays a red mask on snow (**left**). Algae also flourish in an ice-locked lake, where the author and a fellow scientist take a census.



Diverse cells house busy factories of life

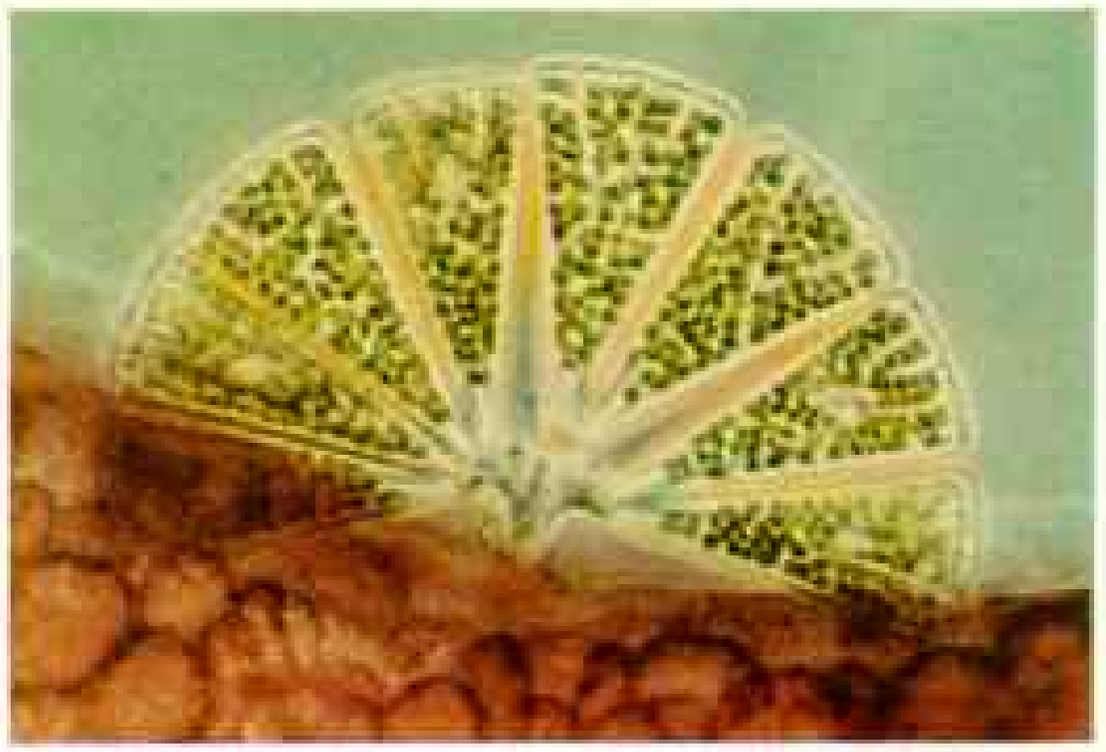
IMAGINE A PLANT without true roots, leaves, flowers, or seeds. What remain are cells containing chlorophyll—a rough-and-ready definition of algae. They may grow as a single cell, as a colony of like cells, or as multiple cells with specialized functions. They may grow alone or in company with other organisms. They may grow into fanciful shapes or filmy traceries, usually in exuberant numbers.

Acetabularia (**left**), an amazing 1½-inch-high giant cell, serves as a handy subject for research in plant biology. Found in the world's tropical oceans, it goes by the nickname "mermaid's wineglass."

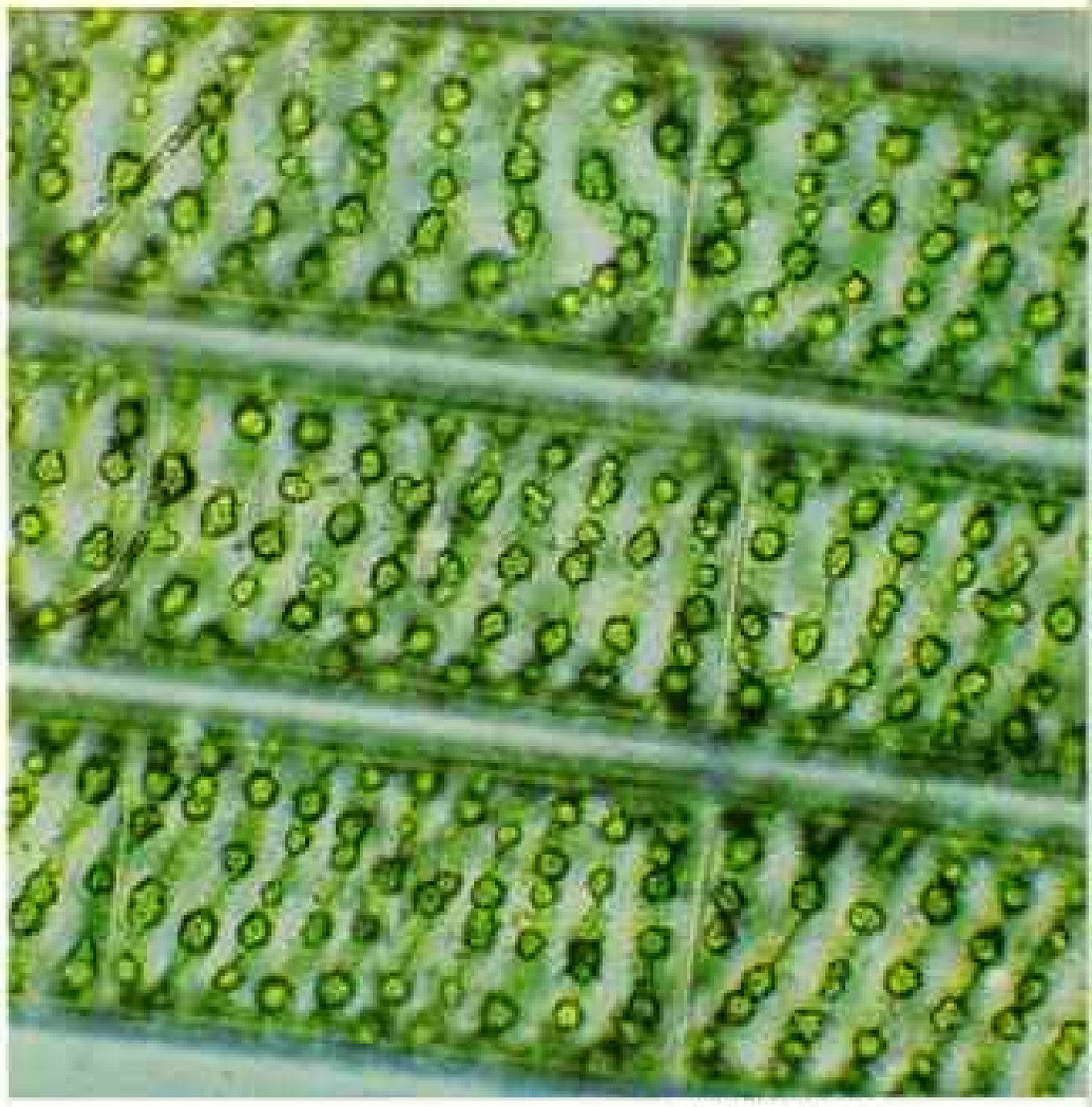
"Mermaid's tresses," the threadlike *Spirogyra* of lakes and ponds, show spiraling beaded ribbons (**right**), actually chloroplasts where life-making chlorophyll does its prodigious work.

Both the desmid (**below**) and the diatom (**upper right**) develop symmetrical shapes. Filigreed with a skeleton of silica, a colony of diatoms, living *Licmophora*, fans itself across another alga, *Bonnemaisonia*, whose chlorophyll is masked by red pigmentation.

A more complex relationship, conferring mutual benefit on both host and guest, colors a hydra (**lower right**). The little aquatic animal takes on the pervasive green of *Chlorella*, an alga that pays its rent by providing oxygen and food for the hydra.



100 TIMES LIFE-SIZE



100 TIMES LIFE-SIZE

6 TIMES LIFE-SIZE (FACING PAGE); 100 TIMES LIFE-SIZE (BELOW)

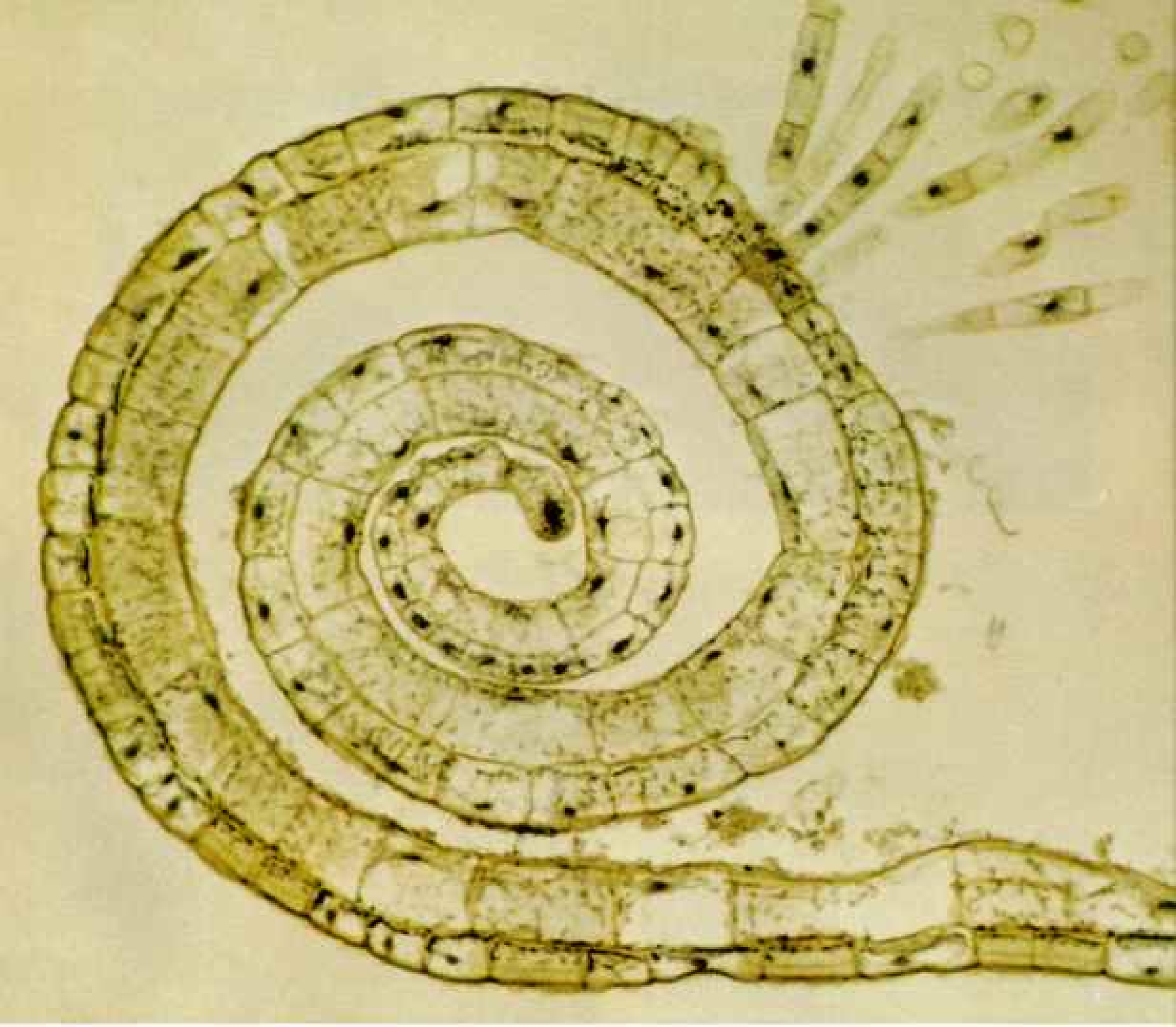
J. ROBERT WAALAND (ABOVE AND TOP RIGHT) AND PAUL A. ZAHL

22 TIMES LIFE-SIZE

Spinach of the sea burdens a Japanese kelp farmer (**below**), hauling a load of *Laminaria* ashore for drying on the island of Hokkaido. *Undaria*, another seaweed favored by the Japanese, is harvested with the aid of an elongated face mask that provides an underwater window (**right**). Except for the use of outboard motors, neither the equipment nor techniques of harvest have changed much since 19th-century artist Heizan Hirasawa depicted the Ainu, bearded aborigines of Japan, collecting seaweed off Hokkaido (**facing page, lower**).

Many peoples around the world use seaweed as organic fertilizer and food. The Japanese cultivate it—on submarine rope arbors—and process it on a large scale. Algal extracts have wide use, chiefly as emulsifiers, in the commercial preparation of ice cream, chocolate milk, salad dressings, and puddings. Another use: as a base for cultures in research on micro-organisms.

HAKODATE CITY MUSEUM, JAPAN (ABOVE) AND
FUJI WATERWAY, BLACK STAR (FACING PAGE AND TOP)



sexually. Some cells served the function of eggs. Other spermlike cells darted around them, seeking the eggs for sexual fusion. Primitive—but from such processes had come the reproductive capabilities common to virtually all higher forms of life.

And algae even earlier had mastered a miracle called chlorophyll. It is perhaps the most remarkable of all chemicals, for it helps create—from a fundamental interreaction of sunlight, carbon dioxide, and water—the nutrients upon which our lives depend. What mysterious forces managed to "invent" so complicated a molecule? The question staggers the scientific imagination.

Though chlorophyll is common to all algae, the green can be masked by other pigments.

"Look at these fancy blue-green algae," Dr. McLaughlin said as we sat at our microscopes in the laboratory. Deftly he prepared a specimen and slipped it beneath my lens. I focused on—I can only call it a wild, surrealistic fantasy. Eerie greens, pale blues and pinks; pearl strands and corkscrews and jellylike globs in which cells floated; and the slow, rhythmical flowing of protoplasm back and forth within some of the cells. How many worlds there may be in a drop of water!

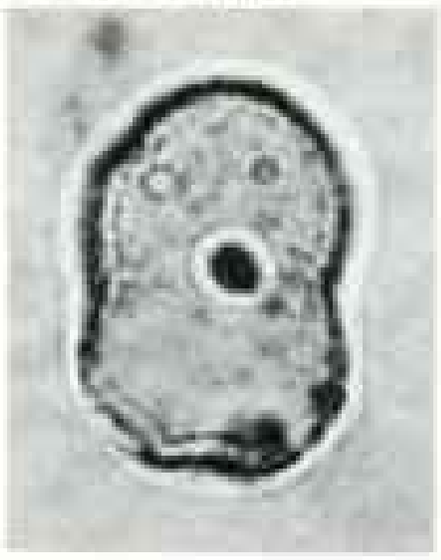
One alga—*Trichodesmium*—is among those that are actually bright red at times, but it lacks the toxicity of the so-called red tides. When it becomes chokingly abundant, it colors large areas of water—hence the Red Sea, and perhaps those Biblical accounts of water turning to blood.

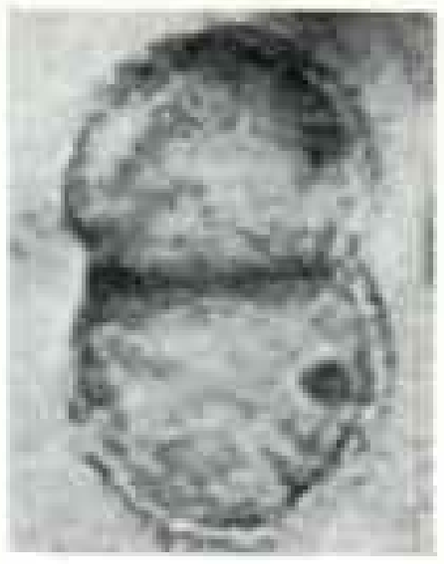
Most algae are eminently useful. They oxygenate water, remove carbon dioxide, help control bacteria, and serve as food for aquatic creatures. But today, especially among the blue-greens, we find "villains." For when nutrients present in sewage or industrial waste—particularly phosphates and nitrates

J. ROBERT WARLAND (OPPOSITE AND ABOVE) AND J. WILLIAM SCHOPF

Life and earth grew old together, recent studies of fossil micro-organisms suggest. Billion-year-old algae (**below**) from rock formations in Australia are arranged in sequence to show that cellular reproduction had begun by that early date. More startling have been finds of algal-like fossils dating back more than three billion years, about three-fourths of earth's life-span, implying that life is six times older than scientists had thought only two decades ago.

Though algae stand as ancestors of complex plants, they still prosper in their primitive forms by thousands of species. When reproductive cells merge within the stem of *Zygnema*, they form dark-green granules (**left**) that can endure extremes of cold or aridity before giving seedlike birth to another generation. Cells at the tip of *Padina*'s spiral (**far left**), specialize in new growth.





—pour into our water in too great quantities, the primitive blue-greens savagely absorb them, and multiply almost explosively.

Villains? Not really, for they didn't ask for those extra nutrients. Left to their natural diets, they would continue as they have for billions of years as unobtrusive members of nature's complexly interwoven community.

Galaxies Glisten in a Microcosmos

Another type of overnourished algae—diatoms of the golden group—clog intake filters in municipal waterworks. Still, diatoms are sheer fascination.

At the Lerner Marine Laboratory on Bimini in the Bahamas, I towed a fine-mesh plankton net through the marvelously clear waters of the Gulf Stream and snared prodigious numbers of these microcosmic marvels, among the most abundant of all algae.

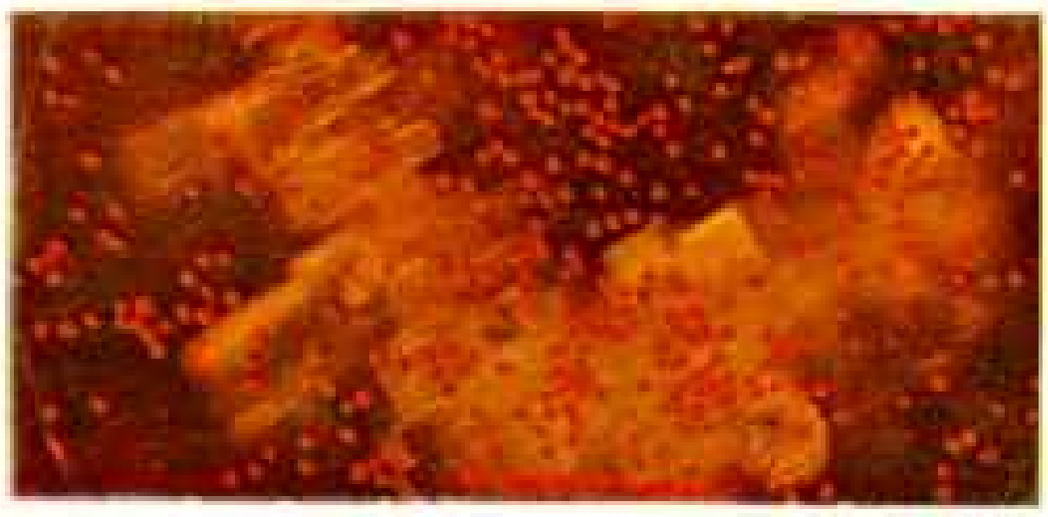
Under my microscope, they were softly gleaming, shifting clouds of ovals, orbs, quarter moons, stars, and torpedoes. Despite their structural diversity, they shared two unvarying features: chlorophyll, and a shell of glassy silica, made like interlocking halves of a pillbox.

Diatoms flourished some 100 million years ago, and their long-lasting skeletons still remain. Near Lompoc, California, more than 300,000 tons of diatom deposits are quarried for industrial use each year (page 372).

The powdery material is used in sugar refining, insulation, silver polish, and various fine filters. Highway center-line paint is impregnated with diatom bits because of their low-angle reflective characteristics.

Some algae, rather than simply reflecting light, actually create it. I have cruised Puerto Rico's Phosphorescent Bay on a dark night and watched the boat's wake gleam with a strange, cold fire. Each drop of water thrown

Saltscape of many hues takes its delicate tints from algae thriving in evaporation pans in Utah's Great Salt Lake, where table salt is extracted along with various minerals used in fertilizers. The hardy algae share this briny world with certain bacteria and minute shrimp, which are harvested as food for aquarium fish.



Drifting free in a solution rapidly crystallizing into salt, ruby orbs of *Dunaliella salina* go their way unaffected. Such salt sold for nonhuman use may retain a pinkish cast. Algae's ability to prosper under unfavorable conditions has increased speculation that life may exist in circumstances once thought prohibitively hostile. Ultimately, algae may be used to recycle astronauts' waste into food.

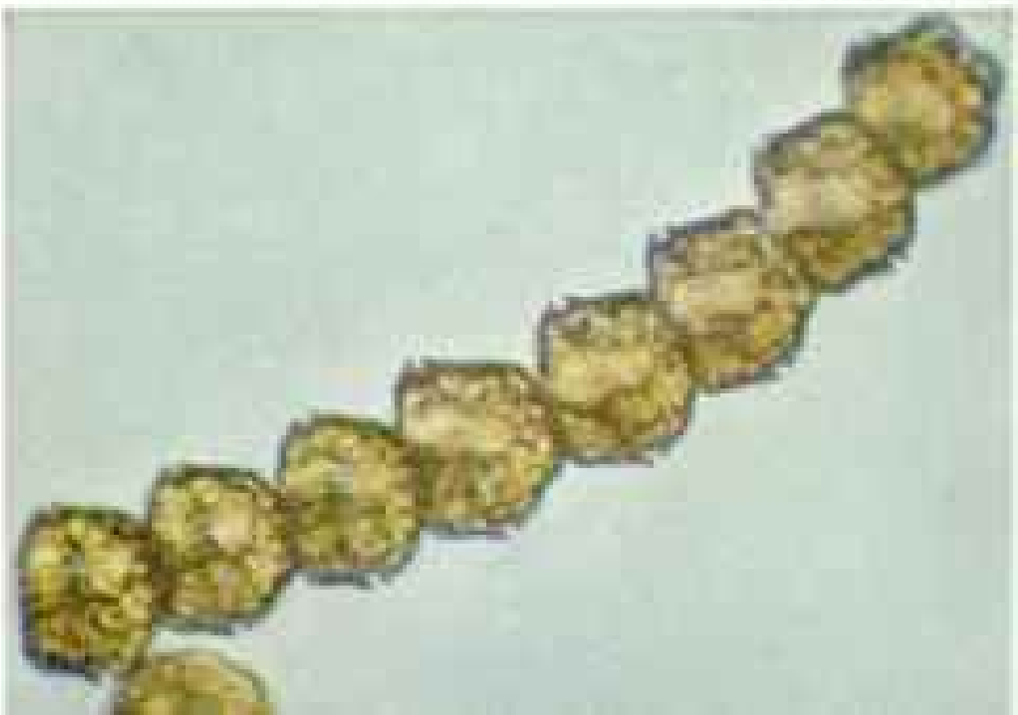
Stain of pollution, nurtured by ill-treated sewage, flowers in an algal bloom where Mattawoman Creek meets the Potomac River near Washington, D. C. Seen as red tendrils against green water in this infrared aerial photograph, such recurrent blooms serve as an alarm, warning that serious problems lie upstream.

