VOL. 161, NO. 2 FEBRUARY 1982

NATIONAL GEOGRAPHIC

SEE "EGYPT: QUEST FOR ETERNITY" WEDNESDAY, FEBRUARY 3, ON PBS TV

RECENTLY, on my way to Kampuchea's fabled Angkor Wat with a team preparing a report for an upcoming issue, I stayed several days in Saigon. After a ten-year absence, it was like meeting an old friend who had fallen on hard times. The once charming and dynamic city seemed to shuffle in place, prematurely aged by postwar poverty. The few foreigners who now stroll the tree-shaded streets are mostly Russian advisers ("Americans without money," a sad merchant told me).

The sight that left me truly joyless was this American-Vietnamese boy outside my hotel. A

WILBUR E. GARRETT

streetwise Oliver Twist, he was part of an outcast group sent to beg by someone who wrote the note for him. He spoke no English.

When the French left in 1954, they took 25,000 French-Asian children to France and gave them citizenship. We left ours behind.

We have turned our backs on Vietnam, and on tens of thousands of half-caste children. Because of their U. S. fathers, they are considered "aliens." They are denied employment, education—and even food-ration cards. A ray of hope in this dismal picture is the bill introduced by Congressman Stewart B. McKinney (R-Conn.) that would give Amerasian children preferred immigration status. Perhaps they won't be forgotten forever.

Wilbur E. Garrett

EDITOR

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COVER: *The Pyramids still dominate the desert at Giza, as they did for centuries before 1798, when Napoleon passed by in his fleeting conquest of Egypt. Photograph by Gordon W. Gahan.*

NAPOLEON

THE LETTERS, brownish with age, were held in large folio volumes. As I scanned the crabbed handwriting, the misspelled words, I could envision the author. He was then 26, of just below average height, skinny, with brown hair and blue-gray eyes. A colleague joked that in the saddle he looked like a boy riding his father's horse, but he commanded the French Army in Italy. And if those blue-gray eyes flashed as he wrote, it was not difficult to understand. He was killing men well and winning battles; he understood now that his intellect was superior and that he might do great things in Europe; and he was in love.

"Joséphine," he wrote, "you should have left Paris on the 5th, you should have left on the 11th; you had not left the 12th . . . My soul was open to happiness: it is full of sorrow. . . . You have never loved. . . . Cruel! . . . Good-bye, Joséphine; stay in Paris; don't write me any more, and at least respect my asylum. A thousand daggers tear at my heart; don't push them in any more. Good-bye, my happiness, my life, everything that exists for me on earth!"

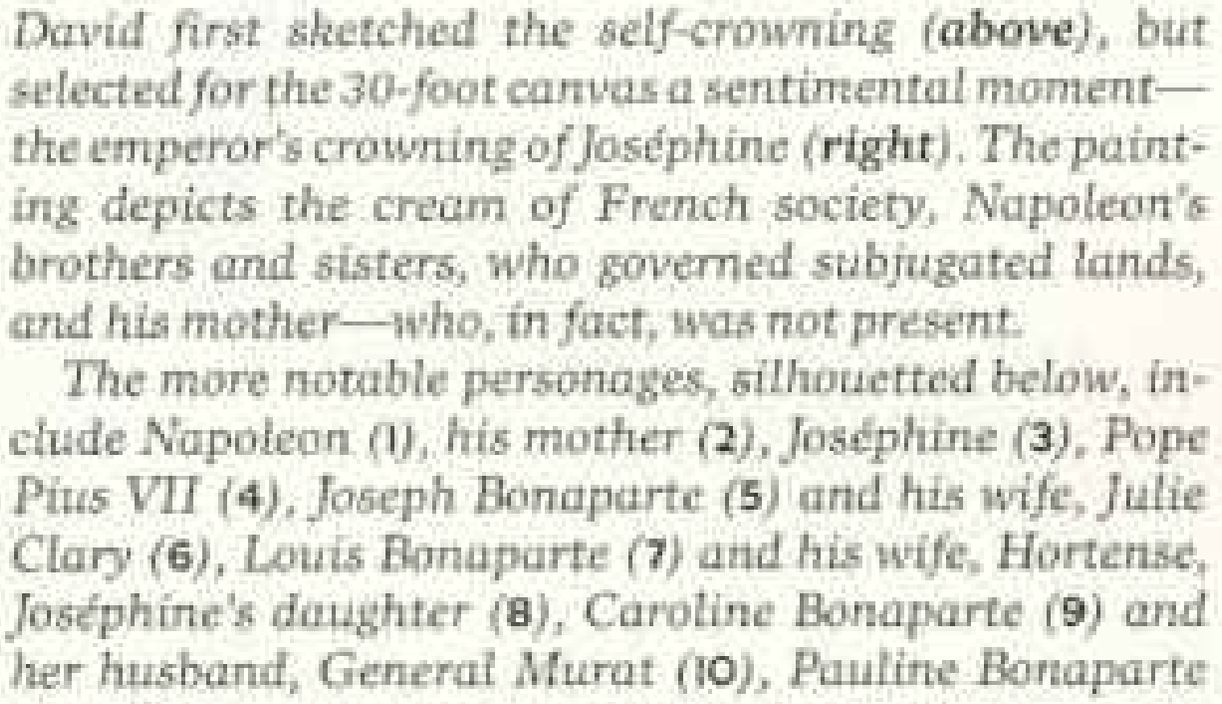
Joséphine did come in time to Italy, but the letters continued. She stayed in a palace; he was often off with the army. "Three days without your letters," he wrote. "Today, alone with the thoughts, the work, the writing, the men and their tedious projects and cackling, I don't even have a note from you

By JOHN J. PUTMAN
NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by GORDON W. GAHAN
NATIONAL GEOGRAPHIC PHOTOGRAPHER

From upstart soldier to emperor, *Napoleon Bonaparte dominated Europe in the tumultuous years after revolution toppled the French monarchy. Military victories in Italy made him a hero at 26. Political maneuvers placed him at the head of France at 30. Then, like Charlemagne, he summoned the pope to preside at his coronation. For the official painting of the 1804 spectacle in Notre Dame Cathedral, artist Jacques Louis David first sketched the self-crowning (***above***), but selected for the 30-foot canvas a sentimental moment—the emperor's crowning of Joséphine (***right***). The painting depicts the cream of French society, Napoleon's brothers and sisters, who governed subjugated lands, and his mother—who, in fact, was not present.*

The more notable personages, silhouetted below, include Napoleon (1), his mother (2), Joséphine (3), Pope Pius VII (4), Joseph Bonaparte (5) and his wife, Julie Clary (6), Louis Bonaparte (7) and his wife, Hortense, Joséphine's daughter (8), Caroline Bonaparte (9) and her husband, General Murat (10), Pauline Bonaparte (11), Elisa Bonaparte (12), Eugène de Beauharnais, son of Joséphine (13), the artist David (14).



