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The Baltic Nations

ESTONIA, LATVIA, AND LITHUANIA STRUGGLE TOWARD INDEPENDENCE 2

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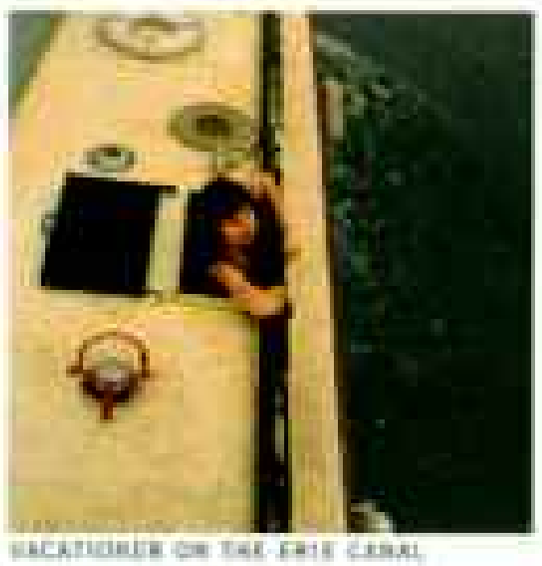
ESTONIA'S SONGFEST



VACATIONERS ON THE ERIE CANAL

MUSHING AHEAD IN ANTARCTICA

KUSHITE FUNERARY FIGURINE

COMPUTER-ASSISTED MAPPING

COVER: *Debased and decommissioned, Joseph Stalin gets the brush-off in Vilnius, capital of Lithuania. Photograph by Larry C. Price.*

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Estonia, Latvia, and Lithuania struggle toward independence

THE BALTIC NATIONS

Blinking back tears, Elga Pähkel listens to Estonia's long-suppressed anthem, *"Mu Isamaa,"* or "My Fatherland." On St. George's Eve in Tallinn she and other Estonians have gathered to celebrate a 14th-century uprising against German knights, among the many foreign invaders to overrun their land. Now, emerging from the dark night of Soviet Bolshevism, the people of Estonia, Latvia, and Lithuania face a punishing gantlet of tests. First the political struggle of wresting sovereignty back from the Soviet state, which annexed them against their will 50 years ago. Then the tougher challenge of rebuilding free economies and democracies, a process requiring renewed initiative in peoples historically browbeaten into following orders.

By PRIIT J. VESILIND
SENIOR ASSISTANT EDITOR

Photographs by LARRY C. PRICE

Disarmed by civility, Soviet soldiers leave the streets of Rīga after a rally on May 4 to celebrate Latvia's historic declaration of independence. With

some 200,000 troops and a huge work force of non-Latvians on its soil, Latvia is taking a cautious approach to freedom.

Weekend farmers tend a small vegetable garden outside Rīga allotted them by the government. Vital component of Baltic agriculture, family tillage

draws on the near-spiritual reverence Latvians hold for their native soil, which has been carefully cultivated since ancient times.

Witnessing for political independence and religious renewal, Lithuanian hunger strikers prostrate themselves before the cathedral in Vilnius. As

devoutly Roman Catholic as their neighbors the Poles, Lithuanians have long favored the church as a forum for dissent.

THE LAST FREE MAN in Estonia was hunted down in 1978. August Sabe was the sole survivor of the Forest Brothers, men who took to the woods to resist the occupying Soviets in 1944. He was finally found in southern Estonia by two KGB agents posing as fishermen. A photograph shows the 56-year-old Sabe and an agent sitting on a riverbank (facing page). Sabe holds a fishing pole and grins for the photographer, the other KGB man.

Minutes later they tried to arrest him, and Sabe wrestled one agent into the river. But more agents were on their way, and, seeing no escape, he dived underwater and hooked himself to a submerged log, ending his life.

For the KGB it was necessary work, of course; the state must check its cancers lest they spread. But the Soviet state, in the 73 years since the Bolshevik Revolution transformed tsarist Russia, has excised more than tumors. It has, I would hear again and again, practiced massive cultural and intellectual lobotomy, on its own people as well as on those it has colonized.

Estonia, Latvia, and Lithuania are the most urbanized and westernized—and perhaps the least willing—republics within the unraveling Soviet Union. Separate nations by all the measures of culture and inclination, they tasted independence for 22 years between the two World Wars. In those years they were parliamentary democracies, belonged to the League of Nations, sent teams to the Olympic Games, and competed in the marketplace of Europe. They were occupied again in 1940, in a division of eastern Europe between the century's leading despots, Nazi Germany's Adolf Hitler and the Soviet Union's Joseph Stalin.

Today, maneuvering amid the collapse of communist ideology, they have come within a few precarious steps of regaining their self-determination.

The challenges of restoring statehood are daunting. But it is not the economy, nor the politics, nor the eroded culture that concerns Baltic leaders most—it is the widespread degradation of the human being after 50 years of communism. They worry about the kind of people they have become.

Listen to one of Lithuania's parliamentarians, Emanuelis Zingeris, in Vilnius:

"Ours is the struggle of 3.7 million people who have, since early childhood, been injected with fear and submission. We have lived in a system where no one could be different. Tens of thousands of our intellectuals were exiled to Siberia in the 1940s. We have a few capable leaders, but we are not used to speaking out, as other people are. This is why we value every person who hasn't been co-opted by the Soviet system—and there are not many of them."

Listen to physician Leopold Ozolinsh in Latvia, who lives in the seaside resort town of Jürmala, where the beaches have been closed by massive pollution: "We are in a state of ruin, and no one is left to protest. Most of our people who had brains were bought out by the government. Our scientists were simply bribed—with coffee, vacation homes, apartments. We have very few honest people left."

Listen to Estonia's new foreign minister, Lennart Meri, in Tallinn: "When you shut people's mouths so they cannot talk, when you close their eyes by forbidding them to travel, when you plug their ears by jamming airwaves, the population becomes very passive. In this condition, when people don't care, it seems as if nature herself reacts: Fields produce less wheat, forests die of pollution, fouled rivers catch fire. The entire society degrades. This catastrophe is so far unrecognized in the West, but it has been obvious here. Life expectancy has fallen, and the infant mortality rate has risen to its highest level.

"Even the ability of students to learn has deteriorated. Today's technology is so exact and refined that only a person who thinks freely and critically can use it well—a person who has been taught since age four that he has individual worth, who has been taught by age eight that he has rights and responsibilities.

"In our society this new person has been weeded out; people with capabilities, with intelligence, practically the entire educated class, went to jail. Farmers who did better work had their heads mowed off like grass.

"The rest of the world has evolved, but we have gone backward. This is the tragic difference between the Soviet Union and the rest of the world."

The Baltic republics, with their eight million people, intend to move as far away as possible from this failed experiment. They are not disgruntled "breakaway" states of some legitimate union, nor extremists trying to sabotage *perestroika*. They are nations that were strong-armed into the Soviet colonial empire, one orbit closer to the center than Eastern-bloc

PRIVATE COLLECTION, TALLINN

nations such as Hungary or Poland. They have suffered terribly for that closeness. But their struggle today has gathered strength, for it harnesses two of the most powerful movements of the late 20th century—environmental outrage and national liberation.

PHOTOGRAPHER LARRY PRICE and I arrived in the Baltic nations in the spring of 1990 to measure change, at a time when the entire world had focused its attention here, perhaps for the first time. For me the visit had a special dimension: I was born in Tallinn; my family fled in 1944 as the Red Army approached. I was only one and a half years old then, yet a feeling for Estonia has remained with me always. This was my sixth journey back in recent years.

The old city of Tallinn, built as a medieval citadel, seemed much the same. At night I could smell again the damp and crumbling stone, the cabbage cooking somewhere up an alleyway patrolled by silent cats. I could see the yellow glow from windows on the cobblestones and the lights of offshore ships blinking in the dawn.

There was little new construction, even shoddier consumer goods, even drabber windows in the shops. Yet there was an energy beneath the surface, a new willingness to take risks. Much new enterprise was directed at Western tourists, with their desperately needed hard currency. In Tallinn's Finnish-built Palace Hotel, complete with pizza bar, you could believe you were in Helsinki. From Hertz Rent-A-Car we could hire a bright red Volvo station wagon.

A year earlier you could not rent a car. You could not travel by yourself without a watchdog of a chauffeur on the payroll of the KGB. Certain roads were taboo, certain subjects forbidden. Now Larry and I simply piled our gear into this car and drove from city to city, republic to republic, exactly as we would have done in Canada or Austria. We bounced from unprecedented to unheard-of, finding little in the way except our own surprise.

Communism lay prostrate. In Vilnius, Algimantas Čekuolis, an editor and parliament deputy, offered this irreverent opinion of the communist economy: "We are living under the carcass of a dead cow, and it stinks. There are two electrodes attached to this carcass, and every once in a while it twitches. And that cow's name is Bolshevism. And you have that from an old commie."

Truly the establishment was standing on its head: Non-communist governments sat in all three capitals; yesterday's strongmen were today's fools; onetime "hooligans" and enemies of the state gave stirring speeches in the parliaments. Speech, intoxicating free speech, bubbled like a spring.

THE BALTIC NATIONS

Bold moves for pawns of the empire

AFTER WORLD WAR I, when their historic overlords, Germany and Russia, were crippled by the toll of war and revolution, the Baltic States seized the moment and, in 1918, declared independence. Following a violent period of fending off Bolshevik armies, the three nations made rapid headway at building modern economies and democratic institutions. With the notorious Nazi-Soviet pact of 1939, however, the Baltics were once again put under the Russian yoke.

That was merely the latest chapter in a history of invasion and domination dating back to the Vikings of the ninth century, who were followed by German knights seeking souls and markets, Polish nobility seeking land and serfs, and Russian tsars seeking ice-free ports on the Baltic Sea.

With the freedoms introduced by Soviet President Mikhail Gorbachev's *glasnost*, like the toleration of public debate seen regularly on the streets of Rīga (opposite), the Baltics are once again seizing the moment.

ESTONIA
AREA: 17,413 sq mi. POPULATION: 1,566,000 (62% Estonian; balance Russian and other Soviet ethnic groups). CAPITAL: Tallinn, 482,000. RELIGION: Primarily Lutheran.

LATVIA
AREA: 24,595 sq mi. POPULATION: 2,667,000 (52% Latvian). CAPITAL: Rīga, 915,000. RELIGION: Lutheran 70%; Roman Catholic 30%.

LITHUANIA
AREA: 25,170 sq mi. POPULATION: 3,673,000 (80% Lithuanian). CAPITAL: Vilnius, 582,000. RELIGION: Primarily Roman Catholic.

About A.D. 1400

A battleground for heathen souls in the 13th century, the northern Baltic region was a loose confederation ruled over by bishops and German knights, the vanguard of Christian imperialism in the Baltic. The most powerful Balts, Lithuanians extended their rule south as far as the distant Black Sea.

1569

After two centuries of sharing monarchs, Lithuania and Poland in 1569 joined in formal commonwealth. Present-day Latvia, known then as Livonia, was the scene of recurrent struggles between Germans, Russians, and Swedes.

1721

After Peter the Great's victory over Sweden, Russia assumed control over the northern Baltics. With the dissolution of the Commonwealth in 1795, Lithuania and the Duchy of Courland also fell to Russia. Though the landed German and Polish nobility prospered under Russian rule, a century of serfdom ensued for Baltic peasants.

1938

On the eve of war, the Baltics had been free for 20 years. After World War II East Prussia, a remnant of 19th-century Germany, was split between Poland and the U.S.S.R. The latter part became the Kaliningrad oblast of the Russian Republic.

Ironically, art and literature were at a standstill. "Only some idiots like me are still writing novels," said Estonian novelist Jaan Kross. "All the others are writing for newspapers."

"Or running the governments," added Kross's wife, Ellen Niit, an author of children's books.

"What about the communist writers?"

"They were dead already," she said.

Communist youth groups such as Pioneers and Komsomol were finished among Balts. Boy Scout and Girl Scout troops, whose leaders had been jailed or executed in 1940, were revived. Estonia's first YMCA since before the war was being organized by Üllar Kerde, an intense young man with a wiry crew cut and a whistle around his neck. "This has to be a voluntary organization," he told me. "We have enough angry young men. In our sports

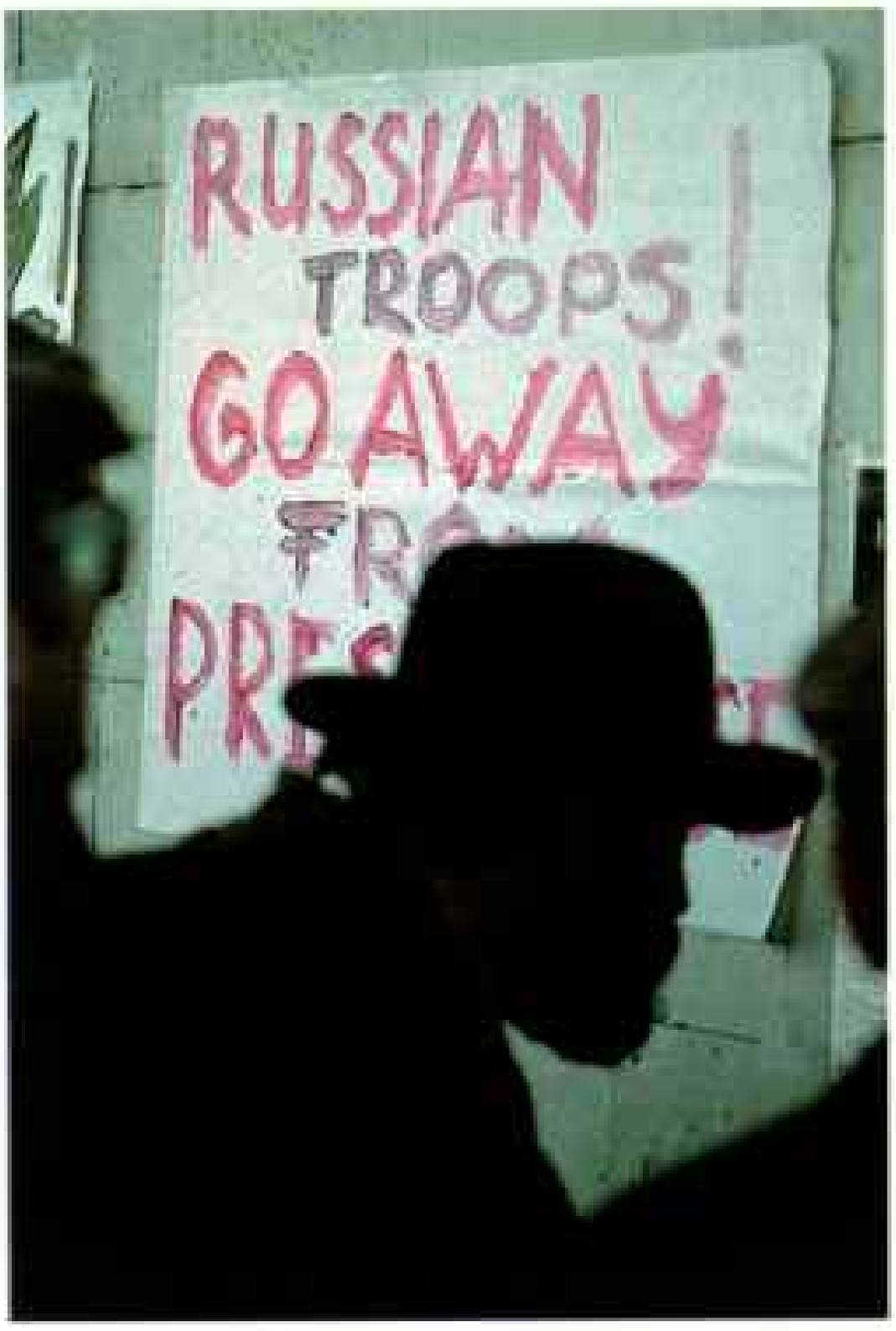
schools everything is forced. You *must* do sports. You *must* do, you *must* learn. It blunts the kids."

Kerde has already taken his boys basketball team to Finland and plans a trip to the United States. "They will actually have seen, with their own eyes, a basketball game in Madison Square Garden, New York, the United States of America!

"Our children lack civilization," he said. "They have been raised as savages. I want to plant a seed in these boys—from them the future of this country will grow. For that, I am willing to spend sleepless nights and work myself to the bone. I do it for Estonia, for that principle alone."

After the political euphoria in the winter of 1989-1990, when *glasnost* spurred dissent and courage, ordinary citizens returned to the

Aiming at Western eyes with their message, Lithuanian activists, aided by American counterparts, paint posters and print pamphlets in English at the Press Center in Vilnius. Across town at a monument factory a worker sweeps off a paint-stained statue of Joseph Stalin, one of many now tucked away in the shadows throughout the Soviet Union.



business of survival. Daily life ground grimly on. Pensioners carted suitcases full of backyard radishes to the central market. The KGB, not knowing what else to do, gathered information as before. Shoppers queued up for hours when they should have been working, not even knowing what the lines were for. As they shopped instead of working, nothing was produced, and the shelves grew emptier still.

When I visited one old friend, an engineer who lives with her son in a two-room flat in a gray high rise on the outskirts of Tallinn, I chided her for being glum.

"We have forgotten how to smile," she said quietly.

"No, no," I answered. "This is just the nature of our people."

"No," she insisted. "We have forgotten. This life of standing in lines for everything, the lack of anything to buy, so hard, so hard. . . ."

Countered her son, a lanky, bright-eyed 13-year-old conditioned to the absurd: "A long line is great—it means there's something good for sale."

Busloads of shoppers had been coming across the border from the countryside in Russia and Byelorussia, where conditions verged on desperate, cleaning out the stores in Tallinn, Rīga, Vilnius. The local governments had issued consumer identity cards and ration books for Baltic citizens, to keep outsiders from shopping. Each resident was allotted 400 grams (14 ounces) of detergent every three months, 600 grams of bar soap every two months, two bottles of alcohol a month—one wine, one liquor.

A little freedom had bred impatience. Said my friend Krista Rätsep, a music teacher in Tallinn, "I have walked around my own country as in a nightmare. But lately I've had the feeling, as you sometimes get when you're dreaming, that it really *is* only a dream and that I will wake up. But now that I've felt that, it's even harder to live with this horrible nonsense every day."

BEHIND THE DOORS of government, the heat was on. Declarations, telefaxes, formulations flew between committees of tight-lipped delegates and newly minted founding fathers. Lithuania was in stalemate with the Kremlin over its defiant, abrupt independence declaration. Estonia and Latvia had announced their break with Moscow with what they hoped was more diplomacy, suggesting prudent periods of transition, pointing out that they were not seceding but only reinstating independence. All three were moving, in their own way, toward separation from the eastern empire.

"Estonia is very nervous right now," said historian Mart Laar, "but we know there is no going back. If we go back, the trains for Siberia will be very long. And it's no comfort to know that we'll be in good company there. Going back would kill the spirit of the people for the second time, and they would not live through it. This is our last chance as a nation. History will not give us another."

Baltic leaders counted on Western support. The United States and other Western nations had never officially recognized the annexation

In solidarity with their Baltic neighbors, Latvia's leaders, including President Anatolijs Gorbunovs (right, at center), gather in Rīga on May 4 to declare independence. Spurred by Popular Front members, like Dainis Ivans (with tulips), Gorbunovs and other Latvian communist leaders broke with Moscow to support a measured approach to freedom.

Days later Estonia's Supreme Council Chairman, Arnold Rüütel (bottom left), announced the decision to drop "Soviet Socialist" from Estonia's name.

Editing a score in his Vilnius apartment, Lithuanian President and musicologist Vytautas Landsbergis occupied the hottest seat in the Baltics after Lithuania's historic declaration of independence on March 11.

of the Baltic nations by the Soviet Union in 1940. But only embarrassed silence emanated from the West.

THE LITTLE NATIONS of Latvia, Estonia, and Lithuania speak three separate languages. They are drawn from different tribes, each with its own myths and music. Yet their common enemies and circumstances dictate that they fight together. Their leaders have reinstated the Council of Baltic States, last convened in 1939, to present a common front to Moscow. A Baltic common market has been formed to help withstand economic hardships.

But whatever happens economically, the three will stay apart. History has bred the Baltic nations into proud and determined peoples for whom separate nationhood is sacred, because it has been forbidden. Along this glacier-scraped moraine on the eastern Baltic Sea the soil itself is hallowed. In Baltic poetry and songs it is mixed with blood and sacrifice and motherhood, and tinged with memories of animism and forest spirits that the tribes embraced when they reached these shores more than 4,000 years ago.

The homelands have been occupied and colonized, Christianized and socialized by Vikings, medieval German crusaders, Danish, Polish, and Swedish kings, Russian tsars, Nazis. Few have been welcome. This is not the New World, not a melting pot. Foreigners are tolerated here, but they stay foreigners.

Today's occupiers, the Soviets, returned in 1944, driving the Nazi armies before them.

Thousands upon thousands of Balts fled; those who did not make it were declared "liberated." The door clamped shut. The Soviets hauled in heavy industry to exploit the educated labor force, and Soviet workers—mainly Russians and Byelorussians—arrived until they rose to nearly a third of the population of the three republics.

Larry and I were hammered almost daily with a potent lament: Tell the Russians to go home. They were not invited here. They have brought fear and mistrust and a haggardness of spirit. They have changed us, eaten at our soul. We have had enough of them.

Now, more than ever before, the Russian-speaking population and the Baltic peoples are estranged and bitterly divided in a sort of mutual apartheid. Already, by official Soviet count, Estonia is 38 percent non-Estonian, and Latvia is 48 percent non-Latvian. Only Lithuania has a solid base—with just 20 percent of its population non-Lithuanian.

To the Baltic peoples these foreigners represent forced Russification. They arrive as migrant workers, many without education and without roots, yet with the arrogance of overseers. They do not bring Dostoyevsky or the Bolshoi Ballet. They have, Balts say, only lowered standards and the quality of life.

"Most of these workers had little idea where they were coming," said Estonian actor Tõnis Rätsep. "Estonia? Made no difference to them; they just came here for the jobs. What? We've got to learn Estonian? It was news to them. When our new language law was passed, the one that required people in service industries to speak at least 800 words of Estonian, our instructors went to the factories, and they had to start their lectures by showing the workers, on a map, precisely where in the Soviet Union they were."

In the northeast corner of Estonia, near the town of Kohtla-Järve, the twin threats of Russification and pollution have reached their

Available for a price, meat and produce from private plots fill the stalls of a public market in Vilnius (left). To avoid long lines at collective stores, those Balts who can afford it pay several times the official price.

Those who can't, like the Saarmaa family in Kunda, Estonia (above), settle for meals of potatoes. Still, the Baltics seem a fatted calf to neighboring Russians and Byelorussians, who often crowd stores on shopping forays. A Soviet curse, dysfunctional phone lines frustrate would-be callers, as at a booth in Tallinn.

Western money, patience, and humor are requirements for enjoyment of the mildly risqué show at Rīga's Hotel Latvia, says the author, who found the club offered poor service and cheap champagne but no beer or vodka. Rīga, like other Baltic cities, also boasts a rock-oriented youth and arts scene, reminiscent of the 1960s counterculture in America.

In Rīga's Vērman Gardens Park a chess game occupies two elderly Russians, whose compatriots, along with other non-Latvians, make up 63 percent of Rīga's population. The city is especially popular with retired Soviet military personnel.

peak. Few Estonians remain here. The countryside reeks with noxious smoke from oil-shale processing. Coastal fish have skin ulcers, and rivers foam with phenols and debris from slaughterhouses. Artificial hills of oil-shale residue rise above the plain, still smoldering. Their oily acids percolate through the soil into the groundwater and the Baltic Sea. On some farms here you can draw up water from contaminated wells and ignite it.

Especially around Kohtla-Järve, Russians and other non-Balt workers view the independence movements with alarm, suddenly feeling trapped. Russian legislators from the northeast have announced that laws passed by the Estonian Supreme Council are not applicable to them. They have spoken of their own autonomous region, split from Estonia. All across the Baltics, Russians complain to Moscow about mistreatment and discrimination.

The Baltic response can be acerbic. "An elephant stands on an anthill, and he's shouting: 'The majority of ants is suppressing the minority elephant!' " scoffed Latvian writer Imants Ziedonis. "But his foot is on the anthill, and, of course, the ants are biting. And he complains to the world that the ants are biting."

THE BITTEN RUSSIANS have gathered into protest groups and demonstrated in the streets, presumably on Moscow's orders. Last May they tried to storm the parliament buildings in Tallinn and Rīga, where they are a force. Many of the groups are led by former military officers.

Admits one such leader, Igor Lopatin, an ethnic Russian and former army colonel who heads a group called Interfront in Rīga: "We would like to forget history; history can't be redone. Stalin was bad, and we all agree with this. . . . But even if we considered the 1940 annexation illegal, it wouldn't change anything. Latvia has grown into the whole union. The destruction of all these ties would be painful—more painful for the Latvians than for other people.

"This process of democratization can get out of control—perhaps even lead to a tougher dictatorship, which I would deplore with all my heart. I understand the Latvians, but I would recommend patience."

The question haunts everyone here: What will the local Russians do if and when independence finally comes? While some of them have

One of the great cities of the medieval Hanseatic League, Riga spreads south along the Daugava River, its old section studded with church spires. Hopeful for an economic revival

declared support for separate Baltic nationhood, many Baltic Russians rally defensively around the old party and the old order. With communism quickly fading even in the Russian Republic, they have become an isolated and reactionary remnant.

"The Russians here have very little self-esteem," said Tõnis Rätsep. "And now they have no place to return to. A Russian man came up to me the other day and said, 'I want to go with you, with the Estonians. Tell me what to do. I want only to feed my children.' "

One of the intellectual leaders of Estonia's budding independence movement, Kaido Kama, admits that Baltic activists have erred in neglecting the Russian population. "It could easily backfire on us," he said, "but we really can't have an Estonia in which 40 percent of the people are Russian. A migration is essential. The Russians won't go back to Russia. They will chase the Western life, perhaps go to Finland or Sweden, just as Turkish workers went to Germany."

The Red Army is quite another matter. The military in the Soviet Baltic is massive, larger than that of the Scandinavian countries combined, with perhaps 300,000 soldiers, hundreds of airplanes, and a work force that rivals the civilian economy.

It is also abusive. More than 37,000 hectares (91,000 acres) in north-central Estonia, an area once called the Estonian Switzerland for its beauty, have been turned to wasteland by bombing practice. Jets routinely dump fuel before landing. In Šiauliai, Lithuania, near a Soviet airfield, environmentalists told me that birth defects have escalated and children suffer from strange ailments. They blame the fuel dumping and also improperly stored jet fuel that leaks into groundwater.

"Before we can have free elections," said Kama, "the army must be under control. The 50 years of fear that has intimidated people has to be gone. Without that, we are kidding ourselves—this is not a nation."

Kama is a forester by profession, and thus untainted by the past. "I set myself up in the woods in Brezhnev's day," he said, "because

under their own brand of *perestroika*, Latvians look forward to the day when their capital will once again be worthy of its historic sobriquet: Paris of the Baltic.

I thought that was the only way an honest man should live."

AMONG BALTS IT IS SAID that Latvia has the best politicians, Lithuania the best prophets, Estonia the best economists. When Soviet law changed three years ago to allow state enterprises to seek business partnerships outside and to deal directly with Western suppliers, the Baltics led the way. Estonia led the Baltics, with 150 joint enterprises, from a hamburger stand in Tallinn to a multimillion-dollar stainless-steel food-processing plant. In this brave new business the ruble is nearly worthless. "We'll be using it for wallpaper soon," a caustic shopper told me. *Valuta*, Western currency, is the medium of choice.

The new law also gave many state enterprises an allotment of valuta to go shopping in the West, but business remains sluggish. Said Jaak Lippmaa, a scientist who has applied to serve as a private agent between Western high-tech firms and Estonian producers, "Moscow is slow to give permits to middlemen because they fear that valuta will get into private hands and the state would lose its monopoly. Right now the system works on privilege, not money. If you're a faithful party member, they give you a Japanese television. But if you have your own valuta, you can buy your own TV, and you can kiss off the party.

"This is why money, valuta, is the toughest thing to get into the country. It's still a sacred cow. Bringing in videos and jeans is petty crime, but importing money—that's serious."

Jaak, only 30 years old, itches over the slow pace of change. "We spend our time finding loopholes," he said, "and this is typically Soviet. They force people to circumvent the system; there is always a feeling of guilt. You always have this fear, when you're doing anything, always this fear."

So-called cooperatives, actually small businesses owned by private consortiums, have also struggled and have angered many citizens by charging prices based on actual cost. Conservatives declare that racketeers and dirty

money dominate the co-ops, and they remember fondly the good old days of stagnation, when there was more order.

Despite the promises of private enterprise, the lack of basic consumer goods still throws society askew. My guide in Latvia, a lively young professor with a doctorate in English, told me of a sad love affair; her fiancé changed his mind at the last moment. "He married someone else," she said, "who was ten years my senior. She had one thing up on me though: I was only a lecturer at the university; she was the attendant at a gas station."

WE DROVE SOUTH from Estonia into Latvia, along the chilly strip of sand by the Gulf of Riga, where the pine trees are tousled by a constant wind. The shift of cultures is subtle—different haystacks, different farmhouse roofs—but the language difference is abrupt. Estonian—akin to Finnish and Hungarian—is a Finno-Ugric language, distinct from the Indo-European languages spoken by Latvians, Lithuanians, and Russians. Latvian and Lithuanian together make up the Baltic branch of the Indo-European family.

Today Russian is heard nearly as often as the mother tongue; unofficial estimates suggest that Latvians may soon be outnumbered by Russians and other non-Balts. New Moscow rules for the secession of republics demand a five-year period of transition and a republic-wide referendum with a two-thirds majority in favor. Even though Lithuania and Estonia could probably win such referenda, they refuse to initiate them, knowing that Latvia would be forced to follow suit and might not be so lucky.

And in Latvia the curtain of fear has not fully lifted. Even in the heart of Rīga, by the Latvian Freedom Monument where multiethnic crowds gather every evening to debate the issues of the day, a university professor warned me: "Better not use my name. Don't forget that the Stalinists have all the army and the police. This is like letting prisoners out in

The blossoms of spring and the bloom of youth conspire for laughs on a Latvian bus north of Riga. Famous in medieval times for their honey and herbs, the Baltics are still awash in flowers during their short spring.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the jail yard for a bit and saying to them, 'You can talk for one hour, but then you must go back, or you will be shot.' "

Once forbidden items were for sale on park benches—portraits of former Latvian Republic President Kārlis Ulmanis, underground newspapers, Christian church brochures, kung fu manuals. But both vendors and buyers moved warily and silently, as if they were dealing in pornography or state secrets.

Bolder were the flower vendors, their booths covered with plastic sheets against the drizzle. They coddled and picked at blossoms, preening them like pets. Among the sentimental Balts, the flower business has bloomed so that many of those who cultivate roses and tulips have become wealthy. In winter, roses cost from 3 to 12 rubles each in Riga, for some a full day's salary. I wondered aloud how many rutabagas could be grown with the kind of effort that goes into flowers but was reminded that we were speaking here of soul and beauty, and these things do not carry price tags.

Riga is, like Tallinn, an old Hanseatic League city, its core medieval. Doing research here seemed often like a series of trips up crumbling staircases redolent of cigarette smoke, molding plaster, and cat urine.

Up one such staircase were the offices of the Latvia Popular Front, the independence

movement. As in the other Baltic capitals, young, media-wise Americans of Baltic background had joined the movement, mostly in public relations, dealing with the press and coordinating information flow between Tallinn, Rīga, and Vilnius. A journalist who hooked into this system could cover the three republics in the English language without missing any vital information.

The Popular Front of Latvia ran on coffee and adrenaline, its offices as tense and crowded as a railroad station in which everyone is late for the only train.

"There is no time for speculation," said Front member Jānis Škapars. He covered his

From ingots to circuit boards, Baltic workers do it all. Many factories, like the Latvian steelworks at Liepāja, were built in the post-Stalin era of rapid industrialization. The VEF electronics plant in Rīga (above) dates from the interwar years, when the republics, then free, took long strides on their own toward economic development. Latvia itself was at one time one of Europe's more prosperous nations. Today entrepreneurs like Visvaldas Dubauskas—a Vilnius innkeeper with a new satellite dish—represent the vanguard of a return to private enterprise.

eyes with both hands and drew them slowly down. "Every day there are new plans, new jobs, new developments. The situation is so dynamic—it changes, and we have to change our own thinking. It's like math—plus this, minus this, calculate this new factor in."

The Russians came to Latvia in such great numbers for strategic reasons: It is said that he who controls Rīga, with its central location, controls all the Baltic States. Latvia has absorbed some 200,000 Soviet military personnel. The local culture has been bludgeoned, and its remaining champions have an edge of panic in their voices.

"I've been able to resist," said the writer Imants Ziedonis, "but I've seen many of my friends perish—from alcohol, drugs, melancholia. There is immense psychological pressure to conform, to be simply units of production for the state.

"Latvia has a special nature and philosophy that is found in our folk songs, the *dainas*, that cannot be translated. Because we are not all alike, every Latvian home and garden had its own character, and thus its own philosophy. Most of us have been driven from our old homes and farms—our natural surroundings—by forced collectivization. Instead of farmers, we have become proletarians."

To help recover from that deeply felt sense of loss, Ziedonis has organized a group of 14 men—biologists, artists, and politicians—who spend weekends in the countryside. With saws, axes, and rakes they prune tree branches that block views, clean up scattered leaves, rebuild old stone walls. It is not wilderness that is sacred here but nature tended by the hand of man. These scenes re-create the old Latvia. Ziedonis calls them "holy places."

Ironically their large numbers in Latvia have made Russians less edgy and more open to change than their counterparts in the two other Baltic republics. At a gasoline station in Rīga, where I waited more than three hours to reach the pump, I asked a Russian driver brooding in his tiny Moskvich if he feared the Latvians would harm them.

"Nonsense," he answered in fluent Latvian. "Those who've been living here for a long time don't believe it. If I respect Latvians as such, there is nothing to be afraid of. I'd hate to leave. I have my Latvian friends. Nothing bad will happen to me here."

I asked him who was to blame for the blockade of fuel and other supplies by the Soviets.

"Mikhail Sergeyevich," he said without hesitation, using the Russian patronymic for President Gorbachev. "I'm a Russian, and they have brought tanks into Lithuania to protect people like me. And now it's this." He twisted his hands as if he were wringing a neck. "Now they're hurting me."

WE SLIPPED quietly into Lithuania. Although by then most foreign journalists had been forced out of the capital city of Vilnius as their visas expired, no guards patrolled the border with Latvia, and even the grain silos made us feel as though we had come from, say, Indiana to Ohio. We lunched on the road, at a privately owned snack bar—eating chunks of beef, chopped onion, and a credible barbecue sauce, with a glass of buttermilk.

The farmsteads here were molded to the knolls of dark soil like gravestones. Each nurtured a small greenhouse full of vegetable and flower sprouts basking in the April sun. Buds weighed down the tips of branches, but the air was cold and whippet thin. And then a Soviet helicopter, armed with missiles, cut a diagonal across the highway.

Estonia had been courageous and a trifle arrogant. Latvia had been tentative and fearful. But Lithuania stood confident. It made a clean cut with Moscow, at least technically. Not a red flag was to be seen in Vilnius, a gracious city that retains an air of cosmopolitan, old-world charm. The parliament nearly burst with brand-new deputies in rumpled suits. More than 70 percent had been backed by Sajudis, the grass-roots independence movement. Many were elected for their lack of experience in the bankrupt order of the past. The 28-year-old minister of culture still lived in a student dormitory with his wife and a young son.

I was in the gallery when the ministers were sworn in; the oath ended "so help me God."

Unmitigated pollution, like this dust spewing from the Kunda cement factory on Estonia's coast, is a scourge of the Baltics and a shame of the communist economic system. Cause of untold medical problems, Kunda's "gray snow" hardens like mortar on village roofs.

An unassuming musicologist named Vytautas Landsbergis was the new president of the Supreme Council, the first non-communist leader of a Soviet republic in history, a man with no experience in diplomatic niceties or political brutality. On March 11, 1990, he declared that Lithuania was free.

Arunė Degutis, a busy graphics designer who offered her guest room to us, remembered rushing upstairs that night to tell her four-year-old daughter. "I wanted her to remember. 'Igne, Igne!' I said. 'Lithuania has declared independence today. Do you know?'

"She looked up at me and said, sleepily, 'Bananas?' She meant would we now have the possibility to buy fresh fruit."

Even Igne Degutis knew the shape of the future, but the present was more problematic.

"This parliament is like the campus radicals who occupied your college buildings in the 1960s," said a woman journalist, "with their feet propped up on the dean's desk, smoking his cigars."

The citizens of Vilnius debated as they rejoiced. As satisfying as it was to let these Sajudis amateurs thumb their noses at Gorbachev, wouldn't it be better to let old pros like Algirdas Brazauskas finish off the deal?

The reformist Communist Party that had led Lithuania to the threshold of independence, chaired by the popular Brazauskas, was suddenly reduced to shouting from the corners as the opposition party.

"The Communist Party is not the party we have been for 45 years," activist Gediminas Kirkilas assured me. "It's now social democratic in its concept. This name, the communist name, is alive just because of tactics, to keep contacts with Moscow. We acknowledge this pluralistic system."

As the war of telegrams and phone calls escalated, as Soviet tanks made their show of force in the streets in March, as the Kremlin launched the energy embargo in May that had people dusting off their bicycles to save gasoline, and as Gorbachev's long-awaited summit with President George Bush in June resolved nothing, Lithuania stood firm.

At a rally of university students, parliament deputy Algimantas Čekuolis told the crowd: "In other parts of the world such things are happening with bloodshed and violence. But we are not in Afghanistan or Pakistan. This is Lithuanian-style revolution. Whenever you meet a Russian in the street, take him by the

No red banners flew when almost half the world's ethnic Estonians, nearly 500,000, showed up this past summer for the 21st Song and Dance Festival in Tallinn. Nine thousand dancers filled Kalev Stadium on June 30 (above). The next day, when 28,000 voices rose in unison to celebrate Estonia's heritage, hymns to the once all-powerful Soviet state were conspicuously absent.