U. S. GEOLOGICAL SURVEY

Thin white line of dead fish draws a boundary between benign water near shore and the poisonous algal bloom of *Gymnodinium breve*, at times so rust-colored that it is called a red tide. The beach fringes Florida's Sanibel Island, a paradise for shell collectors. An estimated 50 million pounds of fish died in one such outbreak.

M. WOODBRIDGE WILLIAMS (ABOVE AND BELOW)

Fifth columns of *Gonyaulax* cells, here dividing into a chain, may build up rapidly. Because of a natural toxicity, high concentrations can form harmful red tides. One *Gonyaulax* species poisons the sea life that feeds on it but has no ill effects on man. But other species can build up in shellfish in quantities lethal to human beings. In 1972 a red tide closed many New England clam beds.

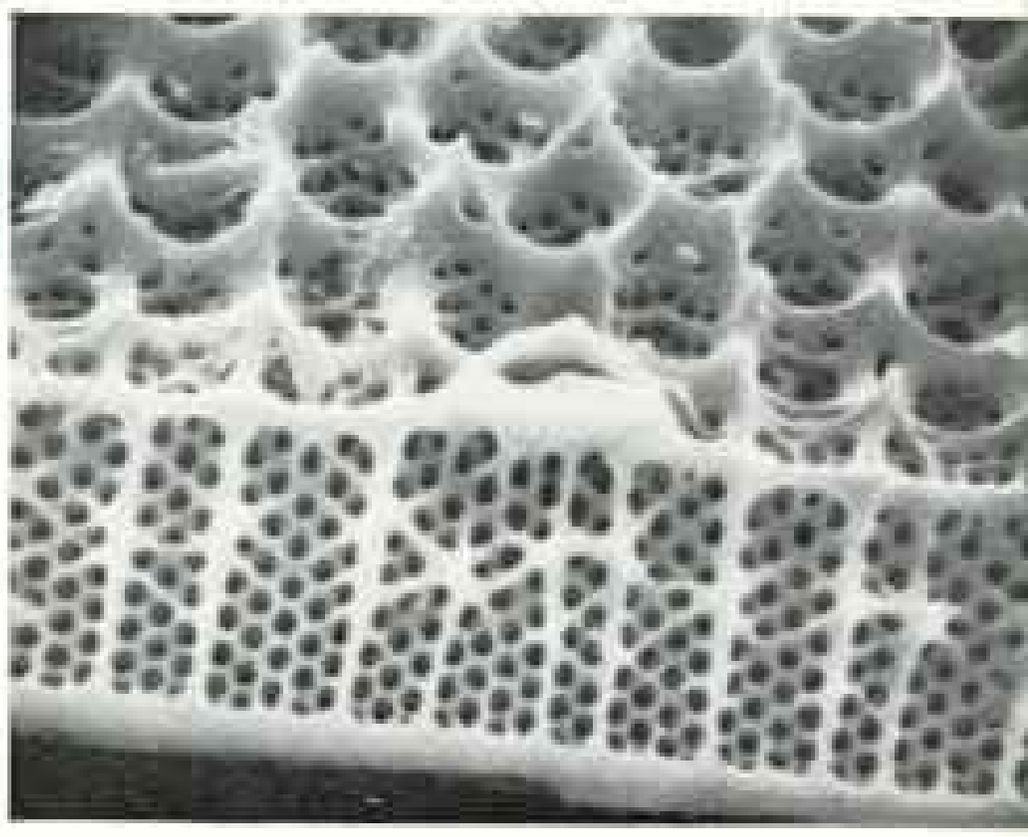


200 TIMES LIFE-SIZE

RICHARD B. HOOVER (ABOVE); CHARLES O'REAR (LOWER LEFT); JOHNS-MANVILLE CORPORATION

Baubles from the sea's boutique, minute skeletons of silica (**above**) were crafted by diatoms, single-celled marine algae. Raining by the unimaginable billions to the floors of ancient oceans, they compacted into deep sedimentary beds. Here mined by the Johns-Manville Corporation at Lompoc, California (**below left**), the diatomaceous earth makes an exceptionally fine filtering agent. A scanning electron microscope's view of the edge of a diatom's shell (**below right**) shows its porous particle-trapping structure.

250 TIMES LIFE-SIZE (ABOVE); 5,000 (BELOW)



up by the bow was a twinkling star.* This was caused by teeming algae called *Pyrodinium*—Greek for "whirling fire." Curiously they luminesce only when agitated.

One notorious member of the same clan —*Gymnodinium breve*—is the red tide of Florida's west coast that occasionally spreads havoc among fish and displeasure among swimmers. This species carries a potent poison; fortunately, few other algae do.

Another troublemaker—the green alga *Bracteacoccus*—turned up a decade ago in the famed Lascaux Cave of southwest France. Prehistoric wall paintings sprouted a green growth. Scientists determined that streams of visitors had introduced an alga and the conditions that made it thrive—light, heat, humidity, carbon dioxide, and organic sustenance in breath, sweat, and pollen. Now only selected scholars may enter the cave.

On Islamorada in the Florida Keys I joined chemist James M. Holbert and his biologist wife Jean on a search for seaweed algae. We waded into the shallows near the shore where an underwater forest grew. It was predominantly green and brown, but with touches of showy yellow, red, and purple. Some seaweeds bore tufts that resembled shaving brushes, others had fans or grapelike clusters or delicate feather dusters.

With plastic collecting bags full, we returned to shore and sorted our catch. Jean saved damaged specimens for her garden, for seaweed is an excellent fertilizer; her flower beds glowed with health.

Jim took the rest of the weed to his laboratory, where he would treat it with organic solvents, searching for new substances that might be useful in medicine. "After all," Jim said, "we know that many land plants are used in the manufacture of pharmaceuticals; why not aquatic plants?"

Serving Raw Squid? Try Seaweed Garnish

A taste for seaweed must be acquired. But it can be done. I once spent two weeks in a Japanese port 150 miles northwest of Tokyo, living in a provincial hotel. Every meal included seaweed dishes. Some weed was shredded, some floated in broth, some garnished main dishes of raw squid and octopus.

I choked when I first tasted the seaweed. Perhaps a drop or two of soy sauce would help. It did. By the time my visit to Japan ended, I was an avid seaweed devotee.

Most seaweeds belong to the red algae division, with some 5,000 species, or to the brown algae group, with about 1,500 species. Here again, color tags are misleading. Chlorophyll is present in all of them. Often, though, its green is disguised by other pigments—red, yellow, or brown.

Some colored seaweeds develop the hardness of brick by depositing calcium salts within their tissues. They add to the rigidity of the coral reefs on which they grow, as well as to the flamboyant color.

Sargassum Shelters Myriad Creatures

A favorite subject of fiction writers used to be the Sargasso Sea. There, according to authors with more imagination than knowledge, ancient Spanish galleons lay trapped, the skeletons of their long-dead crews still clad in armor.

Well, this much was accurate: There is a Sargasso Sea. Stretching almost halfway across the North Atlantic, miles of ocean surface is covered by huge patches of seaweed—*Sargassum*. Slow circular currents tend to keep the seaweed congregated there.

Columbus encountered it and reported it to the world. Today marine biologists find it intriguing. Its patches are floating zoos. Within the grapelike clusters hide carnivorous sargassum fish, small flying fish, tiny crabs and shrimp, and scores of other miniature creatures. This *Sargassum* usually floats free, buoyed by tiny natural air bladders, though other species attach themselves to rocks in coastal waters.

Industry has yet to find a commercial use for *Sargassum*, but another type of seaweed—*Macrocystis*—the giant kelp found in the Pacific—is harvested regularly off California to obtain algin, a chemical with many commercial uses.† These kelps are the most massive of all sea plants—the world's largest algae, in fact. Kelp was once a major source of iodine and potassium; now mineral deposits yield those chemicals.

Reproduction among seaweeds, as with the smaller algae, can be a complicated matter. Some, like floating *Sargassum*, proliferate simply by the fragmentation of their tissues. Others multiply by means of spores. Many others produce cells that are the equivalent of eggs and sperm. Some algae reproduce

*The author described this spectacular "bay of fire" in the July 1960 NATIONAL GEOGRAPHIC.

†A report on Pacific kelp and the creatures that live in it appeared in the August 1972 GEOGRAPHIC.

KATHY LITTLEFIELD, NATIONAL GEOGRAPHIC STAFF (ABOVE); AND PAUL A. ZAHL

Antler of elk kelp, a sweeping rack of *Pelagophycus* grows in the Pacific off California. The buoyant bladder near the diver's hand contains carbon monoxide.

Vintage of the deep takes the form of midget grapes (**left**). Globules of *Botryocladia,* such as these washed up on the coast of Brazil, serve to absorb light and perform photosynthesis.

Museling in on a mollusk, the pestiferous alga *Codium* can foul the bivalve's ability to jet from place to place. As if unaware of its possibly fatal hitchhiker, the scallop views the world calmly through dozens of baby-blue eyes.

ASCOPHYLLUM NODOSUM

RHODYMENIA PALMATA

FUCUS EDENTATUS

WATERCOLORS BY MARCIA G. HOMAN

sexually one generation, asexually the next, and then reverse the process.

Whether seaweed or pond scum, any alga is fair game for my collecting bottles. One day last summer I watched the caretaker of a country estate near my home clean a pond's surface with a long-handled rake. He scowled in disgust as he pulled in sheets of green slime—and he raised a quizzical brow when I helped myself to some.

At home, under magnification, scores of algal types were visible, but one upstaged all the others: *Spirogyra*, a thready "waterweed" common in summer ponds and in most biology classrooms.

I wish the caretaker could have looked into my microscope at that pesky slime of his. The hairlike filaments comprised chains of cylindrical cells, each two or three times longer than it was thick. Connected end to end, they formed a thread of indefinite length, with sheaths as transparent as glass. Within each cell spiraled a ribbon of brightest green (page 365). In each cell's center, held there by delicate radiating strands, was an opalescent nucleus.

It is so ironic. This tiny marvel, product of more than three billion years, has become a polluter. Perhaps the environmentalists will have their way one day, and this will be a cleaner, more orderly world, where *Spirogyra* and its 30,000 cousins will once again play the roles that nature long ago assigned to them.

Survival Clue for Hunger-haunted Mankind

For some algae, though, there will be new jobs. Scientists have long realized that *Chlorella*, a common one-celled green form, holds exciting potential as a food source for earth's growing population. Pilot-scale *Chlorella* farms have been tried in the United States, Germany, Japan, and Israel. Their product, high in vitamins and protein, is too costly to market now, but as production costs drop and other food costs rise, we may yet be eating *Chlorella* for dinner. In what form? The Japanese have turned it into a tasteless white powder that can be added to wheat flour.

Chlorella may even go into space. Immense technical problems stand in the way now—but these algae could supply oxygen and food for astronauts, and recycle their wastes.

So next time you pass a green-coated pond or see windrows of decaying seaweed on an ocean beach, consider the potential for mankind. And remember, too, what microscopic glory hides in algae—among nature's lowliest but some of its loveliest works. □

Shag rug of sea wrack drapes the Maine coast at low tide on a summer day (**right**). The three seaweeds illustrated at left grow widely along the New England shore. *Ascophyllum* is depicted in April with its seedlike reproductive pods; in August it forms the near-podless profusion to the left of the tidal pool. To the right is lighter-hued *Fucus*. Both trap enough moisture to protect many creatures that would not otherwise survive low tide. Reddish *Rhodymenia*, in the pool, is locally used as chewing gum.

Nebraska... the Good Life

By ROBERT PAUL JORDAN
ASSISTANT EDITOR

Photographs by
LOWELL GEORGIA

Tapping the prairie wind, a stand of towers pumps water for Herefords in Nebraska's northwest panhandle. Once a broad highway for America's westward migration, Nebraska today swells with an abundance of grain and beef cattle, a tribute to the pioneers who grappled with the harsh, alien plain and harnessed its wealth.

ACROSS THE WIDE MISSOURI at Omaha the sign announces, "Nebraska . . . the Good Life." Continuing west on Interstate 80, travelers pass the good life by.

The prairie comes right up to peaceful hamlets and friendly cities and embraces them. Windmills spin beside picture-book red barns and silvery farmhouses. Cattle graze on rich pastures. An upstart breeze ruffles tawny wheat fields; corn stands knee high in dark-green ranks, though it isn't yet the Fourth of July.

How pleasant, and how soon monotonous. The concrete ribbon stretches away, shimmering. Travelers press on: Cheyenne or bust by 6 p.m. After more than 450 miles of deep sky,

cloud kingdoms, and endless horizon, the land changes its name to Wyoming.

Now, I go a more fortunate way. I turn off the superhighway again and again, a long-absent native son rediscovering Nebraska's plains and people. "We are what we are," they tell me, and I like what I see.

On the southern fringe of the Sand Hills a flotilla of pleasure craft courses a great man-made lake. At the immaculate south-central town of Minden, gay costumes whirl in Danish Day festivities. Southeast, Brownville, a cameo of steamboat days, lolls with its lavender memories. Northwest, forty-million-year-old fossils lie strewn like seashells on moonscape badlands.

Even Interstate 80 proves special. Many times I watch the cars heading west along it. And I wonder: Do those people conjure up prairie schooners rolling to empire along this broad Platte River Valley?* Can they glimpse a ghostly pony express rider galloping beside them into eternity?

I REMEMBER A MORNING when I cut south from the prosperous city of North Platte, swinging through Frontier and Red Willow Counties, past nodding steel mule-heads pumping oil beside fields of waving grain. I rounded bright and busy McCook and promptly at one o'clock—punctuality is a Nebraska virtue—knocked on a farmhouse door near the Kansas border.

Arthur Carmody was expecting me. Level of gaze, ruddy, booted and cowboy hatted, he seemed a proper Westerner even to a last touch: He was strapping a revolver on his hip.

"Might stir up a rattlesnake or two where we're going," he explained.

"You lead the way," I said, politely.

Mr. Carmody, 74, a former state senator, is an authority on Nebraska history. On a little-known battleground a few miles from his home, the hapless American Indian warred on his own kind in major battle one final time, a century ago last August 5.

We drove north in strong sun and clear air scented with new-mown hay, through the fading town of Trenton, whose board sidewalks, gone now, I had trod as a boy. Up a long hill we rode, and onto the wide divide between the Republican River and Frenchman Creek.

In the late 1800's *(Continued on page 385)*

*See "**Close-up: U.S.A.**," fourth of the series, distributed as a supplement with this issue.

Housing comes dirt cheap. A doorway of plastered prairie earth (**right**), attractively papered, frames cattle rancher J. Dean Hersh and his wife, reading in their sod house near Dunning. The fortresslike walls, almost three feet thick, insulate against winter winds as well as searing summer heat.

Settling in 1940 on open land, the Hershes turned to the soil for shelter. "We did some pioneering," says Mrs. Hersh. Her husband demonstrates how he cut and spaded the bluestem sod (**below**) for their three-room house. Once the standard dwellings of settlers, soddies are home today to only a handful of Nebraskans.

Corn gobbler picks a field near Gretna (**right**). Nebraska's three-billion-dollar farm income ranks sixth in the U. S.; half of the state's workers depend on agribusiness.

Corn and football mix well on the plains, from the University of Nebraska's hard-fighting Cornhuskers to thousands of backyard quarterbacks like Ron Stork (**top**), who with his father, Everett, farms 340 acres west of Blair. More sedentary sportsmen husk their corn for a different game—bingo (**above**).


DAY IN THE COUNTRY
CHAMPION
SIXTH PLACE

settlers with their plows and barbed wire remade this lonely land into a checkerboard of billowing wheat and corn, but rugged canyons and gullies still scribe it. Bison beyond number once roamed here. Not far from us, in 1872, "Buffalo Bill" Cody showed Grand Duke Alexis of Russia how to kill the shaggy beasts. His Imperial Highness dispatched eight, one with a revolver at thirty yards. Champagne was served.

It was buffalo that more than 300 Pawnee men, women, and children were after in this big-sky country on that cruel day in 1873. Packhorses laden with equipment, meat, and robes, the party ambled up a narrowing valley during the annual summer hunt. As they were thus pocketed, their traditional enemy, the Sioux, fell upon them, bringing death.

My historian friend led me into that grassy, yucca-spiked defile. Listening to him, the serenity about me exploded:

. . . Squaws huddle in this open pocket, cradling papooses, chanting a Pawnee war song. They do not wait long. A thousand whooping Sioux horsemen dash along the low banks, firing down into the terrified mass. The rout begins; down valley flee the victims in horrid disarray. No attackers fall, but about seventy Pawnees are slain, two-thirds of them women and children, some roasting on pyres of flaming robes. . . .

CATTLE BROWSE TODAY in Massacre Canyon, bawling at intruders. A small creek trickles through the lower part, shaded by ash and cottonwood. I halted there, remembering.

A decade after the battle, my grandparents settled in a sod house a rifle shot east of here. My mother and her brothers and sisters walked here. Once, as a spindly city slicker from Omaha visiting country cousins, I too splashed in this creek and captured frogs for a frog-leg feast.

I was too young then to understand, and now all is gone. All but Massacre Canyon, timeless, undistinguished from a dozen other nearby arroyos. Watching for rattlesnakes, Art Carmody and I hiked back to the car.

As we returned to Trenton, he squinted toward the west. "Just there," he said, pointing, "ran the cattle trail from Texas to Ogallala, Nebraska. Cowboys pushed longhorns over it from 1875 to 1885, stocking the new ranches on the plains, and shipping beef to the populous East. The last leg covered about 250 hot, dusty, and mostly dry miles from Dodge City, Kansas, to Ogallala. Generally it took 18 days."

Back in town, I paused in yesteryear's white-frame general store, which serves as the Hitchcock County Museum. Mrs. Grace Riley, the charming and vivacious grandmother who directs the museum, lingered in the rear of the old store, smiling.

"My stars," she said, "I can still smell the tubs of butter that stood here. People knew every lady's butter by the print she stamped on it. They always wanted to buy my grandmother's—that and her bread was her art. Now, mama never could make nice butter."

Nebraskans dwell easily with their past, I was to find. It has formed them, abetted by

Festooning a cedar bough, ribbons await winners in the North Hills Hunt's "Day in the Country" (**facing page**). Beside ripening cornfields north of Omaha, equestrienne and mount hurdle a fence in the field-hunter competition (**above**). Socialites flock to this event—a combination horse show, auction, and beef barbecue.

place and the vagaries of weather, into a hardy, independent breed. These are bedrock Americans, believers in work, thrifty, conservative, and religious folk with the pioneer spirit still strong. It serves them well.

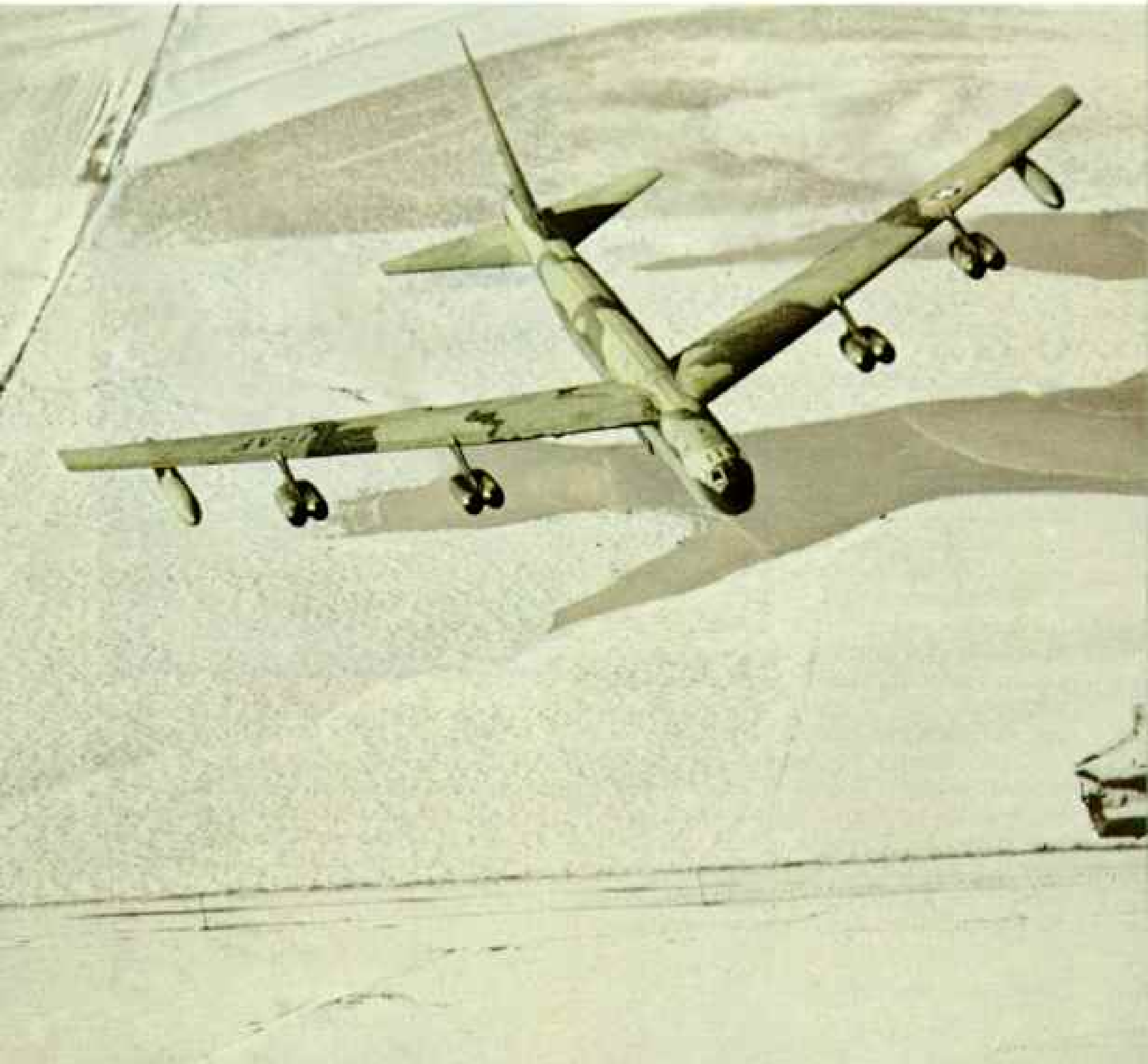
Life remains a gamble. Hail may ruin a crop in minutes. Inflating feed costs can make livestock raising risky. Uncertain market prices pose a constant worry. Machinery can be prohibitively expensive and almost impossible to purchase. Hired help is hard to find. On balance, people remember the lean years more than the good.