PAGES 142-143: ALL BY JACQUES LOUIS DAVID, MUSÉE DU LOUVRE, PARIS

NAPOLEON'S EUROPE

KINGDOM OF DENMARK AND NORWAY

KINGDOM OF SWEDEN

Moscow

Borodino 1812

Berezina 1812

Friedland 1807

PRUSSIA

Neman

RUSSIAN EMPIRE

EUROPE IN 1812

- French Empire
- Subject to France
- Allies of France
- Other empires and countries
- France 1789
- Battle site

HOLLAND

GREAT BRITAIN

DUCHY OF WARSAW

Leipzig 1813

Jena 1806

Waterloo 1815

CONFEDERATION OF THE RHINE

Prague

Austerlitz 1805

Wagram 1809

Vienna

Paris

Fontainebleau

AUSTRIAN EMPIRE

FRENCH EMPIRE

Rochefort

KINGDOM OF ITALY

Lodi 1796

Marengo 1800

ILLYRIAN PROVINCES

Danube

BLACK SEA

Constantinople

OTTOMAN EMPIRE

Toulon

Elba

TUSCANY

CORSICA

Ajaccio

Rome

Somosierra 1808

Madrid

KINGDOM OF NAPLES

KINGDOM OF SARDINIA

KINGDOM OF SPAIN

SICILY

MEDITERRANEAN SEA

Trafalgar 1805

0 KILOMETERS 300

0 STATUTE MILES 200

PAINTING BY ROY ANDERSON
CALLIGRAPHY BY JULIAN WATERS
COMPILED BY MARGUERITE K. HUNTER
NATIONAL GEOGRAPHIC ART DIVISION

CONSULTANTS: DAVID G. CHANDLER, OWEN CONNELLY

LIKE NO MAN since Caesar, Napoleon held the reins of power over most of Europe for more than a decade. A leader of iron will and far-ranging intellect, he could recall campaign details and soldiers' records for years. And he could muster the energy to work 20-hour days, dictating to four secretaries at once.

Most of all, he seized opportunities. The French Revolution had imbued Frenchmen with a new spirit of liberté, égalité, fraternité. They formed citizen armies to fight royalists within France and abroad, giving young Bonaparte the instrument he needed. After French troops ousted English and Spanish forces from Toulon, Napoleon was promoted from artillery captain to brigadier general. Thereafter he was ready to challenge the regimes of powerful neighbors—Austria, Prussia, and Russia.

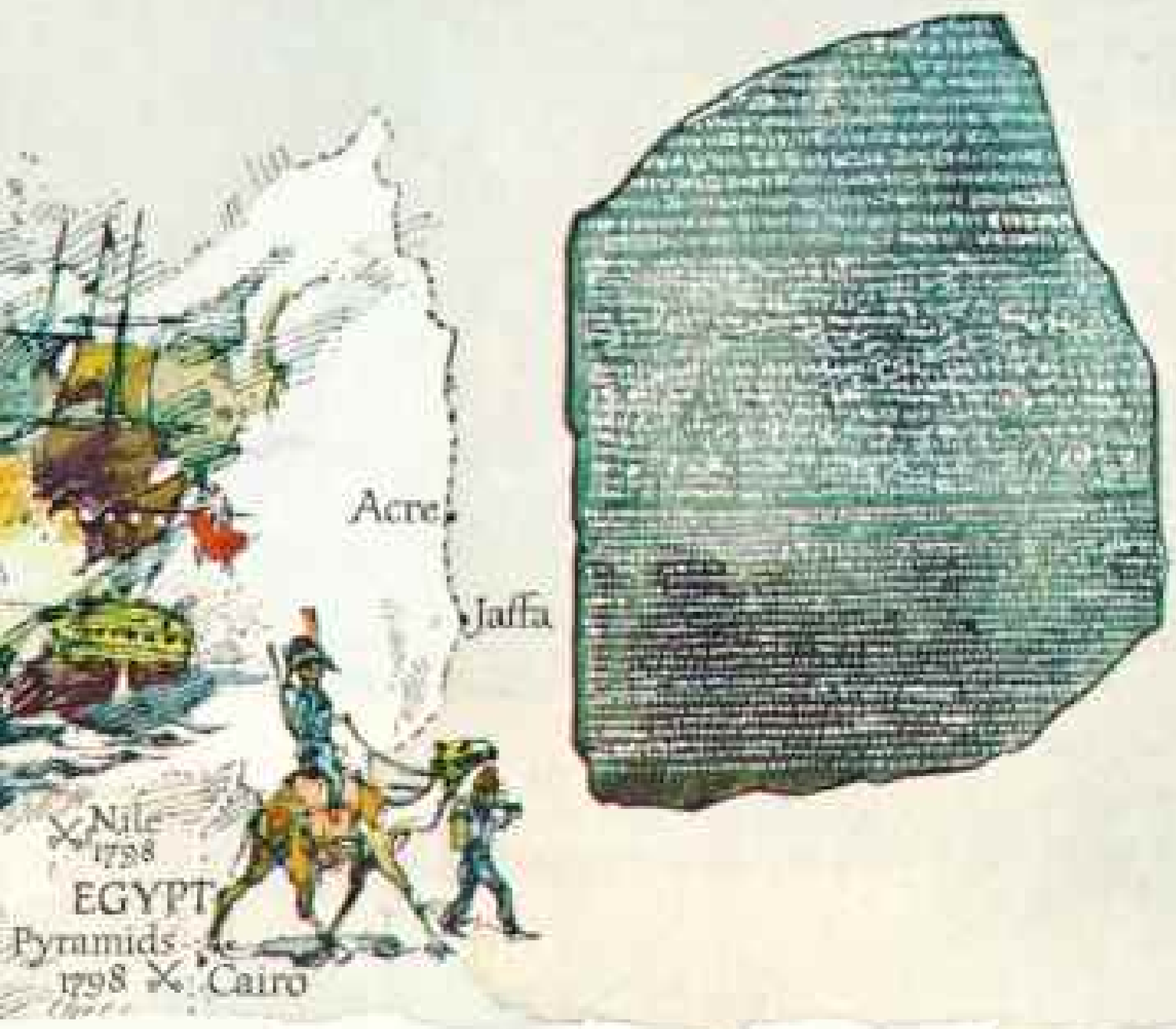
Victories in the first Italian campaign against Austrian forces in 1796-97 gave Napoleon the conviction that he was "a superior being," and he undertook a grandiose expedition to Egypt, a conquest made untenable by a British naval blockade. His second campaign into Italy against a resurgent Austrian army in 1800 assured his absolute control of France.

Through his usual—and masterful—strategy and battlefield tactics, he shattered yet another Austrian army at Austerlitz in 1805, the Prussians at Jena in 1806, the Russians at Friedland in 1807.

Never fully understanding naval warfare, however, he could not beat hated England, to him "a nation of shopkeepers." At the mouth of the Nile and at Trafalgar, Admiral Nelson's fleet retained British mastery of the sea. In retaliation, Napoleon declared the Continent off limits to British trade, but he could not enforce the blockade. Even Josephine ignored it—to import English riding horses and fine muslins.

A genius at war, Napoleon failed to negotiate a lasting peace; to him "every peace treaty means no more than a brief armistice." Gradually France grew war weary. The emperor's judgment wavered. Brooking no rivals, he neglected to train subordinates. Opponents rebuilt their armies and struck back. With the aid of Spanish guerrillas, Wellington checked the emperor's grand design in Spain. The Russians retreated before the invading French, until "General Winter and General Famine" conquered the Grande Armée. In the Battle of the Nations, a coalition at Leipzig pushed Napoleon out of Germany. At Waterloo came final defeat. By 1816 France's borders had shrunk to those of 1789.

In his remarkable life, Napoleon had led two million Frenchmen and one million troops from allied or satellite states into 60 battles that claimed between 450,000 and 1,750,000 casualties. By shaking the foundations of Europe's old order, he instilled in the French a lasting sense of "la gloire."



The Rosetta stone, measuring nearly 4 feet by 2.5 feet, came to light during Napoleon's expedition to Egypt. With a text repeated in hieroglyphs and Greek characters, it made possible the deciphering of the ancient Egyptian script.

that I could put on my heart. . . . Think of me, live for me. . . . adorable Joséphine. One of these nights, the doors will open with a crash: like a jealous man, and there I will be in your bed. A thousand loving kisses."

I closed the volumes in France's National Archives and stepped out into the Paris streets. I was embarked on what would become a grand adventure: a journey in the footsteps of Napoleon Bonaparte.

For four months I would follow his footsteps, seeking to unravel the enigma of his personality, to measure the effect he had in the shaping of modern Europe and France, to see what remains of his legend. I would travel to a dozen nations, from the Soviet Union in the east to Spain in the west, and to Egypt and the tiny island of St. Helena in the South Atlantic.