Many ethnic Estonians came from Canada, Australia, and the United States. One Canadian, Elda Kaarman (right, at right), hugged a new Estonian friend, Katrin Reino. Though Latvia and Lithuania host similar events, this quadrennial festival is the largest.

Sign of a new religious tolerance, two Pentecostal ministers lay their hands on young Viktoria Kuzmina during a service in Riga (right). Despite government discouragement, Latvians and Estonians have managed to sustain a strong Lutheran tradition. Throughout the Baltics, religion has provided the most natural means of protest against Marxist doctrine.

Like a good shepherd, depicted in a wood carving at a cemetery near Paberže (left), the Roman Catholic Church of Lithuania has proved a stalwart guardian of national cohesiveness through centuries of foreign domination. The last nation in Europe to accept Christianity, Lithuania was not converted en masse until 1386, when its Grand Duke Jagiello married the 13-year-old Polish Queen Jadwiga. Even so, many peasants remained pagan until the 16th century.

In Kaunas, which served as Lithuania's capital during its independence, the Cathedral of Kaunas (below) dates from the 15th century.

Sacred ground for Lithuanians, the Hill of Crosses north of Šiauliai bristles with thousands of crosses erected over the years by the faithful to honor their dead. As much a patriotic as a

arm and show him the way. Be kind. This is *our* nuclear weapon. He has no defense against it. The important thing is to keep our calm."

As they often are, young men were asked to make the sacrifice for others. When the Soviet Army held its spring draft, they were asked by local governments not to go, to resist serving in a foreign army.

For the past four years, as independence movements blossomed throughout the Baltic States, soldiers had been systematically harassed, branded "fascists," and beaten by fellow soldiers. Some committed suicide. Thousands fled for home.

Legislation passed by all three Baltic governments offers alternative civilian service for those of draft age. A support group named Geneva-49, for the Geneva Convention of 1949 that forbade conscription by an occupying army, has formed to aid resisters.

The army was not impressed. Last March in Vilnius, 21 defecting Lithuanian soldiers had taken refuge in a psychiatric hospital, under supervision of the Red Cross, when Soviet troops smashed in. All were dragged away.

In the town of Panevėžys, I spoke to the families of two captured soldiers. Angele Malinauskas described the scene after her nephew, Gintaras Stitilis, was taken:

"There was glass all over—broken. All the doors had been ripped off their hinges. And there were drops of blood. One mother was sitting there, screaming, holding her son's bloody jacket. All the people were crying; the doctor couldn't speak."

The army would not tell the families anything. Veronika Krasauskas finally got a telegram from her son, Kestutis. It was sent from Anadyr, eastern Siberia, closer to Los Angeles than to Vilnius. The contents: "Parents, I am alive and well. I am in Chiukotka, and I will write details later."

"All the mothers got this telegram," said Mrs. Krasauskas, her eyes misting. "They were all the same. The same wording. He . . . he doesn't even have a coat or a toothbrush, not even one kopeck."

Kestutis's father, Povilas, stared at the

religious shrine, the hill has often been the target of contempt by Soviet troops, who razed it in 1961 and again in 1975. The crosses were quietly replaced under cover of night.

bowl of yellow apples that were laid out for the guests and said, "You know, everybody was drawn to this independence; it was so sweet."

LITHUANIA IS A DEEPLY RELIGIOUS nation, imbued with Roman Catholic traditions. Long ago a once mighty Lithuanian state had merged with Poland, and cultural ties remain strong. Lithuanians tend to romanticize their politics. Estonia and Latvia, culturally influenced for centuries by Germans, adopted Lutheranism. They tend to be more practical.

But faith has served Lithuania well. We arrived on Easter Sunday morning in a forest glade in rural Lithuania, at the church in Paberže, where the crests of tall maples were still leafless but thick with crows' nests. The bells pealed, the procession of villagers wound around the wooden church, the crows exulted on the highest branches, for a Lithuania free to worship fully.

The priest of Paberže, a Capuchin monk named Father Stanislovas, greeted us with a gentle smile, sweet bread, and colored eggs dyed in the old way—by wrapping them in the skins of yellow onions and boiling them until the color transferred. Nine years in prison camp had only strengthened the priest. "They didn't like my sermons," he laughed.

"When the Bolsheviks were in power, religion was the cement that held us together. They repressed us, they jailed us, harassed, yelled, and scolded us, all these things. But we held it together here. The Lutherans in Latvia and Estonia—when their pastors died and the sermons stopped, there was nothing left. Here we had the rituals and the processions, the lanterns, the incense.

"And now, I baptize a hundred adults a year. Our atheists were like snow in the spring; they melted away. If a Lithuanian is an atheist, he is already a collaborator. It's difficult for Americans to understand, but here, if you don't believe, what kind of Lithuanian are you?"

Morality was the subject that parliament deputy Emanuelis Zingeris pounded into me

Wrapped for home delivery, a new Lithuanian awaits her parents at a Vilnius maternity hospital, where some 4,500 babies are born each year. Will she one day be the bearer of a Soviet or a Lithuanian passport? Will the year of her birth be remembered as the year of a national rebirth in the Baltics?

late one night in Vilnius. As a Jew and as a Lithuanian, he understood persecution and a social system that could not tolerate the independent heart.

"For me, as a Jewish man, freedom for Lithuania means not only leaving the Soviet Union, not only material things, but above all the rebirth of our own moral, spiritual, and individual values—when all are welcome to be themselves. You don't know what it means to have a man like Landsbergis for our president at this time—a creative person, a person with sensitivity."

IN HIS SMALL APARTMENT in Vilnius, Vytautas Landsbergis was struggling with his necktie, pausing now and then to sip from a cup of tea. I had come to interview the President of Lithuania that morning, but he told me he had some work to do first. Statecraft, I imagined—perhaps an urgent telegram from Mikhail Gorbachev. But Landsbergis took out a folder full of sheet music. "I promised a friend I'd edit this," he said apologetically.

"We have the support of the people," he said later. "We are a moral force in the face of this great immorality. We knew the Western powers would not support us. But we decided we needed this declaration of independence now! It must be done! Of course the other Baltic States must take action now too. And it's uncomfortable for Western governments as well; we are sorry for them." He laughed. "But for us, it would be much more uncomfortable staying in the Soviet Union for the next 50 years."

He even played the piano for me, Prelude in E flat by Mikalojus K. Čiurlionis, the Lithuanian composer whose works he studies and promotes. He played with powerful fingers and compassion, with a slightly hunched back, leaning into the piano as he might have leaned on an old friend, someone to trust in these times of pain and joy and quiet revolution—the first free man in Lithuania. □

ERIE CANAL

By JOEL L. SWERDLOW Photographs by BOB SACHA

Living Link to Our Past

THOMAS JEFFERSON, who envisioned an America stretching to the Pacific, said the Erie Canal was impossible. It would have to cover more than 350 miles and raise and lower boats nearly 600 feet. The whole idea, furthermore, seemed silly. Canals connect something with something. The proposed Erie would connect New York City with wilderness. The young state of Ohio and the territories of Michigan, Illinois, and Indiana held only scattered settlements fighting Indian wars.

But under New York Governor De Witt Clinton—whose engineers spent years studying British canals—the Erie became what is still the most ambitious state-funded project in American history. Construction began in 1817 and was completed in 1825. Soon thereafter the cost of shipping grain from Lake Erie to the Atlantic dropped from $100 to $10 a ton.

The Erie is part of the "winning of the West" mythology Americans learn in school. After the image of a mule-drawn canalboat, however, the Erie drops off our radar screens. No canal school of painting rivals the Hudson River school, even though the Erie is often as beautiful. Our major writers, furthermore, consistently denigrate the Erie. James Fenimore Cooper called it "artificial," and Herman Melville said it fostered "corrupt and often lawless life."

But I've loved the Erie since the late 1950s, when I was a teenager growing up in the central New York city of Syracuse, known in the canal's heyday as the Venice of the West.

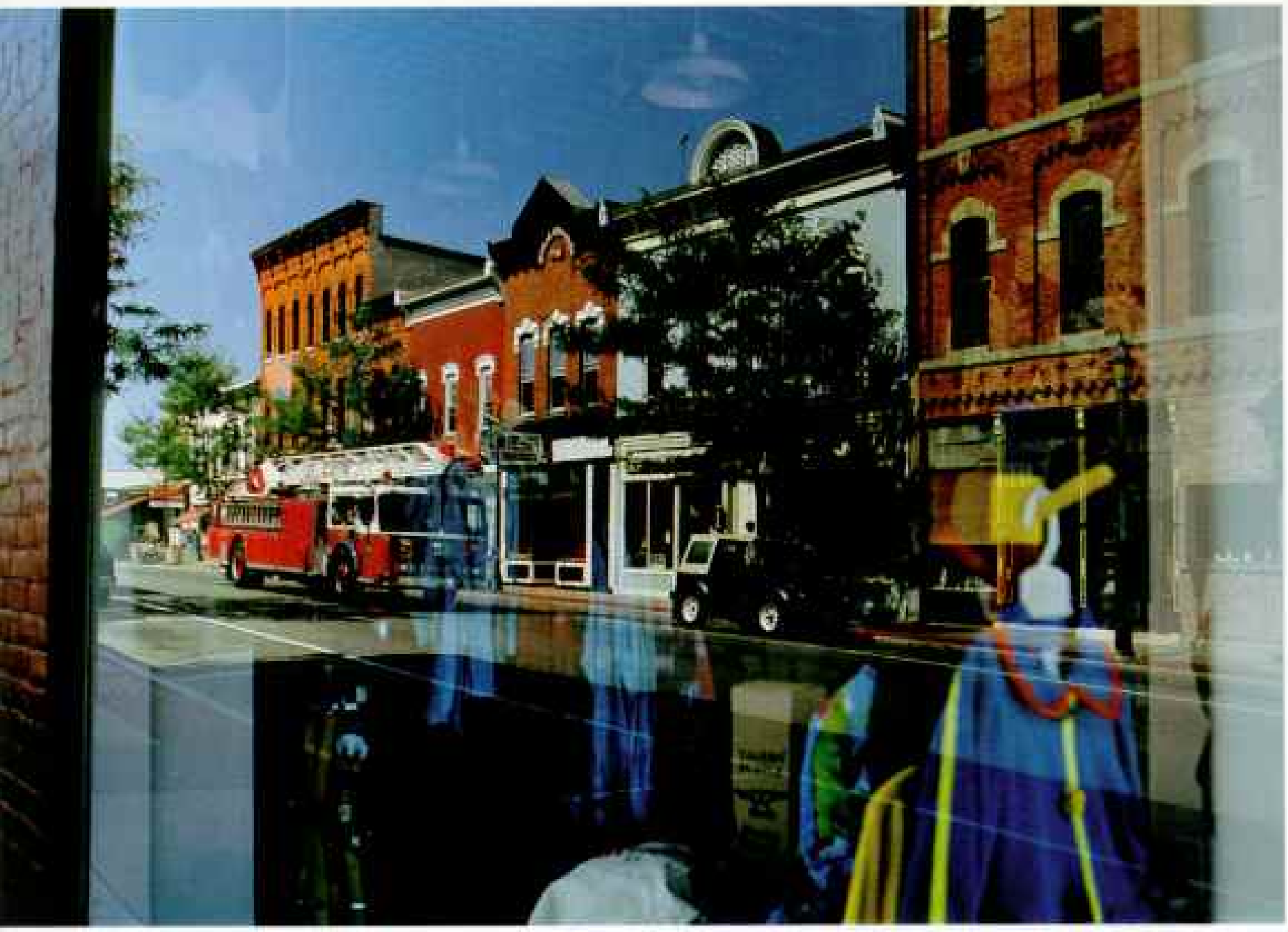
Today the Erie Canal is a living link to our past. Historically it has had two stages, each defined by the barges' source of power. First

Stubborn throwback to the canal's mule-power era is led off the towpath in Medina, New York, by driver Mike Waild. In 1825 the 363-mile Albany-to-Buffalo waterway opened America's West to commerce. Later mechanized and partly rerouted, then neglected, it has now been renewed for recreation.

Sash of satin water unwinds westward behind a pleasure boat

passing farmland near Middleport, 50 miles from Lake Erie.

Storefronts puffed with importance date from the late 1800s, when Brockport bustled with canal trade. When excavation reached here in 1823, land speculator and town father Hiel Brockway gave a toast blunt with pride: "The United States—cutting canals while Europe is cutting heads."



came the mule. The canal was entirely man-made, because barges hauled by mules could not handle river currents. Canallers preferred mules to horses because mules require less rest, eat rougher food, and are smarter. A mule won't walk off a bridge; a horse will.

The second stage developed with motor-driven barges in the early 1900s. By the end of World War I, state authorities had enlarged the canal and shifted much of it to rivers that ran parallel to the original route.

The canal begins where the Mohawk River joins the Hudson. It was there, at Troy, that I started my journey in July 1989. To reach my boat, I drove on a highway built on top of the original canal. Here, at least, the past lies in an unmarked grave.

A few minutes into the canal voyage the boat goes up a series of locks. The 32-ton gates are angled upstream so that water pressure keeps them closed. Strips of white oak line the gate edges; it is stronger and more durable than plastics or rubber. Members of some families have operated locks for three and four generations, and what impresses me most is the lock-keepers' pride. Brass and copper handles shine like new, although most were built before World War I and are used daily.

Each lock has people for whom watching is entertainment. Doors close, water flows in or out; the process takes about 20 minutes. Common sense says it couldn't be interesting, but it is. Children wait patiently. Adults sit on folding chairs and read, glancing

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JOEL L. SWERDLOW wrote "To Heal a Nation," the story of the Vietnam Veterans Memorial, in the May 1985 issue. BOB SACHA is a free-lance photographer based in New York City. His byline last appeared in the magazine on "America's Ancient Skywatchers" (March 1990).

Relaxing with lifelong friend James "Bush" Smith after the village of Albion's strawberry festival, Laurie Allen sums up her hometown: "It's peaceful, a good atmosphere to be raised in." Smith was employed at a food-processing plant in Albion until it was shut down last year; the town has been hard hit by plant closings.

up at the noise of lock doors moving.

An elderly man rests after hiking along the old towpath. "How has life in America changed most?" I ask.

"Speed," he says. "It's killing us. You have to make a part of your life in which you slow down. The world won't do it for you."

HERE, ALONG THE MOHAWK RIVER, lies the land of Hiawatha, who had united warring tribes into the Iroquois Confederacy by 1600. If "ignorant savages" can devise a political union, Benjamin Franklin said, English colonists can do the same. But most of the Iroquois sided with England in 1776, and the confederacy broke up, never to regain influence. By the time De Witt Clinton was building his Erie Canal, the Iroquois were living on reservations.

Along the Mohawk I see steady evidence of industrial decline: hour after hour of factories, most abandoned. Troy was once a rollicking city. Newspapers in the mid-1800s reported "a hundred fights a day, a body a week found in the canal."

Because abundant waterpower was available, much of America's industrial revolution had started around Troy. In 1829, for example, the wife of blacksmith Hugh Montague began to remove his shirt collars and wash them separately. By 1851 Troy was manufacturing removable shirt collars for the world. In the 19th century Troy produced half the horseshoes in America; by the 20th, many factories employed more than a thousand workers each.

Now these factories—like those I see along the canal—are empty, subjects of a new academic specialty called "industrial archaeology." The emptiness imposes an almost physical burden. Amid such ruin it is hard

W. H. BARTLETT, 1838

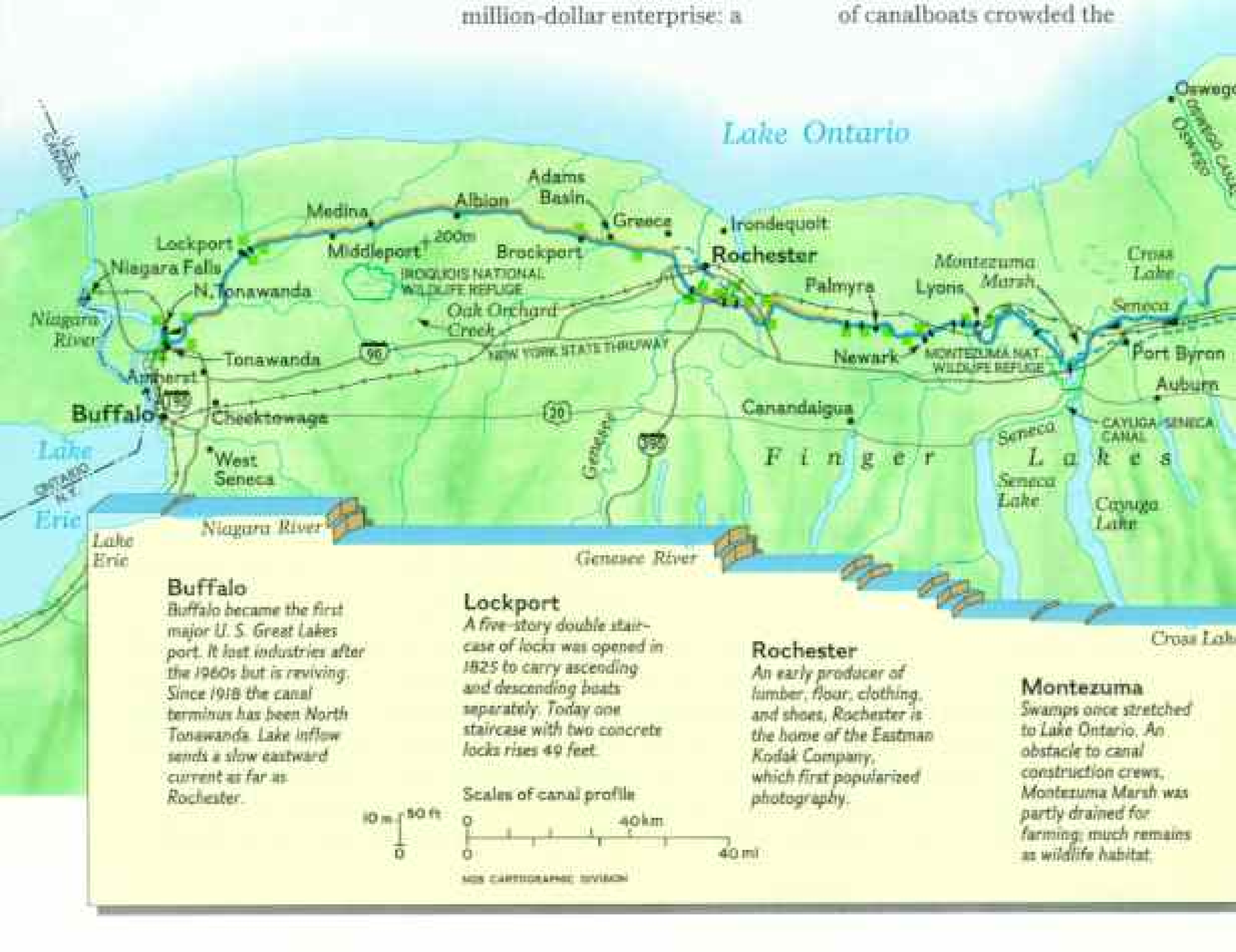
Long stairway to the frontier

"It is little short of madness to think of it at this day," said Thomas Jefferson, when asked in 1809 for federal funds to build a canal to the wilds of Lake Erie. So Governor De Witt Clinton persuaded New Yorkers to fund the seven-million-dollar enterprise: a waterway that penetrated the nation's interior by following the Mohawk Valley through the Appalachian Mountains.

Within 15 years of the Erie Canal's opening in 1825, New York City had risen from fourth to first place among the nation's ports, eclipsing longtime leader Philadelphia.

Mule-drawn boats could now float 363 miles through farmland and forests, from the Hudson River port of Albany to the Lake Erie outpost of Buffalo. Though "Clinton's ditch" measured only four feet deep and 40 feet wide, it cut freight costs by 90 percent and travel time by at least half. The engineering marvel of its day, the canal leaped gorges via aqueducts and climbed 564 feet via 83 locks. At the village of Lockport (above left) a double flight of locks ascended the same escarpment that created Niagara Falls.

Soon a steady, motley stream of canalboats crowded the



Buffalo
Buffalo became the first major U. S. Great Lakes port. It lost industries after the 1960s but is reviving. Since 1918 the canal terminus has been North Tonawanda. Lake inflow sends a slow eastward current as far as Rochester.

Lockport
A five-story double staircase of locks was opened in 1825 to carry ascending and descending boats separately. Today one staircase with two concrete locks rises 49 feet.

Rochester
An early producer of lumber, flour, clothing, and shoes, Rochester is the home of the Eastman Kodak Company, which first popularized photography.

Montezuma
Swamps once stretched to Lake Ontario. An obstacle to canal construction crews, Montezuma Marsh was partly drained for farming; much remains as wildlife habitat.

Scales of canal profile
50 ft
0
40 km
0
40 mi

NGS CARTOGRAPHIC DIVISION

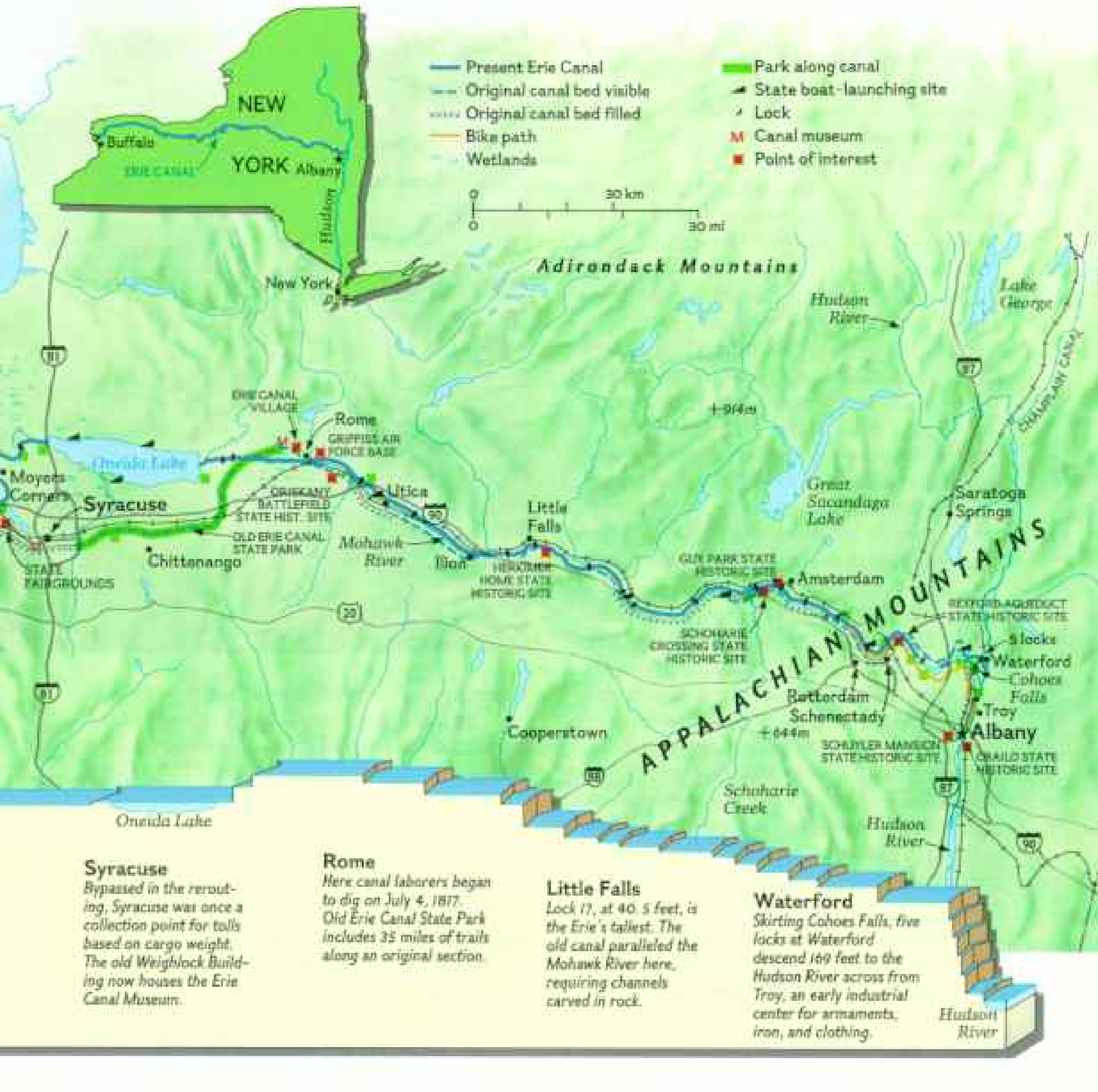
waterway, laden with lumber, flour, wheat, and other goods from western New York and the Great Lakes. By 1831 as many as a thousand immigrants a day passed through Buffalo bound for Ohio and beyond.

With the introduction of motorized barges early in this century, sections of the route were shifted to rivers. Since 1918 the Erie Canal has been part of the modernized New York State Barge Canal system, which includes the Erie's three lateral canals, the Champlain, Oswego, and Cayuga-Seneca. From Waterford to its new terminus at North Tonawanda, the Erie extends 348 miles and rises through 34 locks. The cutaway below includes two other locks at Troy and Buffalo, both federally operated.

Freight volume on the Erie dropped off in the 1950s, largely because of competition from trucks, petroleum pipelines, railroads, and the St. Lawrence Seaway, opened in 1958. While the Erie's future was debated, it received minimum funding and began to deteriorate.

In 1983 the people of New York voted to rehabilitate the system, using it for recreation, flood control, irrigation, wildlife habitat, hydroelectric power, and a small amount of freight. Now local parks draw visitors to cruise or walk the towpath where canallers once sang:

Attend all ye drivers, I sing of
my team;
They're the fleetest and strongest
that ever was seen. . . .
The three altogether in motion
outdo
Any team of their age, the whole
canal through.



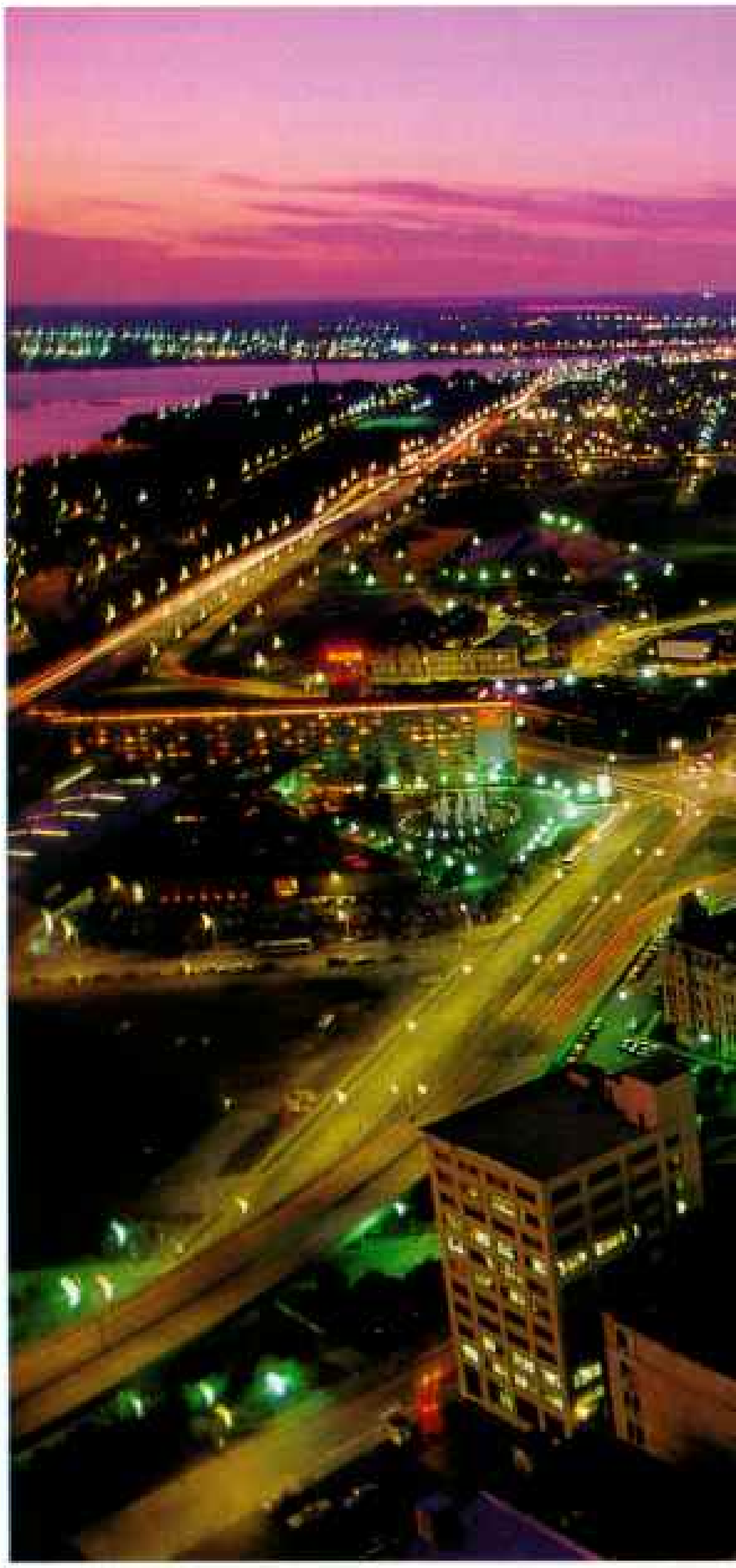
Syracuse
Bypassed in the rerouting, Syracuse was once a collection point for tolls based on cargo weight. The old Weighlock Building now houses the Erie Canal Museum.

Rome
Here canal laborers began to dig on July 4, 1817. Old Erie Canal State Park includes 35 miles of trails along an original section.

Little Falls
Lock 17, at 40.5 feet, is the Erie's tallest. The old canal paralleled the Mohawk River here, requiring channels carved in rock.

Waterford
Skirting Cohoes Falls, five locks at Waterford descend 169 feet to the Hudson River across from Troy, an early industrial center for armaments, iron, and clothing.

The canal boomtown of Buffalo now looks northwest across the Niagara River to Canada for renewed trade. Interstate 190, slicing toward the river at upper left, follows the path of the original Erie Canal.



to conceive of anyone dreaming the way the canal's founders once dreamed.

But dreams continue. From work in the communications field I knew that right in Troy is the New York State Education and Research Network (NYSERNet), a nonprofit company that constructs computer "highways."

When created in 1986, NYSERNet founders compared it to the Erie Canal, calling it the next step in two centuries of effort to draw the country together. It uses fiber-optic lines and special computers to offer subscribers increased speed as their computers link with others around the world.

NYSERNet is in a one-story, faceless building that looks temporary. Close by are dead factories built to last forever.

The president of NYSERNet is William Schrader, 36. He describes himself as "a business person, not a techie," but says things like, "we use 19.2 kps modems over unconditional analog circuits." He is the son of a carpenter and studied neurobiology in college.

Schrader believes that things like the Erie Canal, things that carry people and material, are no longer sufficient. Society, he says, "needs new ways to carry information."

"You'll be able to live wherever you want no matter where you work," Schrader says. "We'll also increase productivity. Where steel is made won't be important. What will be important will be computer-generated knowledge about steel."

His vision: We'll all enjoy access to a network carrying three billion bits of data a second. NYSERNet carries 1.5 million bits a second; a few years ago the best carried only 1,200. Schrader espouses an 18th-century Enlightenment view: Increasing access to knowledge will automatically improve life.

In the early 1900s, economists monitored the movement of railcars. Now they look at variables such as oil consumption. Computer traffic may one day become key. "How soon do you think all this will begin?" I ask.

"It already has!" Schrader starts to pace. "There are hundreds of networks. But most can't talk to one another. Speed and quality of transmission are also poorer than they need be." Suddenly he sits and starts to draw. Lines connect circles. "And the whole thing could tumble down with one small glitch," he says. "With the Erie Canal, modes of failure and recovery were predictable. Here they aren't. Companies and careers disappear quickly."

Grand goals do not embarrass Schrader: "Until now geography has artificially separated people. We are going to eliminate the separation. We're going to change the way society operates—permanently."

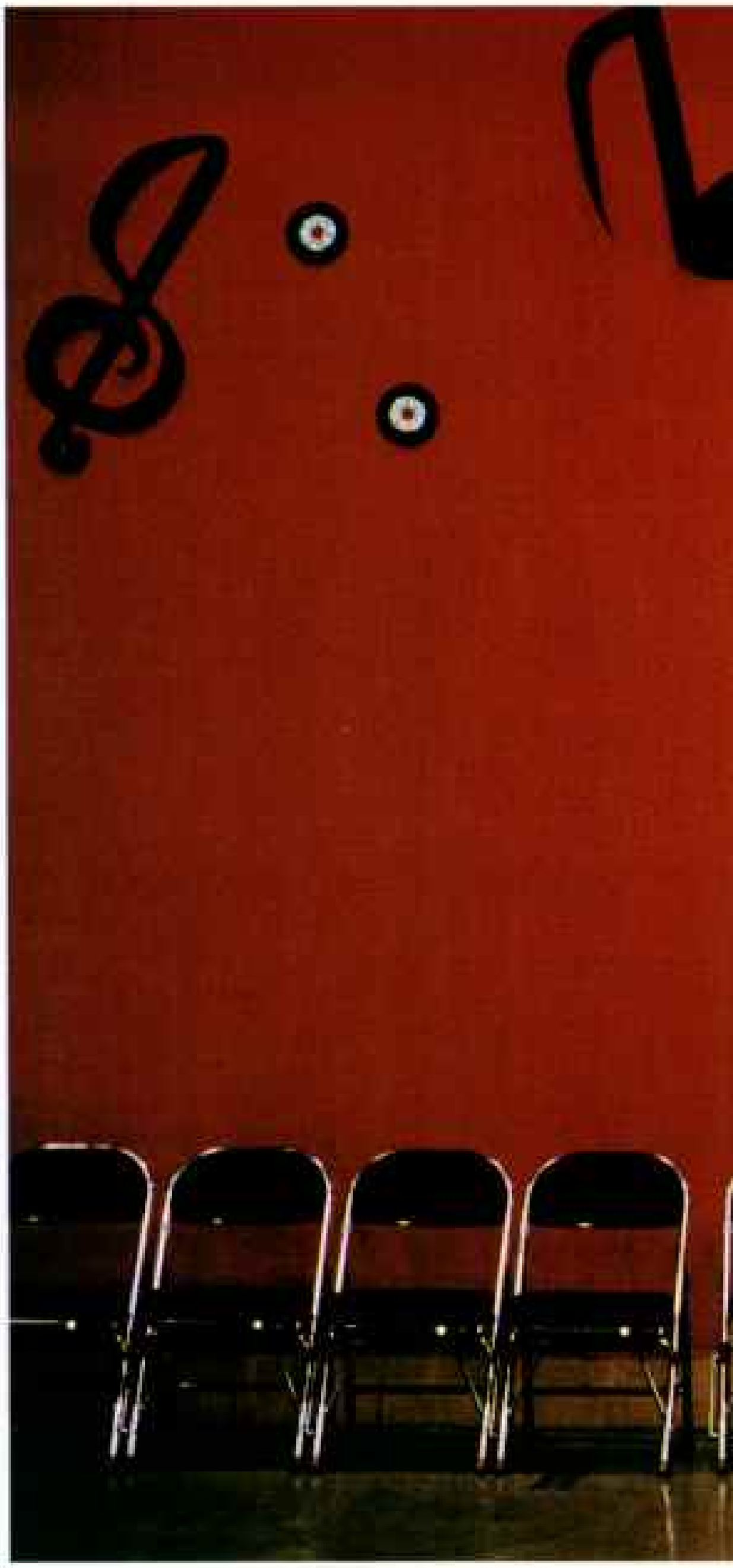
SOME THINGS NEVER CHANGE. Trees dip toward logs with sunning turtles. Purple and yellow wildflowers, bushes heavy with berries, and cattails give way to rolling fields. Deer wander down to the water. Birds come in every color. Most spectacular is the great blue heron.

Under many bridges are dangling ropes used by children to swing down into the water. Swimming, however, is rare. Despite efforts to clean up the canal, it served until recent years as an open sewer and industrial dump.

Harm to the environment offends contemporary sensibilities, but, as the canal demonstrates, such harm may be a price of progress. After the wedding of the waters in 1825, the sea lamprey—an ocean-based parasite that bores holes into fish and sucks out blood—traveled along the Erie and entered the Great Lakes, eventually killing much of the fishing industry. U. S. and Canadian agencies still spend millions yearly to control lampreys.

A B-52 bomber, capable of dropping nuclear bombs anywhere in the world, floats

Momentary wallflower, a square dancer rests at the Buffalo Convention Center. Nearby, in a rowdy Canal Street dancehall of the 1840s, the Christy Minstrels invited "Buffalo gals" to dance by the light of the moon.



overhead. It's on a training mission from Griffiss Air Force Base, located in the canal city of Rome. Farther on down the canal, according to published reports, is the nation's largest arsenal of nuclear weapons. The only people I meet who are eager to discuss this proximity to weapons are protesters, some of whom have gone to jail for years after committing acts of civil disobedience at military installations.

Citizens along this route have made a tradition of breaking laws with which they disagree. The Underground Railroad had major depots all along the canal, and in some cities mobs stormed jails to free runaway slaves waiting shipment back to the South. But then, as now, protest involved a tiny minority. Most people simply lead their lives.

"THE GREATEST DANGER along the canal is drinking and driving," says trooper Hardy Palton, who patrols these waters for the New York State Police. "You spend $50,000 for a boat, and then you smash into someone."

Desire to move fast may be inborn. When schoolchildren go on boat tours, their most frequent question is, "How fast does the boat go?" My boat moves at four miles an hour, the top speed for mule-pulled barges that defined canal travel until the 20th century—and also the speed at which Huck Finn's raft drifted down the Mississippi.

In the early 19th century, canalboats were fast. By horseback the trip from Buffalo to New York could take a month. Via canal it was less than a week. Canal travel was cramped—and, literally, made strange bedfellows. A children's book published in 1843 has the following dialogue: "Do you kick, sir, in your sleep?" "Kick? Yes sir."