Work is hard, and hours long—but some things have changed. One June day I waved down a farmer as he cultivated corn beneath a fiery sun. He jumped off his tractor, glad for the respite, a dusty man wearing bib overalls and a sweat-streaked visor cap. "I've been cultivating twenty hours day and night for a week," he said, scuffing the earth. "The corn'll suffer if I don't break up this hard crust."

On the tractor a large transistor radio squawked. "I like to listen to the ball games," he volunteered, cocking his head. "Course, you got to turn it on pretty loud. It's hard on the ears. My hired man over there"—a finger at the adjoining field—"he's got it better. You have to take care of the help."

I investigated. The hired man, a long-haired youth at the wheel of a new, enclosed-cab, $15,000 tractor, gave me a hand aboard into another world. In air-conditioned comfort we rode along the rows of corn at a steady six miles an hour. Strains of Mozart

386 **WHOOOO-O-O-OOM!** *Streaking only 600 feet above a snow-covered Nebraska farm,*



from a built-in stereo radio filled the cab.

I recalled a wheat harvest in the drought-cursed thirties. How I admired my 14-year-old cousin, Bob Walters, a six-dollar-a-day full hand driving a two-cylinder tractor. I was 12, a lowly dollar-a-day chore boy. That wheat crop failed, burned out. To help keep meat on the table, Bob and I would take the old .22 rifle down from the wall and forage for pigeons and rabbits.

A FEW DAYS LATER I headed my car into the long green swells of the northeast. Five miles north of Beemer I pulled up at the 465-acre general farm of Mr. and Mrs. Quentin A. Bleyhl. Standing at the door, we looked out beyond the barn to fields of corn, oats, and alfalfa, pastures dotted with beef cattle, and pens where hogs took their ease.

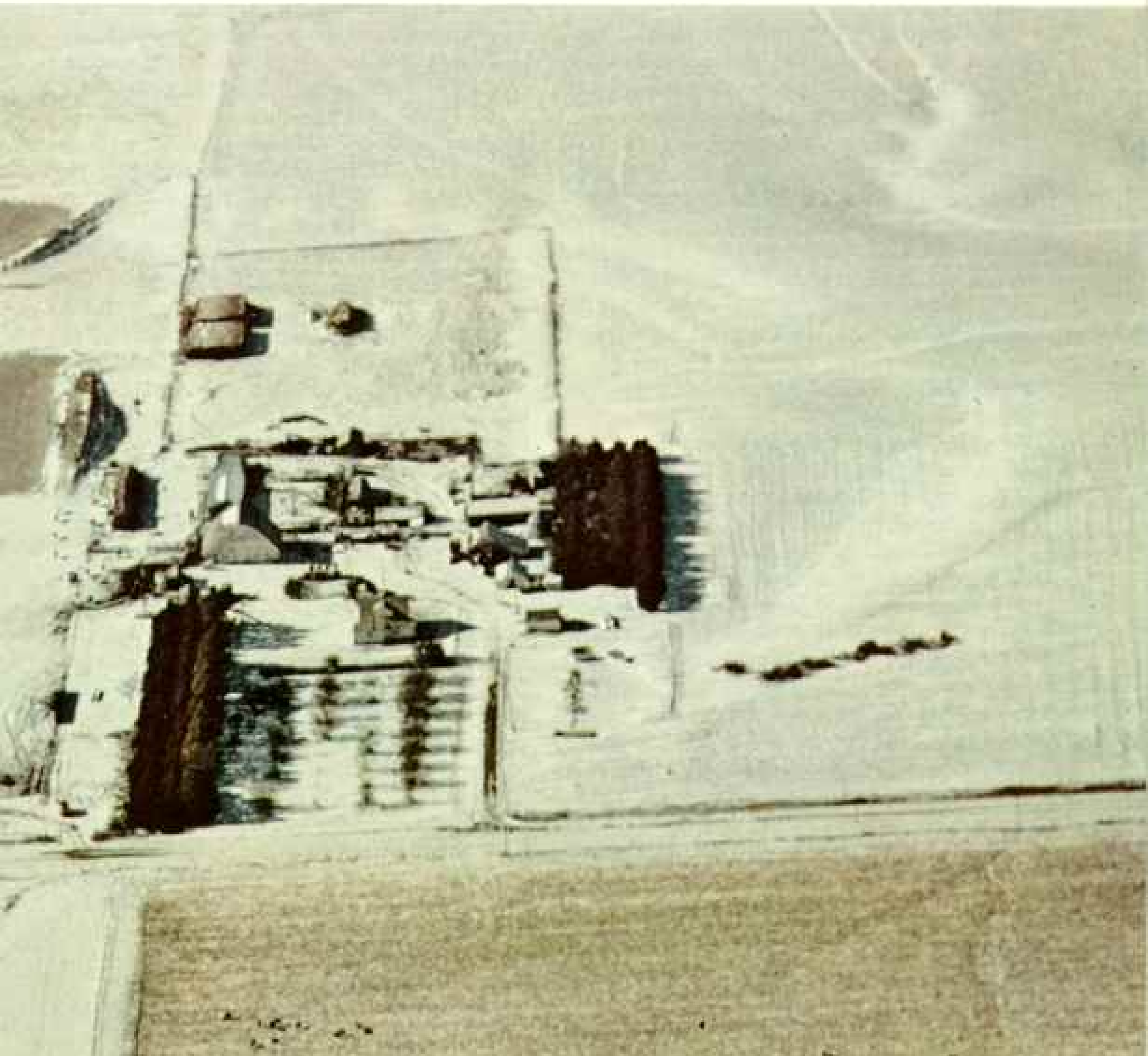
"What you see is fairly typical of this area," said Mr. Bleyhl, "and that includes size, too. Today's laws of economics work against 80- and 160-acre operations."

Tall, smiling Ardis Bleyhl served a meat-and-potatoes dinner of harvest-table proportions that Sunday. While I devoted myself to it, she and her husband spoke of farm life.

"We've had electricity for decades," she said. "The plumbing came indoors long ago. Rural water associations lay pipelines to many farms. We telephone for market reports; our neighbors use electronic communication between field and house; our television set works fine. Milk is delivered to the door."

Many young farm wives, said Mrs. Bleyhl, no longer supplement income with their

a Strategic Air Command B-52 makes a simulated bombing run south of Hastings.



chickens and eggs. They teach school, or are registered nurses, or take jobs in town. Farm people, she continued, hunt, fish, bowl, play golf, go to movies. She herself is active in church and woman's club work.

I turned to her husband, a tanned, muscular man in his fifties. If farming is an arduous, worrisome way to make a living, what is so compelling, so satisfying, about it?

"It seems to me," he answered quietly, "that if you work in industry or business, you take your living from your fellow man. But when you farm, you help your fellow man all the time."

He sat forward. "Sure, you have to wrestle with nature most of your waking hours—but you're helping nature. Sure, you may create a surplus—but not really, because somebody somewhere needs that food. I like to think that if I plant a walnut tree, somebody a hundred years from now is going to have a walnut chair to sit in."

Mrs. Bleyhl writes a sprightly, no-punches-pulled column for the *Nebraska Farmer*. "Nebraska farmers," she once wrote, "have a little different attitude toward life than . . . many other persons. Perhaps it is because, in a highly mobile society, we tend to 'stay put,' with close ties to our homes, our families, and our communities."

Departing, I surveyed the comfortable white farmhouse where such contentment abides. It was built by her grandfather in 1879. Her father, 89, was born in it. So was she.

BUILDING on stay-put pioneers, Nebraska attained statehood in 1867. In the ensuing century she has grown into a colossal breadbasket, ranking sixth among all states in farm income, earning some three billion dollars annually.

After Texas and Iowa, the Cornhusker State raises the most cattle. She stands third in winter wheat and corn, fourth in rye and hay production, sixth in hogs. As Governor J. James Exon told me, "Agriculture—agribusiness—is our bread and butter."

I met Governor Exon in his office at the towering State Capitol in Lincoln, an architectural wonder whose gold-glazed tile dome glints at one across thirty flat, clear miles. He waved me to a chair in front of his desk, helped me set up my tape recorder, and looked into a startling future.

"Of course we hear complaints about food prices," he said. "Transportation, processing, and marketing costs are all a part of it. Why should Nebraska grow all this grain, only to ship it immediately out and let someone far away fatten the livestock?"

The state's chief executive, a ruggedly handsome man, thumped the desk. "Our goal is to feed all our grain to hogs and cattle, process the animals into meat, and supply the United States and foreign markets with the finished product."

I asked when this might take place. Governor Exon leaned back and lighted a cigar. "You can see it coming," he replied. "More and more small packing plants are being built where cattle are fattened. In 15 years we may not be shipping out a single bushel of grain. And people will enjoy the best of beef and pork at a price with less fat in it."

When I mentioned Nebraska's quiet conservatism, the state's number-one booster countered firmly: "We're very progressive as well. We pioneered in 1934 with our unicameral legislature, a one-house, nonpartisan body that now has 49 members. It is a good, neat form of government, and the people like it. Too, Nebraska is the only state with complete public power." He stood, and we walked to the door. "Our rural cast is deceptive," he said. "You'll find great diversity. . . ."

The fact is, Nebraska has a split personality. More than half her 1,525,000 citizens live in towns and cities, and seven of ten dwell in the state's moister eastern third. These are Midwesterners in outlook as well as geography, urban-suburban, many of them, and sometimes urbane. Better than half a million reside in the sprawling metropolis of Omaha. Tidy, roll-up-the-sidewalks Lincoln, the capital, is home to 160,000 more.

The West begins, some say, somewhere beyond the 98th meridian, a quarter of the way across Nebraska; the people bear its mark. The semiarid wide-open spaces teach self-containment, self-reliance, economy of speech, dislike—if not distrust—of cities. In the sparsely populated northwest, a panhandle region nearly as large as Connecticut, New Jersey, and Delaware combined, I heard occasional mutterings of secession. Out there, where Scottsbluff, population 14,500, is the largest city, Colorado and Wyoming can seem more compatible. "What," some people grumbled, "has Lincoln done for us lately?"

Where then, I asked, does Nebraska come together? Two newspaper friends supplied a surprising answer. "Football is our single

most unifying force," said Hollis Limprecht, editor of the *Omaha World-Herald*'s "Magazine of the Midlands." Photographer-writer James Denney added: "Everybody is very proud of the University of Nebraska Cornhuskers. NU's team serves the ego of the entire state."

I AM NOT THE MAN to take issue. On a November Saturday I joined the crush in Memorial Stadium at Lincoln. Surrounding me, sporting red hats, sweaters, coats, pants, shoes, yelling "Go Big Red!" and "We're Number One!," more than 70,000 Nebraskans proclaimed their loyalty.

Something like one of every twenty residents of the state came together in that chaotic scarlet sea (page 397). When they shouted the old fight song's triumphant refrain—"There is . . . no place like . . . Ne . . . bras . . . ka"—I shouted with them in full agreement. *That* was communication.

For many, NU football is a way of life. Season tickets descend through the family. Courts have decided who shall retain the tickets when husband and wife separate. People have mortgaged their homes to follow the team on the road. Around 8,000 flew to Honolulu in December 1971 for a game with the University of Hawaii.

I called one morning on Tom Osborne, NU's tall, sandy-haired young head coach. Could he explain . . ?

"There are several reasons," he answered. "The state has been football oriented for forty or fifty years. People like winners, and we have a strong tradition of success. And there isn't much competition here for the entertainment dollar."

Coach Osborne holds a doctorate of philosophy in educational psychology. As I left, he offered a personal observation: "I meet transplanted Nebraskans everywhere. They're

New life hangs in the balance as the mobile baby hospital of the University of Nebraska Medical Center in Omaha returns from an emergency call 50 miles away. Inside the speeding van, a doctor and medical student Kristine McCulloch (**above**) monitor an infant suffering from a heart disorder and a parathyroid condition. Responding to treatment, the child soon was sent home. Volunteer hospital workers donated the $25,000 van to the center.

very loyal: they're Cornhuskers at heart. They still say, 'Back home. . . .'"

I do too, I must confess. And I believe that Nebraska's roots go deepest along the fertile Platte River Valley. The braided river—"a mile wide and an inch deep"—bisects the state and inspired its name, from the Indian word for "flat water." Many of the cities and towns along the river began as rip-roaring railheads, end-of-line camps. Today, one sees, they move boldly toward the 21st century and carry their heritage with them.

THRIVING GRAND ISLAND, for instance, the state's third largest city with more than 31,000 residents, lives by agriculture, marketing, and food processing. While there, I visited the Farrall Instrument Company. Inventor William R. Farrall's medical electronic devices—a touch-system teaching machine, and aversion-therapy apparatus—are used throughout the world to help severely retarded children and people with mental and emotional problems. Not far away, in a strikingly modern and handsome building, I found the Stuhr Museum of the Prairie Pioneer notably recording how Grand Island and Nebraska came about.

When I stopped at Kearney, 40 miles farther west, this old sentinel of the trail was preparing to celebrate its hundredth birthday. That would be fun, I thought. But Kearney State College proved more compelling to me. At its annual Midwest Conference on World Affairs, diplomats of many countries and students from throughout the state mingled freely and sought mutual understanding.

Upriver at North Platte, I discovered that this energetic city remains more than ever "end-of-line." At the Union Pacific Railroad's vast Bailey Yard, more than 4,000 freight cars are received daily, sorted, assembled into new trains, and dispatched all over the country.

Beside this six-mile-long phalanx of shuttling monsters, I talked with Stephen F. McWilliams, a sturdy 80-year-old retired engineer. "I started in 1911 at 15 cents an hour," he said. "I used to get the engine crews out of bed. There were few telephones in those days, so I rode a bicycle or walked to where they lived and rousted 'em out."

Times change, but Nebraskans remember. At Bridgeport, white-haired Paul Henderson seated me in his living room and casually remarked, "You're sitting on top of some of the ruts of the pioneer wagon trains. You can still see them in many parts of the state."

Mr. Henderson, 78, has seen them all. In a lifelong love affair with the historic way west, he has collected and indexed 18,000 color slides of the mighty wagon road. I spent a morning listening as he retold the epic tale:

How, before and after the Civil War as a territory and in 1867 as a state, this gently rising, virtually obstacle-free land provided a natural funnel for a United States pushing to the Pacific.

First came trappers, fur traders, and explorers, wandering through the "Great American Desert." Humanity flooded after—emigrants in white-topped wagons, soldiers to conquer and dispossess the Indians, freighters, gold rushers, railroaders, cowboys, sodbusters.

In the late 1860's, after sledges spiked steel ribbons to the treeless plains, settlers arrived in growing numbers. Many were Civil War veterans. Many were poor, ambitious people from far-off countries—Germans, Scandinavians, Czechs, Irish. Land was free for most simply by filing a homestead claim, and cheaply bought otherwise. Crops and cattle could ride the rails to market. The lack of trees for firewood and lumber didn't matter. You burned "prairie coal"—buffalo and cow chips; you cut sod into rectangular strips four to six inches thick and painstakingly stacked them atop one another until you had a house. A good house, if built right.

I thought of settlers and sod houses that afternoon, farther west in Gering. There my uncle, Fred H. Walters, and his wife, Jessie, proved up a 120-acre homestead during the 1920's, later acquiring another 80 acres. They started out in a tar-paper shack, planting trees and crops and running a few cows. That shack remains etched in my mind. I

Savage wind across the plain dropped what's left of a baby grand piano into a milo field, a quarter of a mile from the devastated farmhouse of its owner. Although no lives were lost, 17 homesteads were damaged by the tornado's rampage across southeastern Nebraska, part of a tornado belt characterized by collisions of warm and cold air masses. Twisters have written an awesome history of destruction in the state; one in 1913 killed more than 100 people in the Omaha area.

slept many summer nights beside it in a tent.

Now Aunt Jessie and I drove past the old homestead, where a substantial house nestled in a tall grove, and fertile, irrigated fields were sown to potatoes, sugar beets, beans, and alfalfa. "Oh, my," said Aunt Jessie. "I miss the old days. Pshaw. I was born in a sod house in 1900."

She tossed hair as black as when she was a belle. "Father always said that the man who couldn't build a good soddy wasn't worth sic 'em. I remember that he plastered the outside of ours, and mother tacked muslin sheeting against the inside walls and ceiling to keep out the dirt and field mice. It was cool in summer and cozy even in blizzards. When it rained, we caught the drips in pans."

My aunt sighed. "Sometimes I sat in the window beside mother's geraniums and watched twisters twirling far away."

QUITE A NUMBER OF SODDIES still exist (page 381); people live in some, while others serve as storehouses. They are part of the Nebraska pattern; they belong. And as I traveled the state in summer, fall, and winter after an absence of more than thirty years, I came upon much else that seemed familiar.

I recognized my old hometown of Omaha readily, though expressways now soared through it and housing developments had devoured cornfields on the perimeter. At the southern tip, Bellevue—a tiny fur-trading post in the beginning—had burst into a city of some 25,000, bedroom for the Strategic Air Command at Offutt Air Force Base.

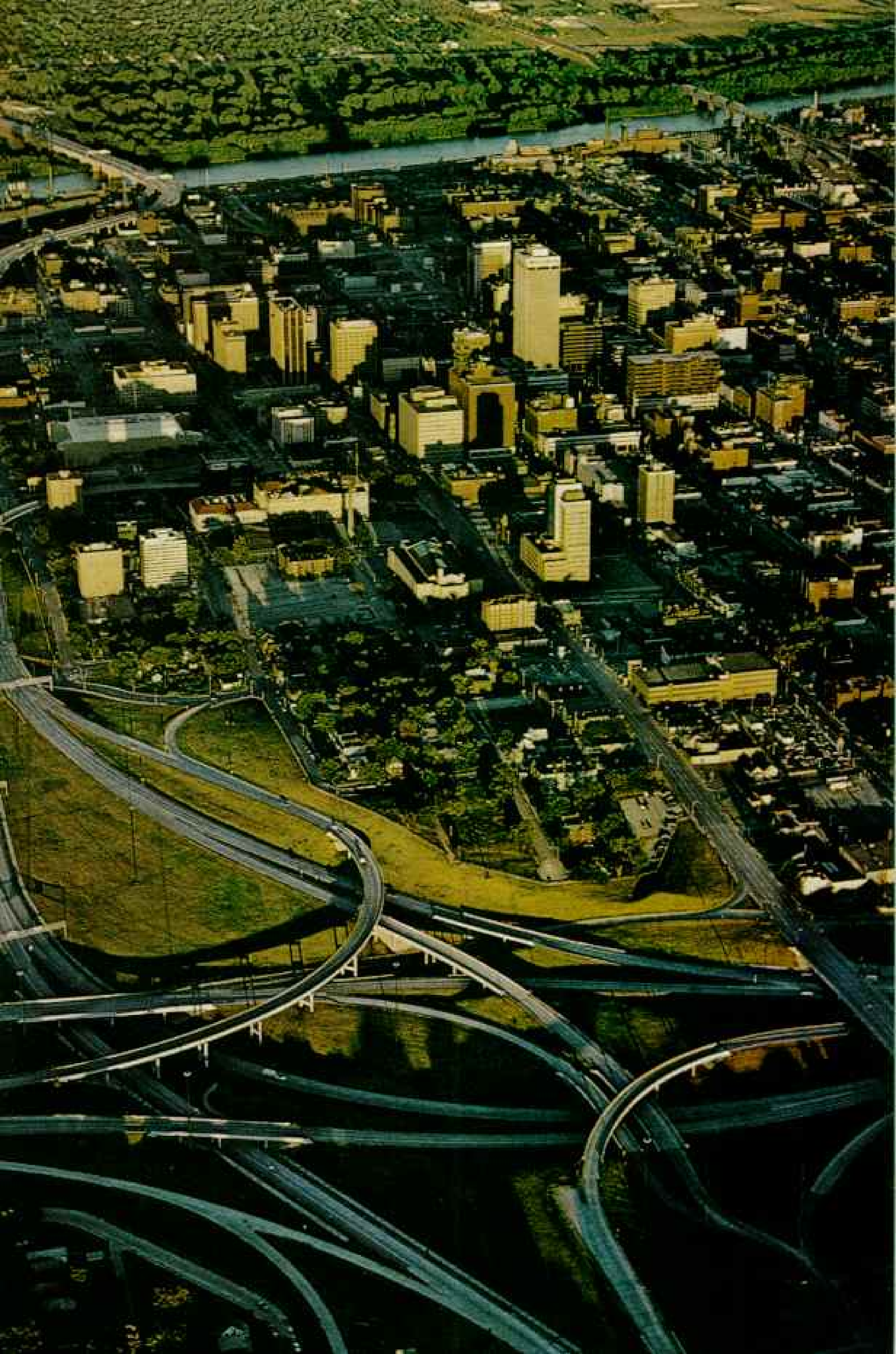
Downtown, sleek glass-and-steel towers *(opposite)* loomed incongruously above dowdy, weather-stained structures that were weary years before my day. Atop one gleaming skyscraper I dined sumptuously on perfect sirloin in the Omaha Press Club's well-appointed restaurant. From my table I gazed out on the moonlit Missouri, admiring how the river slithered between Omaha and Council Bluffs, Iowa, on the far side.*

A small tow of barges slipped upstream, bound perhaps for Sioux City, Iowa. Lewis and Clark, I thought, rowed past here in 1804 toward the unknown Northwest and immortality. Half a century later, steamboats tied up at the levee by the hundreds. From the waterfront in 1865 the Union Pacific set steel ever west. Four years later the country was banded together.