In time I would begin to feel his presence: When I arrived someplace, it often seemed as if he had only just departed; the map cases, the portable field bed, the cheap snuff he favored all having been shoved hurriedly into an army wagon moments before it clattered off.

And I would come to feel I knew the people who had touched his life: his large and quarrelsome family, the many lovers, the implacable enemies, and the men who served him; above all, Joséphine, who, although divorced and dead, would reappear in a vision as he lay dying. The themes of those early letters, when the world and all about him seemed young, would reappear. "She would not embrace me," the dying emperor whispered, "she disappeared at the moment when I was about to take her in my arms. . . ."

THE MOUNTAINS rush down to the sea around Ajaccio, Corsica. Ferryboats slip in and out of the bay, laden with sun-seeking tourists. In the old part of the city, shutters pop open with the morning sun, laundry flutters over narrow lanes, and you may chance upon a procession of sailors, bearing on their shoulders an image of their patron, imploring safety at sea.

Napoleon would recognize his street, his house. He was born on the first floor August 15, 1769. His mother, Letizia, began labor while at Mass and rushed home; there was

Music of the horns *instructs riders and hounds for the hunt, not for the battle, in the forest of Fontainebleau, the country*

château of French royalty. Napoleon frequently hunted here with his family and closest aides. During a chase in 1809, his party bagged 14 stags, 11 does, 18 fawns, and 358 pheasants. The hunt was one of the emperor's few social diversions.

no time to reach her quarters on the second floor. The baby was puny, but filled out after a wet nurse was hired, a sailor's wife.

Letizia was 19, pretty, strong; the father, Carlo, 23, charming, flighty, a lawyer. They were the handsomest couple among Ajaccio's gentry. Both came from families that had come from Italy two centuries before. They spoke Italian, bought their clothes in Italy; Carlo held his degree from Pisa. And so, although the island had recently come into French hands, the boy was christened Italian style, Napoleone Buonaparte.

He developed a strong body, learned to swim, fight, climb trees. He liked especially a farm the family owned in the hills above Ajaccio. I went there with Jean Graziani, an architect helping restore the old house there. "He loved this farm," Jean said. "He did not speak only once about it, but many times." I could understand that affection: There was the smell of sun-warmed earth, olive trees, grape vines, the base of a great oven. I remembered one of his relatives had boasted: "The Buonapartes have never paid for bread, wine, and oil."

"He was in some ways a Corsican," Jean said. "Here the family is very important, very close; so it was with Napoleone, all his life. And he was very proud, like most Corsicans. His mother told him to always put up a good front, to have a nice parlor to receive friends, even if he had to eat only bread."

But there was one Corsican convention that the boy Napoleone would not accept. In Corsica the first son is the most important, the others less so. Napoleone, the second son, constantly harassed and competed with the first, Giuseppe—Joseph.

FRANÇOIS GERARD, MUSÉE NATIONAL DE MALMAISON

"She instilled *into me pride and . . . good sense," Napoleon recalled of his mother, Letizia. Widowed matriarch of a Corsican clan of Italian descent, she played no favorites among her brood of eight and once rapped the emperor's knuckles when he expected her to kiss his hand.*

AT THE AGE OF NINE, Napoleone went off to France to school, along with Giuseppe. Napoleone, with a royal scholarship, attended the Royal Military School of Brienne, in Champagne. Here he spent five years, seeing his family twice.

According to the testimony of classmates, he was a loner, didn't talk much, didn't play much. He read a lot, reflected. The school influenced him. It expounded the rationalist philosophy of the Cartesians; he was taught to classify, to arrange things logically. Teaching was by memorizing, reciting. He had an extraordinary memory, filing things away in his head as if in some giant and always accessible cabinet. And the texts he memorized were those of the ancient Greeks and Romans. A young cadet might well come to admire ancient Rome and its institutions, might dream of himself becoming an Alexander, a Caesar.

From Brienne, Napoleon went to the École Militaire in Paris, graduating in 1785.

For seven years he led the life of a lieutenant in garrison, poverty-stricken, often on leave, usually in Corsica. He skimped to buy books, read, and was influenced by the romanticism and political thought of Rousseau. He wrote himself, on politics, history, the nature of man, a dreamy romance.

These were the years of the French Revolution and its turmoil. In 1789 a mob stormed the Bastille; in '92 the monarchy was overthrown, a republic declared; in '93 the Reign of Terror commenced, with the heads of Louis XVI and Marie Antoinette dropping into the executioners' baskets, along with the heads of thousands of others. Rival revolutionary groups competed for power. "As things are," Napoleon wrote his brother Joseph, "I see only one thing clear; I must keep on the right side of those who have been and can be my friends."

Those friendships, and the Bonaparte luck, paid off. He happened to be near Toulon when a revolutionary army, besieging royalist forces in that city, needed an artillery officer. Napoleon, with that "eye" French generals still marvel at, sized up the situation, positioned the guns, blasted the defenders into submission. The young captain became a brigadier.

Less than two years later he commanded the guard at the Tuileries palace in Paris, where the revolutionary government met, when a mob marched on it. He remembered a similar event during the time of the king; the soldiers had held back, the mob won. He did not hesitate, but gave them "a whiff of grapeshot." Many died, the remainder fled.

That "whiff of grapeshot" made Napoleon well known in Paris, and he was invited into the salons. At one he met Joséphine de Beauharnais, a beautiful Creole born in the French West Indies, the widow of a noble executed during the Terror. She was 32, six years his senior, and had two children, Eugène, 14, and Hortense, 12. She was said to have had many lovers.

Napoleon, the scrawny country boy from Corsica who was still embarrassed by his Italian accent, was smitten: "Madame de Beauharnais was the first woman who gave me any degree of confidence. One day when I was sitting next to her at table, she began to pay me all manner of compliments on my military qualities. Her praise intoxicated me. From that moment I confined my conversation to her and never left her side. I was passionately in love."

The worldly Joséphine was probably surprised at the passion she had evoked. When he proposed marriage, she held back. Still, she was getting older, had the children to support, and he was, in his way, attractive.

Two days after the marriage in March 1796, Napoleon left for southern France and

Boisterous childhood *in Ajaccio, Corsica—in this house where he was born in 1769—ended when Napoleon was nine. Then the French governor recommended him for a place in a royal military school, where he excelled in mathematics and staged mock battles, once in a fort of snow.*

CHARLES THEVOIN, MUSÉE DE L'ARMÉE, PARIS

Boyhood dreams *of outdoing the heroes of antiquity became reality when Napoleon, emulating Hannibal, led an army across the Alps in 1800. Months earlier, after joining a coup that toppled the republican government, he had emerged as First Consul. Now he planned a pincer movement against Austrian forces occupying northern Italy, an operation that required his army to move cannon across the Great St. Bernard Pass* ***(above)****. Always attentive to detail, Napoleon reported that the men hollowed out "tree trunks in the form of troughs, into which were laid the eight pounders and the mortars. One hundred men were harnessed to each gun, and took two days to drag them over the St. Bernard." On May 20 Napoleon himself crossed on muleback, pausing to accept the hospitality of the hospice* ***(left)*** *and coming down from the top "sliding and rolling in the snow." The subsequent victory at Marengo reinforced his popularity—and his hold on France.*

command of the Armée d'Italie. He began to sign his name in the French fashion—Bonaparte. He carried a portrait of Joséphine in a locket and would take it out and kiss it from time to time. The letters began: "My only consolation is in writing to you . . . you are the confidante of all my troubles."

I drove eastward from Milan. There was morning mist, a red sun, the rich smells of corn and dairy farms. Napoleon began his campaign against the Austrians in Italy in mid-April. It was a continuation of war that had begun a few years earlier—a struggle between a revolutionary France, eager to export its new ideas of government, and almost all the rest of Europe, ruled by crowned heads, old ideas.