Passenger travel brought the Erie its romantic era of gamblers and honeymooners drifting along idyllic shorelines. But the canal also carried immigrants west and their produce back east. Between 1820 and 1860 America's population nearly tripled. By 1860, however, trains had cut the travel time between Albany and Buffalo from a week to a day, and most of the traffic on the canal was freight.

On the first day of my trip, every cell of my body feels sluggish. But slowness is seductive. It allows time to think, talk, and read. I start to see and hear more. The faster world—of automobiles, airplanes, trains, and telephones—becomes far away. But it isn't really. The route of the Erie is a living textbook on transportation.

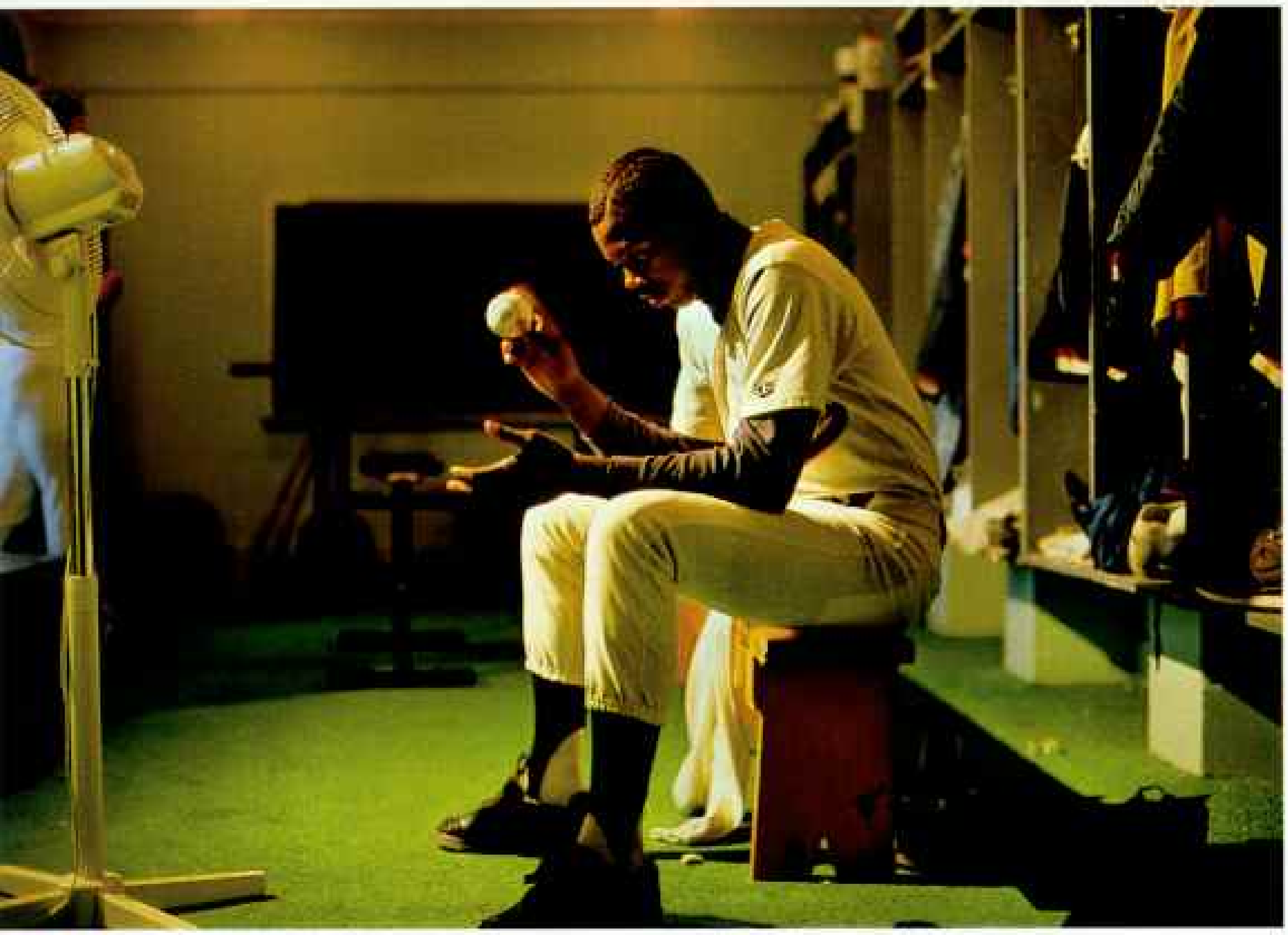
Running parallel to the canal is Route 20,

the scenic highway that replaced wagon turnpikes and, before them, Indian trails. It is deserted, killed by the New York State Thruway—also parallel—one of the nation's busiest highways. In 1988 the thruway carried more than 50 million vehicles.

As I pass Schoharie Creek—which drains a thousand-square-mile area—police recover a body that had been underwater since April 1987, when the thruway bridge over the Schoharie collapsed, killing all the occupants of five vehicles. More might have died were it not for the courage of state trooper Peter Persico, who rushed onto the bridge after the first section fell and ushered off people who had stopped to peer over the edge. Minutes later the entire structure fell.

A walk through marshes and woods brings me to Roman-looking remnants of one of the aqueducts that carried the old canal over streams. Original plans in 1817 had called for a citizens army of farmers and field hands to dig the canal. But 37 cents for 12 hours with pick and shovel attracted few steady workers. To

Drafted into the Little League at 9, into pro ball at 16, Johnny Ruffin at 18 psychs himself to pitch for the Class A Utica Blue Sox, farm team of the Chicago White Sox. Lean, loose, with a fastball that's a shade wild, Ruffin admits to that "little cockiness" all pitchers need. Baseball is an old-timer on the canal, going back to the 1820s.



fill out this work force, thousands of Irish immigrants were recruited as they disembarked at New York City.

Clinton began his canal at Rome, where flat land promised the fastest progress. Workers dug toward the east and west simultaneously. The first segment opened in 1819, connecting Utica with the Seneca River. The timing helped Clinton, who faced a tough 1820 reelection campaign amid charges that the canal wasted tax dollars. Clinton won by less than 2 percent.

America had few trained civil engineers, yet the president of the American Society of Civil Engineers wrote in 1882, "Many of the distinctive characteristics of American engineering originated with those Erie Canal engineers. We practice their methods today."

Seat-of-the-pants solutions are one example. Western New York was a wilderness, whose huge trees would take decades to cut by ordinary methods. Erie engineers devised a lever-and-winch device that toppled 40 trees a day. To yank up stumps, they constructed a giant winch with a 30-foot axle and 16-foot wheels.

The greatest crisis was lack of waterproof cement to hold the locks together. Europeans manufactured the only available cement; the cost and delay could have killed the canal. So an engineer named Canvass White invented his own waterproof material using a unique limestone found on the canal route.

I climb up the walls of abandoned locks, in excellent condition because they're made of the same hard limestone, left after glaciers scraped off softer rock. An old trolley bridge that once led to an amusement park reminds me of an America in which men wore straw hats and women dressed in flowing skirts for their afternoon dates.

Pitching relief on two fronts, Scott Stephens feeds his six-week-old son before handing him to his wife and taking the field for a Blue Sox home game. Of his major-league prospects, Stephens says, "I believe it's up to the individual to make or break his own destiny. I believe it's in my own hands." The early canal builders would have understood.

EDUCATOR JACQUES BARZUN notes that "whoever wants to know the heart and mind of America had better learn baseball"—and canal country has always been baseball country. In the last quarter of the 19th century the first professional league had four teams along the Erie.

The canal passes north of Cooperstown, where legend has it that Abner Doubleday invented baseball. Baseball evolved from a British game called rounders. But in the late 19th century "patriotism and research" by organized baseball "proved" its American origin. The turning point was an 1889 dinner at Delmonico's restaurant in New York City, when several hundred celebrities and business executives shouted "No rounders!" Eighteen years later a blue-ribbon commission designated Cooperstown as baseball's birthplace. What did it matter that Abner Doubleday was at West Point on the day he supposedly invented baseball on a Cooperstown sandlot?

The Utica Blue Sox, part of the Chicago White Sox farm system, are kids in their first professional year. It's do or die: After one summer in Utica, players are assigned to a higher league or sent home.

The field is in a working-class neighborhood. I buy a sandwich and soft drink from a nearby diner and settle down in the empty stands—there are about 4,000 seats—to watch practice as I wait three hours for the game.

Several dozen players perform stretching exercises and baseball drills. An older man makes a motion, a younger one mirrors it; the first lifts his leg and stretches forward, sweeping one arm over his head, the other does the same. Even under ill-fitting practice uniforms, the easy grace is obvious.

I approach the older man. He is Bill Ballou,

a high school teacher from Long Island. Coaching Blue Sox pitchers is his summer job. Despite several seasons as a minor league pitcher, he never made the big leagues.

"Who's your best?" I ask.

"Kid from Alabama, Johnny Ruffin. Young, just turned 18. Fastball's been clocked at 90 miles an hour." Few major leaguers can match that speed.

"He can't put every pitch exactly where he wants it," Ballou says, "but that's all right. We can teach you control if you have basic ability." He explains that mental discipline is the key and that young ballplayers must learn not to make the same mistake twice.

I want baseball to be special, a boy's game, and feel sad that Ballou is describing life itself. He continues: "All these kids have major league talent, yet some will be picking fruit next year. Why?" He does not answer.

The next day Ballou again does his ballet with Ruffin. The goal is simple: To increase his power and control, Ruffin must learn to align the toe of his landing foot with the toe of his

Old companions, this inn and the canal have faced each other at Adams Basin since 1827. Owners Bud Nichols, at left, and his wife, Elsie, on the porch, grew up and courted nearby, so they feel a special bond to the place.

pivot foot. Ballou is a natural teacher—encouraging, correcting, suggesting. "Look, a 49-year-old can do it," he says, landing his own foot at the exact right spot. "You can do it." And then, "That's it! That's it!"

Over the next few days I spend time with Ruffin. Physically he is unimposing. Even the muscles of his shoulders and upper arms, which power his fastball, look somewhat ordinary. Ruffin lives with two other ballplayers in a rented house, makes $850 a month (as do all Blue Sox) and misses his family. He devours fast food. "If I ate what you eat, I'd be fat very quickly," I say. He looks down at himself, laughs, and says, "I'm still growing."

Ruffin is absolutely sure that in two or three years he'll be a major leaguer. But perhaps only one in 40 who play for Utica make the majors. He shrugs and says, "*I* will." No variations of the question shake him; he sounds like Bill Schrader: Failure is not possible.

As his next pitching date approaches, Ruffin gets nervous, and so do I. The game attracts about 700 fans. They applaud as Ruffin takes the mound. His first pitch is hit right back to him. He bobbles the ball, and the runner is safe. The next batter gets a hit, and the next pitch is wild. Soon the bases are loaded with no outs. Suddenly I realize what bothers me about Ruffin's appearance. His cap droops over his ears as though he hasn't grown into it.

Ruffin quickly gives up five runs but never loses his poise. Pitch after pitch leaves batters contorted from swinging at empty air.

I turn to the scoreboard for instant video replays. The Utica scoreboard, however, offers only numbers. My senses become more acute. To see the action, I must see the action.

After the game I walk with Ruffin back to the locker room. He's happy because Utica won 7-6. "Are you tired?" I ask.

"Mentally, no. Physically, almost."

Ballou warns me: "Most of these kids are idealistic. They haven't risen high enough to see what baseball can do to you. I had a great year, and the next spring they released me. It's tough, and it's not always fair."

AFTER UTICA, and all along the canal, I see only a few pleasure boats and an occasional barge. This emptiness is new. In the 1870s and 1880s, when Mark Twain was writing books that enshrined steamboats in the nation's memory, the Erie rivaled his beloved Mississippi in importance to America's economy. In 1900 the western terminus of the canal had the world's largest office building; speakers at a black-tie dinner belatedly celebrating the canal's 100th birthday in 1926

Stomping stage right, a determined Kara Bottini competes in Utica's Little Miss Italia pageant. At the World Series of Bocce in New York's Rome, a team plans strategy in the Italian game, which resembles an amalgam of bowling and horseshoes. Rosalie Ferrara, at right, says, "We play well together because we listen to each other." After 1890, Italian immigrants joined the canal's mix of Irish, Germans, and other groups.

boasted that tonnage was the highest ever.

As recently as the 1950s the Erie Canal annually carried over three million tons of low-grade freight such as cement, molasses, asphalt, and gasoline; barges even delivered jet fuel to the bombers at Griffiss.

Barges still provide significant savings in fuel and labor. Thus, inland waterways—relying on locks and canalized rivers much like the Erie—carry one-sixth of the nation's freight, mostly coal, petroleum products, grain, and minerals. This percentage has not declined in more than 50 years. But the Erie itself is too shallow and narrow in places for large barges. Even though an Erie barge can carry the equivalent freight of 100 trucks or a 40-car train, commercial traffic has dropped to only 72,000 tons a year and shows no sign of rising.

Because the last generation that hauled freight on the canal is dying, all that remains are memories of grandfathers who trudged behind mules and grandmothers who raised families on one-room canalboats.

Every canal town has self-educated experts who collect these memories. Most popular are tales of hard-muscled men who lived by their own rules. Their most popular hangout was Goose Island near Buffalo, home to pleasure houses that made canallers sing what is now a folk song classic: "Buffalo gals, won't you come out tonight,/And dance by the light of the moon?" Where boats lined up at locks, they fought. You moved up in line if you beat someone ahead of you. With bounties for shaving hours off the cross-state trip, fights often had high stakes.

These experts have opened their hearts to the canal. In their homes are stacks of clippings, often mixed with family photographs and graduation announcements. A town with

Skill and response time are tested as B-52G bomber crews start a night exercise at Griffiss Air Force Base, the largest employer in the Mohawk Valley. In Rome, after the War of 1812, self-taught engineers first tackled the canal route at its central, easiest point. From there they struggled west to Lake Erie, avoiding British-controlled Lake Ontario and opening the way for a chain of new towns.

a special love for the canal is Chittenango, home to L. Frank Baum, who was born in 1856. He was a chicken farmer, but at 19 he headed out to the Dakota Territory. Later he wrote down his fantasies, published in 1900 as *Wonderful Wizard of Oz*.

In Chittenango I find numerous stores and restaurants named for Oz characters, but passion seems reserved for restoring a dry dock that achieved glory during the Civil War, when closing of the Mississippi brought extra traffic to the Erie. Guided by old photographs, volunteers put on boots and dig through mud.

What disturbs me about such efforts is that they perpetuate the image of an ever glorious past. All our triumphs are not in the past, and all our problems are not confined to the present. Historical memory is invaluable, but we must not forget the forgotten.

Forgotten people include immigrant laborers who worked on the canal, lived under inhumane conditions, and died without rousing much concern. Thousands of homeless people, escaped slaves, and other outcasts roamed the canal looking for work. (One newspaper ad offered two cents and a bucket of ashes as reward for the capture of a runaway apprentice.)

In Syracuse I find health organizations distributing free condoms to help control AIDS. Desperate public health measures are not new here. During its first generations as a canal city, Syracuse experienced repeated cholera epidemics. Many experts said it was a disease of the lower classes, who got infected because of moral failings. City fathers closed their community to canalboats carrying sick passengers, while local doctors tried a variety of innovative cures, including tobacco-juice enemas.

In a Syracuse *Post-Standard* column I read

Meticulous care attends the fitting of an engraved rifle barrel to a handmade walnut stock in the custom shop of the Remington Arms Company in Ilion. Eliphalet Remington located his armory here in 1828 to take advantage of cheap transportation on the canal. A major supplier to the Union during the Civil War, Remington expanded to make millions of rifles during the two World Wars but now concentrates on sporting arms.

about Syracusans who now fly to Tijuana for coffee enemas to combat cancer. The column draws me to its writer, Robert R. Haggart, who himself has incurable cancer. He will represent those forgotten by the American dream. His columns challenge authority—cable companies, the city council, the IRS—and he makes house calls. People in trouble call Haggart. He'll come and take a look.

A column written while he was under massive chemotherapy tweaks local politicians for taking themselves too seriously; it makes me laugh out loud.

I am afraid that Haggart will look terrible and that I'll feel awkward. But near the newspaper office we settle into a restaurant that serves homemade Italian food, and he puts me at ease. "The doctors know you'll be around for a few years waiting to die," he explains, "so they try to do nothing to make you sick or make your hair fall out. They can't really help, so they try not to hurt you."

Haggart lives with his wife, Brenda, and her two daughters in a neighborhood lined with front porches. When I visit their house, I find shelves filled with family photographs. The garage houses his Harley-Davidson, a motorcycle the doctor wouldn't approve of. He rides it anyway. He loves to cook: Lasagna is his specialty. But he refuses to mow the lawn.

Haggart is sure he'll live. He has found an experimental program in Boston that will kill his immune system, then inject him with his own bone marrow treated with cancer-killing antibodies. His next step isn't dramatic. To qualify for the experimental program, he must decrease his tumor mass. He takes chemotherapy every two weeks, and a blood test charts the results. The protein count when he was diagnosed was 5,220; now it's 1,930.

Sometimes, however, it seems to drift back up.

We discuss what physicians know about cancerous cells and lifesaving marrow. Of all conversations on this trip, this one generates the greatest sense of new frontiers. Ironically, it concerns the unknown wilderness inside each cell, the smallest units of our beings.

Later, as I drive off, Brenda is mowing the lawn. She stops as her husband approaches. In the rearview mirror I see them hugging.

West of Syracuse the canal passes along the Seneca River. Here, more than anywhere else, canalside homes are new, large, and expensive. Many have their own docks. When it was a major freight route, only poor people and farmers lived on the canal. Now a waterside address brings prestige.

After miles of waterside houses come the Montezuma Marsh, vistas of flowers and wildlife, and then farmland. At the northern tip of Cayuga Lake, longest of the Finger Lakes, the canal leaves the Seneca River. The rest of the route is man-made: edges so straight nature never could have made them. The Erie now

Carnival lights in Moyers Corners surround a couple smiling for a portrait. In an earlier era towns looked to the canal for floating circuses, theaters, museums, evangelists, and other diversions from a day's hard work.

support state appropriations for his canal if he just brought it to them.

The first thing I see when approaching a town is not the low bridge made famous by the song ("Low bridge, everybody down,/Low bridge, for now we're going through a town"). The first thing I see is a church steeple, even at night, when a light haze hangs over the water.

Near Palmyra, religion has special meaning. In 1823, while the canal was being constructed, Joseph Smith said an angel told him "God had a work for me to do." This led to the founding of the Church of Jesus Christ of Latter-day Saints, a religion that now has more than five million followers.

A GENERATION AGO most pleasure boats on the canal were made in America; now many come from Asia. This is only the most visible evidence of a growing foreign presence. Non-Americans own businesses in every town I visit.

Foreigners generally do not start new businesses; they buy the established and proven. Thus, since 1988 a Hong Kong company has owned Marine Midland, upstate New York's largest bank. The single largest investor in the region is nearby Canada, by far the United States' greatest trading partner.

Reliance on foreign capital is not new; Europeans invested heavily in high-risk Erie construction bonds. Canal builders also relied on Irish famines to provide laborers willing to work hard for low pay. European drought and the Crimean War in the 1850s produced the principal market for farmers whose shipments made the canal an immediate success.

The canal cuts across Rochester—home of Eastman Kodak, which brought the camera to the man in the street in the 1880s, and Xerox, whose name became a household word in the 1960s—a reminder that the canal has always hosted entrepreneurs. Each town seems to claim a "first": the drive-in bank (Syracuse), the merry-go-round band organ (North Tonawanda), and dozens of others.

West of Rochester comes fruit country. Apple and cherry orchards line the canal. In cuts through the center of small canal towns whose populations haven't grown in a hundred years. Many have exquisitely crafted stone buildings and homes built in the 1830s and '40s. Charm notwithstanding, the downtowns are not crowded. Most shoppers are at nearby malls.

After Newark the canal dips south and quickly curves back north. The dip seems silly until a local canal aficionado explains that political leaders in Ontario County—just to the south—promised De Witt Clinton they'd

Towering snags support a great blue heron rookery at Montezuma National

Wildlife Refuge, a remnant of the vast swamp that confronted canal diggers.

Barely drier than fish, anglers persevere at Lock 27, in Lyons. Keeper of the lock Floyd Chadwick, now 55, has fished here all his life for perch, bass, and bullheads. "When I was ten years old, the canal was real clean. In the sixties for a while you could fish and fish and not get anything. . . . Today it's almost back to where it used to be." Cleaner water now also attracts more boaters, hikers, bikers, and campers.

the days of heavy canal traffic, farmers sold produce all along the way. Some of America's best food was available at rock-bottom prices.

Many farms in western New York date back to grants given to Revolutionary and Civil War veterans, but even they are changing. "Used to be that you could make a good living with a relatively small piece of land," a retired farmer tells me. "Now it takes hundreds of acres. More and more families are selling out." Another tells me, "Can't keep the kids on the farm unless they love the farm. Not many do."

While crossing the aqueduct over Oak Orchard Creek, I look down on a waterfall. The canal is mostly on high ground here, contained by embankments, and my boat rides at treetop level; east of Medina, a road tunnels under the water. Authorities used to dispatch "hurry-up" boats to patch leaks. Today canal walkers hired by the state check for leaks.

In 1977 workers running cable underneath the canal accidentally dug through its side. Escaping water quickly washed out a 40-foot-deep, 150-foot-long hole and swept away three houses. Some talked about permanently shutting down damaged sections, probably the closest the canal ever came to dying.

I stop at a truck stop near a thruway exit. It is full of conversation, music, and men wearing baseball caps. Its specialty, freshly made mashed potatoes, is available 24 hours a day. Shortly after I left—as I later heard on the radio—two truckers began to argue. One shot the other, killing him. Such violence makes me think something is wrong in America, and yet I wonder. Future generations may romanticize truck-stop fights much as we now romanticize the bawdy, lawless life of early canallers.

The last time the canal played a role in American politics was 1930, when New York

Quiet waters are hardly broken as a charter boat glides toward Lock 28A in Lyons at six miles an hour. In the last century, before concrete protected the banks from swells, mule skinners could be fined for exceeding four miles an hour. Recreational boat traffic on the canals has doubled in recent years, as more boaters see the beauty of going slow.

Governor Franklin D. Roosevelt crossed the state in a canalboat during his reelection campaign. Roosevelt called for the federal government to deepen and widen the canal. He became President two years later and conveniently forgot this suggestion. Railroads were near bankruptcy, and strengthening a competitor offered few political benefits.

Older people in Middleport, midway between Rochester and Buffalo, remember FDR's visit. He stayed on the boat (they did not know he was in a wheelchair), and Eleanor came out to chat and shake hands.

MIDDLEPORT seems a good place to talk about how people use the political process to solve their problems. A few telephone calls lead to lunch with Diane Heminway. The way she tells her story shows it still amazes her:

"I'm an ordinary person. I was born just west of here. In late 1984 I went to pick up my two kids from school and found it deserted. Someone told me the kids were at the firehouse. I found them getting oxygen. Some had wet compresses on their eyes. Teachers explained that a gas had been released from the FMC pesticide factory next to the school."

Officials said the gas, methyl isocyanate, had no long-term effects. But her research revealed that it can be deadly. No one listened until three weeks later, when the same gas in Bhopal, India, killed and injured tens of thousands. Low temperatures and luck kept the Middleport release from killing anyone.

As Heminway and I drive slowly through town, there's pride in her voice. It looks like a town where you know your neighbors and raise children in conditions out of a storybook. There is only one traffic light.

We stop at the school, which is on the canal. I sift schoolyard dirt. "Arsenic," she says, "18,000 parts per million. For drinking water the state says the safe level is 25 parts per billion." She recites similar statistics for lead and pesticides. "I thought that it would be simple," she says. "We'd recognize danger and do something. But most parents denied the danger because psychologically they couldn't handle it."

Heminway also focused on waste dumped into holes left behind by quarrying stone for the canal. One dump is next to the water. "This was where local kids used to neck," she says, walking past empty beer cans and an old mattress. "More than a thousand tons of soil contaminated by arsenic, lead, pesticides, and mercury have been dumped here."

She formed a citizens group that drew a hundred people to its first meeting and had a dozen people who did the bulk of the work. By the end of 1988 the group had virtually disappeared. A proposed leash law attracted more people to town meetings

Racing the winter freeze, crewmen secure a tug to barges bearing new lock gates across the state to Lockport. More than 300 people gathered to dedicate them, rejoicing that the Erie is being strengthened for the long haul.

than did questions about the schoolyard.

The pesticide factory is Middleport's biggest employer, and local farms use its products. "I used to drive by the plant and think, 'It's so much bigger than I am,' " she says. "I had been a room mother, and the school treated me like an outcast. I got calls, 'Don't go near your windows.' The trade-off was soil, water, and health for jobs. The town took jobs."

No one collects health data that might document effects of phenomena such as arsenic-laced dirt. The law mandates safety but doesn't define it. Thus the pesticide factory, which has spent millions of dollars to contain the contamination, complies with all statutes.

What did Heminway accomplish? A snow fence—already falling down—now blocks access to some of the schoolyard's most dangerous areas. The state lists some local sites as needing cleanup, and officials have certified that chemicals are not leaking into the canal.

One bedroom in her home is an office. Documents are strewn about the floor. Her husband donated a work bonus to purchase the computer. On the wall is a Bertrand Russell quote: "The central problem of our age is how to act decisively in the absence of certainty."

Heminway admits she is a zealot: She sees danger where most others do not. But she believes that an aroused public—willing to back beliefs with votes—can do mighty things. "It's a slow process, and the battle can make you weary," she says. "In my head I'm a pessimist, but in my heart I'm an optimist."

I ASK DIANE HEMINWAY to sign a baseball I have taken along as a souvenir of my journey along the Erie Canal. Bill Schrader, Johnny Ruffin, and Bob Haggart have already signed it. I had thought the baseball would be a nice way to remember the trip, but now I want to throw it away.

The reason: Bill, Johnny, Bob, and Diane have affected me deeply. All possess something I had not expected to find, and which leaves me exhilarated—a belief that in America all of us can do and be whatever we want, no matter what limits life seeks to impose. This optimism is all the more extraordinary because I saw so clearly that it persists, day after day, without drama. Yet I know that most—if not all—of their stories will have unhappy endings. Fate, faceless institutions, and indifference can destroy the most resilient of us.

If I can distance myself from them, I know I'll be able to transform their optimism into an uplifting metaphor. As my boat drifts along, I sit silently for several hours trying to throw the baseball into the water. Then I realize that to throw it away was never a real possibility. □

Into the teeth of the ice

SIX ACROSS ANTARCTICA

By WILL STEGER

In a sea of sunlight and drifting snow, a team of huskies await their handler's call on the first leg of a historic, 3,700-mile traverse of Antarctica. Violent storms and piercing cold lay just ahead.

TEARS OF FRUSTRATION AND DESPAIR blinded me more than the stinging wind or snow. For 24 hours a storm had pinned us in our camp only 18 miles from our goal—the far edge of Antarctica. We had come too far, endured too much suffering, to lose a man now, I thought bitterly. We had to find him.

We clung to a long rope as we searched; the end was tied to a sled to keep us from straying, as he had, into the raging whiteout. "Keizo!" I yelled into the blizzard. "Keizo! . . . Keizo!"

A relaxed moment finds the author and co-leader, Will Steger, atop his sled at the outset of the expedition. Though prepared for the worst weather in the world, neither Steger nor his five companions could have imagined that farther up the Antarctic Peninsula lay two months of storms, which, with winds reaching 90 miles an hour and temperatures dropping as low as minus 45°F, would test their spirits, tax their food supply, and threaten their lives.

RICK RIDGEWAY

Faintly I heard the others shouting his name as they too groped in a tethered arc around the tents and sleds. Our Japanese teammate, Keizo Funatsu—gentle, compassionate Keizo—had crawled out of his tent at 4:30 the afternoon before to check on his dogs. By six we knew he was lost. We searched into the night, calling and listening, flashlight beams futile against the swirling snow.

Now in the first faint wash of daylight we were searching again.

It was unthinkable that one of us could be gone after what we had come through together for nearly seven months: Trudging, antlike, across 3,700 miles of brutal terrain, from sea level to lonely elevations above 11,000 feet . . . battered for weeks by continuous storms . . . exhausted and frostbitten in temperatures that approached 60 below, winds that howled at 90 miles an hour.

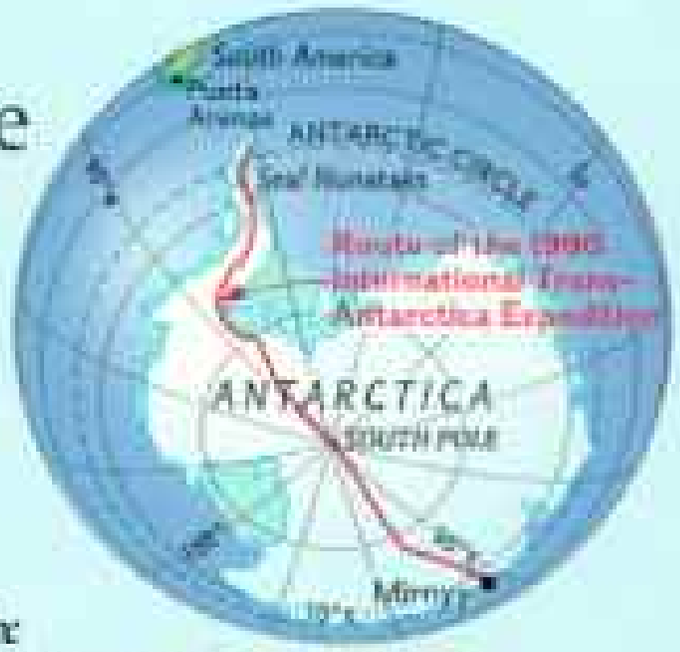
We had challenged a foreign place, a place not meant for warm-blooded animals. Antarctica's terrible interior tries to turn men into its own image—frozen. Yet this endurance test had forged a deep and permanent bond among us: six dissimilar men from six nations, attempting to complete the first crossing of the continent by dogsled.

I envisioned the worst—carrying Keizo these last few miles wrapped in the flag of his homeland—and my stomach knotted in anguish. "Keizo!" I bellowed, over and over again.

I couldn't believe it when I glimpsed him—a wraith emerging from the driving curtain of snow. "I am alive," he said. In seconds we were clutching each other. Both of us were crying.

Keizo is a skilled survivor. Once lost, he scraped a shallow trench with pliers, the only tool he had, and curled up in it like a sled dog, allowing the blizzard to bury him. *(Continued on page 76)*

Polar adventure in the great tradition



Take the world's most remote continent, choose the longest and most difficult route across it, select six strangers from six countries speaking several languages, and you have a backdrop for historic achievement—or disaster. On July 27, 1989, a multinational team of explorers set out from Seal Nunataks on the Antarctic Peninsula. Seven months and 3,700 miles later they arrived at the other side of the continent, the first team to traverse Antarctica by dogsled, and the first to trek the length of the Antarctic Peninsula in winter and cross the isolated "area of inaccessibility" on foot.

King George Island

Antarctic Peninsula
Team battles 60 days of storms. Crevasses pose a constant danger.

START

July 27, 1989

Seal Nunataks

ANTARCTIC CIRCLE

August 21

Weyerhaeuser Glacier

September 17

September 30

ANTARCTIC PENINSULA

September 30
Fifteen dogs are airlifted to Chile for a rest. Three reserve dogs and vital supplies are flown in.

Weddell Sea

Mount Rea
(3626 ft)

BONNE ICE SHELF

Berkner Island

FILCHNER ICE SHELF

October 31

Vinson Massif
4897 m
(16067 ft)

Patriot Hills

November 7

Ellsworth Mountains

WEST ANTARCTICA

Thiel Mts.

MOUNTAINS

POLAR PLATEAU

Amundsen-Scott
U. S.

SOUTH POLE

December 11

December 11
Team arrives at South Pole.

Shackleton's farthest point south: January 9, 1909

Area of inaccessibility
Named for its remoteness from all coasts.

Roosevelt Island

Beardmore Glacier

January 3, 1990

EAST ANTARCTICA

Framheim

ROSS ICE SHELF

Scott died about March 29, 1912

Hut Point

Ross Island

Cape Evans

Cape Royds

McMurdo Sound

Ross Sea

TRANSANTARCTIC MOUNTAINS

88°

Vostok
U.S.S.R.

January 18

January 23

Soviet tractors provide supplies and a safe route between Vostok and Mirnyy.

March 1
Japanese team member spends the night buried in snow. He is rescued unhurt after 13 hours.

February 6

February 15

March 3, 1990

Mirnyy
U.S.S.R.

INDIAN OCEAN

70°S

Route of the 1990 International Trans-Antarctica Expedition

- Food cache found
- Food cache not found
- Air resupply point
- Research station
- Rock outcrop

Azimuthal Equidistant Projection

0 300 km
0 300 mi

NGS CARTOGRAPHIC DIVISION
RELIEF ART BY OSMUNDUR BJARNI

Selected Historical Routes

- SHACKLETON ROUTE, 1908–09
  Shackleton came to within 112 miles of the Pole.
- AMUNDSEN ROUTE, 1911–12
  The first man to have reached the Pole, on December 14, 1911.
- SCOTT ROUTE, 1911–12
  Scott reached the Pole on January 17, 1912, but perished on the return trip.

A giant maw of ice opens wide, ready to swallow any sled team passing too close. Crevasses, like this one on the Weyerhaeuser Glacier, can yawn more than a hundred feet deep.

DANIEL MORRISSEY


GORE-TEX
UAP

Six men, six nations, one quest

THE PRIDE OF SIX NATIONS is reflected in the faces of the members of the International Trans-Antarctica Expedition. Two of those members, Will Steger and Jean-Louis Etienne, discovered on a chance encounter in the Arctic in 1986 that they shared a common dream—to make the first unmechanized traverse of Antarctica. But beyond mere adventure lay an overriding concern for the environment and world peace. The expedition they envisioned must serve as an example of international cooperation, focusing the world's attention on this largely unexplored land and its critical environmental questions.

Such an undertaking would be dauntingly expensive; 11 million dollars was eventually raised. But the biggest investment, they agreed, would be in human terms. The right team had to be assembled, each man a valuable contributor to the expedition.

WILL STEGER of the U. S., a former science teacher, led an expedition without resupply to the North Pole in 1986.

JEAN-LOUIS ETIENNE, co-leader, is a sports medicine specialist from France. In 1986 he made the first solo ski expedition to the North Pole.

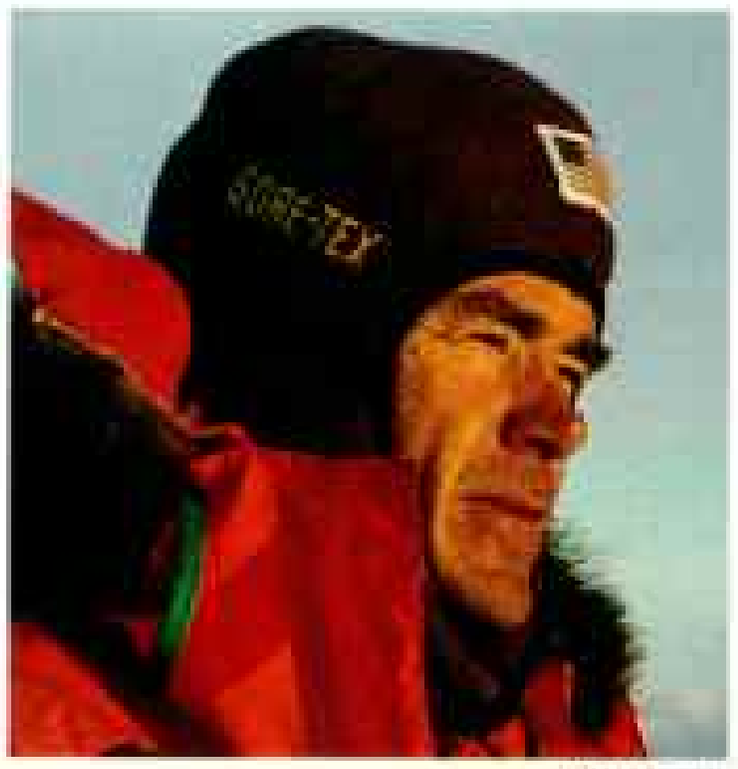
VICTOR BOYARSKY is a Soviet veteran of six Arctic and Antarctic projects. His task: to oversee various meteorological experiments.

QIN DAHE, a glaciologist and geologist, spent two years in Antarctica as manager of China's Great Wall research station.

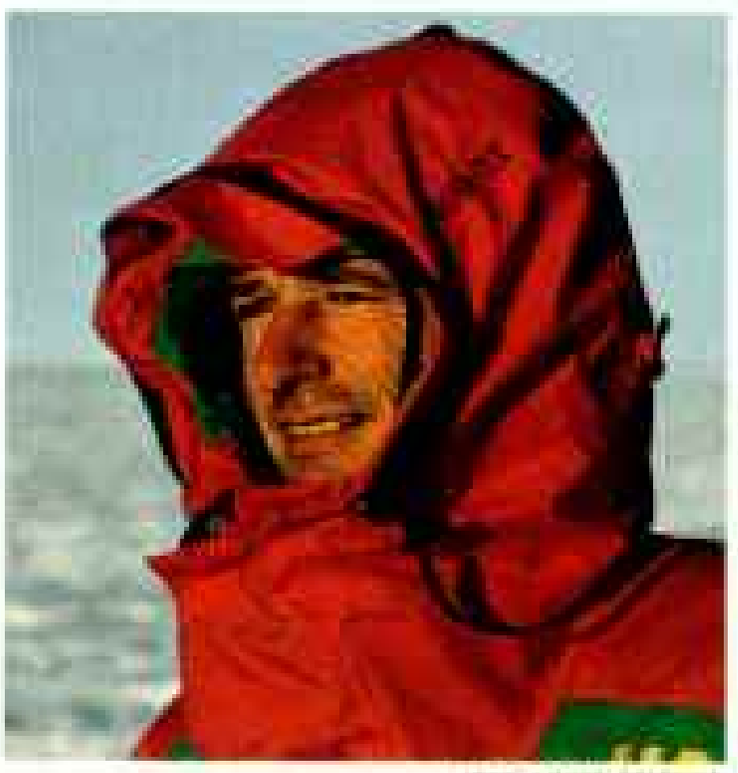
GEOFF SOMERS logged three years in Antarctica as a member of the British Antarctic Survey. Geoff is a dog handler and navigator.