Freights still roar over that roadbed. Omaha remains home to the U. P., and the Burlington Northern maintains regional headquarters here and serves Nebraska as it has for more than a century. Many new industries have come in; the city prospers. Western Electric employs the most people—nearly 7,000. Thirty-four insurance companies center here. International corporations radiate: great food processors like ConAgra, the giant

Urban kernel of a rural state, Omaha brings big-city problems and uptown glitter to Nebraska. An impressive new skyline only camouflages the inner decay that blights many American cities; but a massive redevelopment project planned for the Missouri riverfront, including neighboring Council Bluffs, Iowa, promises a face-lift. A prime market for livestock and grain and a major railroad center, Omaha nurtures a vigorous cultural life as well. Artistically attuned urbanites attend a fashion show at the Joslyn Art Museum (**above**), where a gold-plated steel sculpture by Harry Bertoia undulates like prairie grass.

*See "That Damned Missouri River," by Gordon Young, in the September 1971 NATIONAL GEOGRAPHIC.



Celebrating a mythical monarchy, Omaha's Ak-Sar-Ben civic group crowns royalty in its spacious coliseum. The Knights of Ak-Sar-Ben (Nebraska spelled backward), formed in 1895 by a group of concerned business leaders, bolstered a sagging, depression-ridden Omaha and revived a sense of pride in the entire region. Here the annual coronation ball ushers in the city's 1973 social season and dramatizes Ak-Sar-Ben's many charitable and educational projects.

Countesses and princesses line the aisle of a chessboard realm for the grand procession to the coronation citadel (**left**), decorated with knights and pawns. One princess, Susan Hawkins, became the queen. Backstage, a queen's page gets a final check from her regally coiffed mother (**below**).

Spangled and jeweled, King Ak-Sar-Ben—prominent business leader Samuel Meyer Greenberg—strides theatrically down a carpet to meet his queen.

A prime mover of civic projects in the Omaha area, Ak-Sar-Ben sponsors an annual livestock show and rodeo, 4-H affairs, ice extravaganzas in its coliseum, extensive scholarship programs in Nebraska and Iowa colleges, and a highly popular racetrack for Thoroughbreds.

construction firm of Peter Kiewit Sons' Co., globe-hopping architect-engineers such as Henningson, Durham & Richardson, Inc., and the Leo A. Daly Company.

I spent days prowling Omaha. At the stockyards, a grizzled buyer scowled. "We used to handle a lot more cattle and hogs than now," he declared, toothpick bobbing. "But we're still one of the biggest meat-packers anywhere in the country."

Yes, and some of the people who pack that meat—Poles, Czechs, Ukrainians, Germans—still hold gay neighborhood festivals on closed-off streets. The Joslyn Art Museum's fine collection honors the city. Creighton University and the University of Nebraska's Omaha campuses train tomorrow's lawyers, dentists, physicians, teachers. Ak-Sar-Ben, a nonprofit civic organization, entertains the entire region with horse racing and a fall costume festival highlighted by the coronation of a king and queen (preceding pages); proceeds pay for educational and cultural programs.

ONE GOES HOME AGAIN, it is true, at some cost. Memory carries a sting. Back in the twenties, I recalled, Omaha's official quartet, the Keno Four—with my father singing bass—always rendered its jaunty theme song to warm applause: "Omaha, Omaha, finest place you ever saw. . . ."

Poetic license, certainly, but less so then than now. Today, disadvantaged people live in a ghetto on the near-north side, and dismal turn-of-the-century brick warehouses step back from the waterfront. "Downtown Omaha," Mayor Edward Zorinsky told me, "has been deteriorating for years."

A face-lift is needed. The operation begins as you read this. For openers, headache balls are to level seven square blocks near the river. Something of a miracle promises to galvanize my tough old hub city and the wide area she serves.

Eugene A. Leahy, the dynamic former mayor who heads the Riverfront Development Foundation, related the details one afternoon as we strolled the Missouri's banks. "A whole new life-style," he declared, "is coming to the downtown area—tall office buildings, smart hotels, apartments, townhouses, a university campus, all tied in by a mall of walkways, trees, and pools. And a 'marina city' will bring pleasure-boating to the front door."

Gene Leahy was merely warming up. He swept an arm along the river. Omaha, he went on, will serve as the focal point for an even larger development: a linear park and 54 miles of scenic highway on the Nebraska side and 90 on the Iowa side. Industrial parks, new housing, motels, and restaurants will be built. The project involves six counties and six cities and towns in the two states.

Next morning I cruised the waterfront in a trim houseboat, trying to envision the sparkling skyline that would rise here. Alden Aust, the city's quiet-spoken planning director, accompanied me. Spray kicked up in our faces as we chopped through a towboat's wake, and a small excursion boat loaded with waving children churned past. Otherwise, the river was empty.

"Long ago," Mr. Aust observed, "people turned their backs on this beautiful river. Now they are returning. Private investment and public funds both will pay for this recycling of a city and a region. A billion dollars may not be enough. We've drawn the basic plans. Our target date is 1985, but the program could go on for decades."

OMAHA GOES ITS OWN WAY. It looks east to Iowa, north to Minnesota and the Dakotas, south to Missouri and Kansas, and—of course—west to Nebraska.

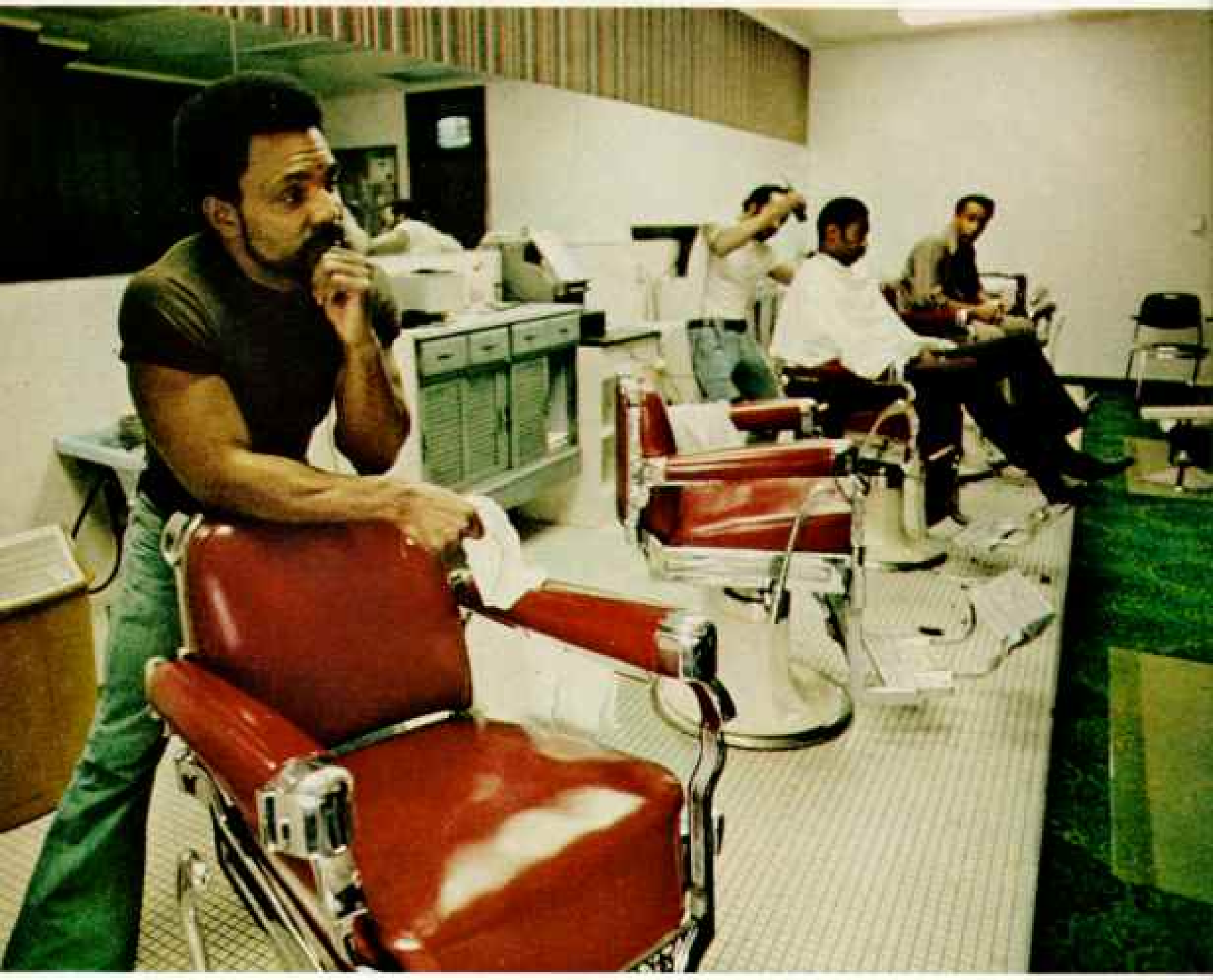
Lincoln bespeaks the Cornhusker State far better. As the state capital and university seat, it provides an excellent cross section.

I stayed in the capital several times, and found it making few pretensions. At base, it seemed little changed from the city I lived in during my years at Lincoln High School. A well-kept, small-town kind of place, it acts as market, rail center, grain storer, banker, maker of golf carts, home of insurance companies. More than 160 churches rise above its quiet streets—one for every 1,000 persons. Families play and picnic in 48 parks, covering 4,555 acres.

Scarlet legions flaunt their school color in Lincoln, home of the University of Nebraska. The nationally ranked Cornhuskers attract more than 70,000 fiercely partisan fans to home football games in Memorial Stadium. On the horizon, the gold-tipped spire of the State Capitol towers over a progressive city characterized by its clean, youthful industry.

HUSKERS

Spokesman for a troubled minority, State Senator Ernest Chambers works in a barbershop in Omaha. Chided by colleagues for not wearing a coat and tie to sessions of the legislature, Chambers responded by placing a boy's shirt with a clip-on tie on his desk. "I told them to talk to the shirt if they wanted to," he said, "but if they wanted to talk to a man they could talk to me." The state's only black legislator, Senator Chambers plans to run for the governorship this year.



With each of my visits, the city's face seemed more youthful. New industry has found Lincoln in recent years—IBM, Addressograph Multigraph Corporation, Square D Company, Control Data. Now construction was catching up. I watched bulldozers shifting earth for a two-block federal office building; work was under way on a 250-room Hilton Hotel; plans for a bus terminal-parking garage were completed; new entertainment centers and restaurants opened.

Prosperity, I learned, was becoming a pleasant problem. "We don't want to grow for growth's sake," asserted John R. Fraker, the Chamber of Commerce's forthright head. "We're concerned with quality. This is a quality city."

And something more, I decided as I walked about. People had time to nod, and many to smile. When I called on Mayor Sam Schwartzkopf, he told me about an experiment he and Mrs. Schwartzkopf conducted: "One day Dorothy and I walked down O Street—the main street—and sat on the benches.

Isolated from the American mainstream, Sioux Indians Mary Poor Bear and her daughter Tina Marie (**left**) share a discouraging history with Nebraska's 15,000 other Indians. Lack of education and motivation, among other problems, challenge the recently formed Nebraska Indian Commission, directed by Santee Sioux Robert B. Mackey. "We are human beings," says Mr. Mackey, "and want only an equal place in the sun."

Old World hoedown. Children of immigrants swirl in the streets of Wilber during the annual Czech Festival (**below**). A potpourri of Europeans—Czechs, Poles, Swedes—settled in Nebraska in the late 19th century. Many gathered in small towns which still preserve their traditions. In Wilber, 90 percent of the townsfolk are of Czechoslovakian origin.

We just looked people in the eye and said, 'Hi, how are you?' Seventy-five percent came right back with a friendly response."

This ready communication, the visitor sees, also flows between town and gown. Nebraska University's 21,000 students, together with 2,000 more at Nebraska Wesleyan and Union College, keep the city young at heart.

Helping keep Nebraska in the forefront of agricultural progress, I found, were two immensely painstaking scientists at NU's Agricultural Experiment Station. Through genetic manipulation, Dr. John W. Schmidt and Dr. Virgil A. Johnson work to improve wheat—staple of a third of the world.

"The object," Dr. Johnson told me, "is to increase yield and strengthen disease resistance." He held up a head of wheat in one hand, a small forceps in the other.

"Wheat, being self-pollinating, is a closed genetic system," he said. "We crossbreed—by hand—thousands of genetic entities. When a promising variety results, it is a rare recombination of the parents' best traits. If

Tumbling froth flows into the Niobrara River, delighting bathers east of Valentine. Nebraska's highest cascade, 68-foot Smith Falls and its mossy, tree-rimmed canyon may become part of a recreation area under a proposed water-development project. Once considered too dry to support extensive agriculture, Nebraska in fact lies over great groundwater reserves: at least 40,000 shallow wells and numerous storage reservoirs irrigate more than five million acres.

you start with 500 crosses, after selecting for seven or eight years you may have only one or two lines left."

Agronomists Schmidt and Johnson now keep tab on more than 100,000 lines in the field. Since 1954 they have named and released 17 new varieties. One—Scout—has become the most widely grown wheat in the U. S.

IT WAS TIME TO GET BACK in the field myself. I put Lincoln behind and drove northwest. At Verdigre, near the Missouri River boundary with South Dakota, an unforgettable character named Alfred H. Marshall took me in charge.

Oh, he seemed like anybody else—late fifties, graying, glasses, small moustache, slightly rumpled clothes, talkative. But he turned out to be a farmer, home builder, electrician, musician, chairman of the Verdigre District School Board, husband and father, and a wide-ranging friend of man.

Six days a week, rural carrier Marshall delivers the mail to 185 farm families, many, like himself, of Czech background. In a small battered car, light flashing on its roof, he wheels over his 121-mile route—ten miles of it paved, twelve dirt, the rest gravel. He has been doing this in all weather for 37 years.

With special permission I rode beside Al Marshall a couple of days, pulse skittering with the tires as we charged over snow-slick hills—how could he be *so sure* nothing awaited us on the blind side?

"Gets to be like breathin'," he remarked amiably, swooping down on a flag-up mailbox. He reached through the car window into it: "Now *that* annoys me. Loose pennies, for stamps. They always fall out in the snow. Should be in an envelope."

If this mailman lags behind a little, picking pennies out of the snow, people along his route will be waiting by the roadside. He chats with a farmer, a grandmother in a babushka, a pretty young teacher at a one-room schoolhouse.

Should it be St. Valentine's Day, he tosses candy in the boxes for the youngsters. He knows who is ill, and who is expecting; he is a godfather many times over. He watches for the dogs that will give him a run, pulls over to hear the telephone lines humming, points to a woodland where eagles sometimes soar.

Al Marshall, in short, is a happy man. He claims he has the best job in the world. He cares, and he is by no means alone.

So, I am convinced, do the rest of his friends and neighbors in Verdigre. In 1971-72 they pitched in and raised a million dollars to make their pleasant village an even better place to live in—new elementary school, 55-bed nursing home, 30-acre recreational area, clinics for the dentist and optometrist who have been attracted here.

Last year Verdigre, population 625, was named an All-America City. You won't find a prouder community anywhere.

On the other hand, it would be difficult to discover a more moribund town than Niobrara, just 12 miles north. I came upon it moldering on the Missouri River floodplain, waterlogged beyond redemption, waiting to die and be reborn.

A spokesman for the U. S. Army Corps of Engineers gave me the reason. Gavins Point Dam on the Missouri River has backed up silt, creating a rising groundwater table. Swamps have emerged, basements are perpetually flooded, homes and business buildings suffer structural damage. Niobrara's 600 residents must move, and many are sad.

Plans to relocate were well along when I stopped in Niobrara. Townspeople had voted to settle on elevated ground just south of the present site. The Federal Government is buying all property within the town's limits, and paying all planning and relocation costs. By the end of 1975, Niobrarans may be perched high and dry in a model community. If I know Nebraskans, many will never feel the same. But they will make do.

A FEW DAYS after I left the northeast, I poked into the dry, lonely high plains of Sioux County in the far northwest. Humanity gave few signs—a windmill, occasional ranch buildings. The nearest town lay miles away. Once I spied a small herd of pronghorn antelope; spying me, they fled beyond view as swift as the wind that buffeted my car.

Then I saw what I sought, a weathered old house trailer resting beside State Highway 71. I knocked; Public School District No. 77 indeed was in session. Mrs. David Hughson, the attractive brown-haired teacher, introduced me to her only pupils—brothers Kelly and Jerry Murphy, ages 12 and 13.

Two more bashful lads I do not expect to meet, or more fortunate ones in their education. Monday through Friday from 8:45 a.m. to 3:15 p.m., these ranch boys receive 35-year-old Mrs. Hughson's full but relaxed attention. They study the same things as their counterparts in city schools, turning to educational TV for science lessons.

"I've had more pupils than just two," said Mrs. Hughson, smiling. "Three, last year." A rancher's wife, she has a bachelor's degree in education. "We range here from kindergarten through the eighth grade," she said. "The first girl I ever taught just got married. My own two children never attended rural school with more than three companions. Now they're on the high-school honor roll."

SIOUX COUNTY'S 2,063 square miles average about one person for each square mile, which is misleading, because Harrison, the county seat and only town, has some 380 residents. Nonetheless, this struck me as massed humanity compared to what I found farther north in the sere and agonized badlands around isolated Toadstool Park. There one walks in the eerie gray-green solitude of the ages.

Over vast periods of geologic time torrents of water cut through this land. It left behind sterile buttes of sandstone and clay, deep canyons riven and twisted, serrated conical mounds, weirdly balanced rocks. "What you see," said Dr. Larry D. Agenbroad, "is untouched from forty million years ago."

An earth scientist at Nebraska's excellent Chadron State College, the young educator had kindly offered to show me this remote vestige of prehistory. He halted near the top of a large mound and pointed to a small rounded pile of white chips. "That's the carapace of an ancient land turtle," he said. "This is a bone hunter's paradise."

Countless fossil fragments wash out of the soft banks each year, Dr. Agenbroad explained, as weather erodes away an inch or two. Saber-toothed cats, camels, deer, crocodiles, others—all yield their remains here. Though it is a common discovery, I myself prize a rhinoceros tooth I picked out among fossils strewn on canyon floors. It reposes in my study now and tells me of life and struggle beyond calculable time.

The ghosts of history take many shapes. A score of miles southwest of antiquity's boneyard, we drove up to a tree-shaded camp above a small creek. Cattle drank from a pond nearby, ignoring the activity about them. I saw 20 students under Dr. Agenbroad's direction carefully excavating a site where Indians had killed perhaps as many as

400 bison—about 9,000 years ago (left).

"This is the third year we've excavated," he said. "We believe that a small hunting party came upon the animals, drove them over a steep bank here, and butchered them."

His voice took on a quiet note of excitement. "We're not positive yet, but we have indications that these bison are transitional between their extinct ancestors and the buffalo of today."

IT SEEMED almost anticlimactic, later that day near the town of Crawford, to prowl through the officers' quarters and post headquarters building—now a museum—of Fort Robinson. This defunct outpost on the plains lived by the bugle from the Indian wars of the 1870's through World War II. Nebraska now owns 13,000 of its acres.

The Nebraska State Historical Society, a dedicated and professional organization, is carefully restoring some key structures and re-creating others. A reconstruction of the old guardhouse gave me pause; Crazy Horse, the great Oglala Sioux war chief who helped crush Custer at the Little Big Horn in 1876, had met death by bayonet here a year later, attempting to avoid confinement.

At the headquarters museum, curator Vance E. Nelson and I halted before a showcase. A small sign quoted Red Cloud, another Sioux war chief: "I will go now and I will fight you. As long as I live I will fight you for the last hunting grounds of my people."

These words seemed more powerful and poignant than ever. Militant Indians had occupied this old building briefly not long before my visit. Nebraska Indian Commission Director Robert Mackey, a Santee Sioux, later gave me a simple explanation: Indians contend that the land should have reverted to them when the U. S. declared it surplus.

I made it a point to talk with a number of Indians in various parts of the state. To be blunt, all felt that the white man considers them—like Fort Robinson—surplus, offering only token encouragement.

"Look at our participation in something as basic as education," said Mr. Mackey, a thoughtful, articulate man. "Most of our children drop out before completing elementary school. Last year, 25,000 young people graduated from Nebraska high schools. Only 45 were Indians. At the university you'll find only 22 Indian students."

Opportunities are few for most of Nebraska's 15,000 Indians. Torn from the land they love, unable to live by the white man's schedules, uneducated, without job skills, they drift between the reservation's limbo and heedless towns and cities. They are fringe people, almost unseen.

Few red men roam Indian country anymore, but cattle beyond count do. The grassy Sand Hills of north-central Nebraska, which cover about a fourth of the state, are one of the world's most concentrated beef-raising kingdoms. Oddly enough, you don't see many cows as you drive through this spacious land—they're behind the undulating dunes.

SAND HILLS ranch houses are far between, towns few, roads occasional, and cars rare. One morning in Gordon—"The Little Town With a Big Smile"—I asked a service-station operator the distance to the next community south, Ellsworth. He grinned; I was his. "You'll think it's a hundred miles," he said, "but it's only fifty-six."

I drove those miles and many more with pleasure, past endless yellow-green hillocks wearing azure lakes in their clefts. Ducks rafted on the water, plovers stalked the shores, meadlowlarks and redwing blackbirds flashed through the air. Here and there stood a lonely tree.