Napoleon fought by new rules, marching at night, fighting in the rain and on Sundays, gambling boldly. The old generals opposing him were baffled. Victory followed victory: Lodi, Castiglione, Arcola, Rivoli, Mantua.

My destination was Lodi, for something special happened to Napoleon there. It is a quiet town; a stone bridge has replaced the wooden one of Napoleon's time. Below it, fishermen with 20-foot poles seek the *barbi* and *cavedani* that break the surface.

Napoleon reached here early in the campaign, desperate for a decisive victory. He found the Austrian rear guard across that bridge. He wanted that bridge. He rode into the center of the fighting, personally sited 24 cannon, then with a stirring speech sent a column of grenadiers charging across the bridge into the mouths of the Austrian cannon. The Austrians broke and fled.

The battle established Napoleon with his troops: They dubbed him *"le petit caporal,"* since generals rarely fought alongside their men. By such courage, by winning, and by attention to his men, Napoleon bound them to him; without this, they would never have met his extraordinary demands.

Afterward the young general said to one officer: "They have seen nothing yet. . . . In our days no one has conceived anything great; it is for me to set the example." Those fantasies of glory every schoolboy has—they could be made real!

In only a year Napoleon had driven the Austrians out of northern Italy and to within sight of Vienna. They sued for peace. Napoleon sent back to Paris cargoes of treasure from Italy, including its art: Caravaggios, Botticellis, Giottos, Tintorettos, even the four bronze horses from Venice's Basilica of San Marco. He returned there himself, the man of the hour.

"It is with artillery *that war is made," according to Napoleon, who exploited the lighter cannon developed under Louis XV. Here Lt. Col. Marc Neuville, a curator of the Musée de l'Armée in Paris, cradles a one-quarter model of a Gribeauval cannon. The real gun weighed more than two tons and shot 16-pound balls two rounds per minute. Interchangeable equipment and maneuverability made these cannon the pride of the French Army.*

THE YOUNG GENERAL now sought a new field for action. He chose Egypt. To seize it would cripple British interests in the Mediterranean, provide a stepping-stone to India. Surely he remembered those schoolbooks

describing Alexander the Great; like Alexander, he took with him scholars and scientists. His Egyptian expedition would begin the study of Egyptology, bring a new Egyptian fashion to the salons of Paris. Its impact on Egypt would be even greater.

Cairo had changed in the years since I had seen it last. It seemed to bulge with swirling tides of people, honking cars. Helmeted soldiers with bayoneted weapons seemed everywhere. Some things endured: the dust and special smells, the evening breeze off the Nile, the sun dropping like a great orange coin into some slot in the earth.

I drove to the edge of the city, where new houses and freshly cut roads edged into fields of maize. "Here," my guide said, "this is the battlefield." We scanned the horizon, then climbed atop the car and looked again. There! In the distance thumbnail-size triangles, dark gray in the haze. Fighting here, Napoleon had exhorted his men by referring to those distant pyramids: "Soldiers, 40 centuries look down on you!"

The enemy was a pushover: The Mamluk horsemen, gorgeously enrobed, heavily armed, fought in medieval fashion. Thousands of the enemy died, 30 Frenchmen.

"The coming of Napoleon was a shock to us," a Cairo University professor said. "Before, we thought what we had was the best in the world, and that we were the masters of everything. We thought of ourselves not as nations but as Muslims; we lived in the Muslim home, *Darul-Islam;* everything else was the place of the infidels.

"If we were defeated, the reason must be first that we had forgotten the ways of God, committed sin; and God had sent these people to punish us. Later we understood that the reason for our defeat was the difference between the medieval and modern world. We began to watch the French: their courts, their doctors, even their cabarets.

"This is what was behind the so-called modernization of our country in the 19th century. The English would occupy us later, but the French stayed in our minds: the idea of the French Revolution, their manners, their language. To this day the old ladies of our elite class speak French."

If Napoleon shocked Egypt, he would himself receive a shock there. An officer confided to him what most others knew: Joséphine was unfaithful; she was often seen in Paris with a dashing and amusing young hussar, Hippolyte Charles. "I have great private unhappiness," Napoleon wrote to brother Joseph, "the veil has at last quite fallen from my eyes."

From this time he seemed to become more brutal. On a campaign into Syria he ordered the massacre of 3,000 prisoners of war at Jaffa; when that campaign proved unsuccessful, he slipped away from Egypt, leaving his stranded army under the command of another general—who was so informed only after Napoleon left.

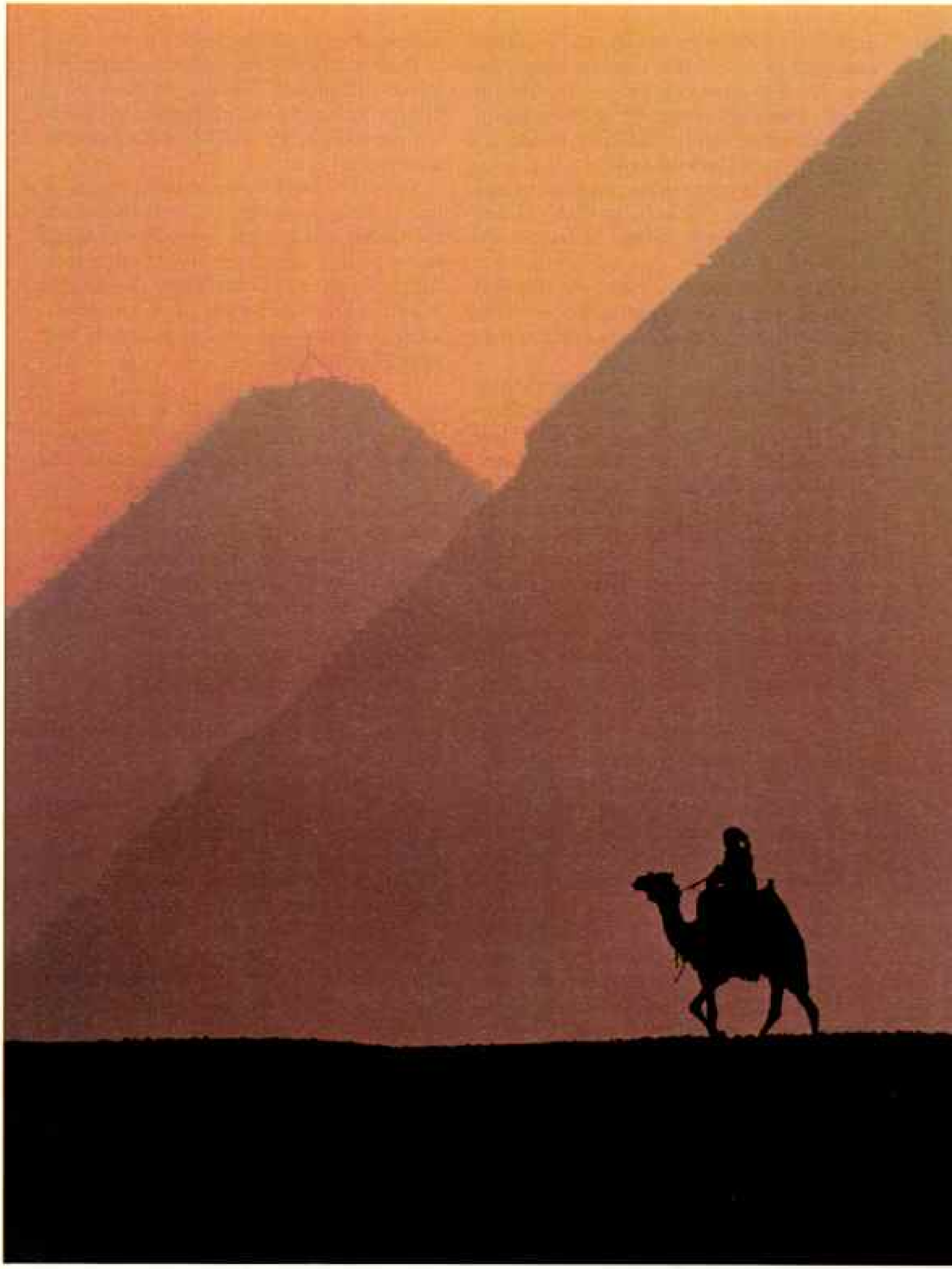
MY HELICOPTER crossed a ridge in the Swiss Alps, dropped through the mist, paused on the snow-covered courtyard of the 900-year-old hospice of the Great St. Bernard Pass. A monastery door popped open, a monk stepped out, his cassock fluttering in the wind. "Welcome," said Abbot Jean-Michel Girard, and led me inside. The rapid crossing of this pass in May 1800, when there was still snow, was among Napoleon's most dramatic exploits.