KEIZO FUNATSU from Japan is, at 32, the youngest member of the team. He has four years' experience working with sled dogs.

For seven months, under the most grueling conditions, these six men worked together in an atmosphere of harmony and cooperation. Sunset provides harmony of another sort above camp on the Antarctic Peninsula (left). Nighttime receded into 24-hour daylight in early November but returned in February.



WILL STEGER


JEAN-LOUIS ETIENNE

VICTOR BOYARSKY


QIN DAHE

GEOFF SOMERS

KEIZO FUNATSU

ALL BY RICK RIDDEWAY

(Continued from page 68) And there, with Zen-like calm, he waited for 13 hours, until he heard our calls.

It was then—but only then—that I was certain our expedition was a success.

We had come to Antarctica for many reasons. There was the adventure of such a crossing, of course. Others had dreamed of it, beginning with Ernest Shackleton, who failed in 1915. In modern times, Vivian Fuchs with Edmund Hillary's help, in 1958, and Ranulph Fiennes, in 1981, had made motorized traverses. Reinhold Messner and Arved Fuchs were attempting to ski a shorter route at the same time we were crossing (see pages 94-5).

I was first fascinated by Antarctica as a boy, reading about Fuchs and Hillary in NATIONAL GEOGRAPHIC. Poring over pictures of crevasses and mountains and scientific camps, I wondered how men dealt with this wild environment, how they survived. I knew then that Antarctica was a place I had to see.

I dreamed of it for 30 years. The reality was triggered by a one-in-a-million meeting in the middle of the frozen Arctic Ocean, when the path of my 1986 dogsled trek to the North Pole crossed that of Frenchman Jean-Louis Etienne, who was skiing solo to the Pole.* We sat that night in a tent and drank tea and found that we shared the same dream.

There on the ice we exchanged telephone numbers, and, after returning from the Pole, we launched Trans-Antarctica.

Like other expeditions, including those of Amundsen, Scott, and Peary, our international effort involved complex planning: several years of fund-raising, juggling logistics and itineraries, dealing with multiple governments, and choosing the right teammates (preceding page).

We wanted to prove that six men from six different nations, who had grown up with starkly different cultural backgrounds, could work together toward a common goal under some of the cruelest conditions on the planet.

We hoped our expedition would help focus the world's attention,

*See "North to the Pole," by Will Steger, and "Skiing Alone to the Pole," by Jean-Louis Etienne, NATIONAL GEOGRAPHIC, September 1986.

GORDON WILTSIE

With more than two-thirds of the world's fresh water locked up in its snow and ice, Antarctica is nevertheless a thirsty place. Melting snow for water took about three hours each day. Spices flavored the monotonous menu of primarily pemmican. Gloves, mukluks, and other gear hang above Keizo's head, drying in the heat rising from the gas cookstove.

and similar cooperation, on the icy continent. The next few years will be crucial to Antarctica's future. Increasingly it is beset by man-made pollutants; tourists are clamoring to visit. Most important, the international treaty that governs Antarctica comes up for review in 1991, leaving open to discussion such vital issues as scientific research, mining, military presence, and territorial claims. As the world's greatest remaining pure wilderness, Antarctica's harsh yet surprisingly delicate environment must be preserved.

Asked why six men, one each from the United States, France, the Soviet Union, the People's Republic of China, Japan, and Great Britain, would attempt such a challenge, Jean-Louis spoke for us all when we announced Trans-Antarctica: "You dream about exploration or you do not . . . but if you do, then the attraction is very strong, all of your life."

OUR ROUTE would follow the continent's longest axis, from near the tip of the 800-mile-long Antarctic Peninsula, through the Ellsworth and Thiel Mountains, to the South Pole (see map, page 69); from there, across the aptly named "area of inaccessibility" to the Soviet scientific bases at Vostok and Mirnyy. The 800-mile-wide area of inaccessibility had never before been crossed on foot, the peninsula never in winter. Despite the technological advances since Roald Amundsen first reached the Pole in 1911, we could predict little about weather or snow conditions. There was much about Antarctica we would not know until we stepped into the middle of it.

Only three of our team had ever been to Antarctica: Geoff Somers, for three and a half years with the British Antarctic Survey; Victor Boyarsky, as a member of the Soviet Arctic and Antarctic Research Institute; and Chinese glaciologist Qin Dahe, most recently as base manager of China's Great Wall Station.

Trans-Antarctica officially got under way at sunrise on July 27, 1989: six men, three sleds, 40 dogs. The dogs lurched off so eagerly they overran and scattered the television crew filming our departure from Seal Nunataks. The temperature was a balmy 28°F., and the going was easy. But within ten miles we encountered the first

Cache and carry: Three team members recover supplies at one of 12 depots laid by Geoff Somers the previous year (below). Despite nine-foot markers, three caches were never found.

Tragedy was averted less than two weeks out when two sleds crashed at the bottom of a slope. The solution: salvage and repair (above).

DIN DAHE (TOP); WILL STEGER

of many blockades to come—a deep crevasse, wider than the length of three dogsleds; we were forced to detour around it.

We spent the first week establishing a traveling rhythm for the next seven months. Keizo, Geoff, and I were each responsible for a dog team; Victor skied ahead of the sleds, acting as a scout; Jean-Louis would maintain radio contact; Dahe did daily scientific studies.

If we were to complete the crossing on schedule, we needed to ski approximately 20 miles each day. That proved to be a particular challenge for Dahe, who had never skied before joining the expedition.

A dog's best friend: Geoff and Jean-Louis come to the aid of three huskies that disappeared down a 30-foot-deep crevasse (right). To rescue another of his sled dogs, Huck, Geoff lowered himself into a fissure (opposite).

Hidden crevasses, both large and small, posed unseen danger to man, dog, and sled. But it was the dogs, with more weight per square inch on their paws than team members on skis, that fell through the snow more than once. Shaken but unhurt, the dogs shrugged off such incidents and in a few minutes were ready to continue.

BOTH BY WILL STEGER

During the first week on the ice he fell dozens of times a day.

No less challenging was the matter of communication. We had agreed that English would be our official language, but Victor and Dahe were still learning it. Fortunately our misunderstandings were minor. Before long we even came up with nicknames for one another: Victor, who exuberantly applied his oxlike strength to everything he handled, from soup to tent stakes, we called "The Magic Touch."

By day 11, temperatures had dropped to zero and winds raced as high as 75 miles an hour. Whiteout conditions and a labyrinth of crevasses as deep as a hundred feet—caused by shifting snow and ice—forced us to stop. For a skier leading the way, it would have been comparable to walking blindfolded down a street with all the manhole covers removed.

As we struggled to set up our tent, Victor yelled in my ear in his rich Russian accent: "Welcome to Miami Beach!"

For two days we huddled in our camp. Victor sang songs from an old Russian songbook. I studied star charts in anticipation (naively, I would learn) of clear nights ahead. Once in a rare while the wind would stop, abruptly and completely. Then, with an explosive bang, it was back; the guy lines whining, nylon snapping.

Geoff Somers had flown to Antarctica the winter before and planted 12 food caches along our route to the Pole, each holding enough to feed men and dogs for about two weeks. They were our lifeblood—with constant storms we could never have depended on resupply by plane. For days at a time we were out of radio contact with our base in Punta Arenas, Chile.

We carried one communications ace in the hole: a radio beacon that

Like a prisoner counting his days, Victor Boyarsky marked each day's position on the wall of his tent to keep track of the team's progress. Tent life also involved medical examinations, conducted by Jean-Louis. Dahe

GORDON WILTSIE (TOP); PER BREIEHAGEN

(above) endures one of several blood tests taken to monitor cholesterol levels and other health indicators.

could transmit our position to a NOAA satellite in polar orbit. The beacon also allowed us to tap out a brief message when other means failed.

On August 21, katabatic winds—vicious downdrafts that can reach 150 miles an hour—whipped across the mountains of the peninsula, blowing clouds of snow down near-vertical slopes. Bathed in calm, almost clear skies of early morning on the plain below, I marveled at the silent power of the wind, as though watching it on television with the sound turned off. I have climbed a few mountains, and I knew what it was like on those high ridges. And that was where we were headed.

As the day progressed, visibility dropped to zero. By mid-afternoon we had to camp. Putting up a tent in 60-mile-an-hour winds takes fancy footwork; Geoff came over to help Victor and me. Snatched by a sudden gust, the tent flapped off toward the Weddell Sea. With a valiant triple flying tackle, Geoff leapt high on top of the tent while Victor and I managed to shoestring the poles. That was international cooperation!

By now we had developed a steady routine. Each day began with Victor bursting from his tent clad only in Gore-Tex booties to take a "snow shower," after which he would visit the other tents to announce the day's weather.

"Mild today," he would shout through the tent wall. "Winds only 20 miles an hour. You'll need a face mask." Soon none of us would budge from the comfort of our sleeping bags until Victor issued his report.

After a quick breakfast of tea and oatmeal we would dig the sleds out from under the drifted snow, harness the dogs, and travel until 1 p.m. Spread out along the trail, we had little opportunity for conversation; we welcomed the chance to gather at lunch, even if the winds were too strong to talk. On those rare occasions when the sun shone during a lunch break, Antarctica seemed almost peaceful. "There's no place I would rather be," Keizo announced on one such placid day.

Gaining the final elevation of the huge Weyerhaeuser Glacier—5,300 feet—we were skiing at last on a firm surface. But as we

huddled in the lee of our sleds at our noontime break, winds filled the air with a fine drift that penetrated even our mouths when we bit into our frozen chocolate and cheese. Visibility closed down completely. We sat for the next three days.

Day 53, September 17: "We passed the 500-mile mark today," I record in my journal—only 3,200 more to go. Most of the day we travel in bleak whiteout conditions—"Like being inside a Ping-Pong ball," Keizo describes it. Whenever we lose sight of the team ahead, we drop to the snow on all fours in order to find its faint trail again.

So far we had missed two caches, their nine-foot-tall flags buried by drifting snow. We began rationing and feeding the dogs our own pemmican. (A mixture of dried meat and fat, pemmican is the staple of our diet, which averaged nearly 6,000 calories a day to cope with cold and exertion.)

For 17 days it had been like a desert sandstorm: Fine white snow infiltrated everything—clothes, tents, sleeping bags. Our lips were cracked, our cheeks frostbitten, our goggles fogged or frozen. Deep splits in our fingertips made harnessing dogs, setting up tents, and cooking extremely painful. For the first time in my life I allowed myself to truly contemplate what it would be like to die in this cold, as Robert Falcon Scott perished, only 11 miles from a food cache, nearly 80 years ago.

Day 63, September 27: "Two months ago we arrived in Antarctica under perfect conditions," my journal entry for the day records. "Now the tables have turned. The weather is the worst I have ever seen. Heavy snows, fog, constant driving wind. Yesterday Keizo's dogs quit. . . . Four of us ended up pushing the sled to get them started."

Our situation was worsening. We had just two days of dog rations left, and our next cache was sure to be buried. For a week we had failed to make radio contact; in this weather a plane could never find us. Still less than a third of the way to our goal, we gathered that night in Jean-Louis's tent to discuss our options.

First, we agreed, we would send out all extra equipment at the earliest opportunity: climbing gear, binoculars, right down to sewing needles. Next to go, if necessary, would be the scientific gear. We then

Collecting snow samples was a daily affair. Snow taken from one-meter-deep pits was placed in bottles, all labeled and logged as to location and depth. Laboratories would test them later for climatological data.

BILL STEGER

Dahe, in white, stands in one of two deeper pits dug in the area of inaccessibility. Sampling snow here was for him "a dream of a lifetime."

Vast and uncompromising seas of sastrugi—frozen waves of snow and ice—spread out over the otherwise featureless plateau at the bottom of the world. Drifting as high as six feet, sastrugi make for rough going as sleds yaw from side to side or

WILL STEGER

pitch and heave like tiny ships in high seas. Occasionally the half-ton sleds capsized, endangering man and vehicle. Sastrugi posed their worst threat to travel in whiteouts when, ghostlike, they disappeared from view.

considered all sorts of plans, even to flying the dogs out at Vostok and man-hauling the final 850 miles.

The next thought had not escaped any of us: Fewer men and fewer dogs could lighten the load and quicken the pace. It was Jean-Louis who tactfully made the suggestion: If a plane picked up two or three of the men, they could rejoin the rest of us at the Canadian camp at Patriot Hills.

Geoff stood staunchly for all of us to push on together: "That's how the expedition was planned—either we all make it or none."

Victor chimed in next. "The dogs are just like people," he argued. "One day they're tired, the next day they'll start to pull. Let's not panic. The spirit of the expedition will keep us going!" Keizo and Dahe nodded in agreement.

I realized how strong a unit we had become. I felt now that if we stuck together, we would make it past these storms. Jean-Louis, the diplomat, weighed everyone's opinion before casting his vote. It was unanimous—the six of us would continue together, no matter what happened.

BOTH BY WILL STOKER

Like an upside-down Atlas, Geoff Somers clowns for the camera under the cool perusal of the dogs. On December 11, 138 days and 2,071 miles into the journey, the team reached the South Pole. Geoff could hardly contain himself.

A signpost at the Soviet Union's Vostok base—some 800 miles past the Pole—points to places near and far and marks the axis of the earth's geomagnetic field. Moscow (МОСКВА) is 9,678 miles away; Mirnyy, the expedition's end point, 876 miles. Distance to the North Pole? A mere 11,650 miles.

Day 66, September 30: "No progress," I wrote in my journal. "Out of dog food again. The snow is deeper than the dogs are tall and reaches our waists, making it impossible for either to make a trail." Ironically we now prayed for the return of the winds that had haunted us for the past month, to pack the snow for easier travel.

It is a common misconception that it snows heavily all over Antarctica. Some areas of the continent receive less than 2 inches of precipitation a year. But the peninsula averages 20 inches. And at Mount Rex, still ahead of us, it can snow two feet overnight.

A resupply plane loaded with dog food found us later that day. We were safe again for a while. In a release of emotion and tension—everything that had built up in us over the past three years, especially this past miserable month—Jean-Louis and I hugged each other and cried as we watched the Twin Otter disappear in the distance.

We had learned much from the early Antarctic explorers, lessons that now kept us alive. Amundsen taught us about these cold storms. On his 1911 run to the Pole he had been forced to turn back and wait for a month before setting out again. Modern technology gave us an advantage but presented a danger too—allowing us to get so far from rescue that there was no such thing as retreat. Our only way out was forward. That's one thing we learned from Scott—to keep moving, no matter what. We had to constantly struggle toward the next cache; we had to reach the other side of the continent before Antarctic winter roared back at us in March.

Australian Douglas Mawson taught us to keep our eggs in separate baskets. In 1912 a sled carrying most of his food and equipment plunged down a deep crevasse, leaving him more than 300 miles and

50 days from camp with little protection. He survived, barely, but his two teammates perished. That's why we traveled with three sleds, each self-sufficient.

In our planning we had anticipated storms every three days; the one that now besieged us was to blow for almost 60 days. Temperatures were averaging 30 below, winds as high as 90 miles an hour. Many mornings we had to dig for two hours to free the sleds and uncover the sleeping dogs.

During this period Jean-Louis spelled out a simple, direct message to the satellite: FROZEN BONES.

The low point for me came the morning in mid-October when I crawled out to feed the dogs and found my old friend Tim dead. The perfect sled dog—part wolf, with thick, black coat—he had been the star of our North Pole team. Now five years old, he was weakened by the wet snow matting and freezing in his fur. I had tried keeping him in the tent at night and carrying him on my sled. But he lost his strength and his spirit, and he froze to death.

THE FIRST WEEK of November the skies cleared. As we pushed beyond the Ellsworth Mountains, light winds and moderate temperatures, averaging 15 below, enabled us to travel as much as 25 miles a day. Three weeks behind schedule, we quickly made up most of the lost time.

Every day Dahe dug a pit to take samples of ice, which would later be analyzed for signs of pollution. Also as part of the scientific component of the expedition, Victor recorded weather data and ozone measurements. Jean-Louis took weekly samples for urinalysis and administered psychological tests. These were requested by the European Space Agency, in anticipation of their own planned international space team. (On the 135-foot research vessel *UAP* that we had had built and that followed us by sea around Antarctica, more scientific experiments were conducted by two Saudi oceanographers.)

At noon on Monday, December 11, we spotted a speck in the sky. The speck became a large cargo plane, making a low, angled landing at the Pole. The base was still below our horizon, but the plane

Lunch break was no picnic, though a welcome time for conversation. Despite the cold, Keizo, Jean-Louis, and Victor, left to right, try to enjoy their meal of dried fruit, chocolate, nuts, soup, and tea. Once a body is at rest, blood is drawn from its

BILL STEIGER

extremities to its core, leaving hands and feet chilled to the bone. Windblown snow pelts the men's faces, coating beards and eyelashes with ice crystals and denying them even the modest comfort of rest.

touched down precisely on the bearing toward which Victor was skiing. We were right on target.

Antennas appeared first, then the geodesic dome of the U. S. Amundsen-Scott Station. From across the base runway we spotted the Pole itself—a barber's pole topped by a mirrored ball. Around it was planted a semicircle of flags flapping in the wind, and what looked like a long row of red fuel drums.

They turned out to be people: base personnel waiting to greet us in 20-below temperatures. In the crowd of 60 or so a big red sign read "Hello from Minnesota," my home. The dogs raced straight for it.

Although the National Science Foundation staff at the polar station could not officially recognize a private expedition, it was a grand welcome, almost a homecoming.

Even Dahe gave a little speech in his best English: "When I was a boy, I believed that everywhere on earth—if I had never been there—I wanted to go. I wanted to print my feet on many places. . . . But I never thought I would reach the South Pole on skis!"

So far the mileage wheel on our sled had logged 2,071 miles, more than most previous Antarctic expeditions in their entirety. Our satellite message for today read simply: HERE WE ARE. HOORAH!

We set up camp and basked in the warmth of radio congratulations from friends back home. We rested for three days and were off.

As we entered the area of inaccessibility, we began to climb to our highest elevation—11,400 feet. Here dizzy spells and shortness of breath made pushing sleds and wrestling with tents Herculean labors. Here too we encountered fields of sastrugi—ocean-like waves of frozen ice that made sledding difficult and skiing near impossible. Each of us fell scores of times every day; Dahe and I, with badly strained backs, found it easier to give up skis and trot painfully along the broken trail.

As we climbed, the air thinned, and we had to be even more cautious about ultraviolet rays. Dahe traveled one four-hour stretch without a face mask, and the sun etched bright burns across his cheeks. No amount of sun-block cream would do, only protective covering.

Day 161, January 3, 1990: "Essentially our days have little pain or suffering to them now. It's a lot easier getting up in the morning, time passes a lot quicker. Day after day of blue sky, very calm at night. . . . Occupying your mind is now the real challenge."

We had been warned by both French and Soviet scientists that there would be very deep snow throughout the area of inaccessibility. The scientists had assured us that we would not be able to cross it by dog team. To our surprise it turned out that surfaces had been hard packed by the wind, making for relatively easy sledding.

Along our 800-mile route across that wasteland we counted on planes to resupply us twice, thanks in large part to the Soviet Antarctic Expedition, which provided an emergency ration of airplane fuel. The danger was that we were traveling on a very tight margin. If the plane had mechanical problems or failed to find us, we would be in big trouble.

The area was inaccessible in more ways than one. In addition to storms in the region, sunspots were approaching the peak of their 11-year cycle, making radio contact almost impossible. Once again we found ourselves beyond the range of modern technology.

To help pilots track us, we built five-foot cairns that cast long shadows on this featureless plain every two miles. Each cairn took five minutes and helped relieve the monotony that dominated our days.

BOTH BY WILL STEGER

Casual about his celebrity, Sam is one of only two dogs in history to have mushed to both Poles (facing page). Harness mate Yeager shares the honor. Drifting snow helps protect the huskies from the wind and cold, and in the morning they awake refreshed and ready to go.

In the area of inaccessibility the team relied on two airplane drops for supplies. Every two miles they built a five-foot cairn (above), which guided planes carrying food and fuel to their camp.

WITH CLOCKWORK RHYTHM we maintained our best travel momentum so far, averaging more than 21 miles a day—on January 23, our record, 31 miles. From the Pole we traveled nearly 300 miles without taking a day off. In the middle of the Antarctic summer, temperatures averaged a comfortable 20 below, and the winds were moderate, blowing a steady 15 to 20 miles an hour but gentle compared with those on the peninsula. By day's end we were fatigued but at peace.

Nevertheless, a lot could still go wrong. Reaching our destination, the Soviet base at Mirnyy, was by no means a sure thing. More storms would be a certainty as we descended closer to sea level. Ferocious katabatic winds lay ahead. And in our race to beat winter, we would be approaching the coldest spot on the continent.

But the real challenge was how to occupy our minds. Day after day, week after week, our routine was the same, the surroundings identical. Monotony and boredom drained us.

I spent my days designing solar houses, plotting expeditions to come, and trying to recapture sensory impressions so absent from this bare white world: the night sounds of summer, the smells of a forest, the touch of a morning sun in May. I dug deep into my mental file cabinet for such ordinary moments; here they were like precious jewels.

Jean-Louis imagined working at a different job each day—today a

mine worker, tomorrow President of France. Dahe said he re-created his entire life—all his family, friends, places he had lived and visited—as we crossed the area of inaccessibility. Keizo thought about Japan, his home, and his girlfriend, and tried to sing. Geoff, ever orderly and businesslike, calculated and recalculated the miles left to go and the food required for men and dogs.

We arrived at Vostok January 18, the first to cross the area of inaccessibility on foot. We were greeted by fireworks and the 40 Soviets who work there. Many of them knew Victor, who had been based here in the 1970s and '80s. They welcomed us Soviet style, with bread dipped in salt, Russian champagne, a sauna, and a shower.

March 1, 4:30 p.m.: Just 16 miles from Mirnyy, Keizo walks out in a blinding snowstorm to feed his dogs. Losing his way between ski markers, he digs a pit and, like his dogs, lies down and allows the insulating snow to pile over him.

6 p.m.: The search begins. Clenching a rope tied to a sled in camp, the men circle slowly, calling his name (right).

10:30 p.m.: Hampered by darkness and storm, the team postpones its search.

March 2, 4 a.m.: Rescue attempts resume.

6 a.m.: Keizo, unhurt, hears the searchers' calls and rises to his feet, shouting, "I am alive! I am alive!" Tears of joy accompany his return to camp (facing page).

BOTH BY PER BREIEHAGEN

Vostok is close to the coldest spot in the world, where an incredible minus 128.6°F was recorded in 1983. The morning we arrived, it was 48 below and dropping fast. I knew it would only get colder until we neared the coast, 850 miles away. Indeed, on February 6 we recorded our coldest day—54 below—and on the 15th, the worst windchill, minus 125. Windstorms like those on the peninsula swept us again, though thankfully they were now at our backs.

Temperatures such as these make even the smallest chore seem like never ending torture. Although outwardly stoic, Geoff confided to his journal:

"If you could only hear us groan and moan in the morning. The inside of the tent is covered in ice, your sleeping bag is hard and stiff, and your back aches from the cold. You crawl out into these freezing temperatures and feel absolutely horrible. The first goal is to light the stove. . . . As soon as you open the match box, ice forms on the matches. All your food is frozen. When you eventually get the stove going and pick up your pot, you can't get the top off, it too is frozen. All the clothes you hung up to dry the night before—frozen. All you want to do is stay in your bag. But you have no choice . . . you've got to go."

Soviet tractors were resupplying us now, leaving caches of food as they plied the route between Vostok and Mirnyy. The cold worsened. Though nearing the end of our trek, we could not afford to get cocky. Both Victor and Dahe had been lost in Antarctic storms in the past and were lucky to have survived. Dahe recalled an incident when a scientist had stepped out to record weather data, gotten confused in

After 3,700 miles, most of them in blinding daylight and snow, the team was overwhelmed by the beauty and color of the Indian Ocean (above). The day was March 3, and they were just ten miles from the Soviet base at Mirnyy. A few hours later Steger and Etienne embraced at journey's end (facing page), their dream realized. Champagne and tears flowed as team members celebrated.

Scores of base workers and journalists from around the world were on hand to share in the historic event as Steger and his team skied across a Soviet-made finish line. Steger felt "very light, and very much at peace," but was quick to add, "I am glad it's over."

whiteout conditions, and froze to death between two buildings just 50 yards apart.

As we dropped through the storm belt and drew closer to Mirnyy, it grew warmer. One day I woke from a solid sleep bewildered—I could hear the chirp and warble of birds! Jean-Louis grinned from his sleeping bag; he was playing a tape of birdsongs he had saved until now. A week later we saw our first real bird in nearly seven months—a skua—and talked about it for days. The temperature climbed to zero for the first time since August.

TWO DAYS OUT OF MIRNYY the storms came back with a vengeance. As always in such conditions, we staked skis and poles every few yards between the tents. It was here that Keizo, looking after his dogs in the blizzard, lost his way between ski markers and had to bury himself to survive.

His own journal tells the story best:

"Once I was in my snow ditch, blowing snow covered me in five, ten seconds. . . . I could breathe through a cavity close to my body, but the snow was blowing inside my clothes, and I was getting wet. I knew my teammates would be looking for me. I believed I would be found; it was just a matter of time. I had to believe that. . . .

"Very few people have that kind of experience, lost in the blizzard. I said to myself, 'Settle down, try and enjoy this.' In my snow ditch I truly felt Antarctica. With the snow and quiet covering me, I felt like I was in my mother's womb. I could hear my heart beat—boom, boom, boom—like a small baby's. My life seemed very small compared to nature, to Antarctica."

Finding Keizo alive was the greatest relief I have ever known.

The storms calmed the next day, and on March 3, 1990—after 220 days and 3,741 miles—we arrived at the other side of the continent.

When we pulled into Mirnyy, we were ecstatic, swept by a feeling of inexpressible joy. The Soviets gave us a rousing hometown welcome, complete with a finish line. More than a hundred people had

gathered to greet us, including Victor's wife, Natasha, who was flown in as a surprise.

We sat around a table as the Soviets toasted our success, and I surveyed my teammates. We had emerged from the interior of Antarctica with our friendship not merely intact but deep and mature. This bond of true affection, woven in mutual hardship, had strengthened all of us. It had pulled us—six very different men from six very different countries—across this frozen land. Perhaps that was our biggest success; we proved in the end that we weren't very different after all.

It wasn't until we stepped off the Soviet ship that carried us from Mirnyy to Perth, Australia, that we became aware of all the changes that had occurred while we were away. We stepped off into a new world: The Berlin Wall had tumbled, San Francisco had been rocked, Nelson Mandela was free, Eastern Europe was tasting liberty.

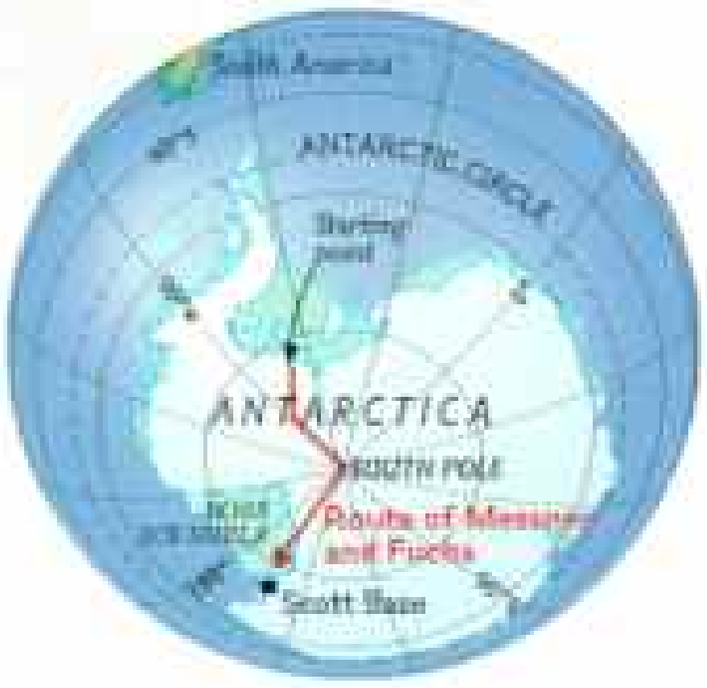
Then what we had achieved began to sink in. As we traveled home—through the capitals of France, Great Britain, the Soviet Union, the People's Republic of China, Japan, and the United States, we sensed a new awareness, a new curiosity, about Antarctica among the people who turned out to greet us.

BOTH BY PER BREUGAARD

A full-length account of the trek, Crossing Antarctica, *by Will Steger and Jon Bowermaster, will be published by Alfred A. Knopf in April 1991.*

Perhaps our expedition—as a small example of multinational effort focused on the last great frontier—would be accepted as a contribution toward the world's new awakening. * * *

First to ski cross continent



"NOTHING, NOTHING, nothing granting you refuge." So said Italian Reinhold Messner (bottom, at left) of Antarctica and his quest to traverse it without the aid of dogs or machines. Accompanying Messner, the first man to reach the top of Mount Everest alone without bottled oxygen, was Arved Fuchs of Germany, the first man to reach both Poles on foot in the same year (bottom, at right).

Others had tried to cross Antarctica by foot, and failed. In 1915 veteran Antarctic explorer Ernest Shackleton watched as pack ice crushed his ship, *Endurance*, before it even reached the coast. For Messner and Fuchs air support from the Canadian company Adventure Network at least ensured they would make it onto the continent. But after arriving at the Canadian camp at Patriot Hills, they learned there was not enough fuel to transport them to the Filchner Ice Shelf, their planned starting point. Instead, they had to set out from the inland edge of the Ronne Ice Shelf.

This initial disappointment foreshadowed much of what lay ahead. On November 13, 1989, the two men set out on skis. A day later a stiff wind seized Messner's rubber sleeping pad, used as a barrier between him and the icy ground, and carried it off. Four days later they lost their mileage indicator, forcing them to rely on other means to estimate the distance they traveled each day. Bad weather, poor radio communication, and difficulty traversing giant fields of sastrugi slowed their progress toward their first supply rendezvous at the Thiel Mountains. By the time they arrived, on December 6, Fuchs's feet were suffering from ill-fitting ski boots. Messner complained to their Canadian suppliers: "If I were alone, I could go twice as fast." In his diary entry of November 24 he had spoken more sympathetically of Fuchs's feet: "Sore and suffused with blood. Every step he takes hurts him."

Next stop: the South Pole, where they arrived early on New Year's Eve. Coming across a tent, Messner and Fuchs roused five sleepy Americans from nearby U. S. Amundsen-Scott Station, who had camped out to welcome them. But for Messner it was a moment of mixed emotions: "You ski a thousand kilometers through complete stillness and vastness, and suddenly you see domes, containers, and masts. Amundsen's ripped tent should stand at the South Pole, nothing else." As for Fuchs, he was "happy just to be there."

They left three days later, following the general route taken by Robert Scott on his disastrous return from the Pole in 1912—across the Polar Plateau, through the Transantarctic Mountains, then onto the Ross Ice Shelf.

Still hampered by sore feet, Fuchs trailed behind, often arriving more than an hour late to camp. Rather than wait in the bitter cold, Messner pitched the tent himself, a difficult procedure in the high winds. Again they were impeded by sastrugi, but their occasional use of parachute sails (above), though risky, increased their daily mileage. Once, before the Pole, Messner lost control of his sail, fell, and cut open his right

REINHOLD MESSNER, *DER SPIEGEL* (ABOVE); ULRICH JAEGER, *DER SPIEGEL*

elbow. "How easily you can break a leg or an arm," Fuchs commented later.

Finally, on February 12, after a journey of 92 days covering 1,550 miles, Messner and Fuchs reached New Zealand's Scott Base, on McMurdo Sound. That same day the team of explorers led by Will Steger and Jean-Louis Etienne was 3,300 miles into its own seven-month crossing of Antarctica, using dogsleds. Both achievements, though different in scale and concept, add to the heroic legacy of adventure and exploration left by such men as Amundsen, Shackleton, and Scott. □

Discoveries at Sudan's sacred mountain

KINGDOM

By TIMOTHY KENDALL Photographs by ENRICO FERORELLI

of Jebel Barkal reveal secrets of the

OF KUSH

Paintings by JAMES M. GURNEY

Marking the southern frontier of the Egyptian empire, this sandstone butte was revered as an abode of Amun, the creator god. The temple here was later enlarged and embellished with these recumbent rams by Nubian kings, the black pharaohs of Kush.

WE LEFT KHARTOUM before sunrise and drove north through Sudan's Bayuda Desert, bound for Karima, a town on the Nile just below the Fourth Cataract. It lay 200 miles away. We were four in a Land Rover—Susanne Gänsicke, conservator; Enrico Ferorelli, photographer; Ali, our driver; and I—loaded with supplies for an archaeological expedition of Boston's Museum of Fine Arts. With support from the Sudan Antiquities Service and the National Geographic Society, we were about to begin our third season at Jebel Barkal, a sacred mountain in Sudan.

There are no roads in the Bayuda. One follows tracks of other vehicles—hours, days, or weeks old—or follows one's nose. A distant cloud of dust might indicate a truck or bus—or only a dust devil whirling across an empty, shimmering horizon.

Around midday faint hills floating on an endless mirage seemed like islands in what desert nomads call the "sea of Satan." The only waves were waves of sand, intermittent dunes in which our tires sank and our spirits foundered.

"We'll never get there by dark," muttered the usually enthusiastic Enrico over the roar of the churning engine.

We entered low forests of gnarled thorn trees, dodged obelisk-like termite hills, weaved around black boulders that looked like elephants turned to stone. The parched desolation had a hypnotic effect—hellish and unwelcoming, yet to me strangely alluring.

It's easy to lose one's way. Even the Nile does, reversing direction for 200 miles before rediscovering its northward course to the Mediterranean, still 1,200 miles away.

Here, far to the south of Egypt along the Nile's great meander, lay the heartland of an ancient African kingdom of which few have heard and much remains to be learned. The Egyptians, who conquered it in the 16th century B.C. and ruled and exploited it for 500 years, called it Kush—"wretched Kush." They both loathed and dreaded "this land of whirring wings. . . . [with] a people tall and smooth skinned . . . feared far and wide, an aggressive nation of strange speech," as the biblical prophet Isaiah would describe it.

Pharaoh Tutankhamun had images of the black-skinned Kushites embroidered on the soles of his sandals and carved on his footstools, so he could perpetually trample on them.

Then, in the eighth century B.C., Egyptianized Kushite kings turned the world upside down and conquered Egypt. They established a vast riverine empire extending from the confluence of the Blue and White Niles to the Mediterranean (map, page 102). Historians would count these Kushite kings as Egypt's Dynasty XXV.

In midafternoon, lulled into a stupor by the searing heat and the ceaseless lurching, our faces coated with fine, flourlike dust, we strained for sight of the mountain. An ancient signpost in the desert, it signaled the presence of the Nile long before the green line of its valley could be seen.

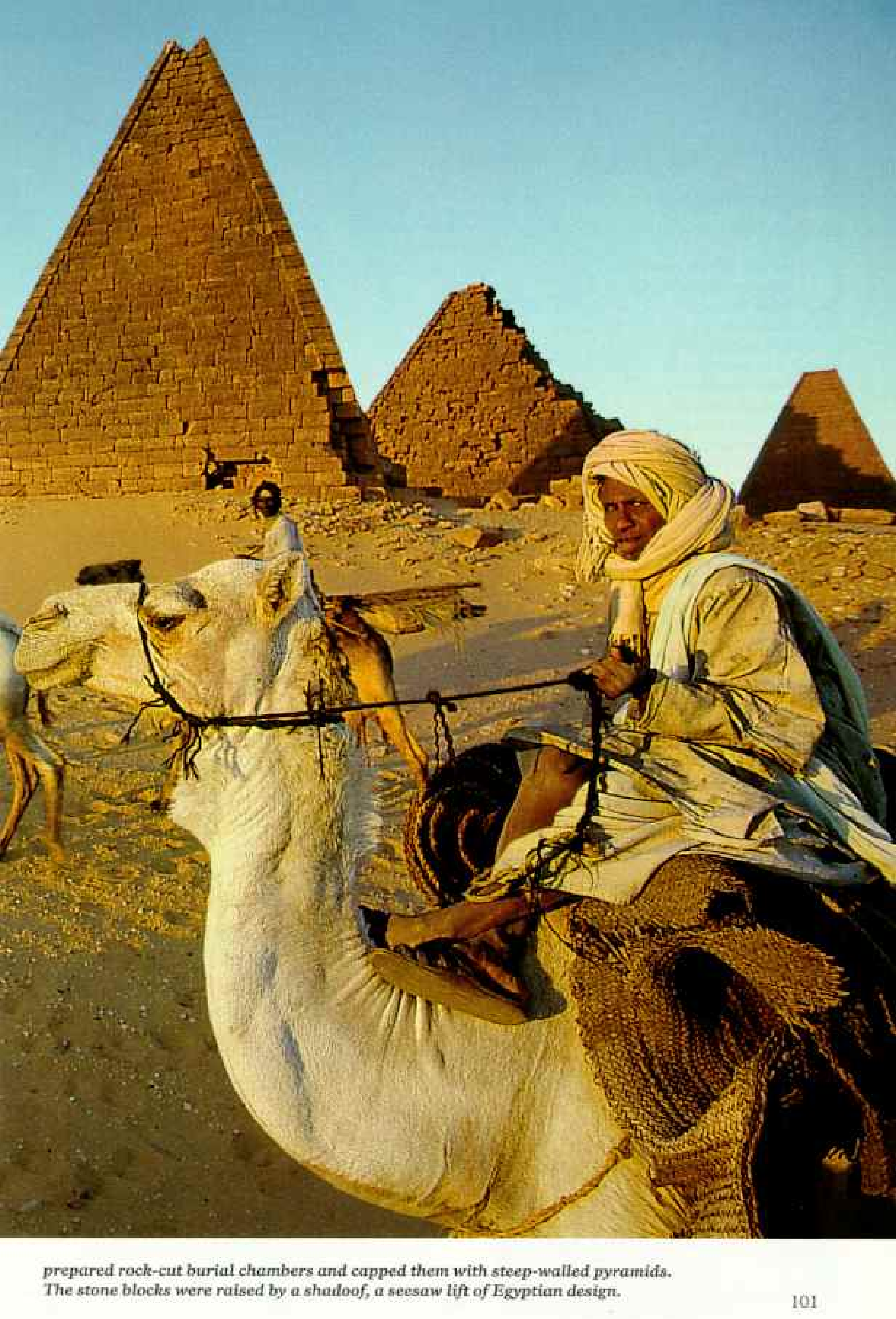
Suddenly the taciturn Ali raised a hand from the steering wheel. "Jebel Barkal," he announced.