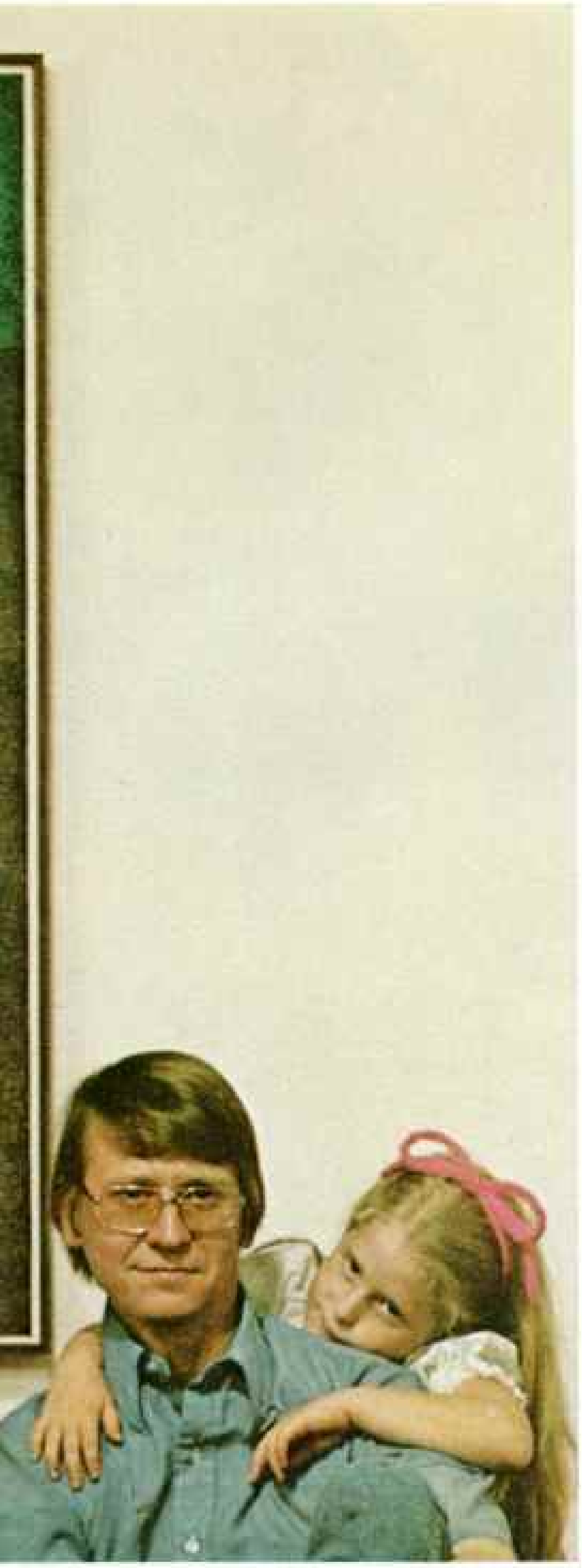
Still, I saw man making his mark everywhere on the meadows; it was haying time, and haystacks popped up like mushrooms. Beside one field a rancher gestured at his 12-year-old son, who was baling hay. "That young feller made 11,000 bales last year," he told me.

The late Mari Sandoz wrote of this land and its sturdy people with power and grace in *Old Jules*, the biography of her pioneering father, and other books and articles. Old Jules, I believe, would find kinship with today's Sand Hills people, even though some use airplanes and helicopters to patrol their

Scene of ancient slaughter emerges from the Hudson-Meng Paleo-Indian bison kill site near Crawford (**left**), where students from Chadron State College expose 9,000-year-old bones, prehistoric weapons, and butchering tools.

Corrugated grasslands near Cozad surround Central Midway Lake (**following pages**), noted for its boating and fishing. The Sand Hills to the north also lure hunters and fishermen from throughout the country.

Darkling sky, rich soil, and an enduring farmer: "Sunday Before the Rain" reflects the quiet strength of rural Nebraska in a painting by Allan K. Tubach, sitting with his 5-year-old daughter, Lisa. A native Nebraskan, art director of the *Omaha World-Herald*, and one of the Midwest's outstanding young painters, Mr. Tubach explores the essence of life on the great American prairie. People



close to the soil live here, fortified with the self-reliance of their pioneer forebears, insulated from moral uncertainty by solid convictions, and proud of the bounty of their harvests.

50,000- and 100,000-acre spreads. They did without the fancies to get where they are.

I suspect that many Nebraskans remain willing at heart to do without the fancies. Those who have moved to the cities remember well the farm, the ranch, the little town whence they sprang. They remember the old white house with its elm-shaded yard, and the neat white picket fence setting it off. The Nebraska that Willa Cather immortalized in her novels lives on as surely as the house I have just described, which happens to be Miss Cather's late-19th-century girlhood home in the south-central town of Red Cloud.

There, and in Brownville, on the Missouri River in the southeast, I found the quintessence of my home state. In Red Cloud, in the turreted old building that memorializes Willa Cather, I quickened to her words. They rang true to all I had seen: "...furrows a mile long...brown earth...strong clean smell...soft deep sky of happiness...."

AND WHAT OF BROWNVILLE? Some residents call it the "Cradle of Nebraska." There I ended my journey. The town rests beside the broad Big Muddy, living with its memories of steamboats and covered wagons and freighters rolling west, and fewer than 200 reside where 2,000 once went about their business. Steamboating and freighting were doomed by the arrival of railroads in Nebraska.

For all that, there was no need to mourn the glory that was Brownville. Enough people care, I discovered, to have restored many of its fine old buildings, and visitors flock to them. Artists and artisans have made their way here, and summer folk-life festivals and old-time fiddlers' contests set the town humming. At the Brownville Village Theatre, Nebraska Wesleyan University's players perform to packed houses.

I looked in on a rehearsal of Oscar Wilde's *The Importance of Being Earnest*. I walked into the old Lone Tree Saloon, where some say outlaw Jesse James once played poker, and found a jaunty miller stone-grinding corn, wheat, and other grains. And two and a half miles downstream on the riverbank, I stared at a bulky nuclear power plant that cost nearly a third of a billion dollars. It would soon go into operation.

That's Nebraska for you. Nebraskans will handle whatever comes, and make the good life out of it. □

Bavaria

Mod, Medieval—and Bewitching

By GARY JENNINGS

Photographs by GEORGE F. MOBLEY

NATIONAL GEOGRAPHIC PHOTOGRAPHER

THE BEAUTIFUL blue Danube is no longer blue. It is brownish. But it is undeniably beautiful—and this day it was boisterous as well. With two young friends, blond-bearded Jörg and long-haired Walter, I was trying one of Bavaria's summer water sports: spinning down a river on an unpowered, rudderless, inflated raft.

With Walter exhorting, "*Schneller!* Faster!" and Jörg warning, "*Vorsicht!* Take care!" we bore down on the massive 828-year-old Stone Bridge that spans the Danube and ties Regensburg's timeless inner city, with its aged gingerbread buildings, to the modern northern suburb.

Then we crashed into one of the bridge's arched stone piers. Into the drink spilled all three of us. But we caught our raft, beached it on the bank, and, bruised, waterlogged, and exhausted, tugged on sopping shirts over our swim trunks. Slowly we sloshed up the bank to the old Historische Wurstküche (the Historic Sausage Kitchen) that has looked out on the Danube since 1320.

We might have been back in the 14th century as we wolfed down delicious sausages, sauerkraut, and dark beer at an outdoor trestle table. Then a chimney sweep strode through the restaurant, as gaunt and black as Lucifer.

"Quick! Touch him!" urged Jörg. "It will bring you good luck all day."

I engaged the sweep in conversation, surreptitiously touching his sooty shoulder, and asked whether he thought there was any truth in the good-luck tradition.

"I don't know about that," he said grumpily. "All I know is that whenever I come into the Wurstküche here, they make me spread out newspapers—" suiting the action to the words "—before I sit down."

An eagerness for 20th-century modernity and a loving perpetuation of tradition—trendy youngsters like Walter and Jörg

Land of *Gemütlichkeit*—comradeship and good cheer—erupts during Fasching, a chaotic pre-Lenten carnival much like Mardi Gras. Here in Munich, Bavaria's capital, snow deters neither street revelers nor ensuing masquerades. Ash Wednesday signals an austere end to weeks of pageantry, but in this lively land other festivals always await celebration. Best known is Oktoberfest, the autumnal fun fair whose boisterous beer pavilions, hearty food, and brass bands (**next pages**) draw millions of visitors.

Window on yesterday, Munich's town-hall glockenspiel (**left**) comes to life at 11 each morning, when, to pealing chimes, animated figures reenact a traditional joust and dance.

Night enfolds the towering grandeur of Munich's skyline (**right**): from left, the 12th-century Peterskirche; the twin-domed Frauenkirche; the New Town Hall, built in the 19th century; and the Heiliggeistkirche (Church of the Holy Ghost).

in a setting at once medieval and as up-to-date as tomorrow—that is Bavaria. It occurs to me now that my friends' contradictory shouts—"Faster!" and "Take care!"—accurately reflect both Bavaria's current boom and the Bavarians' simultaneous desire to hold on to all that is good of the olden times.

I first came into Bavaria (Bayern in German) by train from the northwest, following or crossing the trails of Napoleon's armies, Crusaders, Charlemagne's paladins, Roman legions, roving prehistoric Celts, and the sixth-century Germanic tribes called Baivarii, who gave their name to the land.

As northern Germany's factories and smoking chimneys gradually gave way to Bavaria's tidy farms, I recalled a contemporary writer's comment on this country. "Visitors from austere Northern Germany call it *niedlich*, bewitching," Emil Lengyel wrote. "Here Nature is good to its children, and they are good to Nature."

Niedlich actually means "bewitching" in the sense of a charming miniature, like a dollhouse, and the countryside of Bavaria certainly fits that description. In blue-and-gold summer and blue-and-white winter, I stopped to view the scenery everywhere from the rolling Franconian Jura plateau north of the Danube, through numberless toy-town villages, to the craggy Alps that separate Bavaria from Austria to the south. Each vista was as beautiful, perfect, and complete unto itself as the landscape one used to see through the peephole of an old-fashioned Easter egg.

Just as I found Bavaria different from the rest of Germany, so I found Bavarians different from other Germans. In the Alps of Oberbayern, or Upper Bavaria, the owner of a village restaurant tried to explain this difference to me. "The Bavarians shoot slower than the Prussians," he said. "They're not so quick on the trigger and so they're likelier to hit their target."

"Why do you say Prussians?" I asked. "What about the Rhinelanders and the. . . ?"

He interrupted brusquely. "Everybody north of the Danube is a Prussian!"

That is not true, of course; Bavaria itself extends well north of the Danube. In fact, as the river arcs across Bavaria it is nearer the southern border than the northern (map, page 416). With 27,239 square miles, Bavaria is the largest state of the Federal Republic of Germany, about twice as big as such entire nations as Belgium and Denmark. Since 1806 Bavaria has been in turn a kingdom, a member of the German Empire, a state of the Weimar Republic, and a part of Hitler's Third Reich.

Bavaria Treasures Its Cloak of Greenery

Although the ten and a half million Bavarians represent about a sixth of West Germany's population, Bavaria is the second least densely populated German state. It is also among the least industrialized and least polluted, with a third of the land still richly forested and two thirds of its people living in rural districts.

"We Bavarians will never give up our woodlands, even if all the rest of the world gets paved over," a forest ranger told me as we strolled through the lovely Bavarian Forest along *(Continued on page 418)*

The Alps: Bavaria's sports arena

FAR FROM TRODDEN WAYS, a lone skier slices through virgin snow that mantles slopes and silent, majestic evergreens on Tegelberg (**left**). At Inzell, speed-blurred motorcyclists at the World Ice Speedway Championships flash around a slick track on tires studded with 1⅛-inch steel spikes (**below**). And on the Riessersee near Garmisch-Partenkirchen (**right**), friends pass a sunny afternoon with a game of *Eisstockschiessen*—akin to curling—beneath a heart-stopping Alpine vista.

Avid outdoorsmen, Bavarians indulge in a cavalcade of sports perfectly suited to their jagged, lake-spattered land. Warmer months bring swimming, mountaineering, fishing, hiking, and camping, as well as kayaking on swift streams that thread the countryside.

Monument to one man's whimsy, the storybook castle of Neuschwanstein rises above a forest near Füssen. The extravagance of its builder, Ludwig II, earned the king the epithet of "Mad Ludwig." But today Neuschwanstein's value as a tourist magnet far surpasses its original cost.

Ludwig ruled an independent Bavaria until 1871, when Prussian Chancellor Otto von Bismarck drew it into the German Empire. Largest of West Germany's states and among the least densely populated, the "Free State of Bavaria" (**below**) embraces a culture more like Vienna's than Berlin's.

RICHMOND CRAWFORD, JR.

Bavaria

Elevations in feet
Roads in red

0 100
STATUTE MILES

the state's eastern edge. "And we treasure the forest creatures, too. My job is to keep close check on who hunts what in here. When snow is deep or the ground is frozen, absolutely no hunting is allowed. Furthermore, we set up feeding stations to help the animals survive the winter."

Most urban centers of Bavaria also retain a delightful rusticity, because all the large Bavarian cities date from the Middle Ages or earlier. A city's outer precincts may be an uninspiring conglomeration of 19th-century factories and edifices of glass and steel. But its central section, the original city—sometimes still encircled by a great wall, as at Nürnberg—is usually a charming jumble of alley-narrow streets and half-timbered facades with mullioned windows, high-peaked gables, and tipsy chimney pots.

Even Munich (or München), Bavaria's capital and West Germany's third largest city, after West Berlin and Hamburg, is a city of human dimensions. Much of it is new, rebuilt after World War II destroyed about half of it. But it has no skyscrapers and no feeling of canyon claustrophobia. With 1,340,000 people, it did, until recently, suffer horrendous traffic jams. In 1972, though, the city's efficient subway system went into operation, and this has reduced the number of cars—and jams.

Capital Caters to People, Not Cars

"Anyway, Munich is for strolling in," said architect Louis von Waberer. "The way to see Munich is on foot. There are car-free parks, promenades, and plazas set aside just for pedestrians. The streets are shaded and green with trees, and, at almost any turning, you will come upon one of our 600 or so beautiful fountains."

One of the favorite recreations for a Münchener in summertime is to sit over a beer or an ice cream at a sidewalk café at twilight and watch the world go by. A stranger who joined me at my table—an accepted practice—told me:

"They recently took a poll all over Germany, asking people where they'd like to live if they had their choice, and, do you know, three out of four said Munich. Why? Because there are jobs here, and we're close to the mountains and the lakes for recreation, and the city itself is a wonderland. So the city has grown like mad in recent years."

Tourists also flock here. The biggest influx came in 1972, when Munich was the site of the Olympics, for which was built the most modern and elegant "Olympic landscape" in the history of the games. The XXth Olympiad was the best-attended in history, with 4.8 million paid admissions; an estimated one billion other spectators in 80 countries attended by way of television. Sadly, Bavaria's capital and the games were blighted by "the Munich massacre," the kidnaping and slaughter of Israeli athletes by Arab terrorists.

As intended, the 740-acre Olympic site remains in use. Its 47,000-seat stadium is now Munich's main sports arena. The 950-foot Olympic Tower, with its revolving sky restaurant, is a major attraction for both Münchener and tourist. The athletes' Olympic Village and Press City have become a housing and shopping complex for the people of Munich.

Artisan Resists Planned Obsolescence

Munich is an old city—it was founded in 1158. And a young one—40 percent of the people are under 30. Afro hairdos, beards, miniskirts, and tie-dyed jeans abound. But Munich will never be mistaken for New York or London. For here is still seen the traditional Bavarian costume: women in *Dirndln* and men in short lederhosen or below-the-knee *Leder-Bundhosen*.

In the loft workshop of Josef Mühlpointner I watched these leather pants being made—painstakingly, one pair at a time—by an elderly craftsman, his face as tanned and leathery as the breeches. "This pair I am working on is for a man from Regensburg," he said, "so the embroidery must be distinctively Regensburger. I can instantly recognize a man's native region by the embroidery pattern that decorates his lederhosen. With a woman's dirndl, it's the colors that are supposed to tell her hometown. Regensburg's colors are red and white."

Why were the lederhosen still made by hand in the centuries-old way? Sentiment?

"No, practicality," the old man explained. "I will never mass-produce them; I intend for each pair to last a man a lifetime."

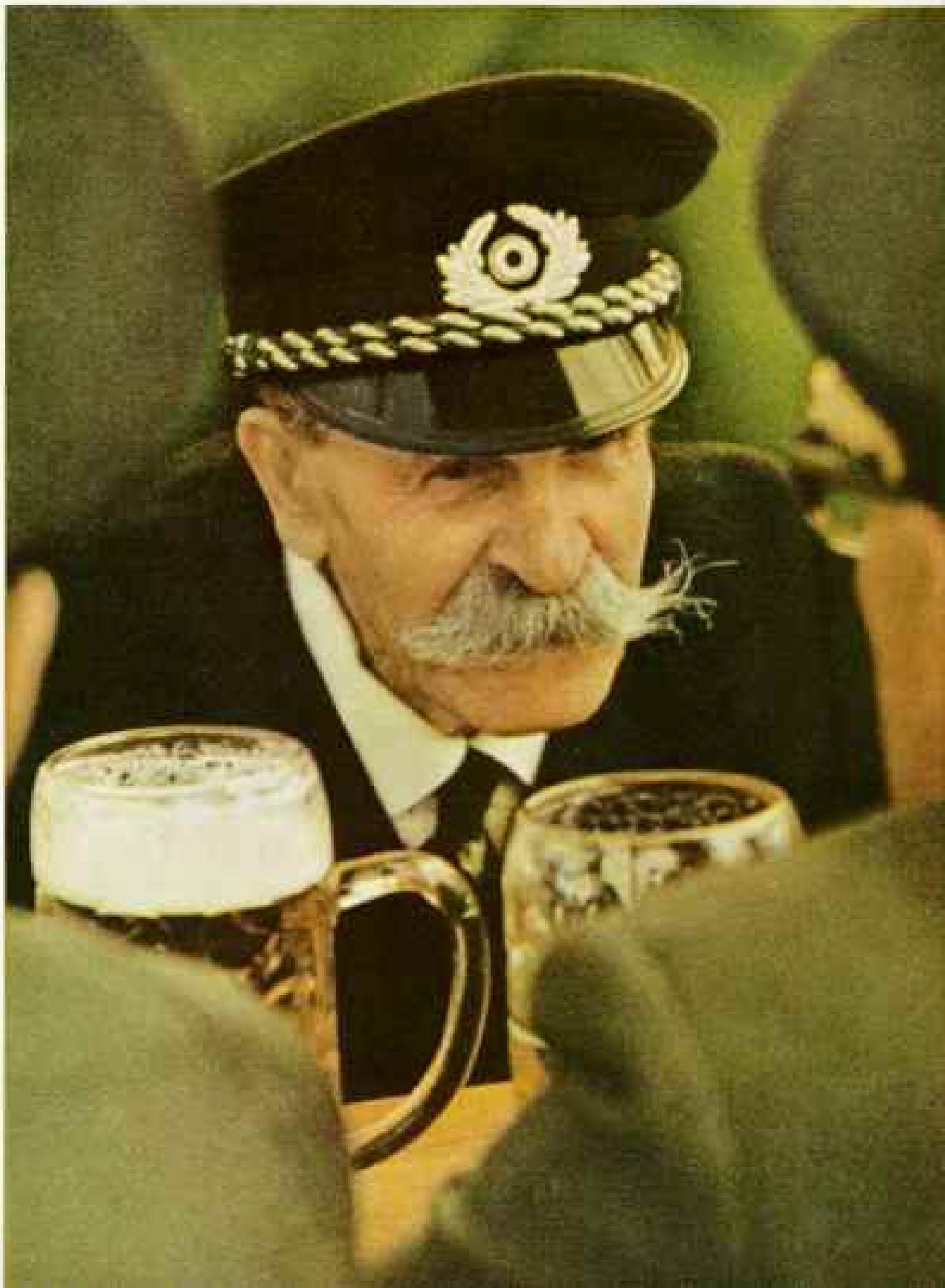
To see a well-known Bavarian product that is mass-produced, I visited the Bayerische Motoren Werke, manufacturers of the popular BMW automobile. I followed the assembly line to its end, and there I test-drove one of the sleek newly minted cars. I took it from a standstill up through the smoothly meshing

gears, the speedometer needle registering 50, 100, 150, nearly 200 kilometers (almost 120 miles) an hour, but the car remained motionless. The wheels whirred on a conveyor-belt road circling endlessly on spinning rollers. An octopus of wires and cables led from the car's innards to a bank of computers monitoring its performance.

I continued on through the factory with engineer Julius Hertrampf, who told me, "We have 18,500 employees here, turning out 850 cars a day. Twenty-two percent of our workers are women, and they get exactly the same pay that men get. Only sixty percent of our workers are Germans; the others come from 40 different nations. The new people pouring into Munich are mainly from Turkey, Yugoslavia, Italy, and Greece, seeking jobs and also seeking hard German marks to send home." Bavaria's thousands of immigrants have made the state's larger cities, Munich in particular, richly cosmopolitan.

More and more factories have located in Bavaria. It is the site of West Germany's first atomic power plant and its first nuclear research center. Especially attracted is light industry, such as the manufacture of electronic components. This industrial revolution has led one optimistic economist to predict that "by 1985 Bavaria will have completed its transition from being one of Germany's weakest states economically, to being its richest, and the nearest thing in Germany to booming California in the United States."

Bavaria has long differed from the rest of Germany in insisting on its ability to manage its own internal affairs. In West Germany's predominantly two-party political system, Bavaria alone maintains a state party. And the Bavarian Government shared responsibility with the national government in making the agonizing decisions about how to handle



"Liquid bread," Bavarians call their favorite beverage, brewed from local hops and barley. Last year they quaffed some 230 liters (about 60 gallons) of beer per person, nearly 60 percent above the national average.