He had been back in Paris only seven months when a new Austrian threat sent him marching again toward Italy. He had used the time well: He had joined in a coup d'etat that overthrew the old republican government; had emerged as one of three consuls governing France, then became First Consul. The general who arrived here was also his country's political leader.

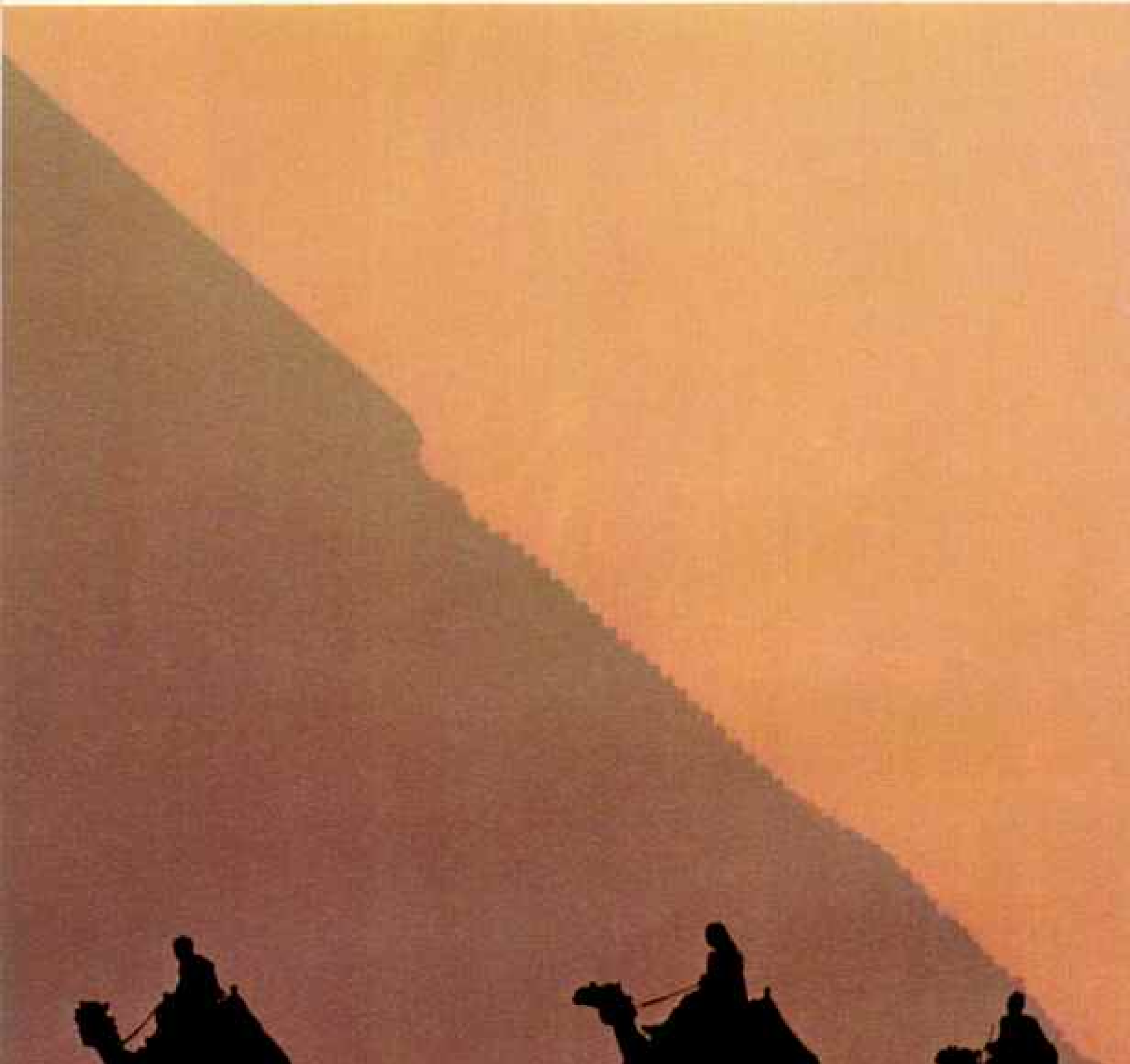
"He crossed in one day," the abbot said. "He stopped here to rest, to eat, to drink. We have only a few souvenirs: the room where, tradition says, he rested; a tomb he ordered built for one of his generals."

Life has changed at the hospice since Napoleon's day. A tunnel was built under the pass in the 1960s; the monks no longer have travelers to rescue. Now they hold retreats for local young people, who come on skis. And the dogs—no longer needed, except for the tourist season. They stay in the valley in winter. But some things endure. The congregation had cooperated with Napoleon: "We still have farms given us by Napoleon, lands to support us, in Italy."

In the valley below the hospice I found another souvenir of Napoleon: an unpaid



From the Great Pyramids *"40 centuries look down on you!" Napoleon told his men during the conquest of Egypt, aimed at destroying British primacy in the Mediterranean. Here on July 21, 1798, French artillery and impregnable infantry squares*



decimated Mamluk horsemen. But within days Admiral Nelson annihilated the French fleet and set up a blockade. During his year in Egypt, Napoleon introduced modern administration, science, and technology, leaving a lasting imprint.

bill. The village of Bourg St. Pierre was pressing for payment. The village lawyer explained. "He needed mule drivers, men to help with the artillery. He agreed to pay. Here is his letter: 'I will reimburse you for everything. . . . This is only just.'

"But he became occupied; only part was paid. The interest on the unpaid part is substantial. I wrote the President of France, and the French consul in Geneva has made inquiries." The lawyer smiled: "It is not a question of money, but of closing an issue." I wished him well, then followed Napoleon into Italy to Marengo, where he once again defeated an Austrian army.

Napoleon would in time have himself crowned King of Italy and install Joséphine's son, Eugène, as his viceroy. Eugène would never disappoint him; the Italians would. "Napoleon despised us," Professor Carlo Capra of the University of Milan said. "He once wrote to Prince Eugène that he knew more in his little finger than all the Italians put together. On another occasion he said that in the whole kingdom of Italy, there were only two men of character. He may have had reason: We were used to being conquered, to dealing slyly with those who conquered us."

Whatever his feelings, Napoleon shaped the course of Italian history. "He rather rudely awoke us from a sleep," the professor said. "He abolished feudalism, gave us a constitution, provided opportunities for a new middle class. The 20 years the French were here are also considered the beginning of the *Risorgimento*, the movement that led to the unification of Italy; Napoleon took a patchwork of little states and molded them into only three. Even today, in our laws and government, we can see his framework."

IT WAS IN ITALY that Napoleon first began to put into practice his ideas on government; it was back in France, its own administration shattered by years of turmoil, that he turned his full attention to implementing those ideas. "What he tried to do," a historian told me, "was to strip the government down and organize it—as if it were an army, as he organized himself. To simplify, codify." The vast structure he created has shaped France since that day.