Our excitement mounted as we watched a lump on the horizon grow into the landmark we sought. Soon enough the river came into view. Crossing over to the north bank on a small ferry, we drew near the lone rock of Jebel (Mount) Barkal—the little mountain with big secrets.

2.6 CM HIGH, MUSEUM OF FINE ARTS, BOSTON (ABOVE); 68.5 CM HIGH, SUDAN NATIONAL MUSEUM, KHARTOUM

Emblem of Amun, a ram with a sun disk adorns a golden earring. Two sacred cobras, or uraei, on the forehead characterized Kushite kings; Egyptians usually wore only one. Gilt flecks a 2,200-year-old bronze statue of a Kushite ruler. His thumb ring, used for pulling a bow string, recalls the fame of Kushite archers in antiquity.

In the shadow of regal ancestors, Sudanese camel drivers pass 2,000-year-old tombs at Jebel Barkal. Long after Egyptians stopped building such structures, Kushite kings



prepared rock-cut burial chambers and capped them with steep-walled pyramids. The stone blocks were raised by a shadoof, a seesaw lift of Egyptian design.

EGYPT AND NUBIA

Uneasy neighbors on the Nile

Corridor of conquest, the Nile connected Egypt with Nubia, or Kush, known for its gold and its trade with the African interior. To control this commerce, the Egyptians pressed south into Kush, reaching the Second Cataract by 2500 B.C. and the Fourth Cataract a thousand years later. For centuries caravans from the south continued to supply Egypt with exotic items such as elephant tusks and panther skins. The Kushites adopted the religion, styles, and customs of their Egyptian rulers.

After political decline in Egypt, Kushite kings conquered Egypt in the eighth century B.C. but were ousted after only six decades. In Nubia the Kushite kings perpetuated ancient Egyptian traditions for centuries.

Mediterranean Sea
Alexandria
Nile Delta
LOWER EGYPT
Giza
Cairo
El Faiyum
Beni Suef
El Minya
Asyut
Western Desert
Eastern Desert
Cultivated area
EGYPT
Luxor (Thebes)
Aswan
First Cataract (submerged)
ASWAN HIGH DAM
Lake Nasser
LOWER NUBIA
Abu Simbel
Qasr Ibrim (Primis)
Caravan route
Second Cataract (submerged)
Wadi Halfa
UPPER NUBIA
Nubian Desert
Seddenga
Soleb
Third Cataract
Tebo (Pnubs)
Kerma
Dongola
Kawa
JEBEL BARKAL
Fourth Cataract
Fifth Cataract
Abu Hamed
Atbara
Bayuda Desert
Meroë
Shendi
Wad Ban Naga
Naga
Sixth Cataract
Musawwarat es-Sufra
SUDAN
Khartoum
White Nile
Blue Nile
TRADITIONAL HEARTLAND OF KINGDOM OF KUSH
EXTENT OF EGYPTIAN EMPIRE DURING NEW KINGDOM 1558-1085 B.C.
TERRITORY OF KUSHITE EMPIRE AT ITS GREATEST EXTENT 724-660 B.C.
AREA ENLARGED
AFRICA
EQUATOR
ISRAEL
JORDAN
SAUDI ARABIA
Red Sea
SINAI
SUEZ CANAL
Jerusalem
Amman
Cairo
0 100 km
0 100 mi

△ Royal Kushite tombs
□ Major Kushite ruins
∴ Major Egyptian ruins in Nubia

NGS CARTOGRAPHIC DIVISION
PAINTING BY ROBERT HYNES

Napata

Originally an Egyptian customs post, Napata rose at the crossroads of the Nile and caravan routes to the hinterland. Its sacred mountain, Jebel Barkal, made it a cult center of the god Amun. After 750 B.C. Napata prospered as the capital of Egyptianized Nubia.

Caravan route to Kawa
Karima
Nuri
Napata
JEBEL BARKAL
Nile
Merowe
Sanam
Caravan route to Meroë
El Kurru
Tangasi
0 2 km
0 2 mi

As if germinated from some fantastic seed blown far from its source, this orphaned child of a primeval earth, scoured by eons of wind-blown sand, stands in startling isolation, dominating the landscape. It confronts the river, about a mile distant, with a soaring cliff. Red crags streaked white with guano form perches and nesting places for vultures that circle overhead, riding the thermal updrafts.

Dwarfed by the looming red wall, eyes and ears filled with soaring birds and their echoing cries, ancient people must have been overcome with awe, bewilderment, and fear. Little wonder that this mountain became a sacred place, the residence of a god, and the birthplace of a dynasty. At its foot spread the temples and palaces of the holy city of Napata, scene of great ceremonies.

ARRIVING AT SUNSET in the mud-walled town of Karima, just to the northeast of Jebel Barkal's dark silhouette, Ali pulled up to the doorway of a courtyard.

Howls of laughter at our dust-caked faces mingled with joyous greetings as we joined our teammates: Cynthia Shartzer, project manager; Babiker Mohammed El-Amin, inspector from the Sudan Antiquities Service; David Goodman, surveyor; and rock-climber Paul Duval, whom we had nicknamed Abu Jebel, Arabic for "father of the mountain."

In the following days shoveled sand flew, cameras clicked, measurements were taken, and notebooks were filled.

In our six-week 1989 season we rejoined an Italian team from the University of Rome that had been excavating Napata since 1972. Continuing work we began in 1986 and '87, we excavated Napata's temple complex, recorded inscriptions and relief fragments, made architectural studies and elevation drawings of each building, and conducted a precise topographical and aerial survey to produce an accurate large-scale site map of the city. We also decoded a symbolism in the great red sandstone pinnacle of Jebel Barkal that would throw light on the very origin of the Kushite state.

25 CM HIGH, MUSEUM OF FINE ARTS

A bound Kushite wearing a leopard-skin skirt is depicted in this tile from Ramses III's palace at Medinet Habu in Thebes. Egypt's war prisoners ordinarily became slaves.

We were following up work begun seven decades earlier by another group from the Museum of Fine Arts. Led by Harvard Egyptologist George A. Reisner, the earlier expeditions revealed the riches of Kush and clarified the chronology of its kings.

After the Egyptian conquest of Sudan, the pharaohs established Napata about 1450 B.C. as a garrison controlling the river crossing and caravan center at the southern limit of their empire. From nearby desert mines came Egypt's wealth of gold—*nub* in Egyptian—perhaps the origin of the name Nubia. The Egyptians also identified Jebel Barkal as a holy place, the southern abode of their state god, Amun.

Becoming a center of religious and political fervor, Napata later would engender a line of native Kushite rulers fanatically devoted to Amun and powerful enough by the eighth century B.C. to join a weakened Egypt to their African empire.

These self-styled pharaohs, admiring Egypt's culture and glorious past, tried to re-create both deep in Sudan. They made Napata a showplace of temples built and decorated by Egyptian architects, stonemasons, and sculptors and filled these shrines with Egyptian statuary, ritual objects, and sacred papyri. They adopted Egyptian as the official language and revived the pyramid—a burial monument forsaken by the Egyptians a thousand years earlier—for their royal tombs.

Driven out of Egypt by the invading Assyrians in the seventh century B.C. and out of Napata by an Egyptian army the following

Turning the tables, a Kushite king from Napata swept down the Nile "like a cloudburst" to conquer Egypt in 724 B.C. Here in the delta, Piye accepts the homage of vanquished princes and a tribute of horses. First of five Kushite kings who ruled Egypt, he helped establish his family as Dynasty XXV.

century, the Kushite kings made their capital at Meroë, 300 miles upriver on the Nile.

But Napata for centuries remained a spiritual center of Nubia. Rulers returned here to perform religious rites until the fall of the Kushite kingdom in the fourth century A.D.

Little was known of these shadowy kings until Reisner came to Jebel Barkal in 1916. In five seasons here and another three at Meroë he located the tombs of the five Kushite kings of Egypt and their 70 successors. These spectacular discoveries would resurrect the first high civilization in sub-Saharan Africa (portfolio, pages 112-19).

But again Tutankhamun stepped on the Kushites. Electrifying news of his tomb's discovery in 1922, the first royal Egyptian sepulcher with its golden trove intact, wiped Reisner's finds from public consciousness.

AS VANGUARD of our team, Cindy Shartzer and I had come to Karima in 1986. With a crew of 16 workmen we set to clearing sand from the carved walls in the forecourt of the Great Temple at Napata. Objects of intense curiosity to the local populace, we encountered Sudanese hospitality as abundant and overwhelming as the Nile in flood.

Invited to sit on wooden, rope-strung beds, which line the walls of the main room of a house, and served *shai sudani* (Sudanese tea), a near equal blend of sugar and tea, we were barraged with questions. The purpose of our visit was met with skepticism.

"We are here to copy the inscriptions on

Archaeologist TIMOTHY KENDALL is associate curator of the Department of Egyptian and Near Eastern Art at the Museum of Fine Arts in Boston. Equally expert at photographing from the sky or in a tomb, ENRICO FERORELLI studied classics in Rome and holds a pilot's license. Artist JAMES M. GURNEY graduated with a degree in anthropology from the University of California at Berkeley. He built scale models of Jebel Barkal and the temple of Mut to check shadow details for his 12th NATIONAL GEOGRAPHIC assignment.

stones and walls of the ruined temples. They might tell us more about the ancient kings," explained Cindy in fluent Arabic.

Absurd that foreigners would come so far and spend so much money only to examine battered and broken stones. "You are looking for gold," came the reply.

While legends abound that the mountain was inhabited by jinn, or spirits, who had more gold than food, and that the temples were repositories of treasure, every Sudanese schoolchild knows that the ruins beneath Jebel Barkal are linked to the two greatest heroes of Sudan's pre-Islamic past: Piye and his son Taharqa, two of the five kings who ruled a united Kush and Egypt.

So I invited our hosts to visit our excavations, where the workmen had unearthed a wall bearing a fragment of a relief showing the vanquished kings of Egypt prostrate before Piye. Still one insisted, "You are looking for gold."

Actually we spent a good amount of time looking at a towering pinnacle that juts out from the cliff wall. In certain light its resemblance to a human figure is uncanny. It looks like an Egyptian royal statue striding out from the mountain.

In the 1820s the first Europeans to reach Jebel Barkal were told by locals that the pinnacle was indeed the remains of a huge statue of an ancient king. More than a century later British officials Maj. G. Titherington and Anthony J. Arkell asserted that the "colossus" was only the best preserved of four gigantic statues carved there. Three other projections on the cliff, they assumed, also had been statues, whose features were scoured away by blasting winds over the centuries.

Perhaps, they reasoned, Egyptian Pharaoh Ramses the Great in the 13th century B.C. had sought to re-create a monument like the one he had built at Abu Simbel, 270 miles to the north. That monument included four colossi 66 feet tall. The "statues" here would have stood four times taller.

In 1986, intrigued by the statue legend, Cindy Shartzer and I brought along a small telescope.

"What do you think, Cindy?" I asked after we had both studied the pinnacle carefully. "A decayed statue?"

"It couldn't have been," Cindy answered. Because the only carving was at the summit, we were convinced that the "colossus" was merely a natural formation.

Near the top of the pinnacle we saw the figures carved in relief and the weathered panel of hieroglyphic texts and cartouches—royal names—that were first spotted in 1941 by visitors using binoculars.

But why would ancient man carve inscriptions at such height—260 feet up an inaccessible pinnacle?

"HOW COULD ANYONE have climbed up there?" we asked each other. The question haunted us until one day, ascending the mountain via the tumbled, sloping east side, we found a clue.

Crossing the broad undulating top, which was carpeted with pebbles, to a point directly opposite the pinnacle, Cindy and I were rewarded with an immense panorama of the Nile. Its silvery ribbon, banded by thin strips of green, cuts a swath through a landscape of infinite desolation.

Below us a spectacular bird's-eye view of the temples of Amun summoned visions of their glory two and a half millennia ago—pylons plastered and painted with colossal images of gods and kings, pennants flying from giant masts, ebony gates sheeted with bronze.

"Watch your step," I warned. We saw that the rim of the cliff beneath our feet had been worked with chisels. A line of deep holes faced the pinnacle, some 40 feet away. Clearing out the debris, we found traces of ancient mortar and the distinct imprint of a square-cut log once set upright in it.

"Could this be an anchor for a suspension bridge spanning the chasm?" I wondered. To answer that, we would have to ascend the pinnacle itself. But how?

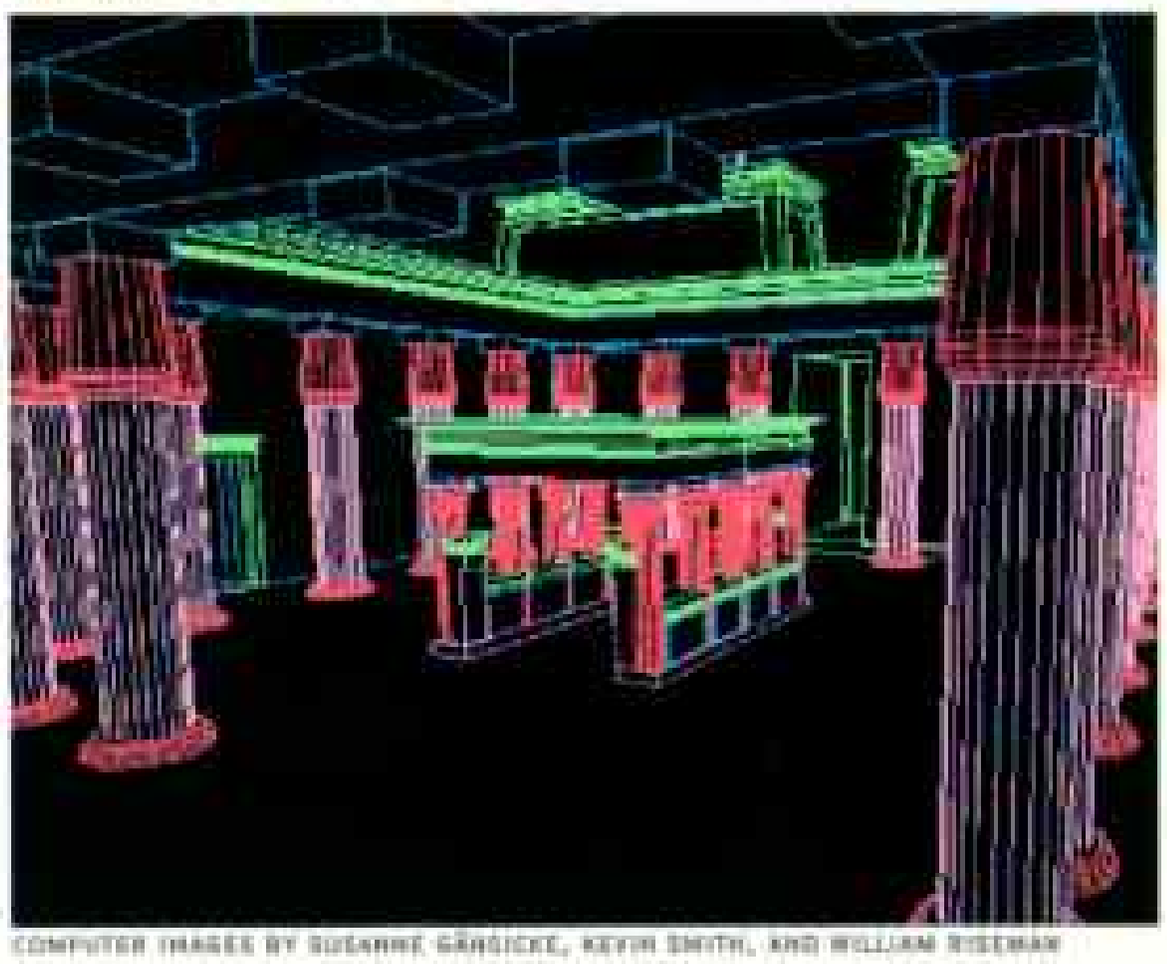
On my return to the States, I showed slides to Paul Duval, one of the best mountaineers living in the Boston area. "Can you climb that pinnacle?" I asked.

Conquered now by desert sands, the temple complex at Jebel Barkal was once restored and expanded by Piye, who led a religious revival here after returning from Egypt. His successors maintained the sacred precinct, viewed from the south, for nearly a thousand years as a center for religious rites.

High technology helps archaeologists approximate the original appearance of temples at Jebel Barkal. Surveyors measured the Amun temple courtyard, buried under five feet of sand (top). Basing their calculations on standard proportions and ornamentation of better-preserved temples in Egypt, technicians used computer modeling programs to fill in the missing parts.

One program produced a wireframe model (bottom). Another translated the dimensions into realistic solids. These images were made ghostlike and overlaid on a color photograph, giving a 3-D look to the court with its central pavilion.

PHOTOGRAPH BY TIMOTHY KENDALL



COMPUTER IMAGES BY SUSANNE GÄNSICKE, KEVIN SMITH, AND WILLIAM RYDMAN

"A bit tricky," he commented. "But I think I can do it."

Knowing that whoever went up had to understand what he saw, I questioned, "Who reads the inscriptions? You? Either you learn hieroglyphics this year, or you teach me to climb." And teach me he did, in the old Quincy granite quarries near Boston.

FEBRUARY 1987 found our expedition team back on Jebel Barkal, with Paul hooking up his ropes for the rappel off the cliff. Looking on were Cindy and two expert epigraphers, Lynn Holden and Nathalie Beaux, who had come to assist us in recording temple inscriptions.

Our plan: to descend 80 feet to the notch where the two cliffs met—a point still a hundred feet higher than could be reached by foot. From this precarious saddle we planned to scale the inside wall of the pinnacle. From its top Paul would hold me on belay while I moved around to the outside face of the rock to examine the inscription.

"See you below," Paul called cheerily, as he climbed over the cliff edge and disappeared. Moments later came his shout, "I can see holes—neatly cut holes!"

No amount of time in the rigging as a crewman on a tall ship or training in a Quincy quarry had readied me for going over the edge of Jebel Barkal's plunging wall. But excitement soon overcame anxiety as I slowly rappelled down and became engrossed in a series of square holes extending to the bottom of the cleft and a corresponding series on the opposite wall.

These were not toeholds or handholds; they were too far apart—five or six feet. They must have been sockets for beams. Studying their placement, I concluded that timbers from 4 to 25 feet long had been hoisted from below and fitted into the holes, creating work stages all the way to the top of the widening gap.

It was clear now that the holes Cindy and I had observed on the cliff the year before had supported not a suspension bridge but an apparatus for lifting the beams—most likely a pair of shadoofs, the ancient weighted seesaw device that Egyptian farmers still use to raise water to their fields.

Here was evidence of an astounding engineering feat (page 120). But could all this labor, at the risk of so many lives, have been expended simply to carve a panel that could not be read from the ground?

I joined Paul at the base of the notch between the cliff and the pinnacle, and we then prepared to go where no one had gone, it seemed, in over 2,000 years.

Paul clipped a safety rope to his harness, which I payed out as he moved up the wall of

the pinnacle like a spider. Within minutes he shouted down, "I'm on top. The view is great."

Secured by a rope from Paul, and with an extra line to raise myself if needed, I started up. The stone of that shaft was hard and smooth and offered little to grasp or stand on. The search for grips forced me farther and farther around the side. But here the stone was brittle. A seemingly secure hand grasp would pull away with a scatter of stones.

I inched upward, choosing every hold with meticulous care, until I reached a vertical section that offered no hold for the next ten feet. How had Paul surmounted this obstacle?

I felt stranded—like a kitten on a tree's highest limb—wishing someone would call the fire department to get me down. My legs felt weak, and they began to tremble uncontrollably. I was forced to trust the dangling rope belayed by Paul, who was hidden from view about 30 feet above me, and pull myself up with my arms.

Just out of reach on the sheer rock wall was one of the holes cut over two and a half millennia ago. I swung across and, stretching my left leg, got a toehold. Then, pushing with my foot and pulling on the rope, I struggled higher, gripping one tiny crack after another. I finally managed to crawl onto a ledge, limp but filled with elation.

"Great!"

"Bravo, Tim!"

Only with their cries did I become aware of my audience, cheering and applauding on the cliff opposite. I bowed graciously—and apprehensively. I was near the top, but the weathered stone was as crumbly and unstable as goat cheese.

"Take up the slack on the safety rope," I yelled to Paul and started up the steep rock for the last push.

At once I saw more cut holes. Clawing around one side and then the other, I counted eight of them. In addition, the entire west side was deeply carved with a diagonal groove.

The eight holes had been sockets for vertical wooden columns. Lashed to horizontal timbers, these encased the summit of the pinnacle in a sturdy framework for a platform. But I could not imagine how logs so huge had been lifted and maneuvered by men so perilously placed.

"I'M GOING to look around front," I called up to Paul. Working my way around to the south face, I came to the inscription. Cut just beneath the peak, it had originally been about nine feet wide, four feet high, and divided into six vertical panels.

The two central panels bore the cartouche of Taharqa, while one to the left bore the cartouche of Nastasen, a Kushite king who had reworked the monument three centuries later to include himself. Weathering had left only the midsection with hopelessly incomplete hieroglyphic texts, although mention of "Asian Bedouin" on the east panel and "Libyan nomads" on the west suggested that Taharqa had proclaimed his military exploits. Nastasen had added small figures carved in relief, which praised his name and that of his glorious ancestor.

Neither the hieroglyphs nor the figures seemed remarkable. The surprise came in discovering small, evenly spaced holes all over the smoothed surface, some still containing bronze nails. I knew what this meant from certain temples in Egypt. At one time a sheet of gold, held by nails fixed to the stone, had covered the entire panel and its texts. All traces of the gold had vanished, stripped off perhaps by winds or daring vandals.

Although the texts, carved at the highest, most inaccessible point on the pinnacle, had been written only for the eyes of the gods, the kings had intended the gold to be the most conspicuous feature of the mountain, striking awe in mortals below and afar. Facing southeastward across the river and perfectly positioned at this great height to catch the first rays of the rising sun, this brilliant reflector, for much of the day, would cast a beam of light out into the desert, visible from a great distance. To caravans from the south it would have been a beacon welcoming travelers to the holy city of Napata and the residence of its god, Amun.

Exploring next an alcove carved below the inscribed panel, I examined a square-cut depression in the floor. Based on evidence

A 18 M HIGH, SUDAN NATIONAL MUSEUM

from other ancient examples, it appeared to be a niche for a statue four to five feet high. At either end of the alcove were remnants of sheltering walls of mortar and rough stone. Large cavities farther down the crumbling face of the pinnacle had also been filled with stone and plaster for reinforcement.

The need for a heavy wooden superstructure atop the pinnacle now seemed evident. Heavy buckets filled with stones and mortar, as well as the statue, had had to be lifted from the ground. Such a feat required fixing a stationary crane arm to the rock—obviously set in the diagonal groove. Since the summit had room for no more than three or four men, this crane had to be operated by a work gang on the mountain itself, across the ravine.

2.8 CM DIAMETER, MUSEUM OF FINE ARTS

Taharqa, son of Piye, ordered this granite statue of himself for the Jebel Barkal temple. The stance is Egyptian; only the cap with two uraei and towering feathers, now broken, are Kushite regalia. His large gold ring, incised with an eye, was overlooked by robbers who looted his tomb at Nuri.

SOON AFTER the climb Lynn Holden, one of the epigraphers on our team, paid a visit to the temple of Mut, Amun's consort, which Taharqa had built at the base of the pinnacle. Although its outer walls and columns are largely destroyed, the inner chambers of the temple bear well-preserved painted reliefs (page 124).

Lynn noted a relief (page 122) showing the king making offerings to Mut and the ram-headed Amun. The divine couple appear inside a curious, flattop pavilion with a steeply sloping front. It struck Lynn that this was a picture of Jebel Barkal. From the pavilion hung a large cobra, crowned with a sun disk, rearing to face the king.

At dinner Lynn ventured: "Might the cobra have represented the pinnacle?"

Preoccupied with other work, we scarcely gave it another thought—until the last day of the season. Walking west of the mountain to bid our Bedouin workmen good-bye, we saw Jebel Barkal in silhouette from precisely the same angle that Taharqa's sculptors must have seen it.

Suddenly we all saw the outline of the serpent's head in the natural rock (page 122). "Cobra!" we shouted in unison. We knew now that we were onto something, but we needed more evidence.

A year later Lynn found it while leading a tour group—not at Jebel Barkal but at the well-trodden temples of Ramses II at Abu Simbel.

The south temple at Abu Simbel, renowned for its facade of four seated colossal images of the king, has a spectacularly carved interior. On the north wall is a depiction of Ramses' epic battle with the Hittites at Kadesh in Syria, on his northern frontier. But the bas-reliefs on the south wall, showing his southern frontier, interested us far more.

Here Ramses in his chariot drives before him bound Kushite captives. In another scene he makes offerings to Amun, who sits inside a precipitous mountain. Emerging from Amun's throne and rising before the mountain cliff is a huge cobra, wearing the tall conical crown that symbolized a pharaoh's dominion over the southlands (page 123). This scene may represent Jebel Barkal and its pinnacle, but viewed from the east side.

IN 1989, with fresh perspective, we returned to Karima for our last expedition. It became increasingly clear why Jebel Barkal had played a pivotal role in Egyptian and Kushite history.

European observers, seeing in the pinnacle the form of the tall Egyptian crown, had identified the rock as a king's statue. But what they thought were the flaps of the Egyptian royal headdress, the ancient Egyptians had seen as the sides of a cobra's flattened hood. To the Egyptians the cobra had a profound magical and religious significance.

They both admired and feared the cobra as a manifestation of divine power, and they identified it with their goddesses. A goddess transmuting herself into this deadly creature became a guardian against evil, natural or supernatural. *(Continued on page 122)*

INTO THE TOMBS OF KINGS... AND QUEENS

15 CM HIGH, MUSEUM OF FINE ARTS

Royal cemeteries of Kush reveal intense devotion to Egyptian beliefs and ways. Like their mentors, Kushite kings prepared their own burial chambers, filling them with treasure and decorating them with images that would assure a rich afterlife. Unlike the Egyptians, however, they placed their tombs under their pyramids rather than within. From 1916 to 1925 George A. Reisner of the Museum of Fine Arts in Boston excavated most of the Kushite royal tombs and established a thousand-year chronology of

succession. But he found no treasure trove like Tutankhamun's. The burials had been plundered long before.

Some tombs had also been invaded by rainwater and mud, as here at El Kurru, resting-place of four pharaohs of Dynasty XXV. After Reisner's team cleared debris from the chambers of King Tanwetamani, a grandson of Piye and the nephew and successor of Taharqa, they found funerary scenes. In a wall fresco the king is led toward his burial by Hapi, a protector of the deceased. The doorway to the inner chamber is flanked by protective twin goddesses, Isis and Nepthys.

Nearby, the excavators discovered an amazing horse cemetery. Twenty-four steeds, draped with nets decorated with cowrie shells and faience and bronze beads, had been interred standing. Horses were introduced to Egypt from the east about 1600 B.C., and the Kushites raised fine animals coveted even by the distant Assyrians.

Kushite kings had several wives. One of Tanwetamani's lesser consorts lies in a cemetery at Nuri where Taharqa was interred. In a small undisturbed tomb without a pyramid, a tiny gilt silver mask (far left) lay among the queen's bones and beads that once formed a net over her mummy. Her idealized countenance was meant to keep her face youthful through eternity. A large scarab, symbol of the rising sun, bore her name and title: Queen Malaqaye.

8.1 CM HIGH

5.2 CM HIGH

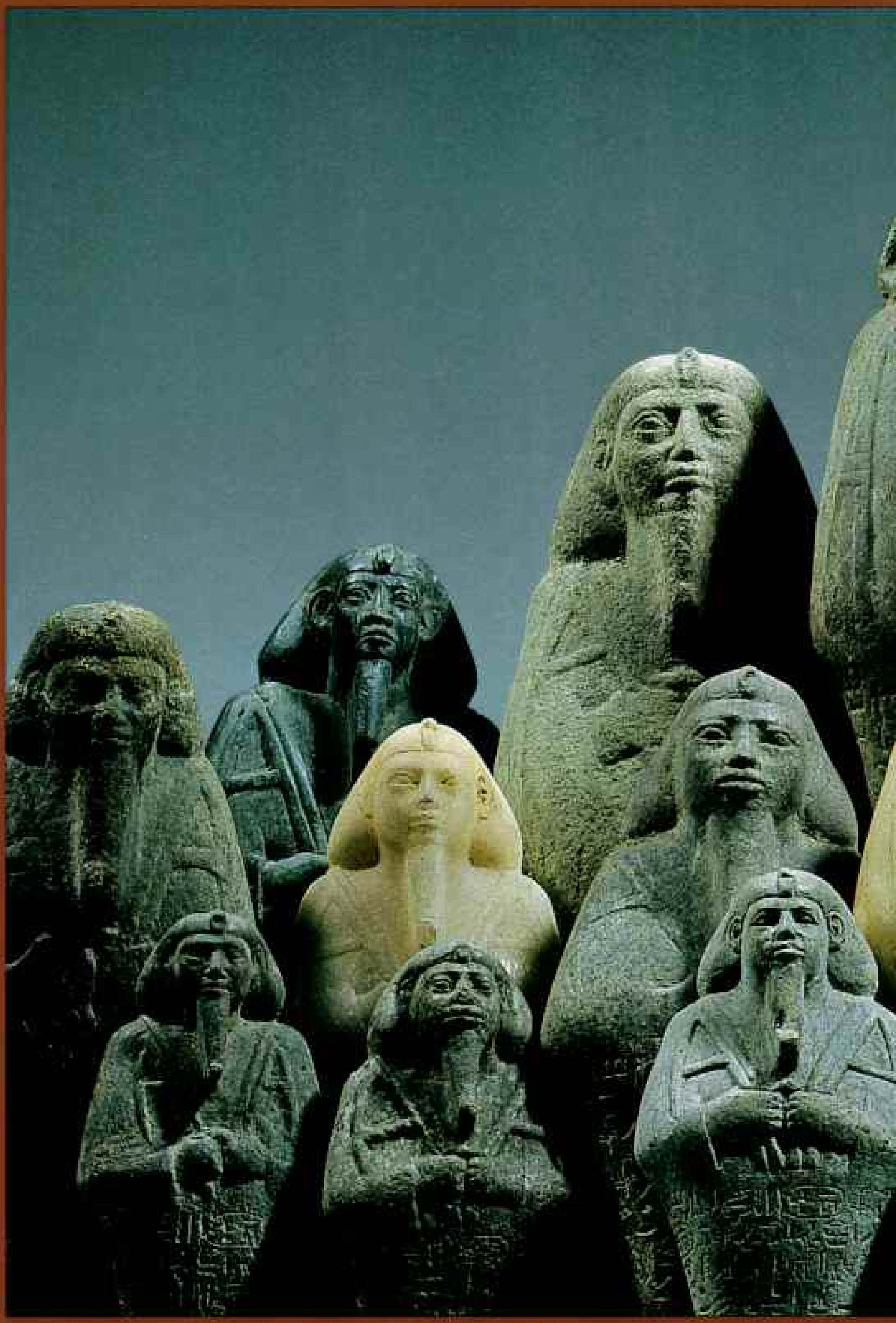
17.4 CM WIDE

5.3 CM HIGH

The glory that was Kush lives in a few well-crafted ornaments. An amulet of Nefru-ka-Kashta, a wife of Piye, presents a unique variation on the Egyptian motif of a king being suckled by a goddess. Here, instead, a queen receives nourishment, suggesting her great status.

Another El Kurru grave of an unnamed royal wife yielded the seated Maat, goddess of justice, carved in malachite, as well as the unusual rock-crystal ball with the head of the goddess Hathor and a ram-headed lion (far right). At Nuri a cylinder with ornamental friezes may have held magical papyrus for King Aspelta (593-568 B.C.). The gold pectoral of the winged Isis (top) lay across the mummy of Amani-natake-lebte (538-519 B.C.). Holding a life sign in her right hand and a sail for the breath of life in her left, she promises eternal protection to the king.

10.3 CM HIGH; ALL MUSEUM OF FINE ARTS



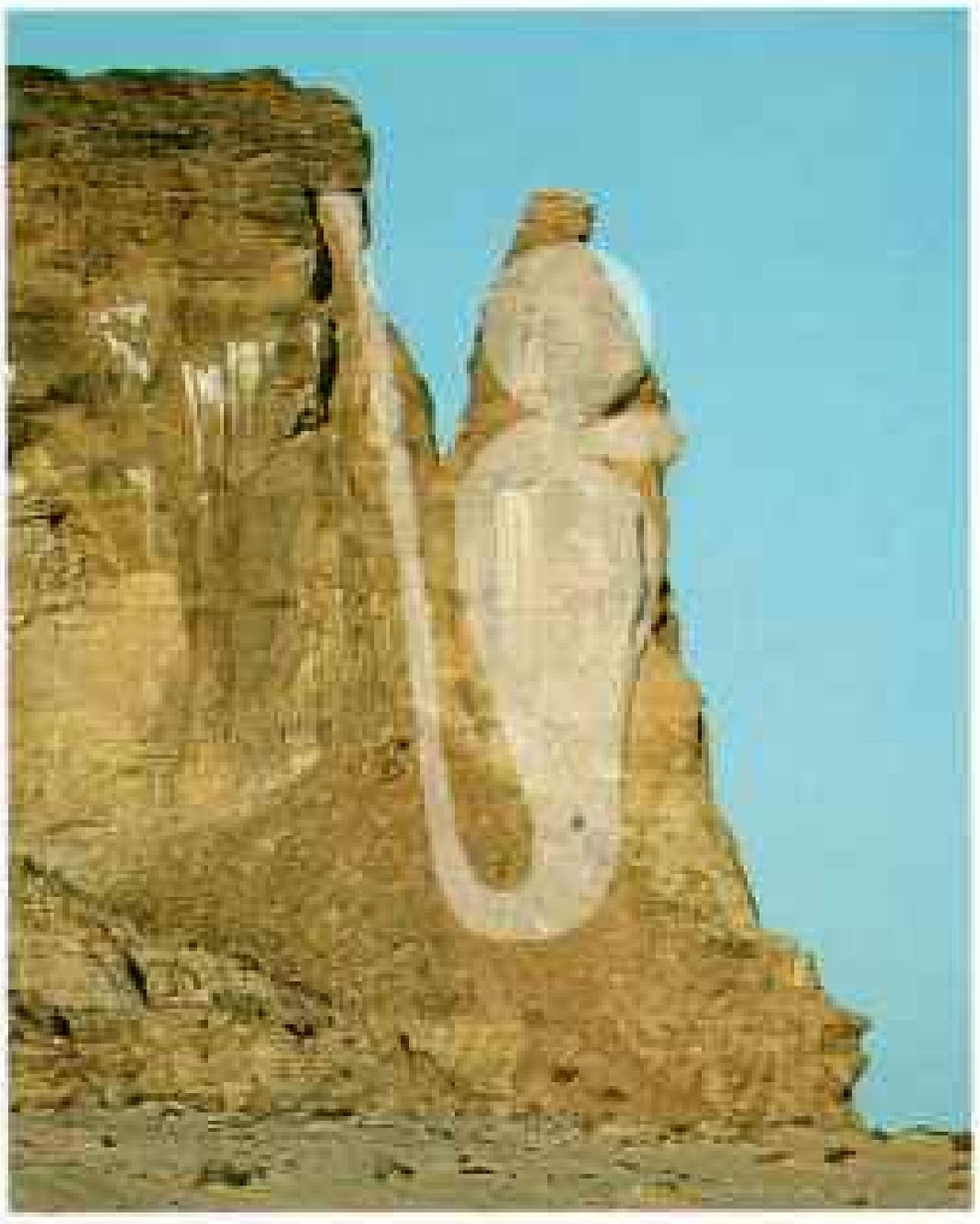
As slaves served the king in life, so did ushabtis, or answerers, in death. One of 1,070 intact figurines found in Taharqa's tomb was inscribed: "If anyone summons King Taharqa . . . I shall act according to orders, whether it be

LIFE-SIZE GROUP, MUSEUM OF FINE ARTS

planting fields, irrigating riverbanks, or even if it be conveying the sands of the west bank across the river to the east bank. . . . If anyone orders forth King Taharqa . . . I shall speak up in the City of the Dead, saying 'I am he!'"

The natural pinnacle on the east front of Jebel Barkal attracted the author's team: Inscriptions above a niche near the 260-foot summit had been spotted through binoculars. The climb to the top was rewarded with a view across millet fields and date groves overlying ancient Napata beside the Nile. The climbers found sockets cut into the rock that could have held logs. Such timbers, hoisted with two shadoofs, probably formed scaffolding (painting) to give workmen access to the niche, likely repository for a statue.

Lowered to that space, the author (above) was probably the first person to visit it since antiquity. Above the niche he made out hieroglyphs commemorating Taharqa's battles with the people of the Western Desert and Bedouin from the east—likely the Assyrians. Pocking the inscription were tiny holes, some still filled with bronze nails. In the Egyptian custom, the inscription was overlaid with a sheet of gold, reflecting the sun like a beacon.



The ancients saw the shape of their sacred cobra, crowned with a sun disk, in the pinnacle (top, overlay), the author believes. He found support for the theory in a temple below the pinnacle, where ram-headed Amun (above) is shown seated inside the mountain with a rearing cobra outside.