This moustachioed gentleman and his companions enjoy their steins in Lindberg, a village tucked deep within the Bavarian Forest that borders Czechoslovakia. Much like mountain people in the United States, these Bavarians keep to themselves, live off rural industries, and shy from sudden change. While lederhosen and sauerkraut make way in Munich for blue jeans and hamburger stands, the forest remains the most conservative area of West Germany's most traditional state.

Showcase for the bizarre, Munich's Schwabing district sets the pace for Germany's avant-garde. Actress Elka Koska, visiting a coffeehouse (**left**), exemplifies the lack of conformity.

Munich has been Germany's Montmartre for generations. Here talented young Thomas Mann wrote *The Magic Mountain* five years before winning the 1929 Nobel Prize for literature. Here two pacesetters of abstract art, Wassily Kandinsky and Paul Klee, studied, painted, and fostered the unconventional. Here, too, several Bertolt Brecht plays were premiered.

Munich—especially Schwabing—still draws talent, youth, and tourists to galleries, craft shops, cafés, and dance clubs. At Tiffany's Nightclub (**above**) couples unwind beneath clustered lights that flash to the pulsing beat of the music.

Schwabing's enduring distaste for convention surfaces in a sidewalk artist (**right**), who retreats behind the mystery of a mask decorated in his own style.

ALL BY JONATHAN BLAIR

the crisis of the Munich massacre and, later, in choosing to exchange the captured Arab terrorists for a skyjacked planeload of passengers.

The Bavarian penchant for independence becomes in Munich a passion for individuality. Sometimes known as "Athens on the Isar," Munich historically has been an intellectual and cultural center of the country. It contains West Germany's largest university, distinguished academies of art and music, the country's most active colonies of painters and composers, and an abundance of theaters and cabarets. Certain restaurants are frequented by aspiring young writers; at one place I learned that even the cook had published a book. Munich's student quarter, Schwabing, is all sidewalk cafés, nightclubs, jazz clubs, beards, budding geniuses, and intense conversation. It also has, alas, the same drug problem that plagues other such quarters.

"Give me twenty marks and twenty

Island of living history girded by 14th-century ramparts, walled

minutes," one student told me, "and I'll get you any kind of fix you want."

Visitors with more legally acceptable tastes can also find anything they want in Munich. Its Deutsches Museum is Europe's largest technological exhibit. Its Hellabrunn Zoo is among the best in Germany. Its Alte Pinakothek is a treasure house of classical art, the foremost "jewels" two altar panels by Bavaria's own Albrecht Dürer. The Nationaltheater, where I saw a stunning performance of Stravinsky's opera-ballet *Oedipus Rex*, is a place from another time—a romantic place, a more gracious time. At intermission the formally attired audience repaired to a chandeliered salon of white marble and burgundy velvet, while the orchestra played softly and champagne corks popped. And, for that while, in that *grande luxe* milieu, I inhabited a Ruritanian era of courtliness I had thought long vanished.

The Ruritanian aura, the heady flavor of

fairy-tale life, pervades Bavaria. Nürnberg, 100 miles northwest of Munich, is remembered as the site of war-crimes trials after World War II, but has been better known since the Middle Ages as "the toy city." Toys even sprout from the facade of the old Liebfrauenkirche on the city's central square. These are the carved figures of seven medieval electors, which come to life every day at noon and troop across the portal of the church to render homage to the enthroned figure of their emperor.

The Gebrüder Fleischmann firm, one of the Nürnberg region's 319 toy factories, specializes in fantastically detailed model trains. Dr. Wolfram Bismarck told me, "We make toys for grown-ups." Here I followed one small unidentifiable fragment of plastic as it went through the factory—the BMW process in miniature. The piece was joined by midget stamping, rolling, and riveting machines to other wee pieces. Lifelike markings were printed on in several colors by one of the world's tiniest printing devices. The whole finally evolved into a locomotive and tender, together less than nine inches long but containing more than 200 parts.

From Nürnberg I drove 50 miles southeast to Regensburg (population 133,500), once a great European crossroads and cultural and political center. Two early holy men, Albert of Ireland and St. Erhard of France, are buried here. Charlemagne lived in the city, as did Frederick I, and Napoleon occupied it. German volunteers for the Second and Third Crusades, those of 1147 and 1189, formed and set out from here.

Patron of travelers, St. Christopher decorates an archway that bridges one of the twisting cobblestone streets of Passau, a medieval town laced by three rivers. The serenity of Passau may vanish with the completion of a new autobahn in 1978.

New Excavations Reap Old Treasures

The early Bavarians built Regensburg inside an abandoned Roman fort of the early Christian Era. Fragments of the fort's wall still stand, and other ancient relics keep coming to light.

"A few years ago," said a Regensburg friend, Gertrud Herbrich, "the city started excavations for a parking lot, and found that the bulldozers were scraping through layer on layer of history. The city fathers postponed the parking lot and began restoration of the Old City." Gertrud took me through tunnels under the 12th-century Niedermünster Church to see in cutaway six different levels of Regensburg's past, from the 10th-century ruins of an earlier church near the surface down to the walls of a 1,700-year-old Roman camp.

The reality of life and death in old Regensburg had its grim side. Gertrud and I descended into the dank cellars of the Altes Rathaus to see torture implements in the 14th-century dungeons. "A criminal of those days," she said, "could be convicted only by his confession. Torture was the surest means of extracting one."

On "the Spanish donkey," the defendant, with a heavy stone tied to each foot, was dropped repeatedly astride an upright door-size slab of wood sharpened on the top edge.

Or he was strapped to "the maiden's lap," a chair with a seat of sharp spikes. Or he was hauled naked up and down "the stretcher," a ladder with triangular, sharp-edged, rotating rungs. Worse torture was available, but rarely necessary.

Still, Bavaria has seen more dreadful inhumanity in our own day. Twelve miles outside Munich stands the town of Dachau, with its infamous concentration camp, Nazi Germany's first. "We get as many as 2,000 visitors a day," its curator, Frau Ruth Jakusch, told me, "and many of the camp's former prisoners make a pilgrimage here on each anniversary of their liberation."

The day I visited the concentration camp, I took along a young Bavarian woman, Renate Pfeifer, who was born six months before World War II ended, and so remembers none of it. She had determinedly never before been to Dachau. When we came to some of the camp's more terrible parts—the crematorium, and its gas chamber disguised as a shower room, colder now than the gray winter day outside—Renate wept. We stopped last at the little Carmelite convent beside the camp, where prayers are perpetually said for Dachau's victims. In the chapel I bought a bloodred candle, and Renate lighted it before the altar.

The men who created the Dachau monstrosity did not let it impinge on their own enjoyment of Bavaria as a place of ease and refuge. In the extreme southeastern tip of the state lies Berchtesgadener Land, a picturesque region cradled by soaring mountains. Here, in Obersalzberg, Hitler, Goering, and Bormann each maintained a chalet, and the Nazi leader entertained British Prime Minister Neville Chamberlain.

During the war a network of underground bunkers, manned by an S.S. detachment, connected the three residences. In 1945 an RAF raid partially destroyed this formidable complex, and in 1952 the Bavarian Government razed most of the remainder.

At the summit of the mountain named Kehlstein, set apart from the complex, was Hitler's loftiest retreat, a hideaway dubbed the "Eagle's Nest" (page 430). The granite-block building with its paneled interior is a restaurant today.

Elsewhere, too, one occasionally finds a trace of those evil days. There exists, for instance, an association of former members of the S.S., the dreaded stalwarts of the Nazi Party. But it isn't much of a club, because practically nobody will rent it a place to hold meetings.

I was glad to descend from the cloud-hung, gloomy, and haunted Eagle's Nest to the tranquil valleys and lakes below, and then to discover that the region's eye-feasting beauty even extends below the ground, hidden in the salt mines called the Salzbergwerk. Salt mining was Berchtesgaden's main industry for 450 years, and still produces 120,000 tons a year.

At the mine I was given a leather apron, and, as the miners do, I put it on hind-side-to, sat on it, and slid down a sort of polished chute into the maw of the earth. I arrived in what appeared to be an enchanted ice palace—tunnels and caverns with translucent white walls and pillars of rock salt. But I remember best the little chapel-like grotto that artistic workers have hewn out. Its arched entrance, salt blocks, and salt carvings are lighted from behind, the whole thing glowing with a pure white beauty beyond description.

Famed Play Rules Out Married Women

Ninety miles due west from Berchtesgaden, another little mountain village nestles at the foot of the Bavarian Alps. Oberammergau is famed throughout Europe as a wood-carving center, and throughout the world for its Passion Play. Some carvers are updating their products from the old rough-hewn "cuckoo-clock school" to sleek modern designs, but the Passion Play holds firm to a 340-year-old tradition. Instituted in 1633 in thanks to God for relief from a plague, it has been performed, with rare exceptions, once a decade ever since.

I visited Oberammergau a couple of years after the 1970 season, which had been attended by some 530,000 visitors from 113 nations. The village was just beginning to speculate on which townsman will be playing the coveted role of Jesus in the 1980 performance. The last man to play Jesus was vacationing when I was there, but I did get to meet Beatrix Schwarz, who performed as Mary.

"I have married since I played the role," she said, "so I can't perform again. It's a tradition that no married woman can perform in the Passion Play."

Like Oberammergau, many another Bavarian town stresses some special attraction to lure visitors. Bayreuth boasts its summer

Wagner Festival; Garmisch-Partenkirchen, skiing in winter, a spa in summer; Lindau on Lake Constance, water sports and a gambling casino. But what I most enjoyed was finding little out-of-the-way places whose charms had not yet been publicized.

One of these is the hamlet of Kreuzstrasse, 30 miles southeast of Munich in the foothills of the Alps. In Max Aichler's restaurant there, an early-morning folkfest was in progress. Nearly everyone was drinking a *Gebirgler Frühschoppen*, which can be translated as a "mountaineer's morning pint." Max invited me to sit at his table, a great honor because it is usually reserved for village elders: the mayor, the fire-brigade chief, the priest.

We sat and drank Max's special concoction —half red wine, half mineral water, with a sprig of dwarf pine in it to add a resinous tang. We passed around a snuffbox, stoppered with a calf's-tail brush, while we watched dancers stomping merrily and listened to shouting music of clarinet, trumpet, guitar, accordion, and flügelhorn.

"This is the sunny-side band," someone at the table confided to me over the noise. "Max wanted the shady-side band, but one of the players was ill."

"The sunny side. . . ?" I asked, puzzled.

"Why, on every mountain there is a sunny side and a shady side, and our mountain has a band for each."

Patrons Lend a Homey Ambience

Max, a burly, bearded man in lederhosen beautifully embroidered with genuine peacock feathers, told me he preferred only real Bavarian clientele in his establishment.

"I look for three things in a man. That he wear working clothes, that he keep his hat on his head, and that he wear something green that's remindful of the woods. Then I know that we're all working people together. It makes for a cozy atmosphere."

In this convivial land, beer enhances many a cozy atmosphere. Indeed, to Bavarians beer is "liquid bread," and they have a saying, "Where there is a brewery there is no need for a bakery." They deem the brew so nutritious that I have even seen babes in arms offered tipples from their mothers' steins.

Of course, for centuries beer has been Bavaria's most famous product. The first brewery was founded there in A.D. 1046; today, of 1,725 German breweries, almost 1,200 are in Bavaria. One could have a Bavarian beer with his meals three times a day —and some do—for more than a year without drinking the same brand twice.

What makes the beers of Bavaria so superb? At Munich's Spatenbrauerei, founded in 1397 and now one of Germany's largest, the aptly named brewmaster, Dr. Georg Beer, showed me a well-worn copy of the Bavarian Purity Edict, written in 1516: "Above all," it commands, "we desire that henceforth throughout our cities and markets, and also in the country, no ingredients other than barley, hops, and water be used for the brewing of beer."

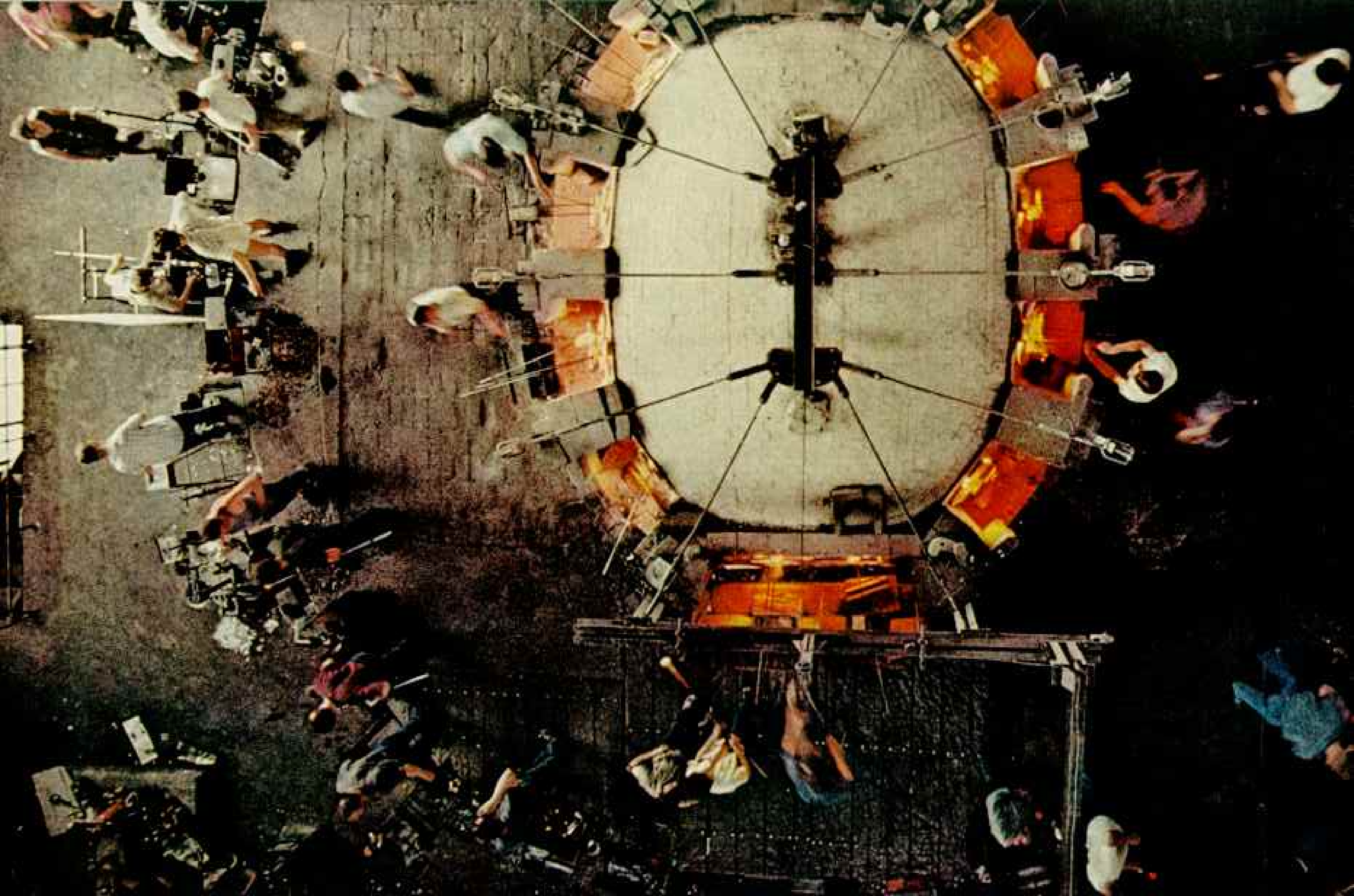
"That edict is still obeyed," said Dr. Beer, "and that is why Bavarian beer is the best in all the world."

In Bavaria, Chemicals and Brew Don't Mix

As we stood dwarfed beside a towering, gleaming 800-barrel copper brew kettle, Dr. Beer explained: "We malt our barley—that is, we let it germinate and then lightly roast it. Beers of some other countries are made from what we call 'raw fruit'—unmalted barley—or they contain some artificial ingredients. Some American beers contain a chemical additive to give them a good head of foam. Because we are so strict about using only natural ingredients and only malted barley, Bavarian beer is more digestible. Foreign visitors say they can drink stein after stein of our product, but only two or three glasses of their native beer."

Almost every Bavarian community has at least one annual beer festival, but none can rival the Oktoberfest of Munich. This 16-day festival in the self-proclaimed beer capital of the world is roaring, rampageous, and rowdy (one year hundreds of people were injured in brawls), and chockablock with crowds and confusion—a vast beer binge, when millions of liters are guzzled. At this season Munich's city symbol is modified, from a monk with

Reason to smile: Gigantic sugar beets bespeak the fertility of a land given to root crops, grains, and livestock. Farms remain traditionally small and family-owned, but intensive cultivation enables them to double American per-acre yields of wheat and rye.



JONATHAN BLAIR CARTOGRAPHICS

Fiery furnace for fine crystal, a kiln at the Eisch Glass Works in Frauenau (**left**) provides "gather"—molten glass—to a ring of master craftsmen. Small industries of highly skilled workers dominate many a Bavarian town. Mittenwald, for example, trains modern masters in the art of violin making (**above**).

Home also to assembly-line industries, Bavaria suffers from a national labor shortage. Some 2½ million "guest workers" from Eastern Europe and the Mediterranean countries hold jobs in West Germany. Turkish laborers and their families crowd Munich's train station en route to a new life.

Refuge in the clouds, Kehlstein House—Hitler's "Eagle's Nest" (**left**)—crowns the lofty Bavarian Alps at Berchtesgaden, within sight of the Führer's native Austria. Once part of a multimillion-dollar retreat for Nazi leaders, the Eagle's Nest now is a restaurant. Spectacular lakes and chasms cleave the surrounding mountains, favorites of skiers.

Man-dwarfing vistas (**right**) thrill visitors to the slopes of Garmisch-Partenkirchen, center for Alpine sports and gateway to 9,721-foot Zugspitze, Germany's highest peak.

prayer book to a child wearing a monk's cowl, holding a pretzel in one hand and a stein of beer in the other.

Bavaria's food is as legendary (and as hearty) as its beer. Home of the pretzel, the strudel, and the dumpling, Bavaria is even better known for its sausages—wurst in infinite variety of size, shape, color, content, spicing, and taste. *Weisswurst, Stadtwurst, Bratwurst, Blutwurst*, and some say 40 more, some say 80. I think I tried them all, accompanied by several acres of sauerkraut. But I also feasted on suckling pig, deer steak, wild boar, numerous of Bavaria's 99 (by the guidebooks' count) dumpling dishes, and that Regensburg specialty, *Waller*, the catfish known as "the king of Danube fish."

Articles of Faith Abound in the Land

Friday remains "fish day" in Bavaria, because 70 percent of Bavarians are Roman Catholics. Housewives select their fish live from big tanks of water set up in the town market on that day. Among the evidences of devoutness are roadside crosses and shrines, and the huge paintings of Biblical subjects such as Adam and Eve or David and Goliath which adorn the entire outside walls of otherwise modest country farmhouses and sometimes big buildings in the cities. Even more evident are the towering cathedrals and churches, paragons of baroque and rococo architecture.

Almost as awe inspiring as the churches are the castles and palaces of Bavaria. Some are in ruins, because they were built as fortresses and suffered for it. A few, dating from much later, were deliberately built in partial ruins to look more picturesque. And some were built to look like fairy-tale castles, such as King Ludwig II's fantastic Schloss Neuschwanstein near Füssen, 60 miles southwest of Munich (pages 416-17). It could easily have served as inspiration for every Walt Disney castle.

Most of Bavaria's palaces, castles, and grand estates are now landmarks for sightseers, a few are hotels or hostels, and some are still home to their original families. But the Wittelsbachs, who ruled Bavaria from 1180 until 1918, no longer live in their big drafty castle at Leutstetten. As Wittelsbach Prince Ludwig von Bayern explained, "It's too expensive to heat." Instead, the prince lives in a more modest castle at Landsberg. With his brother, he raises horses and cattle on property surrounding the larger place, and derives additional income from a family-owned brewery, real estate, and fees collected from visitors to their several castles.

That seems somehow symbolic of Bavaria: a land living in the Middle Ages of castles and enchanted woods, and, at the same time, in this 20th century, where, even for princes, business must come first. But, as much as I admire Bavaria's progress toward modernity, I must confess that I find more appeal in its many remnants of a less busy, less business-like past. I tend to echo my friend Jörg's Vorsicht!—"Take care!"—that Bavaria's lovely and romantic remainders of bygone days be allowed to survive. □

Pound of feathered fury, a female Cooper's hawk streaks to protect her nest

in an emerald wood.

Can the Cooper's Hawk Survive?

By NOEL SNYDER, Ph.D.
Photographs by the author
and HELEN SNYDER

SWIFTLY, soundlessly, the hawk struck. The blow hit me with the impact of a hard fist—a fist equipped with spurs. More from surprise than pain, I recoiled as sharp talons of the powerful bird ripped through my shirt and nicked the flesh of my back.

"Kek kek kek kek!" The female Cooper's hawk cackled in rage, for I was examining her downy new chicks in the twig-built family nest 60 feet above the ground in the crotch of a towering sycamore. Every few seconds she attacked anew—striking at my head or back, flying to a close-in perch, then hurtling at me again with outthrust talons.

Protecting her young, the bird was acting instinctively in the aggressive, courageous manner of her breed. She could not know that I intended no harm to her nestlings. On the contrary, I hoped the research that brought my wife, Helen, and me to the forested mountains of the Southwest would provide knowledge to help save imperiled hawk species all over the United States.

The Cooper's hawk *(Accipiter cooperii)* was the focus of our studies, supported in part by the National Geographic Society, but we also observed goshawks and sharp-shinned hawks, the other two U. S. accipiters, or short-winged hawks. Of the three, the Cooper's hawk was most numerous.

Over a three-year period we spent more than 2,000 hours observing 19 accipiter nests from blinds

Garish eyes and gaping mouth painted on a helmet liner (**right**) fail to frighten the mother hawk attacking Dr. Noel Snyder (**facing page**) as he examines her chicks. During three summers of research, sponsored in part by the National Geographic Society, the zoologist and his wife, Helen, spent some 2,000 hours perched in plywood blinds and tramping the forests of the southwestern desert observing three species of hawks—Cooper's, sharp-shinned, and goshawk. The couple primarily studied the effects of DDT and other chemical pollutants on the birds' reproductive patterns.