He worked furiously, calling in panels of experts, dictating to four secretaries at once, sleeping little. One result: his *Code Napoléon*. In an office above the Seine a distinguished lawyer held up a small red volume containing the civil code of France.

"Twenty-three hundred articles. At least half remain unchanged; little concerning property has been changed. It was drawn up by four lawyers; they discussed things among themselves, then with Napoleon. The cleverness of Napoleon is shown here; he named two conservatives and two liberals. The laws reflect this compromise."

France's most coveted order, *the Legion of Honor was established by Napoleon despite criticism that it was antagonistic to the revolution's ideal of equality. "It is with baubles that men are led," he said, handing out to soldiers and civilians thousands of the valued medals* ***(above)****. For daughters of the recipients, he opened three boarding schools. At Saint-Denis* ***(left)*** *students dine beneath an 1808 portrait of their benefactor, who insisted girls concentrate on household skills to make them "useful women."*

He centralized government. Prefects of the country's 83 departments were appointed by him, as were subprefects and mayors. To this day a city cannot build a road or a bridge without approval from Paris.

He created the first modern bureaucracy; a national civil service; the Bank of France, which remains the central financial institution of the country; a tax system that persisted into this century. He centralized and standardized education, hospitals, began a vast public-works program.

Nothing seemed to escape his eye. He signed an agreement with the pope, paying the clergy's salaries; regulated Protestant churches and paid their ministers; took the Jewish community under protection and summoned a Sanhedrin.

"It bothered him," a rabbi said, "when he heard that the Jews were a nation within a nation, with their own customs. He wanted to assimilate them. It was very controversial. Still, his work remains—our organization is typical of France; we have a great rabbi of the country, and regional rabbis. Almost like prefects."

Along with reform came measures of control: secret police, censorship, and the arrest of some political enemies.

Still, he brought prosperity, stability; and promised to every man "careers open to talent." The First Consul was France's most popular man. "I am so much identified with our . . . institutions . . . that no one would know how to separate me from them," he wrote later. Not until last year, when a new socialist president, pledged to decentralize government, was elected, did anyone begin to seriously tamper with that structure.

ON DECEMBER 2, 1804, Napoleon and his family, all gorgeously tailored, entered Notre Dame Cathedral in Paris for his coronation as Emperor of the French. "If only our father could see us now," he whispered to brother Joseph. It was a splendid ceremony, but had been difficult to arrange, for the family did not accept Joséphine.

Joseph had threatened to absent himself if she was crowned empress; his sisters had at first refused to carry her train, but then agreed to "support it." One of the sisters, it is said, gave a vicious tug on that flowing train as Joséphine approached the altar, almost upsetting her.

There was squabbling over titles—in one row sister Caroline had to faint before Napoleon yielded. His mother wanted a title too. Napoleon thought hard, came up with *altesse impériale*, *madame*, *mère de l'empereur*—which courtiers quickly shortened to *madame mère*, or madame mother.

Napoleon had his own complaints: "Joseph's daughters don't even know yet that I am Emperor—they call me Consul. . . . little Napoleon [his nephew], when he goes past the grenadiers . . . shouts to them 'Long live Nonon the soldier.'"

As for his family's criticism of Joséphine: "They say my wife is untrustworthy and her children's attentions insincere. Well, I like them; they treat me like an old uncle; that sweetens my life. I'm growing old, I'm thirty-six. I want some peace and quiet." The peace he sought, evidently, was domestic.

A FEW MILES EAST OF BRNO, Czechoslovakia, amid rolling farmland and little hills, there is a hillock with two trees on it. If you go there on a cold and snowy day, when the land lies bleak and the trees bare, and there's morning mist and a red sun, you will see the battlefield of Austerlitz as he saw it.

When that sun rose on December 2, 1805, two great armies faced each other, Napoleon's Grande Armée and the combined armies of Austria and Russia—a total of 158,000 men, 400 cannon. When the sun set, 11,000 Russians, 2,000 Austrians, 1,300 French lay dead on the cold earth. The tsar was preparing to retreat toward Russia, the Austrian emperor to seek a treaty.

How did he do it? "He had no formula," said historian Owen Connelly, a combat veteran himself.

"Every battle was fresh. He always sought to concentrate his forces, but once a battle began, there was no pattern. What he really did was sit back and wait for the enemy to make a mistake. His policy: One engages, one waits, one sees. Austerlitz was the classic example. The Russians weakened their center to attack his flank; he saw the weakness, made his attack there, rolled them up."

He prepared his campaigns carefully. He

was known to crawl over his maps on all fours, dividers in hand, measuring distances, studying terrain; so intent he sometimes bumped heads with his map expert, Bacler d'Albe, also on all fours. He would at times explode in anger: He demanded performance, refused to take "no" for an answer. He knocked one marshal's head against a stone wall, knocked another to the floor, hit others with his riding crop.

And there was that memory, that intellect. "Read his letters," urged a French general. "Louis XIV and Colbert would write: 'Monsieur, you will please do all things which are deemed necessary so my glory will be served at its best.' Napoleon would write: 'Monsieur, you will ensure that 15,000 reserve horses will be in Prague 14 September. You will ensure that this order is carefully executed and controlled. And I will check it myself.'

"Modern! Concise! Precise! Like mathematics, music, like Bach!"

And so victory followed victory: Jena and Auerstädt against the Prussians; Heilsberg and Friedland against the Russians; Wagram against the Austrians.

THERE WAS an unexpected heavy snow when I arrived in Vienna. It quietened the lovely old capital. Children appeared with wooden sleds; women turned their faces from the wind-driven snow; vaned caps on chimneys

The glory of France, *Napoleon considered the theater and sponsored the revival of the Comédie Française. He often invited its finest tragedian, Talma, to breakfast to discuss drama, including the proper stage gestures of a monarch. These Comédie Française performers, awaiting entrances in a Molière comedy, work under provisions of an enlightened theatrical code signed by Napoleon in Moscow in 1812.*

spun this way, that way. The city, with its Habsburg monuments, holds a great sense of the past, and of loss.

"Those Napoleonic wars remain in our consciousness," an Austrian army historian told me. "It was the last time that, in the end, we won a war. In those days we had the great army of a great empire; since 1918 we have had the small army of a small country."

A distinguished historian said: "You might describe us now as a small, neutral, little-bit-ambitious state. We don't know what will happen tomorrow, whether the Russians will invade. We have a great fear, always, of the day people will die."

The Schönbrunn Palace, on Vienna's outskirts, has its own tale of loss. It was after the Battle of Wagram that Napoleon decided to divorce Joséphine; she had produced no child, and an emperor must have an heir. He took the hand of Marie Louise, 18-year-old daughter of the Emperor of Austria.

He explained to a critic: "This is . . . a political action, and one to which I have given considerable thought. You don't like this marriage? I do. I regard it as a great success—a success on the level with the victory of Austerlitz."

Surprisingly, the marriage turned into a love match, and Marie Louise promptly produced an heir, little Napoleon. "He has my chest, my mouth, and my eyes," the emperor exulted, and decreed the child King of Rome. But when Napoleon's world fell apart, Marie Louise and the child would be taken from him by her father—the boy to Schönbrunn.

There was a bitter wind on the day I visited the palace; few visitors were about. I tried to conjure up the boy's life there. He was not a prisoner, but in a "special position." His Austrian tutor decreed that "It is necessary to banish everything that might remind him of the life he has led until now." Another remarked, "He knows a great deal about the past, but in this connection maintains a silence . . . quite extraordinary in a child."

This silence would break when he in time received news of his father's death. He wept bitterly. The boy, largely ignored by his mother, died of the Habsburgs' disease, tuberculosis, at the age of 21.

But his story does not end there. "Marie Louise's sister-in-law, the Archduchess Sophie, had a great sentiment for him," a scholar told me. "There were rumors. People said he was the father of her children, Maximilian of Mexico, the Emperor Franz Josef. Her husband was a very modest figure; the boy, very handsome."