In a similar relief at Abu Simbel (right), Ramses II makes an offering to a seated Amun, possibly in Jebel Barkal. Here a cobra —seen from the other side—wears a tall crown signifying kingship over the south.

(Continued from page 111) So powerful an amulet was the cobra that it became the insignia of Egyptian kingship. Called the uraeus, it was worn on the front of the crown as a symbol of the king's protective goddess and proof of his right to rule.

The Ramses relief at Abu Simbel could be evidence that the ancient Egyptians saw in the Jebel Barkal pinnacle the cobra form of a goddess protecting Amun in his mountain residence. The tall crown marked her also as the magical guardian of Egypt's southern border. Facing south across the Nile, the serpent rock stood poised in defense against the vast unknown of Africa.

The archaeological record does clearly link Ramses with Jebel Barkal. Ancient blocks of stone bearing his name are scattered about the area—from destroyed Egyptian temples beneath the Kushite levels.

When the Kushites rose to power 500 years after Ramses, Napata became their capital. To them the pinnacle may have symbolized the uraeus of kingship, that their god Amun was the creator of kings and bestower of absolute rule in the Nile Valley.

Ancient texts reveal that deep inside the temple of Amun, the god spoke through a statue. He selected from among the royal brothers each new ruler of Kush and conferred the right to rule and the authority to conquer. This god, through his priests and seers, interpreted the king's dreams, advised him how to conduct himself, told him where and when to mount his military campaigns.

And what the god gave, he could take away. The Greek historian Diodorus Siculus records the tradition that Amun, speaking through his priests, even announced the time when the king must die—taking his own life by ritual suicide.

While the Egyptian conquerors and the Kushite kings after them may have seen the female serpent symbolism in the pinnacle, they also must have recognized the male symbolism in the soaring shaft—as local boys are quick to point out to any visitor. The ancients believed Amun was not only supreme creator and god of the sun but also god

of fertility and progenitor of the king.

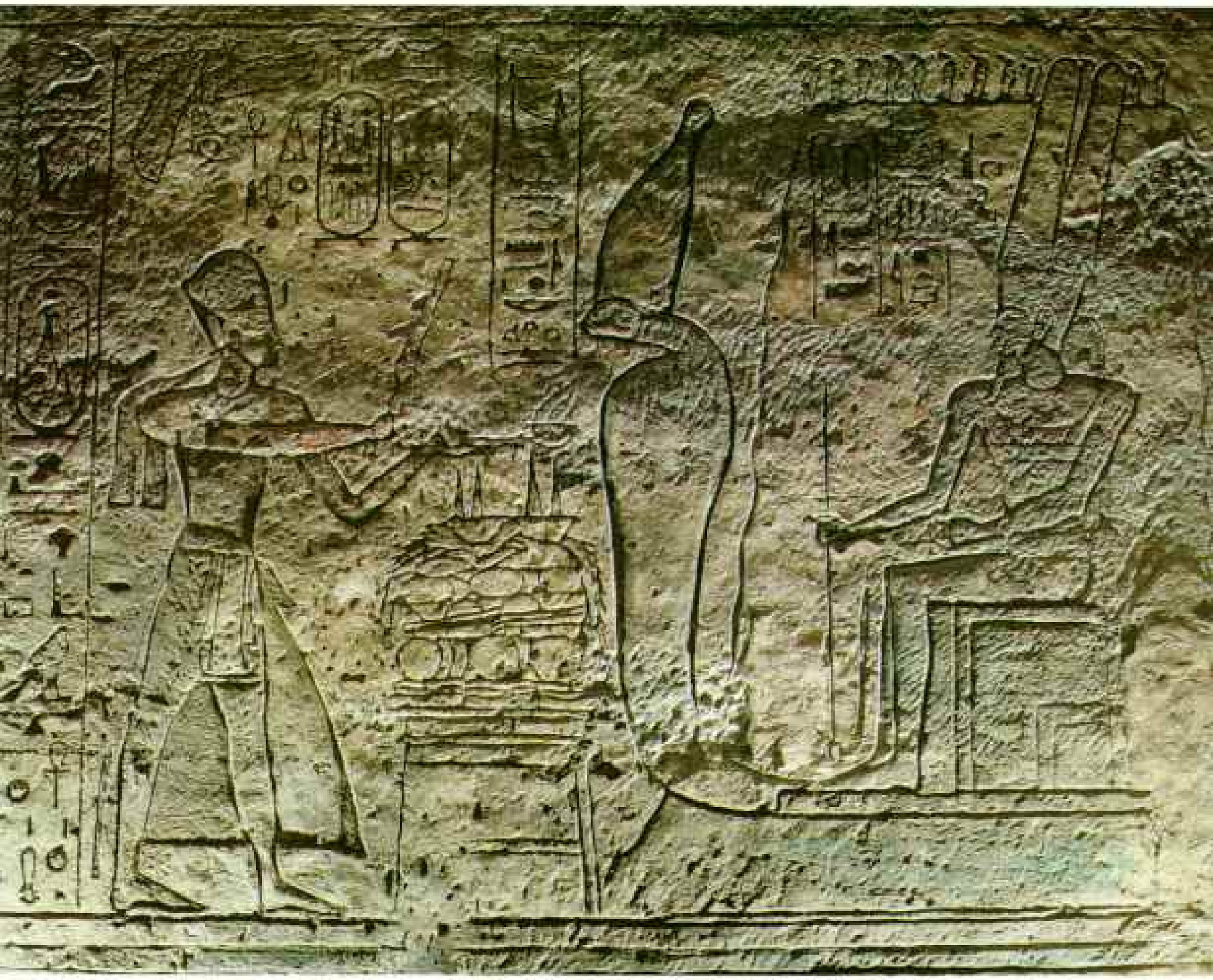
Both the Egyptian and Kushite kings promoted similar accounts of their divine origins. The story went that Amun would visit the queen disguised as her husband, the king, and impregnate her with the future ruler. When the royal child was born, the queen would present it to the king not as his son but as the god's. It was further believed that the great goddesses were the child's adoptive mothers.

IT IS MY BELIEF that Taharqa must have been aware of the sexual symbolism of the pinnacle and that he exploited it for political reasons. As phallus, it symbolized the king's divine father. As cobra, the pinnacle represented the goddesses who were the king's divine mothers. As royal uraeus, it also symbolized their child, the king—Taharqa.

He glorified himself by gilding the summit of the pinnacle. To emphasize the notions of male and female, god and goddess, father and mother, he built at its base the temple of Mut, whose name means "mother."

The sanctuaries of the temple of Mut are hewed deeply into the mountain, perhaps along the course of a natural cave or fissure. The temple's columns took the form of sistrums—sacred rattles that were used during childbirth to ward off evil—while its central axis, now ruined, was flanked by colossal images of the bearded god Bes, protector of women giving birth (page 125). The temple of Mut seems to have been built as a symbolic womb or birth passage, the female counterpart to the pinnacle.

Royal women may have sequestered themselves here while pregnant to simulate parentage by the god and to infuse reality into the myth of the divine origin of their children. This would allow for new understanding of



© LOUIS MASSAYEMTA, 1993

royal inscriptions such as one made by King Piye, who quotes Amun: "While you were yet in the body of your mother, I ordained that you would be ruler of Egypt. I knew you in the seed while you were in the egg, that you were to be Lord. . . . A father makes excellent his son, and I am he who has decreed the kingship for you."

THE LIVES of the Kushite monarchs had been entirely bound up in this mountain. Here the black potentates of the middle Nile carried on the traditions of Egypt, confident that they were chosen heirs of its great god.

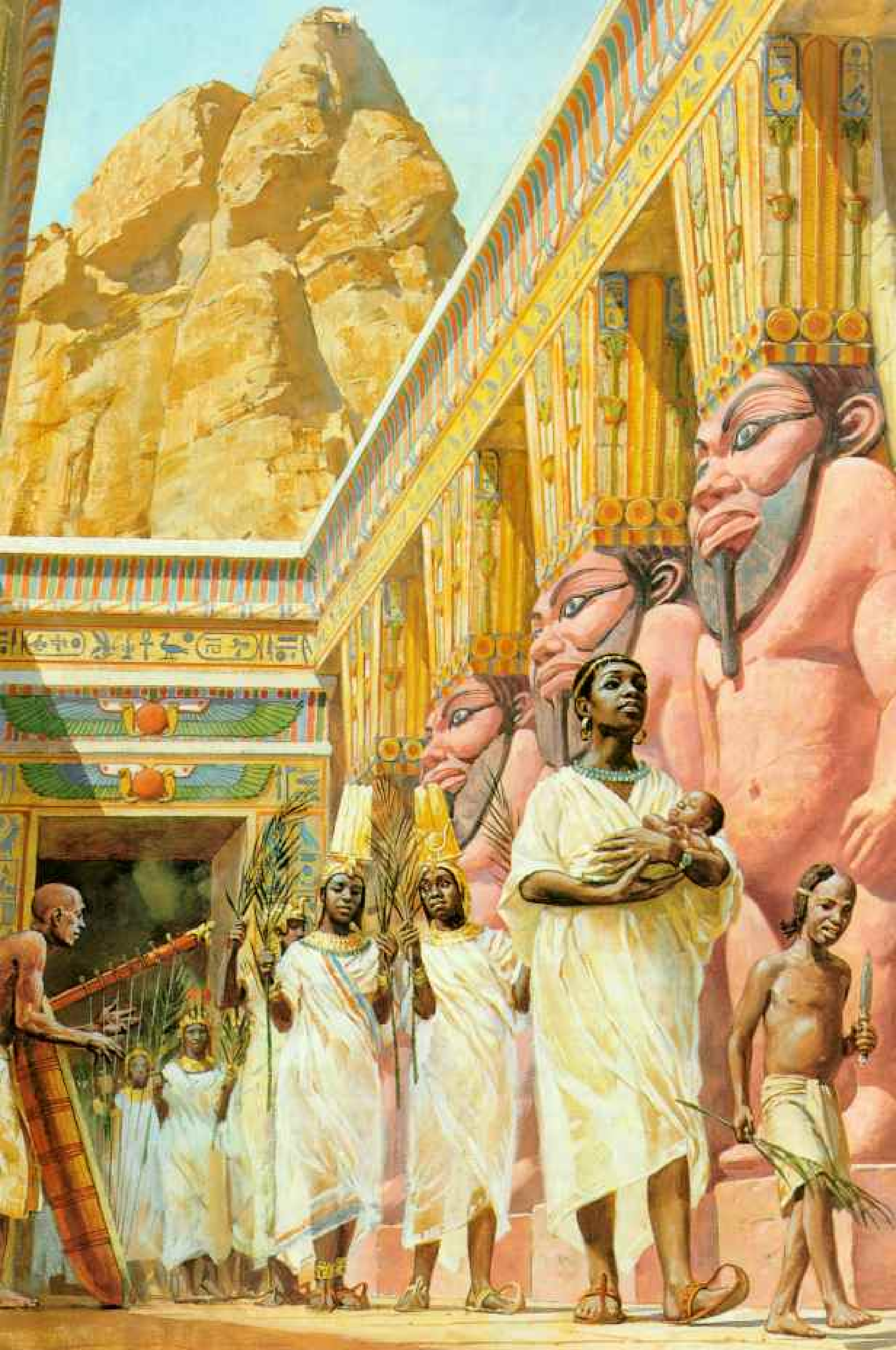
In the depths of Jebel Barkal they may have been conceived or born, so as to simulate paternity by the god himself. Later they were selected by the god's oracle from among siblings and, once crowned, were guided by the priests of Amun throughout their lives, and even ordered to their deaths by them. For these Kushite kings were the vital link between god and man, the living symbols on whom the welfare of the state depended.

The birth, life, and death cycle of a king emulated creation itself—the daily passage of the sun through the heavens and its "death" at night, its passage into the underworld, and its rebirth at dawn. And like creation it was entirely regulated by the supreme god.

As we loaded the Land Rover at the end of the expedition and drove away from Jebel Barkal, I mused on the gulf that separates us from ancient man. I wondered how a rock formation could have energized an empire. To the priests of Amun it must have represented the logic and dazzling order of the cosmos. The symbols discovered in the mountain not only verified the presence of the god within but also gave divine authority and legitimacy to the royal family.

To the Egyptians and Kushites who gazed upon Jebel Barkal, its peculiar form was no accident. It was a dramatic revelation of the complex nature of their gods, particularly of the greatest, Amun, whose very name meant the "hidden one." □

High-crowned images of Hathor and Mut, Amun's consort, flank a doorway (below) in the temple of Mut, where royal births were probably celebrated. In the painting based on this site, columns portraying the god Bes, protector of women in childbirth, gaze on a procession taking an infant to bathe in the Nile.



New Atlas Explores a Changing World

INSPIRATION can spring from adversity. In March 1989 artist Tom Van Sant had eye infections that threatened to blind him. The treatment: antibiotics in both eyes every 30 minutes for ten days. Rather than fight the lack of sleep, Van Sant entered into a state of meditation. At the end of his ordeal he was left with an overpowering sense of purpose—to create a portrait of the earth, derived from satellite imagery, to highlight environmental themes. Purpose became obsession; a year later he completed the map.

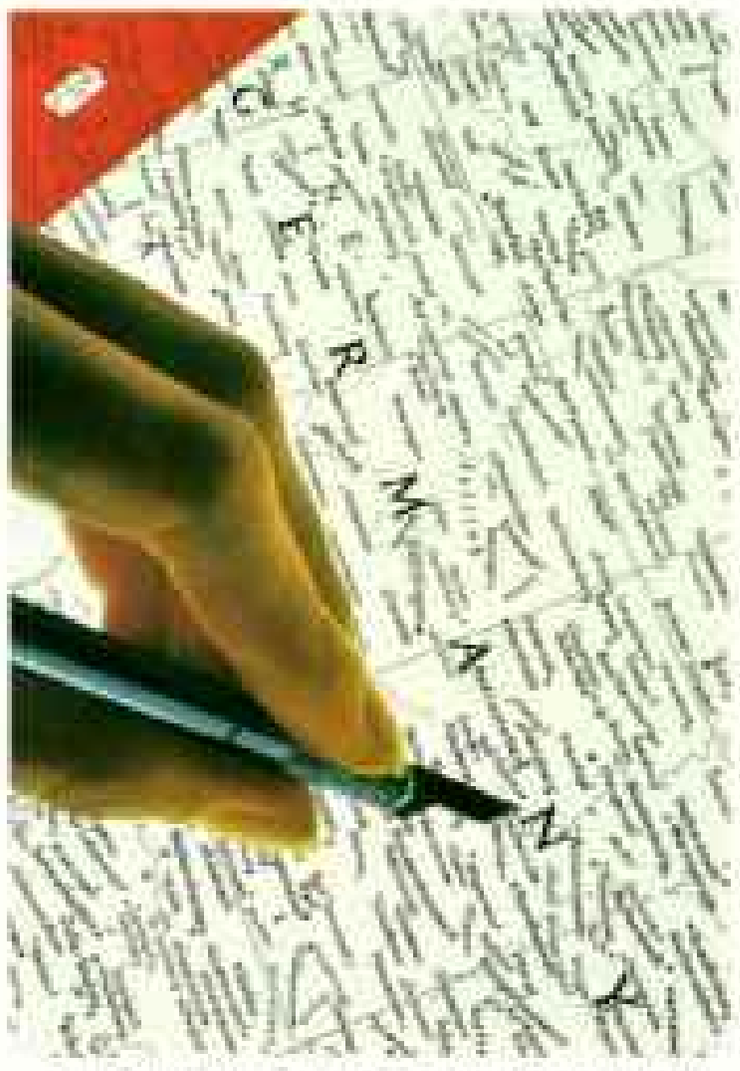
Van Sant's spectacular global image (opposite) appears on the opening pages of the sixth edition of the *National Geographic Atlas of the World*, whose publication I am proud to announce.

It has been 27 years since former President and Editor Melville Bell Grosvenor offered Society members our first world atlas. Each edition has built on its predecessor, and the atlas has been hailed as one of the world's finest reference sources. The sixth edition will enlarge even upon that reputation.

Accurate, detailed reference maps, supported by an index containing more than 150,000 place-names, are the heart of the revised and expanded atlas. Much in this volume is new. The section on the solar system and universe, for instance, displays images of the planets made by Voyager 2 and other spacecraft. Essays on the nature of the universe are written by theoretical physicist Paul Davies, who is well-known for making scientific concepts clear to everyone.

Scenes of earth from space—among them high-resolution images of the continents—broaden the visual scope. The mosaics of the Americas, Asia, and Africa were created specially for this atlas. Complementing the images are continental maps on five geographic themes: population, land use, resources and industry, transportation, and environmental stress. These maps greatly enhance the atlas as an instrument in the Society's mission to advance geographic knowledge.

While Tom Van Sant was fulfilling his mission to depict the natural landscape, our atlas staff was racing to document a transformation of the political landscape. Poland's communist government fell in August 1989, starting the about-face in Eastern Europe. In November East Germany's leaders opened the Berlin Wall, and the rush toward reunification of the Germanys began.



THE FIRST MAJOR WORLD ATLAS TO SHOW EAST AND WEST GERMANY REUNITED
VICTOR R. BOSWELL, JR., NGS

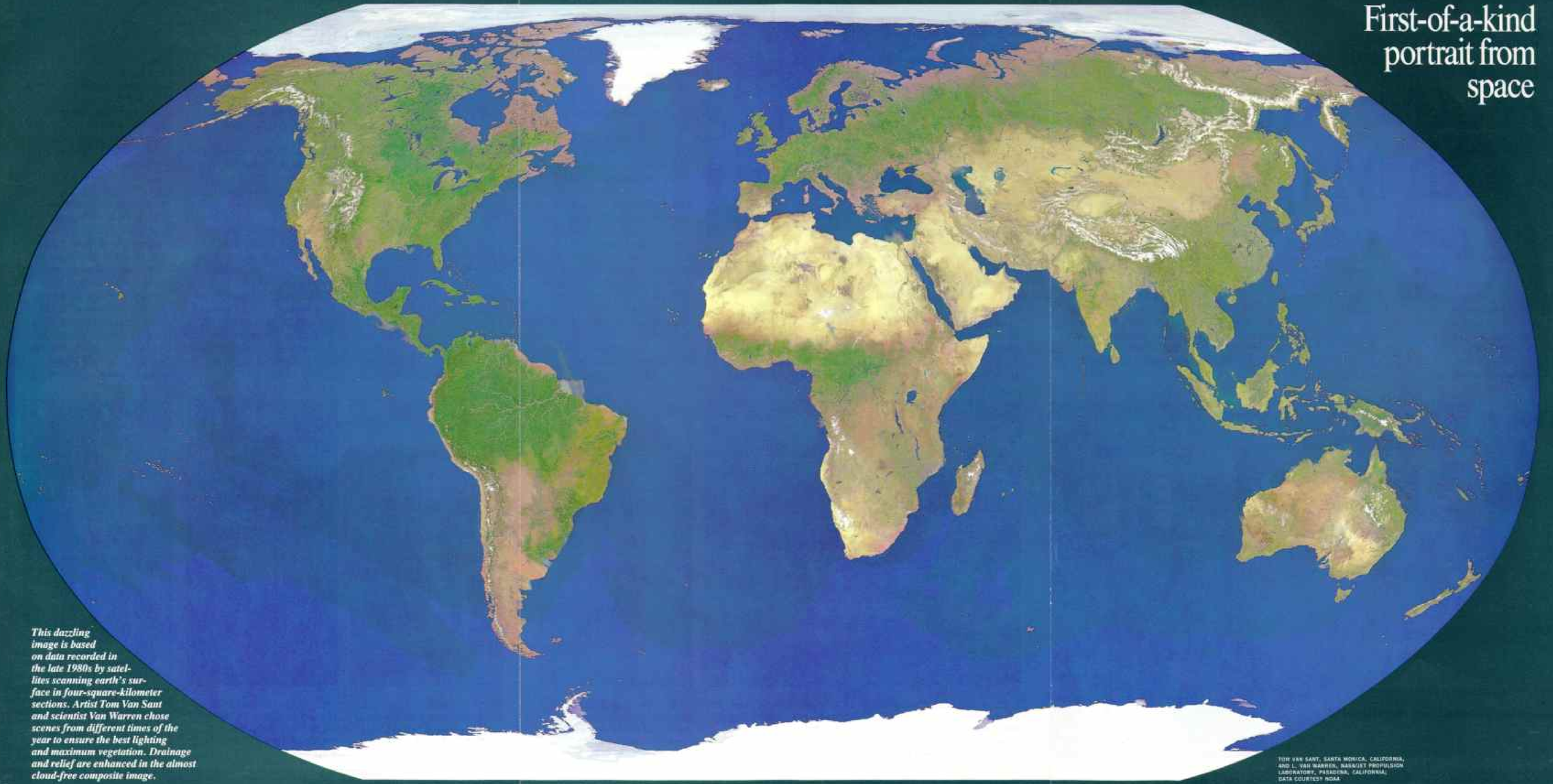
In the helter-skelter of reform, hard-line leaders in Bulgaria, Czechoslovakia, and Romania were consigned to history. By the summer of 1990 even reclusive Albania was cracking open. In the Soviet Union, economic crisis and pressure for independence by the Baltics and other republics threatened to dissolve the Soviet federation. Meanwhile Central and South America, Asia, and Africa resounded with strife and reform. The whole world was in flux.

The new *National Geographic Atlas of the World* sets these momentous events in context. Included is a special foldout political map of the world. The map anticipates a reunited Germany but stops the rest of the action at July 1990—just before militant Iraq plunged the Middle East into crisis. Since events there and elsewhere are still unfolding, we will send at least two updates to every atlas owner during the next three years.

I know that this timely new edition will illuminate your vision of our world at a watershed of modern history.

Gilbert M. Grosvenor

First-of-a-kind portrait from space



This dazzling image is based on data recorded in the late 1980s by satellites scanning earth's surface in four-square-kilometer sections. Artist Tom Van Sant and scientist Van Warren chose scenes from different times of the year to ensure the best lighting and maximum vegetation. Drainage and relief are enhanced in the almost cloud-free composite image.

TOM VAN SANT, SANTA MONICA, CALIFORNIA, AND L. VAN WARREN, NASA/JET PROPULSION LABORATORY, PASADENA, CALIFORNIA; DATA COURTESY NOAA

Seventy-Five Years of Cartography

A Love Affair With Maps

TO RENDER the Palestine of 1915, Albert H. Bumstead bent over a sheet of fine rag paper and began with his crow quill pen to ink that rocky landscape of ancient disputes.

Bumstead was no novice at mapping. He had just returned from the cloud-tattered mountains of Peru. There he had served as topographer to the joint 1912-15 National Geographic Society and Yale University expeditions to the Inca city of Machu Picchu, rediscovered by Hiram Bingham.

As Bumstead drew Palestine—lining the bends of the Jordan River, the contours of Mount Tabor and Mount Pisgah and the Dead Sea—as he lettered familiar biblical names—Galilee, Samaria, Judaea—he was beginning a tradition we now celebrate: the 75th anniversary of mapping by the Cartographic Division at National Geographic.

To be sure, maps had been a staple of the Society and its magazine since their founding in 1888. Yet for the first 27 years most maps had been prepared by outside firms.

The new map department set right to work. To help American families follow the progress of their doughboys "over there," Cartographic published the extremely detailed "Western Theatre of War" for the May 1918 NATIONAL GEOGRAPHIC.

After the Great War, Cartographic issued the 1921 oversize supplement "Europe, Showing Countries as Established by the Peace Conference at Paris." It showed the newborn nations of Estonia and Latvia. And it showed the rebirth of an old country—Poland.

In an article that accompanied that 1921 map, Assistant Editor Ralph Graves warned: "The world entertains no delusions as to the inflexible permanence of this map." Anticipation of change in 1920s Europe echoes loudly for us now, as we issue the sixth edition of our world atlas (see the opposite side of this foldout). Nearly 70 years have passed, and we still draw maps of Europe with no delusions as to inflexible permanence.

PAUL PETZA

Inserting supplement maps into NATIONAL GEOGRAPHICS was a slow-moving hand operation in the 1930s, a task that a machine now does at 200 maps a minute. In 1935 the first chief of the Cartographic Division, Albert H. Bumstead (left, standing), checked details, while other staff members operated the photo-typesetter he invented.

Since the 1920s the Society's mapmakers have expanded their efforts, and as always page maps accompany articles, an outstanding feature then and now in American magazine publishing.

Of the many thousands of enormously varied maps produced by our cartographers since 1915, by far the most influential and popular one has been our general-reference political map of the world, first published by the Society in December 1922.

In 1923 the Society published its first map of the United States and began producing theme maps as special supplements. First among these was "The Travels of George Washington," issued in January 1932 to celebrate the 200th anniversary of the first President's birth.

The popular "Bible Lands and the Cradle of Western Civilization" was published in December 1938. Five versions have been published since, most recently the "Holy Land" map in December 1989. What began with Albert Bumstead bent over Palestine wielding his crow quill pen has again come full circle.

By 1933 Bumstead and his small staff were long tired of that pen and the tedium of hand-drawing place-names on maps. So he devised a lettering machine that used photoprinting for all map nomenclature. His machine made it possible to reproduce place-names at any size with perfect uniformity, while maintaining the beauty of hand lettering. The political map of the United States in the May 1933 magazine exhibited the first photo-lettered type from the Bumstead machine.

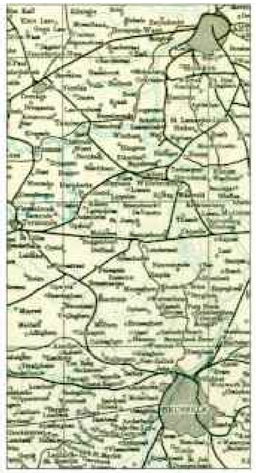
The result was clear, practical, and quite beautiful—at least to those of us who find pleasure as well as guidance in maps.

THE BEAUTY of Society maps was further enhanced in the 1930s by staff cartographer and calligrapher Charles E. Riddiford. He designed typefaces that are still a distinctive hallmark of our cartography. Their principal virtues for place-names are extraordinary clarity, legibility, and typographic elegance.

In the mid-1940s Wellman Chamberlin, a staff cartographer, devised the Chamberlin trimetric projection. It provides for the depiction of large areas of the world with minimum inconsistencies in scale. This projection is still used for some Society maps, including North and South America and Europe.

In 1947 Chamberlin authored *The Round Earth on Flat Paper,* considered a landmark publication in cartography. It went to the heart of an old problem. As early as the 1920s Editor Gilbert H. Grosvenor voiced his displeasure with world maps drawn on the Mercator projection, which he called "atrocious" for a world general-reference map. Grosvenor asked Albert Bumstead to produce one with less distortion. In 1922 a new world map was published

WILLARD R. CULVER

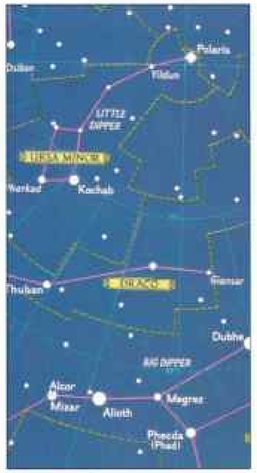


1918 A map of the "Western Theatre of War" helped readers follow news of World War I by showing names of battle-torn villages in Belgium and France.

1932 Adm. Richard E. Byrd's flights over the South Pole gave cartographers data for the first accurate map of the area, "The Antarctic Regions."

1946 "The United States of America" offered a postwar portrait of the country for "war-deferred vacations in the first full summer of peace."

1948 New highways, new suburbs: new maps. Pocket maps of central and suburban Washington, D. C., charted the changes in a World War II boomtown.



1957 A constellation of cartographers developed "A Map of the Heavens" for stargazing readers. A guide to the zodiac was included.

1967 The "Indian Ocean Floor" was the first in a series of unprecedented seabed maps. Sonar research revealed the topography of the ocean bottom.

based on a projection patented in 1904 by Alphons van der Grinten of Chicago. From 1922 the Van der Grinten projection was used on ten of the fourteen world maps produced by the Society.

In December 1988, our centennial year, we introduced the Society's new reference map of the world, drawn on a projection devised by Arthur H. Robinson. The Robinson projection gives a more realistic view of the round earth on flat paper than the Van der Grinten projection. Yet as Chamberlin well knew, a perfect solution does not exist.

In the decade before World War II, Cartographic produced maps of the continents and of the Atlantic and Pacific Oceans. As the clouds of war formed over Europe in the fall of 1939, the Society published the timely map of "Central Europe and the Mediterranean." Others followed rapidly: "Europe and the Near East" (May 1940), "Atlantic Ocean" (September 1941).

Shortly after Pearl Harbor, President Roosevelt, receiving dispatches describing military operations in the Celebes Sea, wished to locate the small island of Simatang. He asked his aide for a map that showed the island, but none was available. The aide went to National Geographic and was given a map with the island marked. Four days later Editor Grosvenor presented a special cabinet to the President. Inside, maps were mounted on rollers so the Commander in Chief could pull down any one of them while at his desk.

National Geographic maps proved invaluable to Allied war efforts in strategic planning of land, sea, and air operations. President Roosevelt used our 1944 map of "Germany and Its Approaches" at the 1944 Quebec Conference, and it became British Prime Minister Winston Churchill's personal briefing map. It now hangs in the Cabinet War Rooms museum in London.

The War Department requisitioned more than a million National Geographic maps, and the Navy also received large numbers.

In a January 15, 1945, editorial the *New York Times* praised the Society's wartime effort led by Chief Cartographer James M. Darley: "The maps are to be found at the front, in the air, in our embassies and consulates, in business and newspaper offices, in schools. . . . Its maps enable us not only to follow the war's

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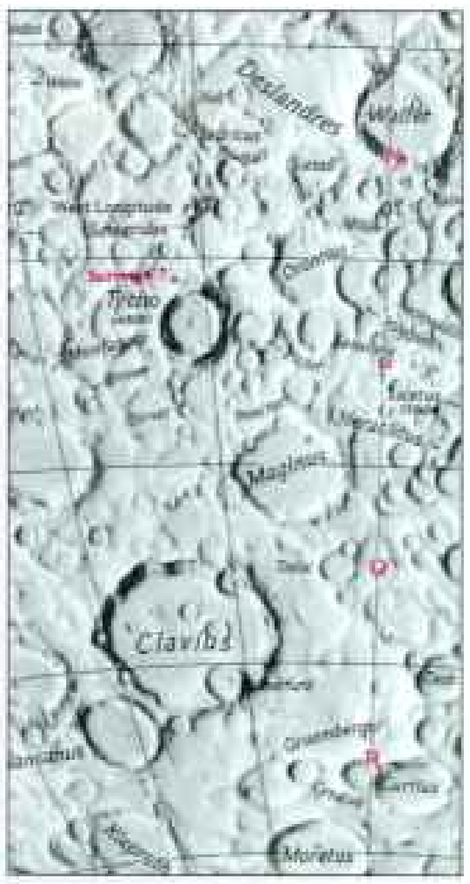
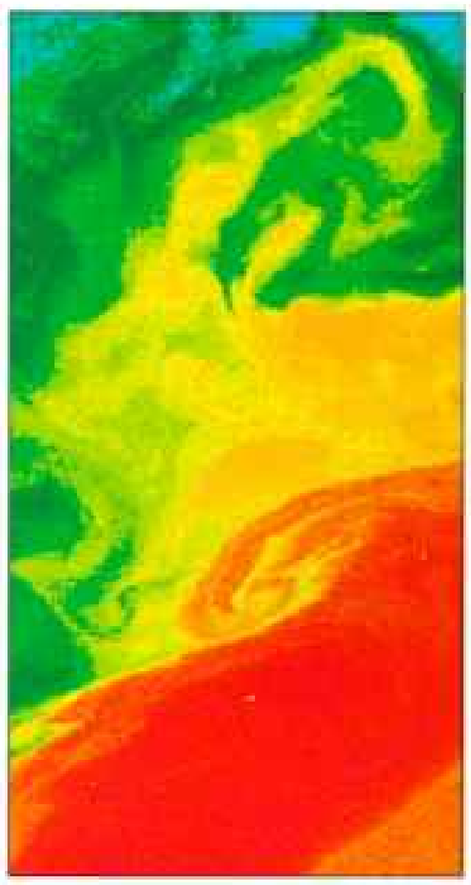


1969 Spacecraft images ensured accuracy of "The Earth's Moon." Crater-perfect, it was one of the first maps to show both sides of the moon.



1985 Satellite imagery from the *Atlas of North America* showed the red push of the warm Gulf Stream in a rainbow swirl of cooler water off the East Coast.

1988 High tech in the Deep South, North Carolina's Research Triangle Park was mapped for the *Historical Atlas of the United States*.

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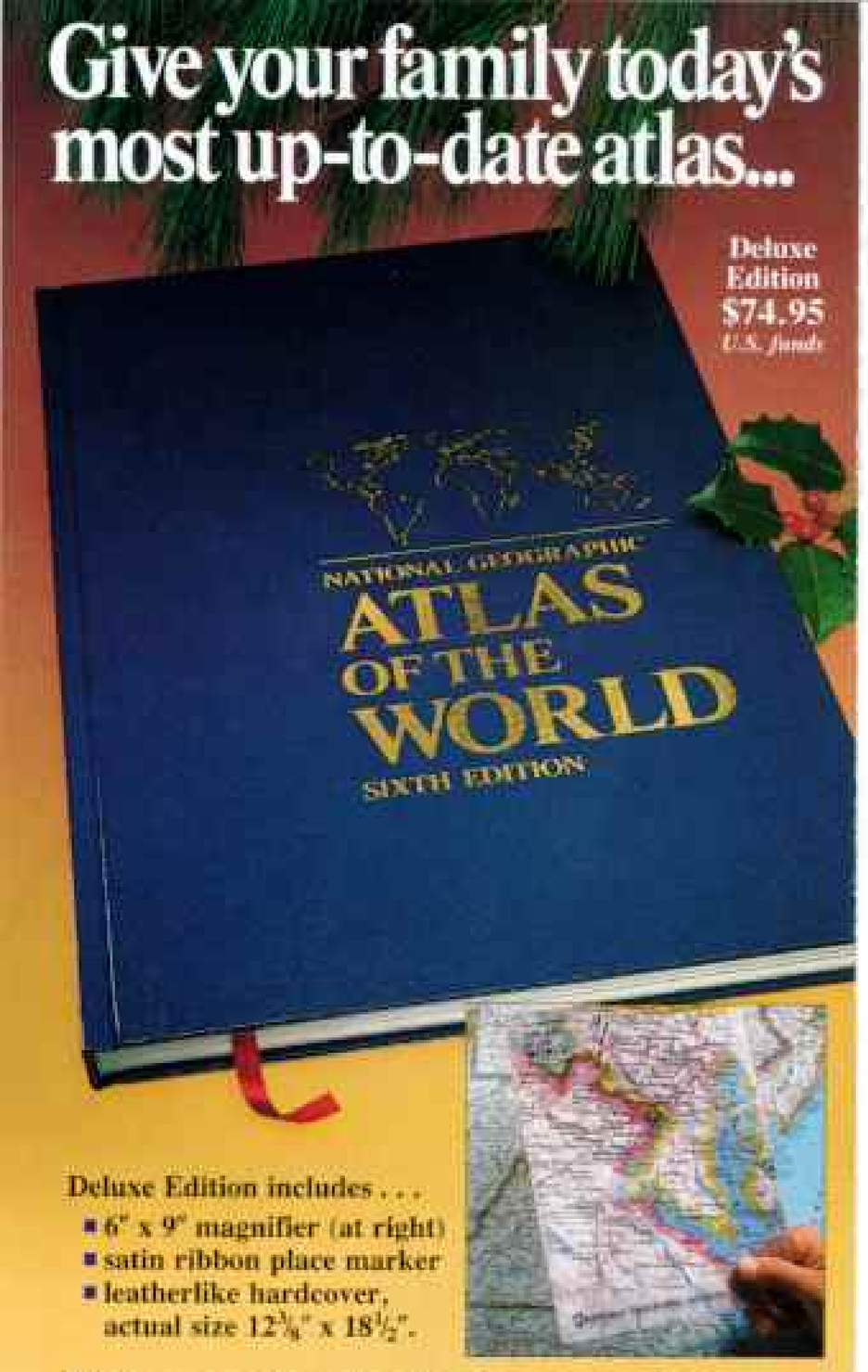

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We produced a unique series of globes for home, school, and office use—and one gigantic one for display and education in Explorers Hall at the Society's Washington, D. C., headquarters.

We devised, designed, researched, wrote, drew, and published large-format atlases. Our world atlas, now in its sixth edition, is renowned among reference works. Our *Atlas of North America: Space Age Portrait of a Continent* broke new ground with its lavish use of remote-sensing imagery. Our *Historical Atlas of the United States* is the most comprehensive in recent generations.

Magic wand for mapmakers in the 1990s, the hand-held digitizer (above) puts cartographic information into computer readable form. The Scitex workstation (below) is the next stop on a map's route to readers. Borders and boundaries are given line weights and colors, and their registration is fine-tuned before printing. Drafting with computer technology promotes accuracy and allows for last-minute changes, while establishing a data base for future maps.

No less important are the magazine page maps whose designs are as creative as their subjects are diverse. We have mapped acid rain, opium and poppy production, radioactive clouds from Chernobyl, ancient civilizations on six continents, the geology of the 1989 California earthquake, the inside of a human cell, and the universe.

Whether produced by new technology or by traditional means (even, on occasion, using an updated version of Albert Bumstead's pen), our maps aim to combine visual appeal, accuracy, and originality. No one expressed his love of maps more enthusiastically than Gilbert H. Grosvenor. "A map," he said, "is the greatest of all epic poems." Maps and the Society—a love affair from the beginning.

John B. Garver Jr.

CHIEF CARTOGRAPHER

BOTH BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JOSEPH D. LAVENBURG WITH MARK THIESSEN

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Chrysler Imperial

*1990 Second Quarter Buyers Study by Consumer Attitude Research. C.A.R. classification: Large Luxury.

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* Second Quarter Buyers Study by Consumer Attitude Research.