"You have to watch their feet," Dr. Snyder warns. Talons digging into his back (**above**) and a slash across his nose (**right**) dramatically prove the wisdom of his words. Usually it is the female Cooper's hawk that becomes belligerent when her nest seems threatened. One particularly pugnacious male, however, boldly defended his domain. That bird, studied by the Snyders for several seasons, earned the nickname "Kamikaze."

In pursuit of elusive small game and birds, the powerful stubby-winged hawks often blast their way through thick foliage. "Hearing them crashing through the limbs," says Dr. Snyder, "makes one wonder how their wings can take it."

On the day before disaster struck, the ill-fated mate of Kamikaze flies in from the "plucking perch," a dining spot on a nearby limb. The following day the Snyders discovered her remains at the foot of the nesting tree (**below, left**); she had perished in the talons of a marauder—possibly a goshawk or great horned owl. Kamikaze, here moving off the pair's four eggs, then tried to carry on alone as both father and mother. In rare fashion, he attempted to incubate the eggs until they hatched. Lacking the female's bare egg-warming breast patch, he failed; the chicks, already peeping in the shells, died.

From tragedy, knowledge: After Kamikaze's failure, the Snyders stripped away the shells and studied the fully developed embryos (**right**). Here and in other unhatched eggs, they consistently found traces of DDE, a breakdown product of DDT. The contaminant causes the birds to lay thin-shelled, easily broken eggs, and may trigger disastrous hormonal changes that affect feeding and mating instincts.

built high in trees. As long as we observed from a distance, the birds acted as if we weren't there. But to make detailed studies of nests, eggs, and chicks, we had to climb to the hawks' aeries, and then attack often ensued, usually from behind.

The breeding activities of one pair of Cooper's hawks had our special attention. The male bird we called "Kamikaze," because he was exceptionally aggressive and fearless in attack, even though it's usually the female—she's half again larger than her mate—that handles nest defense.

Kamikaze and his mate grew accustomed to our blind just 15 feet from their nest. Like most Cooper's hawks in the Southwest, they hunted a variety of woodland creatures—lizards, chipmunks, immature rabbits, and birds such as jays, woodpeckers, grosbeaks, and swifts.

During the final year of our study, tragedy struck Kamikaze's family. One day Helen and I reached the base of their nesting tree to find the unmistakable signs of disaster. A torn wing, some tail and breast feathers, and a few bits of down—these were all that was left of Kamikaze's mate (far left).

Some 45 feet above us, in the crotch of a sycamore, was the rough-looking twig basket of her nest. Here for nearly five weeks she had been incubating four pale blue eggs. Hatching should have started this very day.

What creature could have killed her? Perhaps a bobcat or raccoon, or some larger bird? While Helen searched the ground for clues, I began the climb to check the eggs.

Father Tries to Become a Mother

Without warning I was struck on the head by a furious hawk and nearly knocked from the tree. It was Kamikaze. I hadn't realized he was on the nest. Cackling angrily, he swooped and hit me again and again.

Reaching the nest, I found the eggs in the early stages of hatching, all four chicks cheeping noisily within their punctured shells.

One of the eggs was half crushed, though the chick was still alive and struggling. Apparently the brooding female hawk had been struck from above and part of the impact had been transmitted to the egg. This pointed to the most likely suspects—a goshawk or a great horned owl.

Now, to our surprise, Kamikaze was trying to continue the nesting effort on his own. Normally, the male takes almost no part in the hatching of eggs, brooding, or direct feeding of young. Though males do most of the nest building, their job thereafter is largely to capture food that the females may eat themselves, or tear up to feed their chicks.

At first light next morning, I climbed to the blind and looked across at the nest.

"It looks good," I called softly down to Helen on the ground. "He's still there."

By midmorning, however, I was worried and climbed to the nest, weathering Kamikaze's usual blows. The eggs were cold, the chicks in them dead. Lacking the female's larger size and well-developed brood patch—a spot of breast naked of feathers—he simply could not keep the eggs warm enough.

Surprise Awaits Returning Parent

With the opportunity still at hand to study the behavior of a mateless male Cooper's hawk, we decided to introduce a hatched chick from another nest to replace the lost eggs. But only one other Cooper's hawk nest in our study area was advanced enough to have chicks at the time, and we had not checked it for several weeks. On my arrival at this nest, I was delighted to find four chicks less than a week old. I chose the smallest—as the least likely to survive in its own nest—and began the long trip back. Giving the chick a full meal of rabbit meat, I placed it in the nest and removed the unhatched eggs.

"Just minutes after you left," Helen told me later that day, "Kamikaze flew up and landed on the nest edge. He stared long and hard at the sleeping chick, then reached across and gently bit at the youngster's back. The chick's head flew up, and the astonished male gave a leap into the air. But then cautiously he settled down and began to brood the chick."

The first attempted feeding came at the end of the day, when the male flew in with a freshly killed chipmunk. Then began one of the most agonizing wildlife episodes I have ever observed.

Clearly Kamikaze knew something about feeding chicks, but his motivation was greater than his skill. Instead of cleanly ripping off small chunks of meat, as the female would have done, he tugged tentatively at the chipmunk, then presented his empty bill to the chick. Confronted with nothing to eat, the chick alternately grabbed the male's tongue or attempted to pluck one of his red eyes, apparently mistaking it for meat. Kamikaze finally did rip off a bit of chipmunk, and the

chick got one bite of food. But then the father flew off with the nearly untouched prey.

In later feedings, the male gradually became used to tearing off bits of meat, but he never learned to hold his head high enough to keep his eyes out of danger. Fortunately for adult and chick alike, the youngster gradually stopped jabbing at his eyes.

With things going more smoothly, we entrusted to our male's care a second chick from the same nest as the first. This time Kamikaze accepted the addition without surprise.

A new difficulty now confronted us. Kamikaze refused to brood the chicks at night, when temperatures dropped close to freezing. At darkness, he flew off to roost alone, leaving the nestlings cheeping pathetically.

The chicks would have perished had we not each evening at dark taken the baby birds to our cabin, placing them in a blanket-lined cardboard carton warmed by a light bulb.

At dawn each day we carefully returned them to their nest. At about two weeks of age the chicks were sufficiently developed to

Downy and defiant chicks can devour their weight in food in a day. Fare includes

endure the overnight cold—and our baby-sitting chores were done.

We do not know what Kamikaze would have done had his adopted chicks died. But several times we witnessed him interacting—exchanging calls—with passing females, as if trying to attract a new mate to help with the rearing of the adopted chicks. He never managed it, but with our help he eventually fledged both young successfully.

Though Cooper's hawks were formerly persecuted by man for occasionally taking *chipmunks, lizards, swifts, and jays.*

poultry, they are known today to be valuable members of the wild, helping to maintain stable numbers of small animals by cropping them for food. After DDT's introduction for farm use, however, this species, like other hawks that feed heavily on birds, suffered greatly reduced reproductive success. In the East, where once it was one of the most common hawks, it is now one of the rarest.

Counts made of migrant Cooper's hawks at Hawk Mountain Sanctuary, Pennsylvania, show a sudden sharp drop after 1947, the year of widespread introduction of DDT into agricultural use. Part of our study was to evaluate evidence that might support—or refute—the suspicion that DDT has been the major cause of the decline.

Deadly Chain of Contamination

The rough canyon and mountain regions of the Southwest are not farming country, and hence have not been directly exposed to intensive pesticide spraying. But many Cooper's hawks winter in farm areas where their prey may have eaten contaminated food.

When a hawk eats prey that has assimilated compounds such as DDE, the major breakdown product of DDT, the poisons tend to concentrate in the bird's body. Starting with a preyed-upon animal at the bottom of the food chain, each species that feeds upon another concentrates the same poisons to higher levels, and so on up the line.

The more links in the chain, the greater may be the concentration of poisons at the top. Thus hawks that feed heavily on other birds may have especially contaminated diets.

Small birds make up 80 to 90 percent of the diet of Cooper's hawks in the East, but in the Southwest about half their food is small mammals and lizards. While eastern Cooper's hawks have been declining toward extinction, the species is still relatively stable in the West, where the greater reliance on less-contaminated food is the likely reason for survival. However, the evidence we gathered indicates that western Cooper's hawks are also under heavy stress from pesticides.

While our fate-disrupted pair had successfully raised young over the years, other couples were not so lucky. In several nests we found broken eggs and suspected the cause to be thinning of the shells by DDE.

Out of 60 clutches of Cooper's hawk eggs we examined during the study, we found broken eggs in 11, a disturbingly high rate.

In crook-necked wonder, Kamikaze stares at an adopted offspring. The foundling, brought to the nest by Dr. Snyder, tested the male's ability to raise young. The foster father, although inexperienced in a female's feeding skills, patiently tried to tear off pieces of its prey and to offer tidbits to the baby. An empty beak was often the peeping youngster's only reward.

Hungry, the chick here nips at the adult's crimson eye (**top right**)—perhaps mistaking it for freshly killed prey. To see if the chick

was attracted to the eye or its color, the author substituted a wooden model with interchangeable colored disks (**bottom right**). The chick invariably snapped at the red one, regardless of its position.

Bluish at birth, Cooper's hawks' eyes turn yellow, then red as the birds get older. The mature mother, however, protects her eyes by holding her head high. Kamikaze never quite mastered the technique, but fortunately his charge soon learned that the beak and not the eye held the morsel.

Cooper's hawks usually desert their nests if just one egg of a clutch breaks. Five of the broken eggs had sufficient contents to allow analysis for DDE and other pollutants.

In cooperation with Dr. Jeffrey L. Lincer of Cornell University, we found that the only pollutant abnormally high in the broken eggs was DDE. Other unbroken eggs of Cooper's hawks that we analyzed contained much lower concentrations of this substance. Shells of the broken eggs averaged 16 percent thinner than the average for shells collected prior to 1947, and were obviously fragile.

While concentrations of DDE in eggs are only a few parts per million, the substance is so potent in upsetting the biochemical equilibrium of a bird that even such low levels are significant. We obtained evidence suggesting that DDE, in addition to its effect on eggshells, may also disrupt normal reproductive behavior.

Three pairs of Cooper's hawks that we studied from blinds exhibited disturbed behavior. In one case the female was habitually reluctant to take food from her mate and to feed it to her young. In the other two cases the birds built unusually frail nests. DDE was abnormally high in eggs of all three pairs.

Use of DDT Now Restricted

Fortunately, the Federal Government has recently banned DDT for most uses in the United States, and we may hope for eventual recovery of many species, including the Cooper's hawk, suffering from poisoning by this compound. However, it is well to remember that Cooper's hawks and other species receive contamination primarily from their diet, and many of their prey species are not year-round residents of the United States.

The most contaminated prey of our Cooper's hawks in the Southwest are migrant insect-eating birds that spend half the year in Mexico and Central America. South of the border, restrictions on the use of DDT are presently only a hope for the future.

Pesticides are by no means the only threat to Cooper's hawks. Relentlessly shot and persecuted since the days of the early settlers, the species still faces death at the hands of the uninformed hunter. A 1972 agreement between the United States and Mexico gives full federal protection to all our native raptors, and we can hope that heedless killing of hawks, owls, falcons, and eagles will cease as people become better informed.

Falconry Poses a Growing Threat

To my mind, an even more serious threat lies in the increasing use of Cooper's hawks for falconry. The sport has mushroomed, particularly in California, Colorado, and Illinois, to the extent that the majority of hawk nests observed in one recent study in California had been robbed of all their young.

While many falconers will strongly dispute my conclusions and do not believe the sport harms wild raptor populations, data from our study of Cooper's hawks indicate that hawks partially tamed by handling are much more likely to be shot, if they escape (as they so often do) or are released. Also, birds raised by falconers are generally considered to be poorer hunters than their wild counterparts, and this plus their degree of tameness can lead only to far poorer chances of survival in the wild. Many hawks taken into captivity, of course, do not survive long enough to reenter the wild, or are never given the opportunity to do so.

It is hard to escape the view that falconry is thus a form of predation on raptors, and no natural population can withstand steadily increasing predation.

To me, the pleasures of observing and of studying wild hawks free and unfettered by falconers' jesses and bells far surpass the pleasures of having a captive hunter on the wrist. Let us hope that future generations will have the opportunity to enjoy these birds in their native wilderness.

Surely the Cooper's hawk deserves to be cherished and protected, not alone for its beauty, pride, and power, but also for its place in maintaining a diverse and stable natural environment for man. □

SIX-MONTH INDEX AVAILABLE

As one of the benefits of membership in the National Geographic Society, an index for each six-month volume will be sent free, upon request, to members who bind their GEOGRAPHICS as works of reference. The index to Volume 144 (July-December 1973) is now ready.

Cheetah, swiftest of cats

BIANCA LAQUIS

Majestic African lion

GEORGE F. MOBLEY

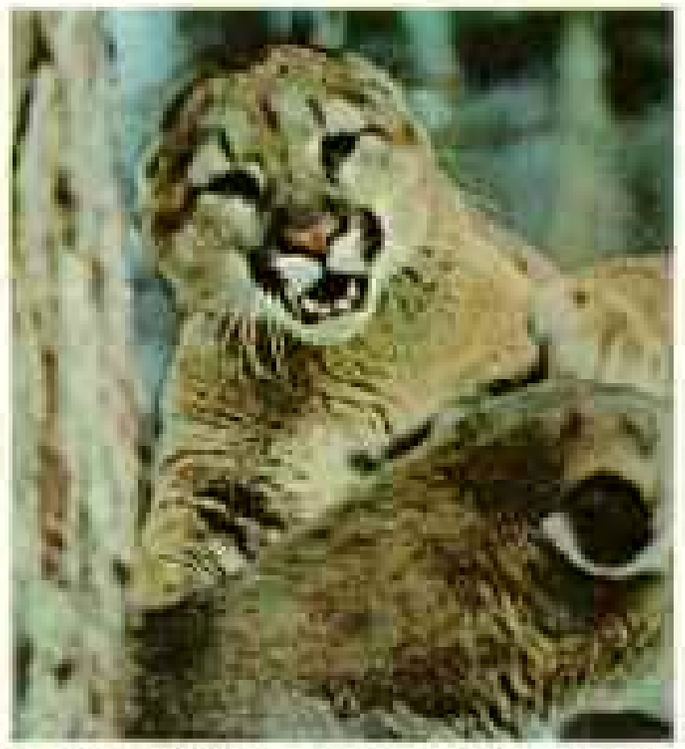
Playful lion cubs

THOMAS NEBBIA

Bengal tiger, silent hunter

NATHAN BENN

Cougar, near extinction



MAURICE HORNOCKER; NICHOLAS DEMORE III, (INSET)

The Big Cats

IN COLOR, FRIDAY, MARCH 15

CONSULT YOUR PAPER FOR TIME AND CHANNEL

JONATHAN WRIGHT

GEORGE KOMLLOS

"THE BIG CATS" prowl their last refuges in National Geographic's third color documentary of the 1973-74 season, on ABC-TV, Friday, March 15.

Man moves among them with trepidation and respect, fascinated by the antics of tumbling tiger cubs, the sinuous speed of the cheetah, the sociability of a pride of thirsty African lions (**top**), and the elusiveness of the mountain lion. This survey probes the behavioral mysteries of these vanishing predators, whose

relationship with man has always been either an uneasy truce or a mortal struggle for remaining wilderness.

Imperiled both by drought and by advancing civilization, the Asiatic lions of Biblical fame—numbering only about two hundred—make their last stand in the stunted-teak Gir forest in India. Here one drags through the brush the carcass of a freshly killed spotted deer (**above**).

In the Amazon River Basin, the natural domain of *el tigre*, the feared jaguar valiantly tries to elude wily professional hunters such as Pedro Alvarado (**top left**). Far from their frigid habitat, two Siberian tiger cubs are reared by Sofia Kowalska (**right**) in a Polish zoo. In Idaho, wildlife expert Dr. Maurice G. Hornocker examines a tranquilized mountain lion (**overleaf**), one of 15 of the endangered cougars he has fitted with electronic tracking devices during the past five years.

Leslie Nielsen narrates the program, made in association with Wolper Productions. Sponsors are Western Electric and the St. Regis Paper Company.

THOMAS NEBBIA

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BARBARA ENGLEBERT (ABOVE) AND VICTOR ENGLEBERT

Swan song of a culture

"I WANTED my children to know these openhearted friends of the desert before the nomadic way of life disappears forever." Thus photojournalist Victor Englebert explains the reason for his sixth journey among the Tuareg, the famed veiled warriors of the southern Sahara. At oft-visited camps, Tuareg children recognized Victor instantly (**above**), and the adults, in their abundant love of youngsters, almost adopted his. A wealthy noble, Mohammed (**upper left**), delights in child's play, tickling the nose of 13-year-old Eric Englebert with a feather. Little Shina (**left**) instantly takes to 15-year-old Barbara.

But the Belgian family found the Tuareg world under attack by an inexorable enemy, as one of the worst droughts in history decimated herds and sent thousands to relief camps. Read Mr. Englebert's intimate, timely report on a besieged people in next month's NATIONAL GEOGRAPHIC. Invite your friends to share all 12 issues for 1974 by filling in the form below.

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"The amount of energy locked up in a single piece of coal is incredible. We must waste no time putting it to use."

E. L. Wilson, Manager, Pilot Plant Operations, Synthetic Fuels Research Division, Exxon.

Coal is one form of energy America has in abundance. In fact, this nation has more coal than any other country in the free world. We have mined only 10% of what we have. More than 400 billion tons of commercially extractable coal are still in the ground.

In terms of the energy this coal contains, it outweighs our oil and natural gas put together. Experts estimate that at the present rate of coal consumption, our reserves could last about 250 years.

Exxon is working on ways to expand the use of coal. We are developing methods which may let America burn more of her vast reserves of high-sulfur coal without violating standards set for air and water quality. We are also developing economical ways to turn coal into gas and oil.

Gas made from coal.

Chemically speaking, coal is similar to both natural gas and crude oil. All three are products of decayed plant or animal matter compressed into hydrocarbons over millions of years.

For years commercial plants have been gasifying coal, producing a low-energy fuel for domestic and limited industrial use. But this gas is expensive to produce, and the available processes have not been commercially proved on certain American coals.

For several years, Exxon has been developing a process to gasify the different types of American coal. Today at a pilot plant in Baytown, Texas, we are perfecting that process. High-surfur coal from the Midwest and low-sulfur coal from the Rocky Mountain States are both being converted into raw gas.

We hope our gas will be less expensive to produce, bringing closer the day when synthetic gas can be made commercially from a wide variety of American coals.

Ten years from now, we expect plants, each producing 250 million cubic feet of synthetic gas a day, will be operating. Each of those plants could meet Cleveland's present gas needs.

At Exxon's pilot plant in Baytown, Texas, various types of American coal are now being converted into cleaner burning synthetic gas.

Oil and gasoline made from coal.

During World War II most of Germany's planes and tanks ran on gasoline made from coal. But the problems were high cost and a relatively small yield of hydrocarbon liquid.

Now, Exxon is developing a coal liquefaction process which promises to be more efficient and less expensive than the World War II process. It also would be more flexible and reliable than other processes now being developed.

So, at another pilot plant in Texas we are converting low- and high-sulfur coal into synthetic crude oil. This oil can be refined into gasoline and other products with today's technology.

Sulfur: A major problem.

The largest potential user of coal today is industry, especially our nation's electric power plants.

Unfortunately, coal from most mines in our Appalachian and Midwestern states contains a lot of sulfur. When burned, it pollutes the air with sulfur oxides. This is a key reason why coal has not been more widely used in recent years.

Sulfur: Two possible solutions.

Exxon is now working on two processes to solve the sulfur problem.

One, being devised for the U.S. Government, would reduce

to know

E. L. Wilson holds a piece of high-sulfur coal from Exxon's Monterey mine in Illinois, and a bottle of synthetic crude oil made from this type of coal. This oil can be refined into gasoline and other products.

the formation of sulfur oxides *while* the coal is burning.

The other process is being developed with a major power plant builder and several electric utilities. It would remove most of the sulfur oxides from the flue gas *after* combustion but before the gas escapes from the stack.

When these processes—or others like them—prove commercially successful, they will enable industry to burn much more coal, freeing large quantities of oil and natural gas for other uses.

Coal's future.

The long-range success of Exxon's gasification, liquefaction and desulfurization projects depends on improving the technology and getting the costs down. As these problems are solved America will need more and more coal.

Last year, U.S. coal mines produced 603 million tons. If coal is to play a key role in filling the energy gap, production will have to more than double by 1985, and continue to increase rapidly thereafter. This means that environmental questions, primarily those of strip mining, must be resolved.

Exxon has already invested tens of millions of dollars in coal conversion and desulfurization research. In the years ahead we plan to spend many times this amount.