THE MARRIAGE to Marie Louise marked a turning point in Napoleon's fortunes. Historian Owen Connelly told me: "In a way, Marie Louise killed him. Before, everybody—even Joséphine—had been compartmentalized. But Marie Louise made him so happy that he lost the compulsion to work."

The preeminent French Napoleonic scholar, Jean Tulard of the Sorbonne, said: "He was a realist, except for his women. After his marriage with Marie Louise, he was blinded by his love and did not think any more. He felt everything was working, he believed in his destiny.

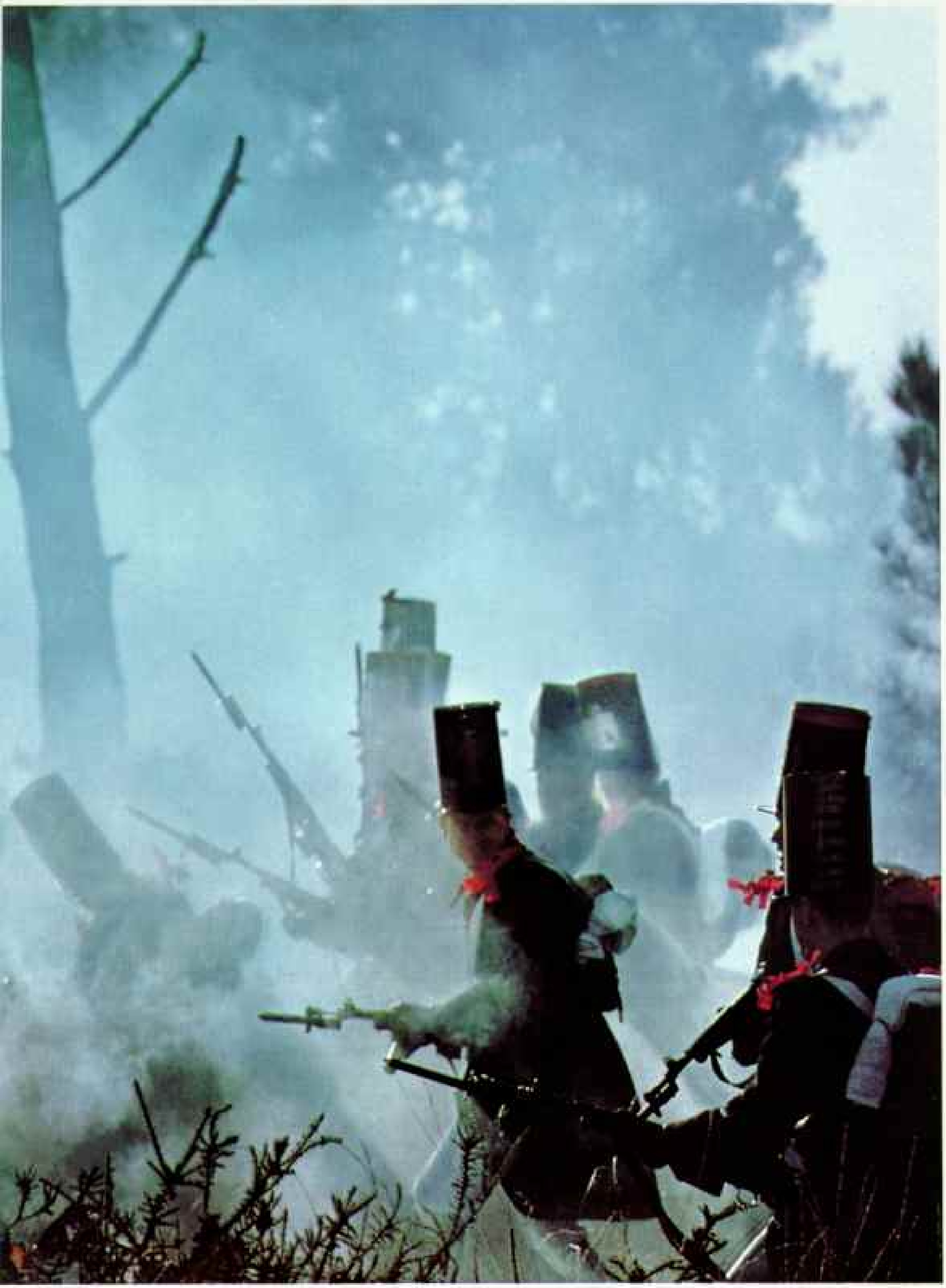
"He was physically worn out, distempered. He used to take very hot baths. Too much *l'amour*. He did not go to Spain, where he was needed, not because he was afraid but because he was unsure. And he was with Marie Louise, and she was more pleasant than the Spanish."

The tough, scrawny Corsican boy, ridden with ambition, given to pouring out his feelings to a woman he loved, had vanished; in his place was a paunchy, middle-aged man.

Poor Joséphine: When he had loved her, she had been unfaithful; when he decided to leave her, she tried to cling to him. At Malmaison, their country house outside Paris, her bedroom bespeaks that divorce. "Before," curator Gérard Hubert said, "it was rectangular and decorated with frescoes; after the divorce she used fabrics to cover

Sign of an emperor, *the N on a frosty pane in Czechoslovakia calls to mind a family story told by this retired seamstress, holding her father's picture. One of her ancestors fought with Napoleon at nearby Austerlitz and then, with a French bride, began a humble dynasty of smiths and farmers in a foreign land.*

Cannon boom, smoke billows, *and bayonets flash as cadets of the Special Military School of Saint-Cyr in Brittany reenact the 1805 Battle of Austerlitz.*



There Napoleon's Grande Armée of 73,000 crushed the 85,000 soldiers of Tsar Alexander I and Austrian Emperor Francis I, sending tremors throughout Europe.

over the frescoes and make the room round.

"She had a tiny mouth," he said, "which she always kept tightly closed because she had terrible teeth. She never laughed wholeheartedly, because of these teeth.

"She had the most incredible, beautiful voice. Napoleon was very nervous and often had problems falling asleep. And he very often in bed asked her to read him something. And she would start reading him a novel or something, and he would fall asleep."

The memories of Joséphine are everywhere here: the mirror in which she looked to change clothes three times a day; a bill for three dozen gloves, extra thin, and three dozen, fine; the bonnets, the little scarves and shawls; the dresses, of which she had 800 just after the divorce, 189 at her death. And her rose garden. Raised amid flowers in the Caribbean, she would die amid flowers in the Paris suburbs.

ONE DAY IN PARIS I went to the Grand Palais to see an exhibition of artworks that had recently been acquired by the French government. One room was filled by portraits of Napoleon and his family. I was surrounded by Bonapartes, life-size, full-length. It was as if a dinner party were about to commence. All were in elegant costume, for once Napoleon had most of Europe under his control, he parceled it out, Corsican style, to his brothers and sisters.

There was Joseph, King of Spain; Louis, King of Holland, and his wife, Hortense; Jérôme, King of Westphalia; Caroline's husband, Murat, King of Naples; Elisa, Grand Duchess of Tuscany.

All but Elisa would disappoint Napoleon. The brothers would identify with their subjects, rather than him; Caroline and Murat would pursue their own ambitions. "My

PIERRE PAUL PRUD'HON, MUSÉE DU LOUVRE, PARIS

"**My Joséphine,** *the first woman whom I have ever loved—and whom I love to distraction.*" *Thus Napoleon described the Parisian sophisticate he married in 1796. Joséphine, a gracious, flattering woman, welcomed the skinny provincial officer to her receptions and soon came to find his passion amusing. The Bonapartes disapproved. She was older, and the widow of an executed aristocrat. She also had been mistress of the powerful politician Barras, who promoted Napoleon after he had put down a royalist-inspired mob.*

Napoleon adored his wife, her two children, and Malmaison (**above left**)*, their country estate near Paris. Here they revived the lavish traditions of the "ancien régime," giving expensive tokens such as this diamond-encrusted snuffbox* (**left**)*. Here, too, Joséphine served as Napoleon's link between aristocrats and republicans. Her love of flowers, reminiscent of her birthplace, Martinique, blossomed into a renowned collection of rare plants, including some 250 varieties of roses.*

Napoleon overlooked his wife's extravagances, but not her inability to bear an heir. To ensure his dynasty, he sadly divorced her in 1809 and made a political match with Marie Louise, daughter of the Austrian emperor.

family," Napoleon would later recall, "have not helped me." Of all the failures, brother Joseph's in Spain was the most costly.