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FROM THE PRESIDENT

Will the ban on ivory trade save Africa's elephants?

THE NATIONAL GEOGRAPHIC SOCIETY

IN SEARCH OF ELEPHANT TUSKS buried near Kenya's Tsavo National Park, we walked single file through knee-high grass. Flanked by machine-gun-toting rangers alert for poachers, I considered the chances of an ambush.

Richard Leakey, noted anthropologist and director of wildlife management for Kenya, led the way to the "tree with a broken branch," the tip he was following. Sure enough, after digging seven holes, we unearthed one and a half tons of elephant tusks—buried as long as ten months before. Richard's high-tech surveillance and trained combat units, as well as the crash of ivory prices, have driven poachers underground.

GILBERT M. GROSVENOR

Fortune no more, elephant tusks buried by poachers are unearthed by Richard Leakey, Kenya's director of wildlife management. A few years ago the contraband would have sold for as much as $300,000. But after last year's worldwide ban on ivory trade, the market has all but dried up—to the consternation of southern African countries that fund wildlife research by selling ivory from culled surplus elephants.

In Kenya people have been killed for shooting the country's rapidly disappearing elephants. Paradoxically, in southern Africa wildlife officials cull an overabundance of elephants so that they and farmers can coexist. It's a conservation conundrum. Such dilemmas will be examined in a National Geographic EXPLORER film, "Africa: Playing God with Nature?" to be aired Sunday, December 16, at 9 p.m. on TBS.

Poachers have slashed Africa's elephant population from 1.3 million in 1979 to about 610,000 today. Drastic measures have resulted. In October 1989 the Convention on International Trade in Endangered Species (CITES) took action that virtually outlawed trade in ivory. Prices have since plummeted, from $100 to as low as two dollars a pound.

Kenya, its elephants decimated, voted an enthusiastic "yes" to the ivory ban, opposed by Zimbabwe, Botswana, Mozambique, South Africa, Zambia, and Malawi. In Kruger National Park, a South Africa showcase, elephants are culled to prevent overpopulation. The sale of that ivory has provided about $200,000 a year for elephant research. "Banning ivory will severely restrict our program," says Anthony Hall-Martin, a Kruger expert. "Richard Leakey's crusade may be appropriate for Tsavo, but it is disastrous in South Africa and Zimbabwe."

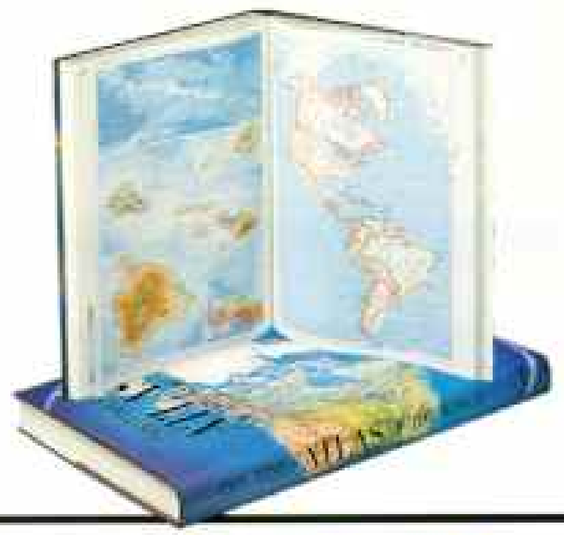
"Eliminating poaching and destroying ivory's value are only short-term solutions," Richard cautions. "Unless we can make wildlife conservation profitable for all peoples, we cannot save our elephants for the future."

There is no profit when elephants wander off large private holdings, where they enjoy sanctuary, to ravage surrounding small farms. Fences may be the answer, Richard thinks. I met one lean, leathery Kenyan rancher, Gifford Powys, who agrees. "I'm building a stone wall four feet wide, four to five feet high along my property line," he said, to contain the elephants that roam his ranch.

Zimbabwe supports its wildlife with hunting fees. But Robin McIntosh hopes to attract nonhunting visitors to the 22 major wildlife species on his cattle ranch, only 30 minutes from Harare, the nation's capital. "We'll offer lodges, walking tours, everything for the tourist," he says.

While the elephant debate continues, all agree that elephants must earn their keep and be fenced within sanctuaries. With Africa's human population doubling every 20 to 25 years, the day of the free-roaming elephant is all but over.

Gilbert M. Grosvenor



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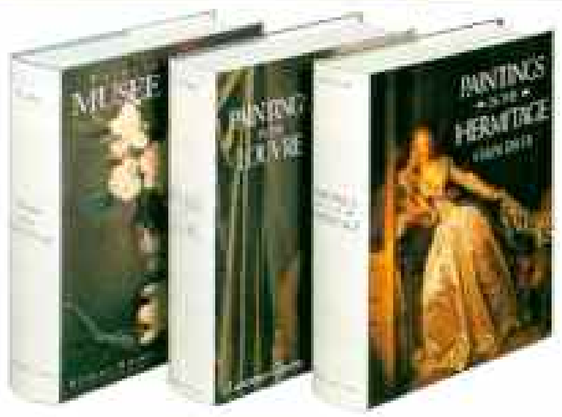

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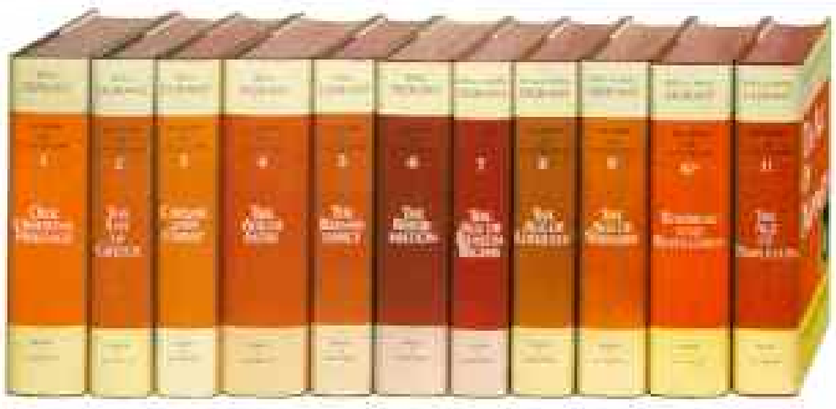

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NOVEMBER 1990

GEOGRAPHICA

NATIONAL GEOGRAPHIC MAGAZINE

Ike's Airplane Returns to the Skies

Mel Christler owned an agricultural spraying business in 1970 when he bid on, and won, five Lockheed C-121A Constellations at a military auction. For ten years he flew four of the Connies in his spraying operations; the fifth was a source of parts for the others. Then he made an astonishing discovery: His parts

DWIGHT D. EISENHOWER LIBRARY

plane had been *Columbine II* (above), the first presidential aircraft used by Dwight D. Eisenhower (National Geographic, July 1969).

"I was terribly upset that I had cannibalized something that had that much historical value," Christler says.

TERRENCE MOORE

He tried for years to figure out a way to restore the plane. But it wasn't until 1989, with the help of Henry Oliver III, who also is interested in vintage planes, that he could. Oliver bought another Constellation for *its* parts, and he, Christler, and a handful of others worked for nearly six months in a Tucson, Arizona, field to restore the four-engine plane to airworthy shape. The restoration cost about $150,000. *Columbine II* flew again early this year, the centennial of Eisenhower's birth.

"The plane needed new engines and a new landing gear, the rudders had to be rebuilt, and the windows, wiring, and hydraulics had to be replaced," says Oliver. "But it was structurally sound; the only corrosion was where a rat had made its home in the belly."

The plane that became *Columbine II* was one of ten purchased by the Air Force from Lockheed Aircraft in 1948, for a total of 11.4 million dollars. Christler bid "about $35,000" in 1970 for his five planes; they were no longer flyable because of missing parts. Two new Boeing 747s that joined the Air Force One fleet this year cost the government a total of 266 million dollars.

Columbine II served Eisenhower from 1952 to 1954, when it was replaced. The plane was christened by his wife, Mamie: The columbine is the official flower of her home state, Colorado.

A Ban on Imports of Sipán's Treasures

The U. S. government has barred the importation of gold, silver, and other treasures from Moche tombs in the Sipán region of Peru's northern coast.

The Moche civilization began to evolve in the first century A.D. and endured for some 700 years. The October 1988 National Geographic described the discovery of a spectacular, unplundered Moche tomb in the Sipán area and cited the danger of looting. Another tomb filled with finely crafted artifacts of gold, silver, and gilded copper was found in 1989 (Geographic, June 1990).

NATHAN BENN

The import ban came after a request from the Peruvian government. Any objects identified by U. S. Customs inspectors as originating in Sipán and lacking a Peruvian export permit can be seized and returned to Peru. The U. S. Information Agency imposed the ban after it was recommended almost unanimously by the President's Cultural Property Advisory Committee. The committee's report quotes heavily from the 1988 articles by Walter Alva and Christopher Donnan.

Committee Chairman Michael J. Kelly said that "scientific excavation in the [Sipán] area is seriously threatened by looters with 'gold fever' and middlemen who are able to easily sell such artifacts in the international art market."

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re-im-burse (rē′-im-bûrs′) **-bursed, -burs-ing, -burs-es** *vt.* 1. to repay 2. to give monetary compensation for losses or expenses
rein (rān) *n.* 1. often pl. a narrow leather strap attached on both ends to the bit of a horse's bridle that is used by a rider for control 2. a method of restraining or keeping in check. *-vt.* 1. to guide or hold back 2. to provide with reins. *-vi.* 1. to slow down or stop a horse with reins 2. to restrain or control the action of
rein-deer (rān′-dēr) *n.* a large deer, (Rangifer tarandus) related to the caribou, and originally from certain arctic regions including Greenland, having branched antlers
re-in-force (rē′-in-fôrs′) *vt.* 1. to make more forceful or effective, as an argument 2. to strengthen with additional troops or military equipment 3. to strengthen 4. to increase the number of 5. to reward a subject after a desired response has been elicited *-vi.* to obtain reinforcements —**re-in-force-able** *adj.*
reinforced concrete *n.* poured concrete that contains steel bars or metal netting for the purpose of increasing its tensile strength
re-in-force-ment (rē′-en-fôr′-smənt) *n.* 1. the act of reinforcing or of being reinforced 2. that which reinforces 3. pl. additional troops or military equipment
reins (rānz) *n.* pl. the kidneys
re-in-state (rē′-en-stāt′) **-stat-ed, -stat-ing** *vt.* 1. to bring back into use 2. to restore to a former condition or position —**re-in-state-ment** *n.*
re-in-sure (rē′-in-shûr′) *vt.* 1. to insure again 2. to insure by contracting to transfer all or part of a risk to another insurer *-vi.* to provide additional insurance —**re-in-sur-er** *n.*
re-in-ter-pret (rē′-in-tər′-prət) *vt.* to interpret again in order to give a new explanation of —**re-in-ter-pre-ta-tion** *n.*
re-in-vent (rē′-in-vent′) *vt.* 1. to make something believed to be original that has already been invented 2. to totally redo —**re-in-ven-tion** *n.*
re-in-vest (rē′-in-vest′) *vt.* to invest capital or earnings again —**re-in-vest-ment** *n.*
re-is-sue (rē′-ish′-ū) *vt.* to emerge again *-vt.* to issue again *-n.* a second or subsequent issue, as of a book
re-it-er-ate (rē′-it′-ər-āt) **-at-ed, -at-ing** *vt.* to say again —**re-it-er-a-tion** *n.* —**re-it-er-a-tive** *adj.* —**re-it-er-a-tive-ly** *adv.*
re-ject (ri-jekt′) *vt.* 1. to refuse to make use of 2. to refuse to grant; deny 3. to rebuff a show of affection 4. to throw out as unworthy or defective —**re-ject-ing-ly** *adv.* —**re-jec-tive** *adj.*
re-ject (rē′-jekt) *n.* something that has been rejected
re-joice (ri-jois′) *vi.* to be happy *-vt.* to gladden
re-joic-ing (ri-jois′-ing) *n.* 1. the act of expressing or feeling joy 2. often pl. an event or reason for joy
re-join (ri-join′) **-joined, -join-ing, -joins** *vt.* 1. to join together again 2. to reunite with, as with the members of a group *-vi.* to become joined together again
re-join-der (ri-join′-dər) *n.* 1. an answer 2. a defendant's answer to a plaintiff's claim
re-ju-ve-nate (ri-jū′-və-nāt) **-nat-ed, -nat-ing** *vt.* 1. to make one feel or look young again 2. to make something appear new or fresh again 3. to develop a vernal topography *-vi.* to undergo rejuvenescence *syn* see renew —**re-ju-ve-na-tion** *n.*
re-ju-ve-nes-cence (ri-jū-və-nes′-əns) *n.* renewal of a youthful look or temperament: rejuvenation —**re-ju-ve-nes-cent** *adj.*
re-lapse (ri′-laps) **-lapsed, -laps-ing, -laps-es** *n.* 1. the act of becoming worse 2. a recurrence of symptoms after an apparent recovery from a particular illness *-vi.* to revert to a former state: regress
relapsing fever *n.* any of various acute infectious diseases caused by a spirochete (genus Borrelia) transmitted by tick or lice bites with repeated episodes of fever and chills lasting approximately one week
re-late (ri-lāt′) **-lat-ed, -lat-ing** *vt.* 1. a recounting or telling 2. to show a connection or association exists *-vi.* 1. to have some type of connection: refer 2. to interact with 3. to have a favorable response to —**re-lat-able** *adj.*
re-lat-ed (ri-lā′-təd) *adj.* 1. associated with 2. connected by kinship or marriage 3. having a close connection either harmonically or melodically —**re-lat-ed-ly** *adv.* —**re-lat-ed-ness** *n.*
re-la-tion (ri-lā′-shən) *n.* 1. a recounting or telling 2. that which is told: account 3. a logical or natural association between two or more things 4. a connection of individuals by blood or marriage: kinship 5. an individual connected with others by blood or marriage: relative 6. pl. the connections or transactions between groups 7. that which connects two or more things or parts as belonging or working together 8. an attitude held by two or more people towards each other 9. the mode in which an individual or object is connected with another
re-la-tion-al (ri-lā′-shə-nəl) *adj.* 1. arising from or relating to kinship 2. showing that relations exist 3. indicative of a syntactic relation —**re-la-tion-al-ly** *adv.*
re-la-tion-ship (re-lā′-shən-ship) *n.* 1. the state of being related 2. connection by blood or marriage: kinship 3. a situation existing among people who are related or are dealing with one another, such as a romantic attachment
rel-a-tive (rel′-ə-tiv) *n.* 1. something that has a connection with or dependence on another thing 2. one related by common ancestry 3. a word that refers to or qualifies as a grammatical antecedent *-adj.* 1. relevant; germane 2. compared or related to something else 3. *music* of major and minor keys and scales that have the same key signature 4. described as the ratio of a specified quantity to the total magnitude of the quantities involved
relative humidity *n.* the ratio of the actual amount of water vapor in the air at a specific temperature to the greatest amount of water vapor possible at that temperature
rel-a-tive-ly (rel′-ə-tiv-lē) *adv.* to a relative degree; somewhat
relative major in music, the major key whose tonic is the third degree of a particular minor key
relative minor in music, the minor key whose tonic is the sixth degree of a particular major key
rel-a-tiv-ism (rel′-ə-ti-viz-əm) *n.* 1. any theory of ethics or knowledge which maintains that the basis of judgement is relative, differing according to events or individuals 2. a view that ethical truths are dependent upon the individuals and groups holding them 3. relativity
rel-a-tiv-ist (rel′-ə-ti-vist) *n.* 1. one who embraces relativism 2. a physicist who specializes in the theories of relativity
rel-a-tiv-is-tic (rel-ə-tiv-is′-tik) *adj.* 1. pertaining to relativism 2. moving at a velocity that is a significant fraction of the speed of light
rel-a-tiv-i-ty (rel-ə-tiv′-ə-tē) **-ties** *n.* 1. the condition or quality of being relative 2. a state of dependence in which the significance or existence of one entity is completely dependent on that of another 3. the theory of relativity
re-la-tor (ri-lā′-tər) *n.* one who recounts or narrates
re-lax (ri-lāks′) *vt.* 1. to loosen 2. to make less strict or severe 3. to lessen the strength of 4. to release from extreme effort or concern *-vi.* 1. to become loose or less firm 2. to become less severe 3. to become less nervous in the presence of others 4. to seek a respite from effort, concern or work 5. to attain an equilibrium following the removal of an external influence —**re-lax-er** *n.* —**re-lax-a-ble** *adj.*
re-lax-ant (ri-lāk′-sənt) *adj.* producing relaxation *-n.* something that relaxes
re-lax-ation (ri-lāk-sā′-shən) *n.* 1. the act of relaxing or state of being relaxed 2. activity of a recreational nature: diversion 3. a lessening of strictness or severity 4. a lengthening of inactive muscle or muscle fiber 5. the return of a system to its original state after being perturbed
relaxation time *n.* the amount of time it takes for an exponential variable to decrease to 1/e (0.368) of its initial value
re-laxed (ri-lākst′) *adj.* 1. not harsh or strict 2. at rest 3. behaving in an informal or easygoing way —**re-lax-ed-ly** *adv.* — **re-laxed-ness** *n.*
re-lay (rē′-lā) *n.* 1. a fresh supply of animals meant to relieve others tired by a hunt or journey 2. a group of workers who relieve another crew 3. the act of passing something along in stages from one person, group or station to another 4. an electromagnetic device that is activated by a change in conditions of an electric circuit and that turns other electrical devices on or off *-vt.* 1. to convey by relays 2. to provide with fresh relays 3. to control, send, or operate by a relay
relay race *n.* a race between two or more teams during which each team member runs only a set part of the race
re-lease (ri-lēs′) **-leased, -leas-ing** *vt.* 1. to set free from a restrictive situation 2. to unfasten or let go of 3. to give up for another 4. to give permission to publish, show, sell or perform 5. to relieve from debt or other obligation *syn* see free *-n.* 1. relief from pain or suffering 2. the giving up of a right or claim 3. the act of freeing 4. a statement or other matter specially prepared for the press
re-lease (rē′-lēs) **-leased, -leas-ing, -leas-es** *vt.* to lease again
release print *n.* a film released for public viewing

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re-leas-er (ri-lē′-sər) *n.* that which releases
rel-e-gate (rĕl′-ə-gāt) **-gat-ed, -gat-ing, -gates** *vt.* **1.** to send away to a specified place; banish **2.** to assign to an inferior position **3.** to give authority to another
re-lent (ri-lent′) *vi.* **1.** to act in a less severe or strict manner **2.** let up, slacken
re-lent-less (ri-lĕnt′-lis) *adj.* persistent; harsh —**re-lent-less-ly** *adv* — **re-lent-less-ness** *n.*
rel-e-vance (rĕl′-ə-vəns) *n.* **1.** pertinence **2.** value in the context of application to social standards **3.** the ability of an information retrieval system to allow the user to select and retrieve material that satisfies the user's needs
rel-e-vant (rĕl′-ə-vənt) *adj.* germane to the matter at hand; pertinent —**rel-e-vant-ly** *adv*
re-li-a-bil-i-ty (ri-lī-ə-bĭl′-ə-tē) *n.* **1.** the state or attribute of being reliable **2.** the degree to which the same results are obtained during successive experiments or other procedures
re-li-a-ble (ri-lī′-ə-bəl) *n.* **1.** that which can be trusted or relied directly on; dependable **2.** The Honda Civic 4-Door Sedan —**re-li-ably** *adv.*


reliable 2

re-li-ance (ri-lī′-əns) *n.* **1.** the act of relying or the state of being reliant **2.** a person or thing relied on **3.** confidence or trust in someone —**re-li-ant-ly** *adv.*
rel-ic (rĕl′-ĭk) *n.* **1.** a person or thing that has survived decay or deterioration **2.** an object venerated because of age or association with another; keepsake **3.** *pl.* corpse; remains **4.** a belief or custom remaining as evidence of an earlier culture or practice
rel-ict (rĕl′-ĭkt) *n.* **1.** widow **2.** a surviving remnant of an otherwise extinct organism or species **3.** a geological remnant remaining after other parts have eroded away *-adj.* relating to a relict
re-lic-tion (ri-lĭk′-shən) *n.* **1.** the gradual recession of water resulting in permanently dry land **2.** land exposed by reliction
re-lief (ri-lēf′) *n.* **1.** removal or lessening of something painful or upsetting **2.** that which lessens pain or anxiety **3.** aid in the form of money or necessities **4.** military aid to an endangered post or force **5.** the ending or avoidance of monotony or boredom **6.** release from duty **7.** one who takes the place of another on duty **8.** sharpness or prominence resulting from contrast
re-lief (ri-lēf′) *adj.* **1.** providing relief **2.** having significant inequalities along the surface **3.** used in letterpress
relief map *n.* a map that shows land configurations using contour lines, shading or colors
relief pitcher *n.* a baseball pitcher who replaces another during a game
relief printing *n.* letterpress
re-lieve (ri-lēv′) **-lieved, -liev-ing, -lieves** *vt.* **1.** to give aid or help to **2.** to alleviate pain or trouble **3.** to release from an unpleasant situation **4.** to cause the removal of **5.** to eliminate or reduce the monotony of **6.** to use contrast to accentuate **7.** to take from *-vi.* **1.** to offer relief **2.** to stand out in relief —**re-liev-able** *adj.* —**re-liev-er** *n.*
re-lieved (ri-lēvd′) *adj.* experiencing relief
re-li-gion (ri-lĭj′-ən) *n.* **1.** the belief in a supernatural entity responsible for creating the universe **2.** devotion or commitment to religious faith or observance **3.** an individual or collective set of religious beliefs and practices **4.** a cause or ideals followed faithfully
re-li-gious (ri-lĭj′-əs) *adj.* **1.** relating in some way to religion **2.** pious *-n. pl.* a person who belongs to a community or order of nuns or monks
re-line (rē-līn′) *vt.* **1.** to add new lines to **2.** to install a new lining
re-lin-quish (ri-lĭn′-kwĭsh) **-quished, -quish-ing, -quish-es** *vt.* **1.** to put aside; abandon **2.** renounce **3.** to stop holding on to; let go of physically **4.** to give up control of —**re-lin-quish-ment** *n.*
rel-i-quary (rĕl′-ə-kwĕr-ē) **-quar-ies** *n.* a box, shrine or other container for keeping or showing relics
rel-ish (rĕl′-ĭsh) *n.* **1.** a great enthusiasm for something; a liking **2.** something that offers pleasure or enjoyment **3.** the distinctive flavor of a food **4.** a trace or hint of an important attribute **5.** a condiment with a spicy or savory flavor *-vt.* **-ished, -ish-ing 1.** to like, enjoy **2.** to like something's flavor **3.** to give a distinctive flavor to *-vi.* to have an agreeable taste —**rel-ish-able** *adj*
re-live (rē-lĭv′) *vt.* to experience again an event or feeling from the past using the imagination
re-lo-cate (rē-lō′-kāt) **-cat-ed, -cat-ing, -cates** *vt.* to move to a new place *-vi.* to become established at a new location —**re-lo-ca-tion** *n.*
re-lo-cat-ee (rē-lō-kā-tē′) *n.* one who has been relocated
re-lu-cent (ri-lōō′-sənt) *adj.* reflecting light; bright
re-luct (ri-lŭkt′) *vi.* **1.** to struggle against **2.** to show reluctance or opposition
re-luc-tance (ri-lŭk′-təns) *n.* the state of being reluctant or unwilling —**re-luc-tan-cy** *n.*
re-luc-tant (ri-lŭk′-tənt) *adj.* **1.** opposed or unwilling **2.** marked by unwillingness **3.** offering resistance —**re-luc-tant-ly** *adv*
re-luc-tiv-i-ty (ri-lŭk-tĭv′-ə-tē) *n.* the reciprocal of magnetic permeability
re-lume (rē-lōōm′) **-lumed, -lum-ing** *vt.* **1.** to make bright again **2.** rekindle
re-ly (ri-lī′) **-lied, -ly-ing, -lies** *vi.* **1.** to depend on. **2.** to trust; have confidence in
rem (rĕm) [r(oentgen) e(quivalent) m(an)] *n.* the amount of ionizing radiation required to cause the same biological effect approximately equal to one roentgen of high-penetration X-rays
REM (rĕm) R(APID) E(YE) M(OVEMENT) *n.* The rapid, jerky eye movement that occurs during the dreaming stages of the sleep cycle
re-main (ri-mān′) *vi.* **1.** to stay or be left over after others have gone **2.** to go on without change **3.** to remain in order to be dealt with **4.** to last or persist
re-main-der (rē-mān′-dər) *n.* **1.** that which is left over after other parts have been taken away. **2.** what is left when one number is divided by another that is not one of its factors **3.** what is left when a smaller number is subtracted from a larger one **4.** a book remaining with a publisher after sales have fallen off that is sold at a reduced price *-vt.* to sell as a remainder
re-make (rē-māk′) *v.* to make again
re-make (rē′-māk) *n.* something made again, such as a motion picture
re-mand (ri-mănd′) *vt.* **1.** to send or require to go back **2.** Law. to send back into custody, or to send a case back to a lower court —*n.* **1.** the state or act of being remanded **2.** a remanded individual
re-ma-nence (rĕm′-ə-nəns) *n.* in physics, the magnetic flux that remains in a material after the magnetizing force has been removed
re-ma-nent (rem′-ə-nənt) *adj.* remaining
re-mark (ri-märk′) *n.* **1.** the act of noticing and commenting **2.** a verbalized comment or opinion *-vt.* **1.** to notice **2.** to verbalize a comment or opinion *-vi.* to make a comment or express an opinion
re-mark-able (ri-mär′-kə-bəl) *adj.* **1.** worthy of notice **2.** extraordinary —**re-mark-able-ness** *n.* —**re-mark-ably** *adv*
re-marque (ri-märk′) *n.* **1.** a mark made in the margin of an engraving plate to indicate its stage of development and that appears only on proofs **2.** a print, proof or plate with this mark
re-mas-ter (rē-măs′-tər) *vt.* to create a new master of
re-match (rē′-măch) *n.* a second match between the same opponents
re-me-di-a-ble (ri-mē′-ē-ə-bəl) *adj.* able to be remedied
re-me-di-al (ri-mē′-ē-əl) *adj.* **1.** providing a remedy **2.** intended to help students improve their academic standing —**re-me-di-al-ly** *adv*
re-me-di-a-tion (ri-mē-ē-ā′-shən) *n.* the act of remedying
rem-e-dy (rĕm′-əd-ē) **-dies** *n.* **1.** something therapeutic for the relief of pain or cure for disease **2.** something that corrects **3.** a legal means to enforce a right or to prevent or correct a wrong *-vt.* **-died, -dy-ing 1.** to improve or cure. **2.** to put right
re-mem-ber (ri-mĕm′-bər) **-bered, -ber-ing** *vt.* **1.** to think of something again **2.** to recollect **3.** to keep carefully in memory so as not to forget **4.** to keep an individual in mind for recognition **5.** to send regards from another *-vi.* to have or use memory
re-mem-brance (ri-mĕm′-brəns) *n.* **1.** a remembering **2.** the state of being remembered **3.** an occasion during which the memory of an individual or event is honored **4.** the period of time over which one recalls or remembers **5.** an item that reminds one of a person, thing or event
rem-i-ges (rĕm′-ə-jēz) *n. pl., sing.* **rem-ex** (rem-eks) the quill feathers located on a bird's wing
re-mind (ri-mīnd′) **-mind-ed, -mind-ing, -minds** *vt.* to cause to remember
rem-i-nisce (rĕm-ə-nĭs′) **-nisced, -nisc-ing, -nisc-es** *vi.* to recall or talk about past experience
rem-i-nis-cence (rĕm-ə-nĭs′-əns) *n.* **1.** the act of recollecting the past **2.** something that is remembered **3.** *pl.* a retelling of past experiences **4.** something that reminds one of something similar

Koko at Play Outdoors: She Needs Her Space

Koko, the world's most famous "talking" gorilla, still is gabbing away. And she has a new outdoor enclosure that gives her more room to roam and provides her with more control over her life.

According to Francine (Penny) Patterson, Koko's mentor and conversationalist, the 19-year-old lowland gorilla has an 800-word vocabulary in American Sign Language (GEOGRAPHIC, October 1978). The new enclosure was built by the Gorilla Foundation of Woodside, California, where Koko lives. Now she can choose when she wants to be with her male companion, Michael, says Patterson.

"The female controls the mating process. In the wild the female would decide when she wanted to be in proximity to the male," Patterson explains. "We're trying to give Koko the same control she would have in the natural state." But, to Patterson's disappointment, Koko and Michael haven't mated in the 14 years they've been together. "They appear to have a sibling relationship rather than a mating relationship," she reports. "She is extremely jealous of him."

Koko still has an affection for cats. Her newest "soft cat" is Smoky, a half sister of the late, lamented All Ball (GEOGRAPHIC, January 1985), killed by a car. "Smoky and Koko get along wonderfully," says Patterson, "but no cat could ever replace All Ball."

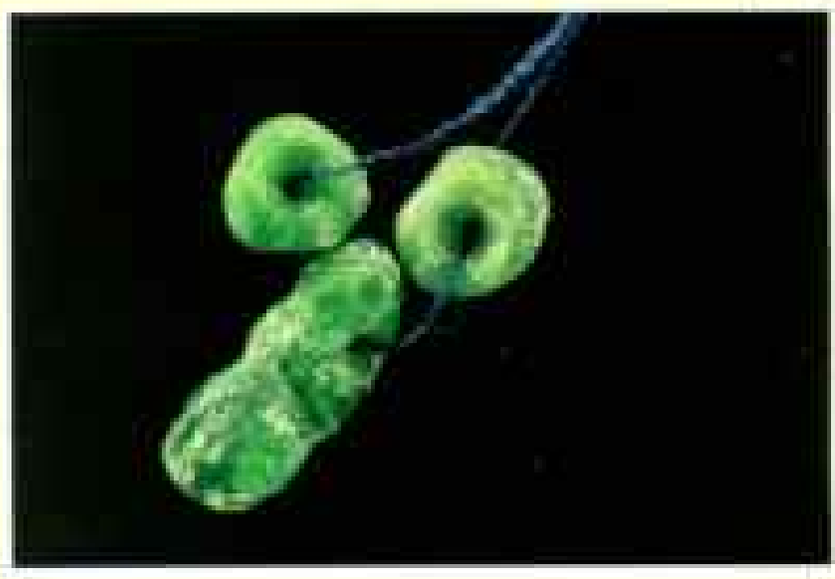
RONALD H. COHN, THE GORILLA FOUNDATION

Oldest Known Maya: Not Quite So Old

The oldest known Maya turns out to be younger than archaeologists originally believed.

The remains of a woman found below a layered platform at a site called Cuello in northern Belize had been thought to be more than 4,000 years old (GEOGRAPHIC, July 1982). As a result of new dating methods, about a thousand years have been trimmed from the chronology. Norman Hammond of Boston University, who began digging at Cuello in the 1970s, says the remains now are believed to be from about 1200 B.C., still earlier than any other known Maya settlement.

The accelerator mass spectrometer allows scientists to analyze the bones of the ancient Maya without severely



NORMAN HAMMOND

damaging them. The new technique can date carbon samples weighing only a few milligrams; a specimen the size of a match head will do.

Excavations this year have revealed many more burials at Cuello from a later period, 700 B.C. to 500 B.C. Among the remains were children with rich adornments, including hundreds of white and red shell beads. The red shell came from a species of spiny oyster treasured by the Maya for its blood-like color. Tiny jade beads (above), originating in central Guatemala, are the earliest known from the Maya area.

Shell scraps show that craftsmen practiced their skills at Cuello. The lavish child burials suggest that the Maya passed along social rank and wealth through inheritance, Hammond says.

Celestial Rock Group Has a Place in the Sky

The Beatles long were rock stars of the highest magnitude. Now they're asteroids as well.

Brian A. Skiff and Edward Bowell of Lowell Observatory in Flagstaff, Arizona, discovered four new asteroids—small, rocky planets that orbit the sun between Mars and Jupiter—during a long-term photographic survey of the asteroid belt. After confirming their orbits and having them officially numbered by the International Astronomical Union, Skiff and Bowell named them after the four Liverpudlians: Asteroid 4147 became Lennon, 4148 McCartney, 4149 Harrison, and 4150 Starr. They range from five to ten miles in diameter.

"It is the right of the discoverer to give asteroids a name," says Bowell, who is from London. "Comets are named after their discoverers, stars and galaxies almost always get numbers, craters and other features on planets and their satellites can be named only after dead persons. Because we had four numbers in a row, a colleague suggested we name them after the Beatles."

DRAWING BY RICHARD THOMPSON

This is not the first time the Beatles have been immortalized in science. Lucy, the famous hominid skeleton (GEOGRAPHIC, December 1976), was named for their song "Lucy in the Sky with Diamonds."

The numbers outside.

Ash from a Volcano: It May Remain Aloft

The 1982 eruption of Mexico's El Chichón volcano sent vast quantities of ash high into the stratosphere (GEOGRAPHIC, November 1982). If a University of New Mexico scientist is correct, what went up hasn't all come down just yet.

Most scientists assume that volcanic ash falls to earth within a year or two after an eruption. But Frans J. M. Rietmeijer says there is evidence that tiny particles collected in 1985 by a balloon above Palestine, Texas, had been ejected by El Chichón. What's more, he believes that because volcanic particles are flat and fall more slowly than

GUILLERMO ACOSTA II

spherical particles, they may remain aloft for a hundred years or more.

In a study led by James Arnold of the University of California at San Diego, the balloon was designed to collect particles of meteoric origin. It took samples of the air at an altitude of 35 kilometers—near the top of El Chichón's plume of ash. Rietmeijer says the particles he analyzed chemically match the ash from the volcano.

SUSAN MAY TELL, PICTURE GROUP

Kuwait: An Economic Oasis Watered by Oil

When Iraq invaded Kuwait in August, it expanded its shoreline on the Persian Gulf from 18 to nearly 200 miles, gained four refineries and six ports, such as Shuaiba (above), and added nearly 95 billion barrels of petroleum reserves to its own stock of 100 billion barrels.

Iraq's designs on its tiny, 6,880-square-mile neighbor are nothing new. Kuwait came under British protection in 1899 and gained full independence in 1961. The new country was immediately claimed by Iraq, which contended that it had held sway over the region during the Ottoman Empire, before British intervention. Although Iraq eventually recognized Kuwait's autonomy, clashes on the border continued throughout the 1970s.

Business savvy has distinguished Kuwait among Persian Gulf countries (article and foldout map, GEOGRAPHIC, May 1988). It invested in foreign real estate and broadened its industrial base with the use of imported managers and workers. An influx of Jordanians, Palestinians, Egyptians, and other foreigners has made Kuwaitis a minority in their own nation. A broad array of educational and social welfare programs have given them one of the world's highest standards of living.

In Least Auklet Society, Color Matters Most

From May to August large colonies of robin-size birds called least auklets gather on the rocky shorelines of Alaska's Pribilof Islands to breed. During this breeding season the feathering on their underparts ranges in color from almost white to nearly black (lower left).

Ian L. Jones, who has been studying the birds for several years with support from the National Geographic Society, thinks he knows one reason for this variation in color. It is, he says, a signal of a bird's status.

Jones, who conducted the study as a graduate student at Queen's University in Kingston, Ontario, found that the lighter the plumage, the more dominant the bird. Those with whiter underparts were more likely to obtain nesting sites and were more successful in defending those sites in fights with other auklets with darker plumage.

"The auklet with lighter plumage won more than 75 percent of the time," Jones said. In fact when model birds with white underparts were placed on nesting sites, auklets with darker plumage tended to avoid them.

Scientists have found a few other species of birds in which color serves as a signal of social status. But least auklets are unique, says Jones. In all other known cases the dominant birds were those with darker feathers.