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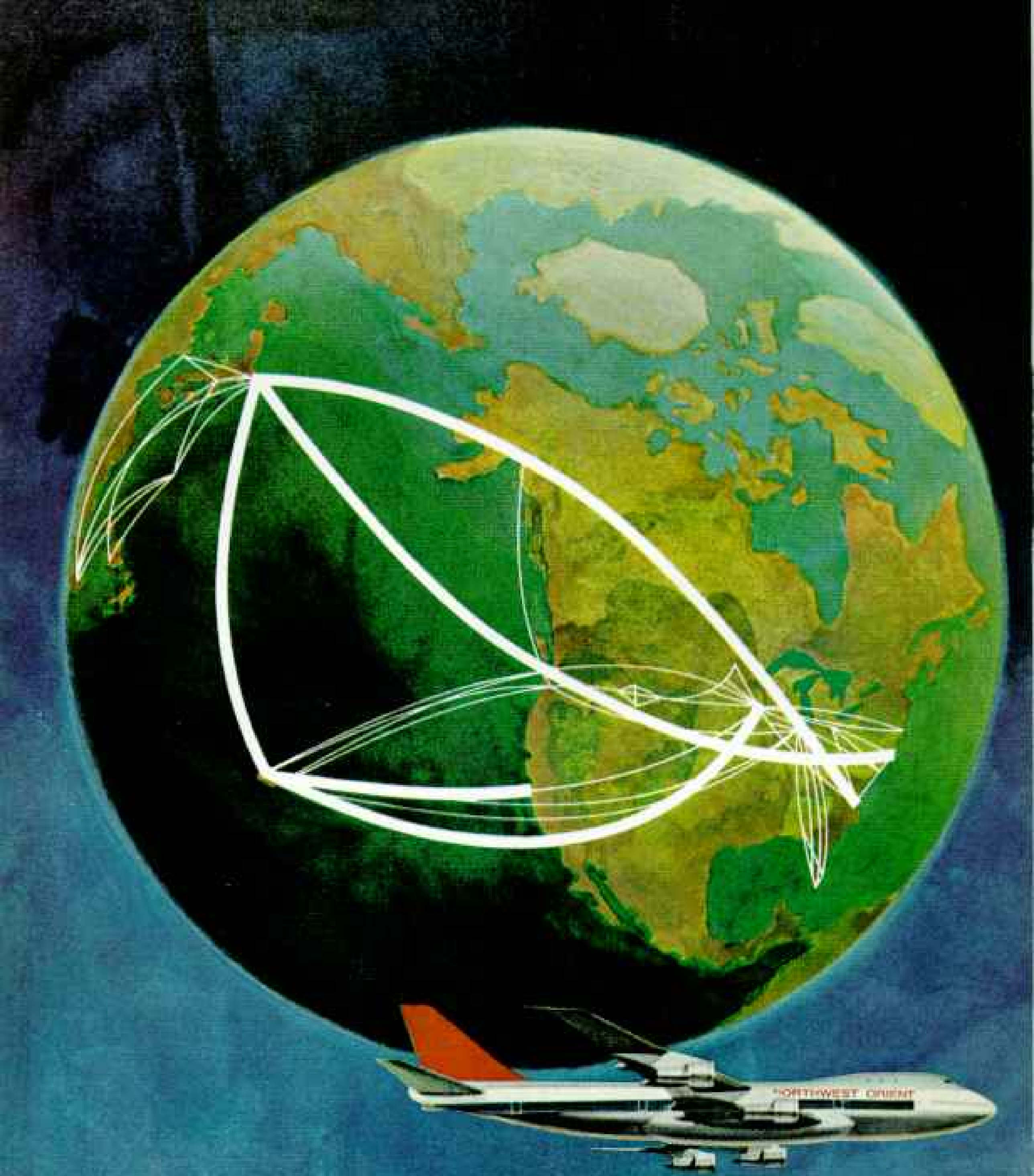

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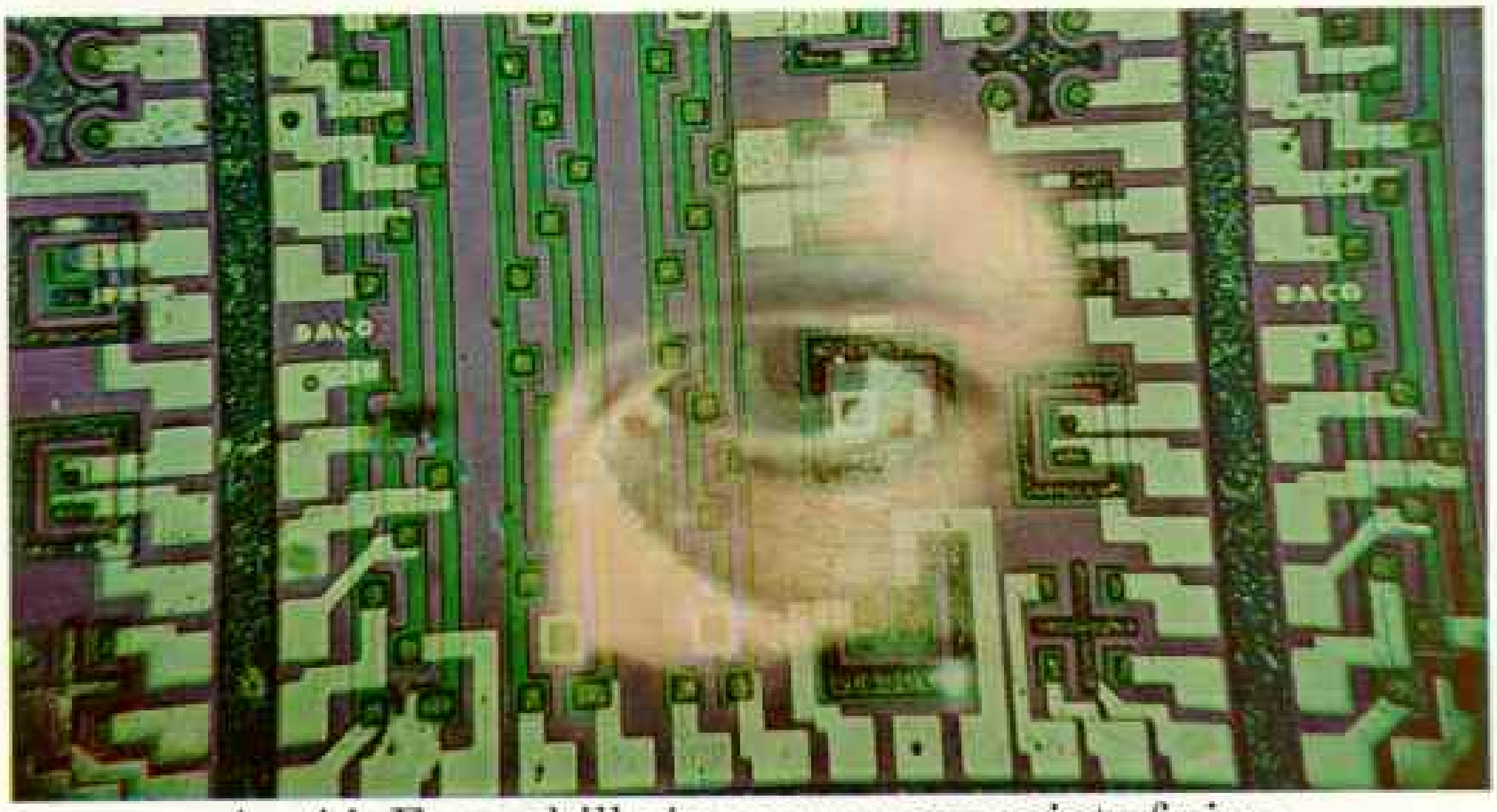

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A car doesn't run on octane alone, no matter what you've heard.

With all the emphasis placed on octane ratings these days, you'd think that's all there is to know about the gasoline you use in your car.

Nothing could be further from the truth.

Octane ratings are extremely important, of course. But only in their particular function of preventing engine "knock", and the loss of power and performance that entails.

But, beyond octane ratings, there are at least two other factors that contribute to the way a gasoline performs in your car.

In the simplest terms, they include: 1) the blend of highly volatile ingredients that promote quick starting and smooth acceleration, with less volatile ingredients which provide the bulk of the heat energy that powers the engine; and 2) a half-dozen important additives, each with a job to do.

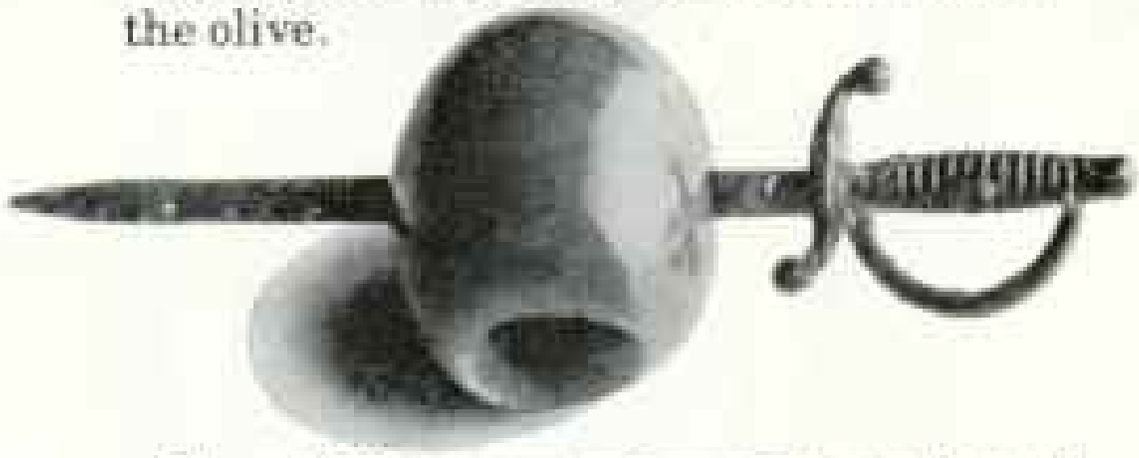
Different brands have different blends. And all good producers must constantly adjust their "blend" to account for seasonal changes in temperature, as well as geographical and climatic conditions.

The additive packages also vary, but are drawn from the following "library" of ingredients, as a rule: a) oxidation inhibitors and metal deactivators to prevent the formation of gum; b) anti-rust agents, to prevent corrosion; c) anti-icers, to reduce carburetor icing; and, d) detergents, to keep the fuel system clean.

Obviously, different brands and grades of gasoline perform differently. And for that matter, no two cars are exactly alike. So, you will find it well worth your while to take the time to discover the right brand and grade of gasoline for your car. You can tell by the "feel" in a tankful or two, usually. When you find the gasoline that satisfies your car's engine, stay with it.

You may think we've told you more about gasoline than you really wanted to know. And, naturally, we don't expect you to remember it all. Just remember this much:

When they tell you octane rating is all there is to gasoline, that's like saying the only noteworthy thing about a martini is the olive.



If you'd like more information on the subject ask at any Gulf Service Station, or write: Gulf Consumer Information, Box 1519-O, Houston, Texas 77001.
We'd be glad to tell you what we can, and we'll try to answer any other questions you might have about your car.

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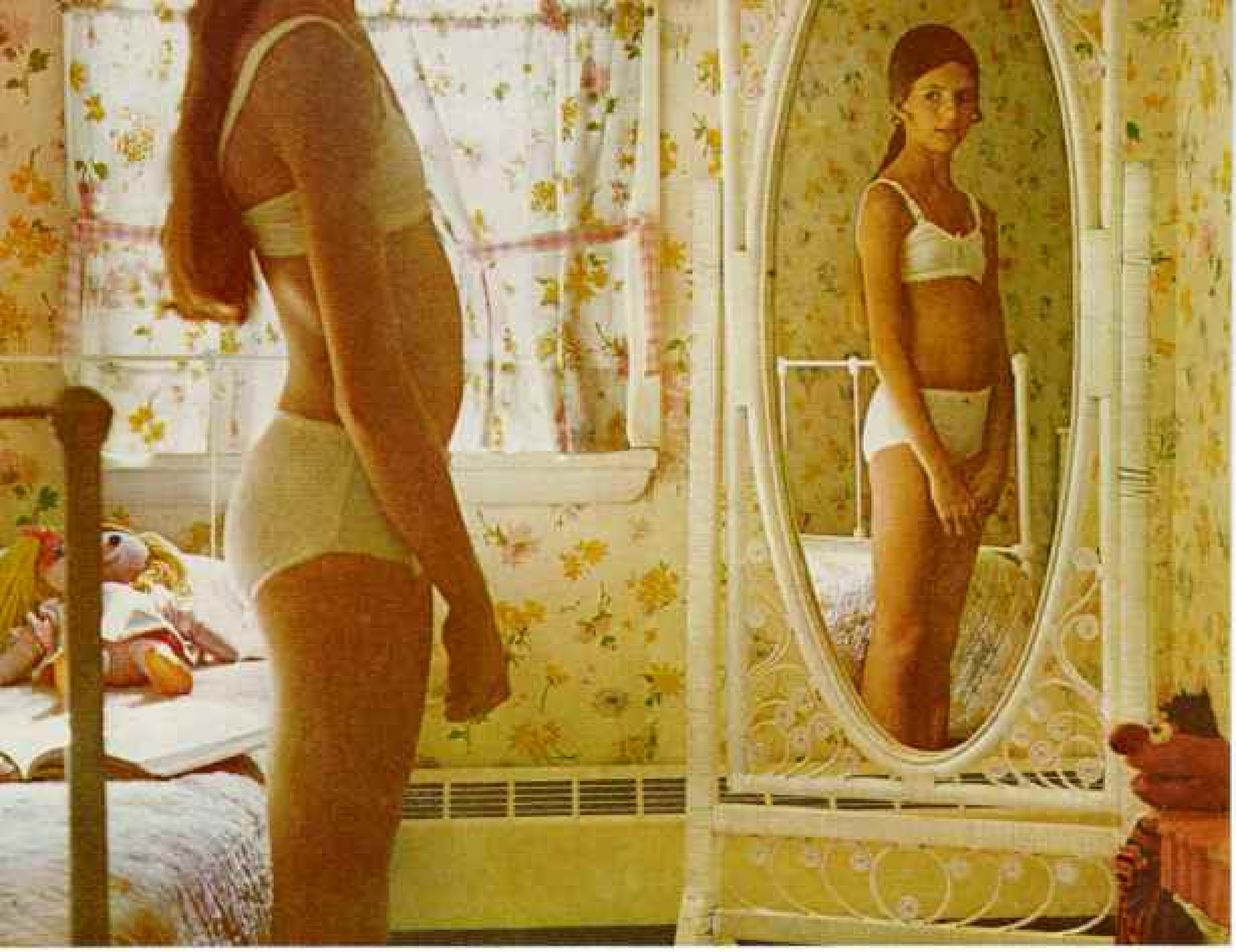

Little girls don't grow up too fast. Fathers are just too slow to notice.

Hidden somewhere in every father's mind is the belief that, all evidence to the contrary, his little girl will remain little forever.

That's why we'd like to remind you that she won't.

Little girls become college freshmen, brides and career women with such astonishing quickness that it could catch you unprepared. So if you'd like to secure your daughter's future, it's never too early to start.

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But, maybe the feature you'll enjoy most is our oldest feature: the quality and reliability you get with every Zenith product.

(In two recent nationwide surveys, independent TV service technicians named Zenith, by more than 2 to 1 over the next best brand, as the color TV needing fewest repairs. Survey details on request.)

We're proud of our record of building dependable, quality products. But if it should ever happen that a Zenith product doesn't live up to your expectations, we want to hear from you. Write the Vice President, Consumer Affairs, Zenith Radio Corp., 1900 N. Austin Ave., Chicago, Ill. 60639.

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FIGUREHEAD OF JOSEPH CONRAD AT MARINE HISTORICAL ASSOCIATION, MYSTIC, CONN.

Woodcarver's art rode with captains courageous in the days of sail.

Figureheads are almost as old as sailing itself. Early Egyptians used them. So did Phoenicians and Vikings. They decorated prows of their ships with carved heads of horses, birds, and wild-eyed dragons. These, the ancient mariners believed, invoked the protection of guiding spirits.

Dawned the age of exploration, the spirits were largely forgotten. But not the figureheads. In England trained hands carved everything from Poseidon with his trident to St. George in wooden armor.

Colonial craftsmen brought the skills to America. In a vacant sail loft near the wharf the shipbuilder would chalk on the floor full-scale plans for the figurehead he envisioned below the bowsprit. The carver marked out the design on a block of seasoned wood and shaped it with mallet and chisel. Some figureheads he drew from live models, perhaps the shipowner's daughter.

Often a carving personified the ship's name—*Twin Sisters*, for example. Or *Joseph Conrad*, whose figurehead is portrayed here.

A tribute to the renowned writer-seaman by another of the same breed, the magnificent head came into being shortly after Capt. Alan Villiers acquired the old Danish square-rigger *Georg Stage* and renamed her in honor of Captain Conrad.

"A sailing ship had to have a figurehead," he declared. "The lovely sweeping lines of her cutwater looked wrong without one." So he asked his friend Bruce Rogers, the renowned typographer, to carve the bearded likeness.

Captain Villiers sailed *Joseph Conrad* around the world—a 57,800-mile voyage that lasted 555 days. He followed in the wake of early navigators, rounding Cape Horn under sail, as they did, and with their zest for exploration.

Villiers described the voyage in the February, 1937, GEOGRAPHIC, echoing a haunting passage from an even earlier issue: "The unchangeable sea preserves for one the sense of its past, the memory of things accomplished by wisdom and daring among its restless waves."

The writer? Joseph Conrad. To Conrad those restless waves were peopled "with unforgettable shades of the masters in the calling which . . . was to be mine, too."

And so they also are to Captain Villiers, as witness his many adventure-filled narratives about men, ships, and the sea. In August, 1968, he took GEOGRAPHIC readers to Mystic Seaport, Connecticut, living museum of America's sailing past.

"I rubbed my eyes and looked again," he wrote. Among a maze of spars and rigging he had spied the jutting figurehead of the *Joseph Conrad*, now permanently moored as a training vessel.

It was a memorable moment he shared, this sequel to a saga that appeared more than 30 years ago. But such moments have come to be expected in the pages of NATIONAL GEOGRAPHIC.

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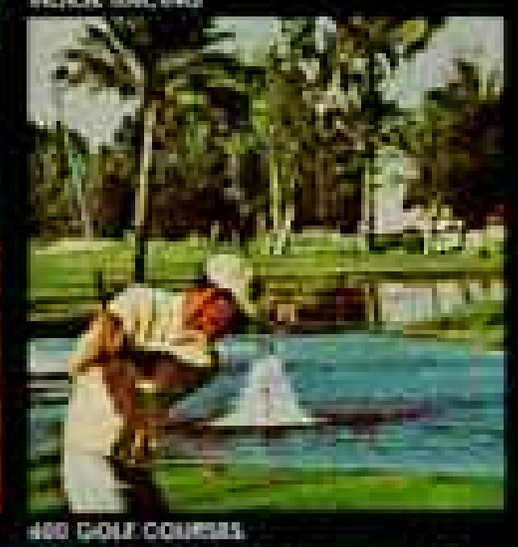
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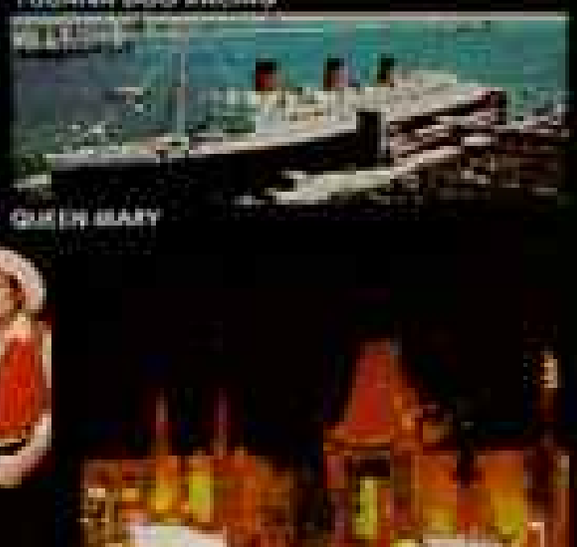
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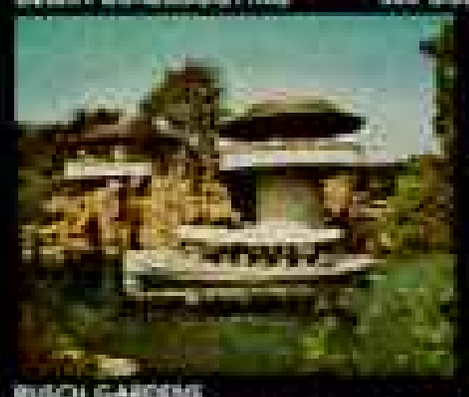
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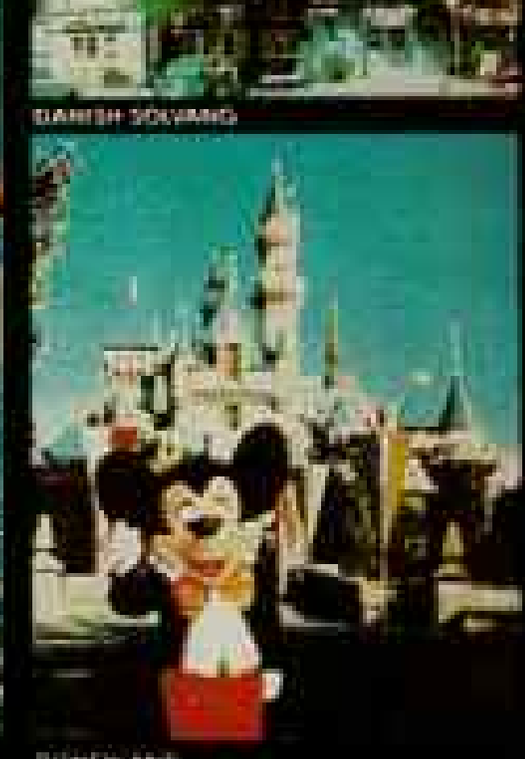
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Some of them think our energy shortage will be over when the weather warms up. A lot of folks think that if we lower our thermostats, drive slower, join a car pool or ride the bus, we'll be back to normal in no time.

Other knowledgeable people are convinced the only answer lies in things like geothermal energy, wind, solar and tidal power.

There's merit in both points of view.

Unquestionably we need to conserve now. But exotic energy sources are just too far away from widespread, practical use.

So what do we do in the meantime?

We need to develop petroleum sources like shale and off-shore wells. And we need to research petroleum alternatives.

The most practical alternative is coal. The U.S. supply alone is estimated to last us 500 years.

Coal's best use right now is electricity generation. But it's also very versatile. Longer range, gasification and liquefaction will allow us to burn it cleanly and supplement our oil and gas supplies.

If we mine and use our coal responsibly, it will give the time we need to research and develop atomic, solar, hydrogen and other non-conventional energy sources.

For additional information, write "Power" – Department 5056G, Caterpillar Tractor Co., Peoria, Illinois 61602.

There are no simple solutions. Only intelligent choices.

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An 1800cc overhead cam engine, power-assist front disc brakes and unibody construction balance the performance of the new 710's.

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