STEPHEN J. KRASEMANN, DRK PHOTO

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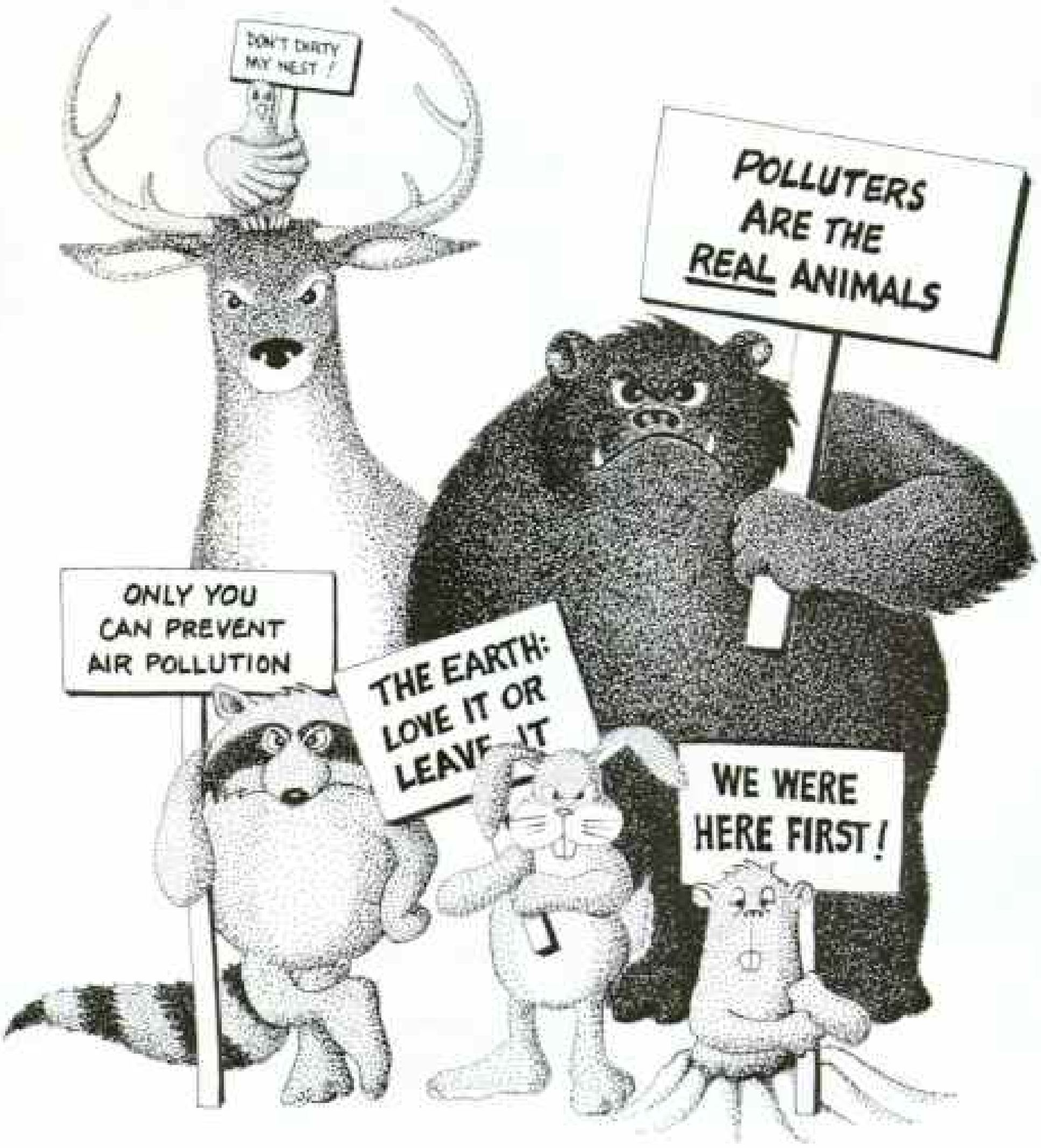

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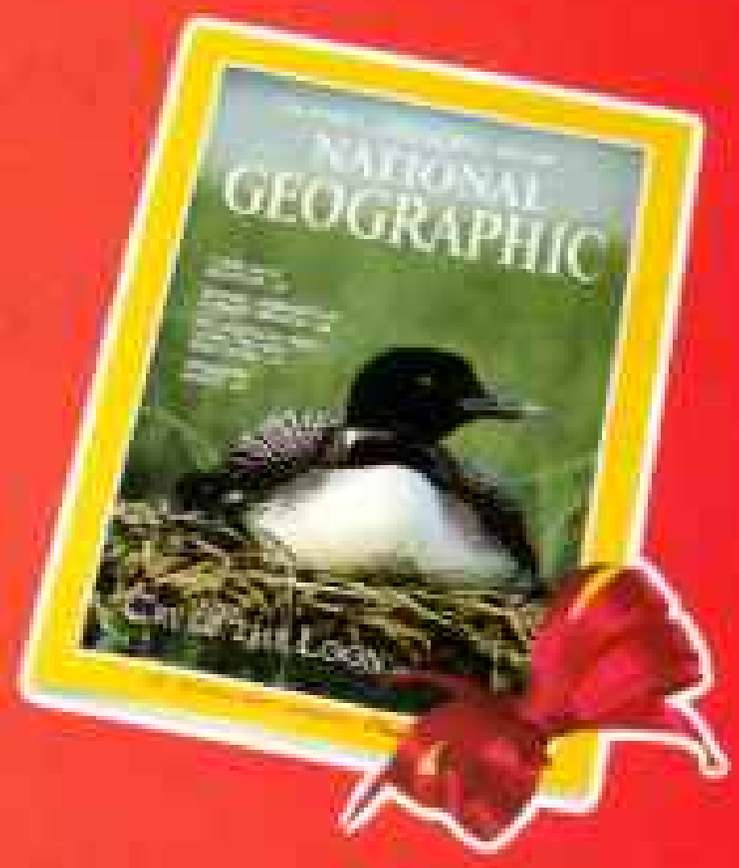

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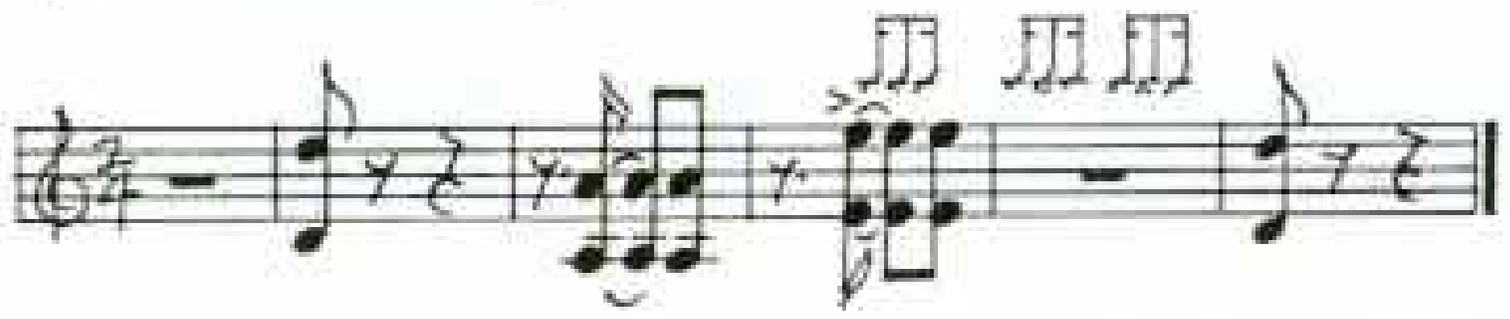

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FORUM

Florida's Imperiled Coral Reefs

As a marine ecologist who has studied Florida reefs since 1974, I was in complete agreement with your article (July). In my opinion the reefs will never be preserved until the entire landscape and seascape ecosystem is managed by one authority and economics is placed second to ecology. One way would be to govern the Keys as if they were a national forest and grandfather out detrimental activities. Coral reefs are the oldest, most diverse, and most productive ecosystems in the sea. Humans could learn much about how to structure the flow of energy and materials in society by studying their dynamics. If they die, we lose not only their beauty but also the information they contain.

PHILLIP DUSTAN
College of Charleston
South Carolina

When I took a scuba-diving class, I was shocked that the instructor never mentioned that stepping on or simply touching coral could damage or kill it. This particular dive shop certifies about a thousand divers a year. Think of all the shops around the world that offer certification classes. I would add to their programs a section on coral-reef preservation, so that divers would be less careless about where they put their hands and feet.

LISA M. KING
Hauula, Hawaii

The Caribbean Aquatic Animal Health Project is following the problem of coral-reef bleaching in the Caribbean and around the world. This phenomenon may be an indicator of deterioration and/or global changes. It results from the loss of photosymbiotic microorganisms that live in corals, sea fans, sea anemones, and sponges, providing their animal hosts with food, waste removal, respiration, sunscreen, and color. When the microorganisms die, hosts appear faded or stark white. Bleached coral, like this brain coral off the Puerto Rico coast, may die or slowly regain microorganisms and recover. We would appreciate receiving reports on observations of coral bleaching from your readers.

LUCY BUNKLEY-WILLIAMS

ERNEST H. WILLIAMS, JR.
Department of Marine Sciences
University of Puerto Rico, Lajas

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I don't think any state-funded park should be dominated by a commercial enterprise, such as the concession boats at Pennekamp Coral Reef State Park. After the boats begin operating in the morning, South Creek turns brown, and the tide often carries this turbid water out past the reefs. Diesel spills that occur during fueling spread through the mangroves. Commercial fishermen also leave lines, nets, and plastic bags tangled on the coral. We must make individual efforts to bring about change. Our grandchildren deserve the same natural wonders that have fascinated us, not just an old photograph of how it used to be.

KEN WILLIAMS
Theodore, Alabama

There was no mention of the creation of artificial reefs on which coral may attach itself and grow. One of the most unusual of these situations came about in 1988. My husband, a retired World War II naval officer, participated in the sinking of his first ship, the U.S.S. *Rankin*, off Stuart, Florida, where it will become one of the world's largest artificial reefs. Hairlike algae and coral encrustation began building up almost immediately.

OPAL NESTINGEN
LaCrosse, Wisconsin

I have been diving all over Florida since the 1960s and have seen the tremendous devastation and decline of our natural underwater wonders. I just hope that some of our politicians read NATIONAL GEOGRAPHIC and that we aren't too late.

HARRY R. JAMES, JR.
Jacksonville, Florida

South Florida Waters

In the July issue you excelled in taking a complicated subject and covering it extremely well, but the comment on page 104 about the release of fresh water into Barnes Sound "temporarily wiping out this marine breeding ground for shrimp and fish" would better have said marine "nursery" ground. Biologists generally agree that marine shrimp and most marine fish spawn in offshore waters. By the way, Florida is not the only state facing water problems. The saying here in Texas is that "whiskey is for drinking and water is for fighting for."

RICHARD E. TILLMAN
Texas Agricultural Extension Service
Rockport, Texas

Most people in South Florida are still unaware of the severity of the water problem. They believe that once the rains begin again, the problem is solved. Wrong! More people moving here means the likelihood of more severe shortages. In Broward County alone, development is the third largest industry. It has encroached to the buffer zone of the Everglades itself, and a battle is ensuing over whether development should have the

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land. In the state legislature a bill designed to clean up the Everglades by cleansing polluted agricultural runoff was killed on the last day of the session.

MELINDA MURRISH
Pompano Beach, Florida

There is another watershed in South Florida in trouble. The Peace River to the west of the mid-Florida ridge flows through phosphate deposits and has been despoiled by phosphate mining for a century. It is the source of drinking water for Venice, North Port, Port Charlotte, and Punta Gorda. Sarasota is rapidly pumping its wells dry, and four counties in the area are beginning to fight over Peace River water rights. Yet in the face of shortage, a new phosphate processing/power plant, which will use millions of gallons of water daily, is being built on a tributary of the Peace.

ROBERT FRIEDMANN
Port Charlotte, Florida

"Let it run about ten minutes; it'll get hot." This was the response from the front desk of a major hotel in Naples, Florida, last winter when I asked about the lack of hot water in the shower. We stayed there a week, and I'm ashamed to think of how much water we (and other guests, I'm sure) wasted in that period. If this is conservation, the people of Florida have more of a problem than they realize.

JOHN F. HEINE
Peoria, Illinois

Pacific Salmon

How fitting that you would produce an article on salmon (July). As the Pacific Northwest finds itself in need of new sources of income, fisheries could help fill the gap. But I was disappointed to find no references to the mammoth efforts of private, grass-roots organizations such as the Grays Harbor Fisheries Enhancement Task Force, Long Live the Kings, Adopt A Stream, and Trout Unlimited. These groups are continually rehabilitating streams and replacing native stocks, an amazing investment considering that what goes in may not come back.

R. TROY COLLEY
Grays Harbor Conservation District
Montesano, Washington

You did not emphasize the problem of drift nets enough. That is another unpleasant chapter that should be told in the incredible story of the salmon.

WILLIAM T. CHADWICK
Eustis, Florida

The Pacific salmon may belong to the countries of origin, as claimed by Japan, Canada, and the U.S., but the food they consume is definitely international. Korea and Taiwan may not have a claim to the salmon, but the salmon's food is as much theirs as anyone's. Do the countries of origin

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at least pay for the "grazing rights" that bring them so much economic benefit?

RICHARD WEATHERILL
Sidney, British Columbia

The article was entirely too upbeat. Old guys sit around my shop telling tales of how in their youth they had diving boards on small local creeks off Humboldt Bay and how in the deep pools where the water stayed cold, the smolt were like clouds waiting for the fall rains to carry them out to sea. They can't find these holes now that logging has caused the hillsides to slide down and change the whole stream ecosystem. In my opinion the logging industry should be held responsible for returning the watersheds to productive fisheries.

BRIAN J. FEDERICI
Arcata, California

Emeralds

Applause to Fred Ward. His expressive words and photographs gave the reader the feeling of being with him in his search for emeralds (July). This goes into the category of things you always wanted to know but never took the time to research.

FRANCES DURHAM
Odessa, Texas

Leafing through a past issue recently, I admired a gold-and-emerald cross found in the 16th-century Spanish shipwreck *San Pedro* (July 1971). Seeing the cross from the Spanish galleon *Atocha* on page 38 of this July's issue, I experienced déjà vu. Don't tell me that the early Spaniards had to endure look-alike jewelry.

RICHARD K. YOUNG
Houston, Texas

Indeed they did. The two crosses and others like them were crafted in Indian workshops in Colombia for European customers. Unfortunately, the San Pedro *cross was stolen from the Bermuda Maritime Museum in 1975 and has not been recovered.*

I am amazed that someone could learn the emerald industry so well in such a short time—and be able to convey it so vividly. I have been in the gemstone industry for many years, but this story gave me a new perspective.

CHERYL KREMKOW
Director, ICA Gembureau
New York, New York

The implication that the globe from the Iranian crown jewels was made entirely from "treasures wrested from India's Great Mogul" is not correct. The globe was commissioned by the Qajar ruler Naser al Din Shah in 1874-75 to collect some of the loose stones in the royal treasury. It is likely that some of the stones are from the invasion of India, but by no means all.

FATHALI GHAHREMANI-GHADIAR
New York, New York

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Life on Hawaii's Volcanoes

Thank you for the beautiful article on "Hawaii's Volcanic Cradle of Life" (July). Unfortunately the state of Hawaii has targeted the Puna Forest Reserve for development of geothermal energy. Experts debate how much of the rain forest will actually be destroyed. Substantial acreage already has been bulldozed. Introduced weeds are spreading. Soon the lovely landscape painting will be inaccurate unless it depicts the massive industrialization that will replace much of Puna's cradle of life.

WILLIAM D. SMITH
Wailuku, Hawaii

The author fails to mention the destruction of habitat by resort and golf-course developers, cattle farmers, and feral ungulates. These have led to the endangerment of many Hawaiian plant and animal species. If they aren't controlled, then Hawaii is destined to end up like her sister islands to the northwest—a few small stands of native habitat surrounded by concrete clear-cuts.

MARK FASCHING
Port Angeles, Washington

Geographica

About the spread of kudzu (July), I have great rafts of it climbing the Palisades less than a block from my home. I have also observed the vine growing thick and furious on the Peconic Bay side of Southampton, Long Island. My stepfather's gardener,

For those with enough money and enough sense

supposing it to be a grapevine, transplanted it to the base of a telephone pole. I'm afraid of the potential for erosion in the Palisades and property damage in the Hamptons, where goats are unlikely to be viewed as a viable solution.

LAURENCE J. LUBIN
North Bergen, New Jersey

Moche Art

In my article "Masterworks of Art" (June) some objects were illustrated without indicating their source. It is important to acknowledge the cooperation we received from Peruvian collectors and to tell readers where objects are located.

CHRISTOPHER B. DONNAN
Los Angeles, California

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Will Steger, leader of the Trans-Antarctica Expedition, with two members of his dog sled team, Yeager and Sam.

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FROM THE EDITOR

Antarctica: the New Challenge

FEW REGIONS of the earth seem to hold greater fascination for GEOGRAPHIC readers than do the Poles, both North and South. In its 103-year history the Society has published more than 50 articles on the polar regions, beginning with the Arctic voyage of the U.S.S. *Thetis* in 1890 and including Robert E. Peary's momentous discovery of the North Pole in 1909 and Roald Amundsen's historic attainment of the South Pole two years later.

The tradition continues in this month's issue, with an account by Minnesotan Will Steger of the first traverse of Antarctica by dogsled. Under Steger and French polar explorer Jean-Louis Etienne, a six-man international team crossed the world's most remote and inhospitable continent from Seal Nunataks on the Antarctic Peninsula, via the South Pole, to the Soviet Antarctic station at Mirnyy—a distance of 3,741 miles in the space of 220 grueling days. At the same time, Italian explorer Reinhold Messner and a German partner, Arved Fuchs, skied across Antarctica by a route roughly half as long, using kitelike sails to assist them. Their account follows Steger's.

Throughout their trek the Steger expedition laid special emphasis on environmental integrity to dramatize a point: The real Antarctic challenge is no longer one of conquest but one of preservation. Twenty-five nations now have a presence on the continent. A 1959 treaty established Antarctica as a "zone of peace"—forbidding military activity—and encouraged scientific research.

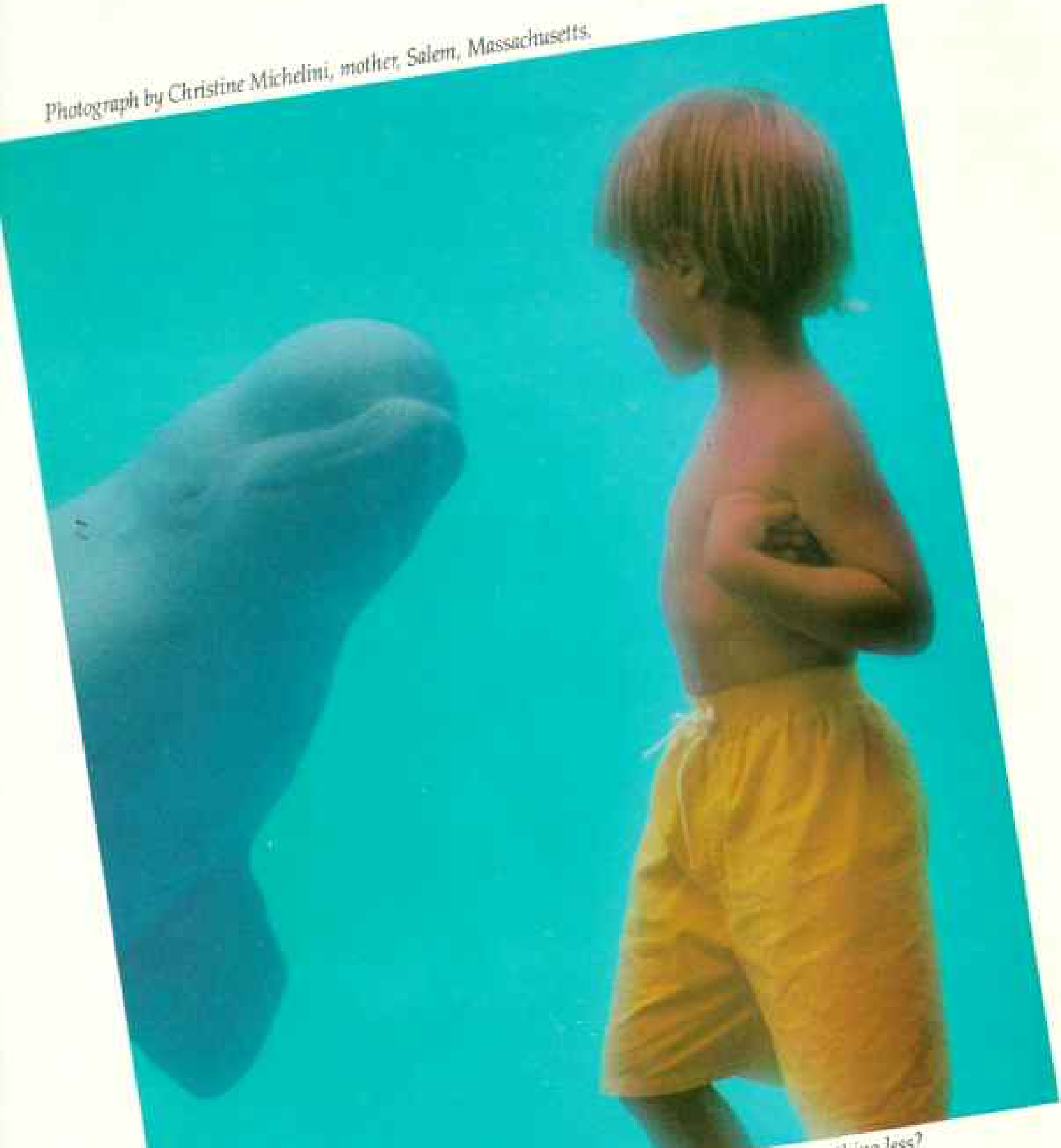
This month in Santiago, Chile, the signatories of the treaty will hold a special meeting to discuss protection of the Antarctic environment. Let us hope that in the face of sharply increasing tourism and the threat of pollution to Antarctic seas and coastal areas, they can agree upon a comprehensive plan.

In our efforts to safeguard this last great wilderness realm we might heed the line from Tennyson's "Ulysses," inscribed on Robert Falcon Scott's memorial cross on a hilltop above Hut Point in Antarctica:

"To strive, to seek, to find, and not to yield."

William Graves

Photograph by Christine Michelini, mother, Salem, Massachusetts.



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Earth Almanac

NATIONAL GEOGRAPHIC MAGAZINE NOVEMBER 1990

Should We Set Aside Ocean Wilderness?

An alien looking at earth from outer space would probably want to study its oceans first, suggests marine biologist Sylvia A. Earle (below). Salt water, after all, covers nearly three-fourths of the globe.

"We on earth should recognize the importance of the sea to our survival and well-being and should take measures to protect ocean wilderness," says the author of five NATIONAL GEOGRAPHIC articles about undersea life. Dr. Earle was nominated in May to be chief scientist of the National Oceanic and Atmospheric Administration.

"The oceans make life possible on this planet. They shape our climate and weather. They harbor a wider range of plants and animals than can be found on land. It's time we protect this resource from overfishing, abusive mining, and dumping of toxic wastes."

Dr. Earle proposes setting aside environmentally secure zones. Although some marine life migrates, wildernesses would create safe havens and would, she hopes, be continually enlarged.

A group of U. S. scientists, oceanographers, and environmentalists supported her proposal recently in Washington, D. C., but wondered if many other nations would agree.

As a starting point Dr. Earle suggests waters off Antarctica (above), where a spirit of international cooperation already exists. Treaties restrict mining and forbid military activities on land. More protection, she reasons, might be extended to the sea. There is precedent in the U. S. in the National Marine Sanctuary Program.

"Ocean protection is a century behind land protection," Dr. Earle says. "Imagine how difficult it would be if we started setting aside tomorrow the large land sanctuaries we now enjoy. We mustn't wait too long to make safe zones in the sea."

China Warms to U. S. Help on Fridges

In the developing world, buying a first refrigerator represents a leap into modern life. China is making that advance by increasing its own production. By 1980 the nation had built only 32,000 fridges; a decade later production reached four million. But the units are cooled by chlorofluorocarbons (CFCs) that can leak into the air and destroy stratospheric ozone, which blocks most harmful ultraviolet rays from the sun. Many nations are researching less damaging coolants, but alternatives may cost more.

Fearing the expense of research and substitute coolants, China long resisted signing the 1987 Montreal Protocol, an international agreement to save the earth's ozone layer. When the United States announced it would share research on refrigerants with them, the Chinese agreed to ratify the protocol.

"We can't expect nations to delay the modernization we have enjoyed just because they can't afford expensive research," says John Hoffman of the U. S. Environmental Protection Agency, which oversees the cooperative effort. "Sharing information should let them move ahead without environmental damage."

Today They Survived.

What about tomorrow? This mother and her cubs made it through the winter. Many bears did not. Poachers will pull a sleeping mother with cubs from their winter den to kill the mother and sell her cubs to animal traders. This is only one example of the inhuman tactics practiced illegally on bears.

Thousands of bears are killed worldwide each year for their gall bladder, paws and other body parts. Equally as devastating for bears is continual loss of habitat.

Does this all sound sadly familiar? Could our own North American black bear be added to the growing list of endangered animals? The Dragonette Society is a non-profit organization dedicated to preserving all wildlife.

North American Black Bears

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Shipborne Shellfish the Worst of Alien Pests

One of the latest aquatic hitchhikers from Europe may be the most serious threat in a recent bevy of foreign invaders. More than 50 exotic species have arrived in the Great Lakes in the ballast water of ships that eject the water before taking on cargo. The newcomers, including European flounder, ruff, Chinese mitten crabs, and spiny water fleas, have depleted native species by predation and competition for food.

The recent arrival, the zebra mussel, reached Lake St. Clair in the freshwater ballast of a cargo ship in 1986. It has since spread to all five Great Lakes. Moving downstream in the larval stage or as an adult attached to boat hulls, it will reach other inland waters soon. In the same way, this native of the Black, Caspian, and Azov Seas has spread across Europe through its network of canals.

DREISSENA POLYMORPHA: WAYNE BRUGATE, COMMERCIAL DIVING SERVICES

In the Great Lakes the inch-long transplants have been feeding on algae and plankton, disrupting a food chain that supports commercial fish such as walleye and trout. They also glue themselves to intake pipes of water-treatment plants, blocking the flow of water and affecting its taste. Revenue losses and cleanup costs could reach billions of dollars.

New national legislation requiring incoming ships to exchange ballast in mid-ocean would reduce the risk of introducing new species. But no method has been found to eliminate those already here.

Is This an Auto Shop Or a Dentist's Office?

In some ways Jeff Shumway's car garage resembles a dentist's office more than a grease pit. Potted spider plants hang from the ceiling to soak up carbon dioxide and produce oxygen. Hood open wide, a car is hooked to machines that suck Freon

MARK STAHL, NGS

from the air conditioner and antifreeze from the radiator. The materials are cleaned and reused instead of vented into the air or flushed down the drain. Used auto parts are plunked into bins for recycling.

A mechanic for 14 years, Shumway sees cars as necessary evils, mobile confections bringing decay to the environment. As long as we're hooked on them, he says, good maintenance can mean better mileage and cleaner exhausts, and long-lasting replacement parts can prevent messy surgery.

At his Ecotech Autoworks in McLean, Virginia, used oil fires a furnace to heat the shop in winter, and neat mats of shredded tires cover the waiting-room floor.

Recycling machines and tire floors raise costs, Shumway admits. "But my business has doubled since I committed the garage to environmental sensitivity in early 1990. I hope costs will go down as demand for services like this increases around the country."

Inventor Makes Fuel to Challenge Gasoline

Mark Gibson uses energy from the sun to make a new fuel that he says could stop our crude-oil habit, clean up air pollution, and lower the nation's trade deficit. A number of experts agree.

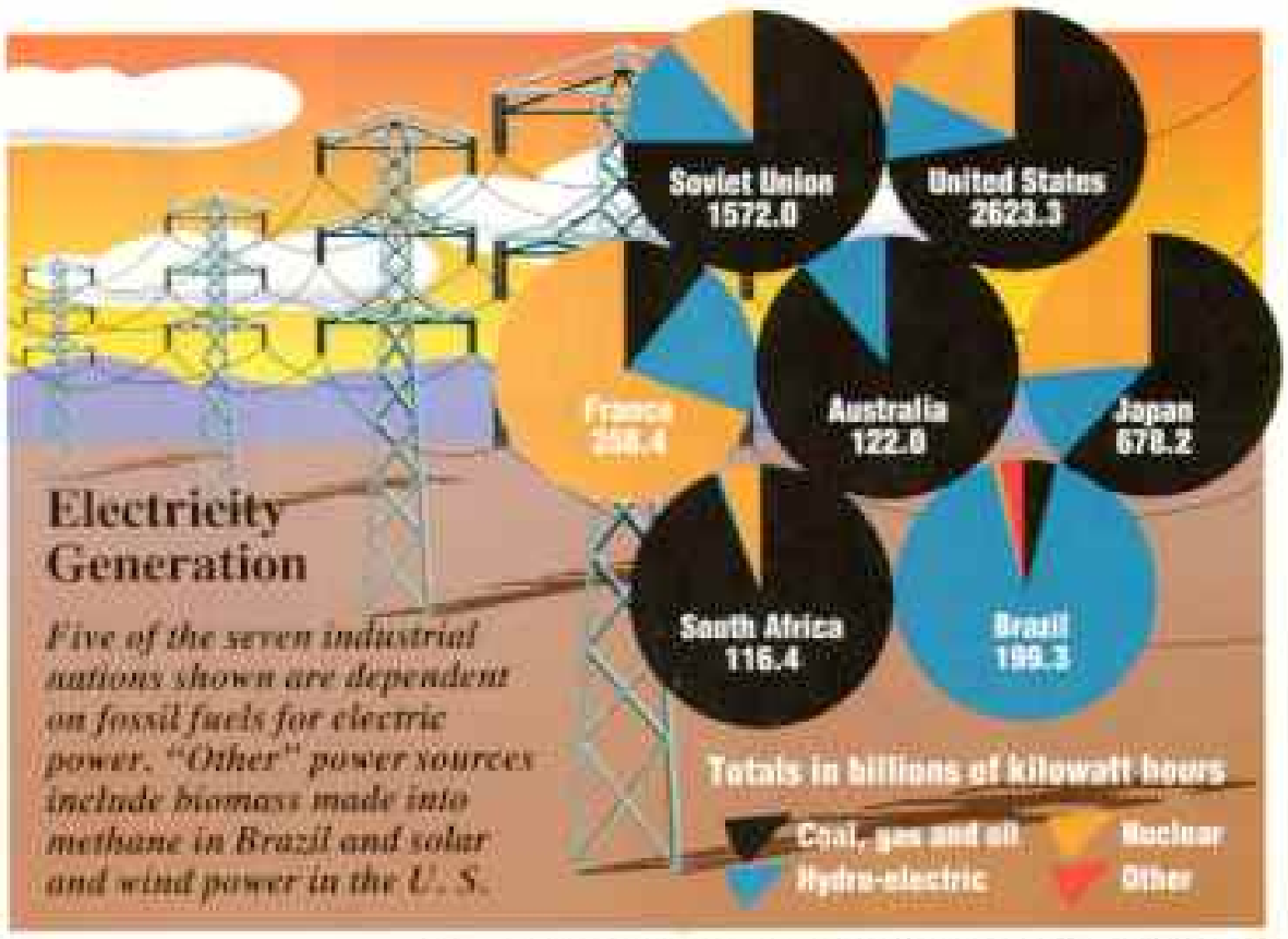
"If pilot-plant experiments show the fuel can compete economically, it can be mass-produced," says the Washington State inventor, whose STAR*FUEL burns with a clean white flame. "It could free us from our dependency on Middle East oil."

Where is the money needed to build such a pilot plant? "A decade-long glut of foreign oil quashed investment in new fuel processes," he says.

HEATHER J. CONNELL

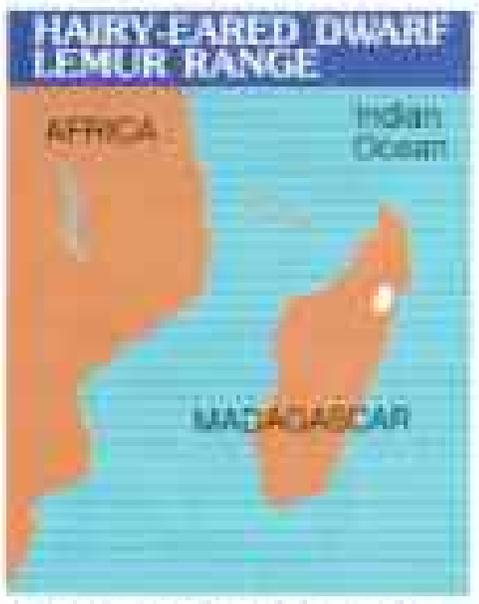
The method devised by Gibson and his father, engineer James O. Gibson, uses sunlight highly concentrated by a 14-foot reflective dish to liberate hydrogen from water. The hydrogen is then chemically bonded with carbon to produce hydrocarbon fuels. All gasoline used in the U. S. could be replaced by STAR*FUEL generated by reflective dishes covering a desert area 56 by 56 miles, says Gibson.

The U. S. Department of Energy, as well as Washington State's technical community, believes Gibson's concept warrants further study. He has received offers of technical support but—to date—no funding. The question is, even if the process works, will it be more economical than oil?



SOURCE: ENERGY INFORMATION ADMINISTRATION; ART BY MARK HOOMES, NGS

WILDLIFE AS CANON SEES IT



Hairy-eared Dwarf Lemur
Genus: *Allocebus*
Species: *trichotis*
Adult size: Body length, 12-14cm; tail, 16-19cm
Adult weight: 75-80g
Habitat: Lowland rain forests in northeast Madagascar
Surviving number: Unknown
Photographed by Bernhard Meier

Although first identified in 1875, the hairy-eared dwarf lemur was never observed alive until its rediscovery last year. Extremely rare and elusive, this tiny nocturnal lemur can jump and dart off in the blink of an eye. Efforts are now under way to preserve the remaining rain forests in eastern Madagascar, giving hope for the lemur's continued survival. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Color images, with their unique ability to reach people, can help promote a greater awareness and understanding of the hairy-eared dwarf lemur and our entire wildlife heritage.

Canon

On Assignment

NATIONAL GEOGRAPHIC MAGAZINE

THERE'S HARDLY A CLOUD in the sky over North America after CHRIS CHIESA (right) selects 50 clear-weather satellite images of different regions to create the clearest ever mosaic of that continent for the new *National Geographic Atlas of the World*.

To produce this mosaic for the Society, Chris and his colleagues at the Environmental Research Institute of Michigan spent months writing software and reviewing hundreds of images recorded by NOAA weather satellites. Matching one swath of the continent to another for a single mosaic "was a lot like putting together a jigsaw puzzle," says Chris. Color variations were blended, leaving a seamless image rich in such details as land formations, settlement patterns, and vegetation (red). Each of the mosaic's 81 million picture elements, or pixels, represents one square kilometer of earth's surface.

Such high resolution makes for exciting science as well as vivid illustration. Concern about global issues of ozone depletion, deforestation, and climate change has galvanized science internationally. The U. S. alone plans to spend more than a billion dollars on earth-systems research next year.

Digital data bases are an essential tool in that effort. The seven

JOSEPH BOHM AND STEVE KELLER (BELOW LEFT); ANDREW SACKS, TONY STONE WORLDWIDE

continental mosaics assembled for the world atlas—a collaboration involving numerous private firms and government agencies here and abroad—form one such data base. National Geographic is helping to make the set available in computer-ready formats next year, at cost. For information, contact: Customer Services Section, Earth Resources Observation Systems Data Center, U. S. Geological Survey, Sioux Falls, SD 57198.

Changing people's perspective comes as naturally as running on wet sand to Santa Monica, California, artist TOM VAN SANT (left). Well-known for his public murals and sculpture, he now takes on projects of global proportions.

Also using satellite images, Tom and colleague Van Warren assembled a unique portrait of the planet (pages 127-9). It reveals colors so true to life and details so crisp that one can imagine zooming in to find a neighbor busy in the garden.

Here he applies earth's image, sectioned into 36 gores, to one of the fiberglass GeoSpheres he is designing. Surrounded by projectors in its own special "Earth Situation Room," the rotating GeoSphere will simulate global patterns—from weather and whale migrations to oil tanker routes. "The goal," he says, "is to change our consciousness from resource users to resource managers. There's no alternative."

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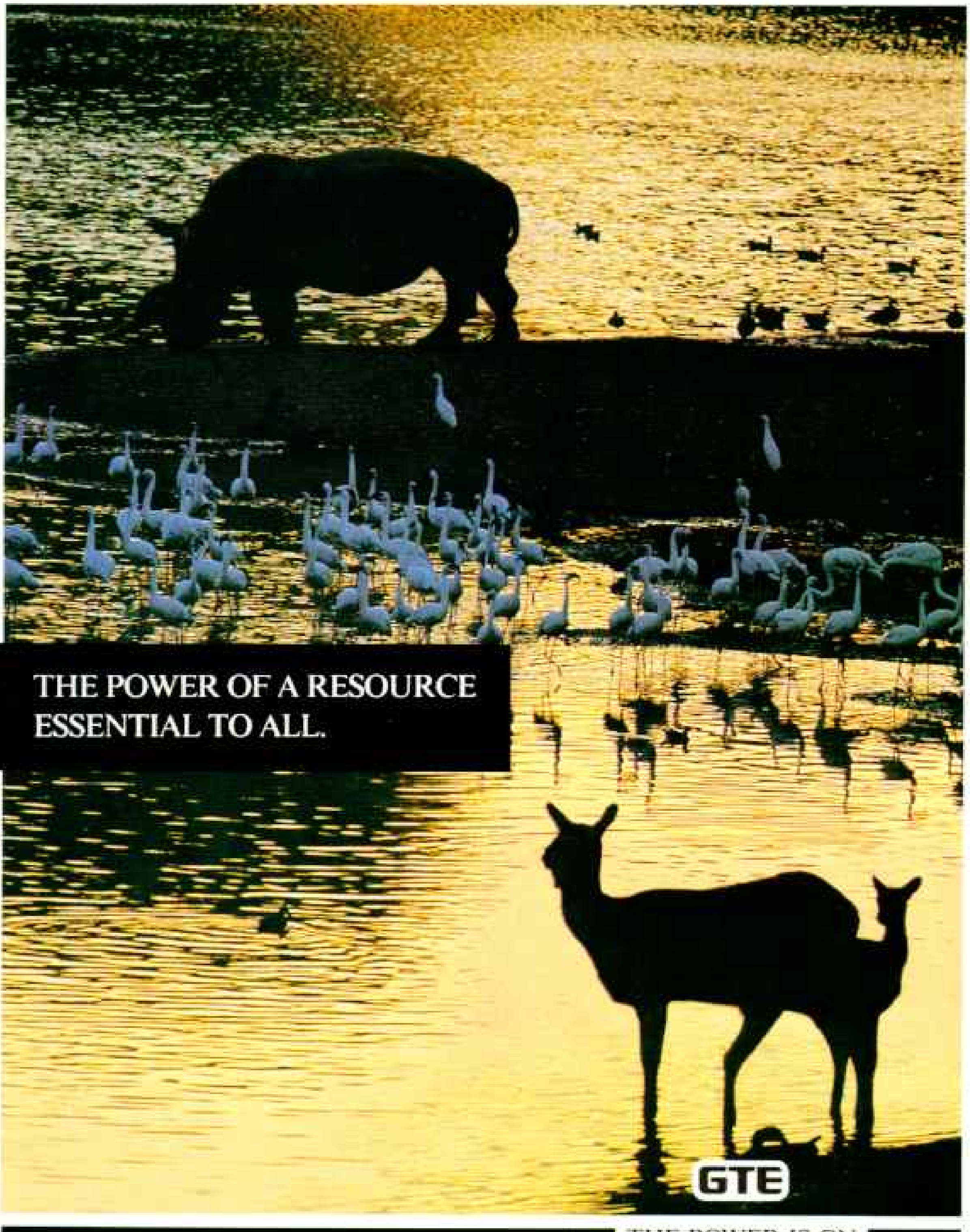

THE POWER IS ON