"I KNOW NOTHING of Napoleon," the old soldier said, "but a lot about the civil war. I was with Franco, but not convinced; a stroke of bad luck." We sat in a tavern in Albarracín, a walled medieval town in the mountains east of Madrid. "I was with General Varela. The other side, *sí*, it was strong: Lister was here. From my company only 52 were left alive. I remember on July 11 a great slaughter, then on the 13th I was wounded.

"It felt only like a blow." He moved a finger across his chest. "The bullet went through the right lung and still is in the left."

Just then came a crack of thunder. The old soldier and the four men seated at a table playing *guiñote* turned in their chairs to look at the door. "I had forgotten the sound," the old soldier said. "It has been so long since rain." The cardplayers resumed playing.

The town, a pocket of resistance against Napoleon, had forgotten the emperor; the emperor never forgot the Spanish.

"It was that miserable Spanish affair that killed me," Napoleon muttered years later on St. Helena. It was ambition to control all Europe and a desire to close Spain's ports to British shipping that led him into Spain; the disarray of the Spanish royal house that led him to put Joseph on the throne.

But Napoleon had misjudged the Spanish. They are, he insisted, "like other peoples and are not a class apart." Thus he was surprised—after he had defeated and dispersed their army, put Joseph on the throne, and gathered compliant Spaniards for an administration—to find that war continued. It continued in the mountains, the countryside, the small places; it was waged without mercy on either side.

Young Victor Hugo was an eyewitness. He came to Spain with his mother to visit his

MINIATURE BY JEAN BAPTISTE ISABEY, MUSÉE NATIONAL DE MALMAISON

Heir in a gilded cage: *An eagerly awaited son was born to Napoleon's second wife, Marie Louise, the 19-year-old former archduchess of Austria, on March 20, 1811, and Paris fountains flowed with wine. Napoleon proclaimed the boy King of Rome, visualizing that city as second only to Paris in his European empire. He wrote to Joséphine: "He has my chest, my mouth, and my eyes. I hope he will fulfill his destiny."*

*But the young Napoleon could not. When the emperor was forced to abdicate three years later, the child who had played at his feet was whisked off to Vienna's Schönbrunn Palace by his grandfather, Emperor Francis I of Austria. Retitled Franz, Duke of Reichstadt, Napoleon's son lived and studied as if in captivity. At age 21 he died of tuberculosis, a common disease of his mother's Habsburg family, in the same room (**far right**) where his father had slept after occupying Vienna some 23 years earlier.*

father, one of Napoleon's generals. Traveling by convoy, stopping for the night in Spanish houses, he remembered: "Even the furniture was hostile; the chairs received you badly and the walls told you: go away!" Leaving Spain, he saw the limbs of a young guerrilla who had been cut to pieces by the authorities and nailed to a cross: "They had taken . . . care to fashion a corpse out of these bits of flesh."

What inspired such passion? In Madrid I talked with Professor Miguel Artola, an authority on that war.

"We had in our minds a memory of the Arab invasion, and how we had refused it and driven them out. And our priests and monks waged a psychological war. They knew Napoleon had imprisoned the pope and taken other measures against the church. They published small religious books and made many sermons explaining that to kill the French was not a sin. And there was a nationalism, a Spanish pride: Napoleon had kicked out our kings and imposed his own kin.

"So when our army was dispersed, the people began to fight. The *guerrilla*—little war—commenced; the word was first used at that time."

Napoleon had believed 80,000 troops would hold Spain; before the end the number reached 320,000. And every day some died. The drain would undermine the chances of success in his next—and boldest—undertaking. As Napoleon had misjudged the Spanish character, so would he misjudge the Russian.

THE GENERAL was a big, burly man, with nine rows of ribbons on his chest; for 30 years he had studied the wars of Napoleon. "Napoleon is famous in Russia," he said. "We know him very well. Why, the most popular cake we have in Russia is called a napoleon." He laughed. "And we Russians are very proud

that such a great war leader we defeated."

When Napoleon crossed the River Neman into Russia on June 24, 1812, he realized he was embarking on his "greatest and most difficult enterprise." He had drawn on other nations to triple the size of his army, from some 200,000 to 600,000. He had assembled thousands of supply wagons, vast herds of cattle and oxen, 30,000 artillery horses, 80,000 cavalry horses. Regiments had been instructed to be self-sufficient, to have their own masons, bakers, tailors, shoemakers, gunsmiths: "We can hope for nothing from the countryside."

And yet. . . .

The general sipped his coffee, continued: "In most European countries, Napoleon would win one or two major battles, then seize the capital and win a peace treaty. He tried to apply in Russia the same doctrine.

His shotgun *a friend, a Spanish hunter drinks with compatriots in the walled town of Albarracín before stalking hare and partridge at sundown. In the mountain fastness of Spain 170 years ago, such men sighted on the bright uniforms of French soldiers. Stubborn resistance by the Spanish drained the military resources Napoleon would need to conquer the whole of Europe.*

Napoleon had sent 80,000 of his finest soldiers and installed his brother Joseph on the throne, and won acceptance by some Spaniards seeking reforms. But other Spaniards unseated Joseph, and Napoleon personally led a campaign against Madrid to restore him. The tough peasants—the guerrilleros—eventually tied down 320,000 French troops. Even though Great Britain sent a well-equipped army to support the Spanish, Napoleon refused to admit that the "Spanish ulcer" was incurable.

He said, 'I don't want anything but some major battles.' He was striving to get that battle, to impose it, but he didn't get it.

"Our war leader, Marshal Kutuzov, said this policy would not work with such large armies; one must defeat with several battles, extended in time and space. So Kutuzov used retreat, wide maneuver, counteroffensive; he delivered different blows with different formations, including bands of partisans. Napoleon met here the resistance not only of the army, but also of the whole people. All sought to drive the invader from the motherland."

The Russian Army did turn to fight, at Borodino, 70 miles from Moscow.

"A massacre," as the general described it to me. "Forty thousand men died. A mass of blood and flesh. And one can only wonder: Was it a defeat or a victory for the Russian

Army. The scientists discuss it till now.

"Personally, I think it was Kutuzov's victory. He retreated to Moscow, but the Russian Army was not destroyed. And as he retreated again from Moscow, he gained reserves, while Napoleon, as he advanced, was losing both men and supplies."

At 2 p.m. on 14 September Napoleon rode up Poklonnaya Hill and looked down on the glistening gold cupolas of Moscow: "Here at last is the famous city!"

He expected to be met by a delegation of citizens; instead he found the city deserted.

Wily Russian adversary, *Marshal Kutuzov overlooks the Borodino battlefield where he slowed Napoleon's advance on Moscow in 1812. French success was empty; Moscow was abandoned and soon ablaze, an atmosphere suggested at dawn in Red Square by a steaming power plant.*

That night the fires began; they raged for five days. In time it became clear that the Russian governor had ordered the burning.

Napoleon wrote the tsar, Alexander I: "The beautiful city of Moscow is no more. . . . Such conduct is atrocious and without reason. . . . I saw the same all the way to Smolensk." He was beginning to learn something of the Russian character.

FOR FIVE WEEKS Napoleon lingered in the Kremlin, hoping to negotiate with Alexander. From the tsar in St. Petersburg, there came only silence.

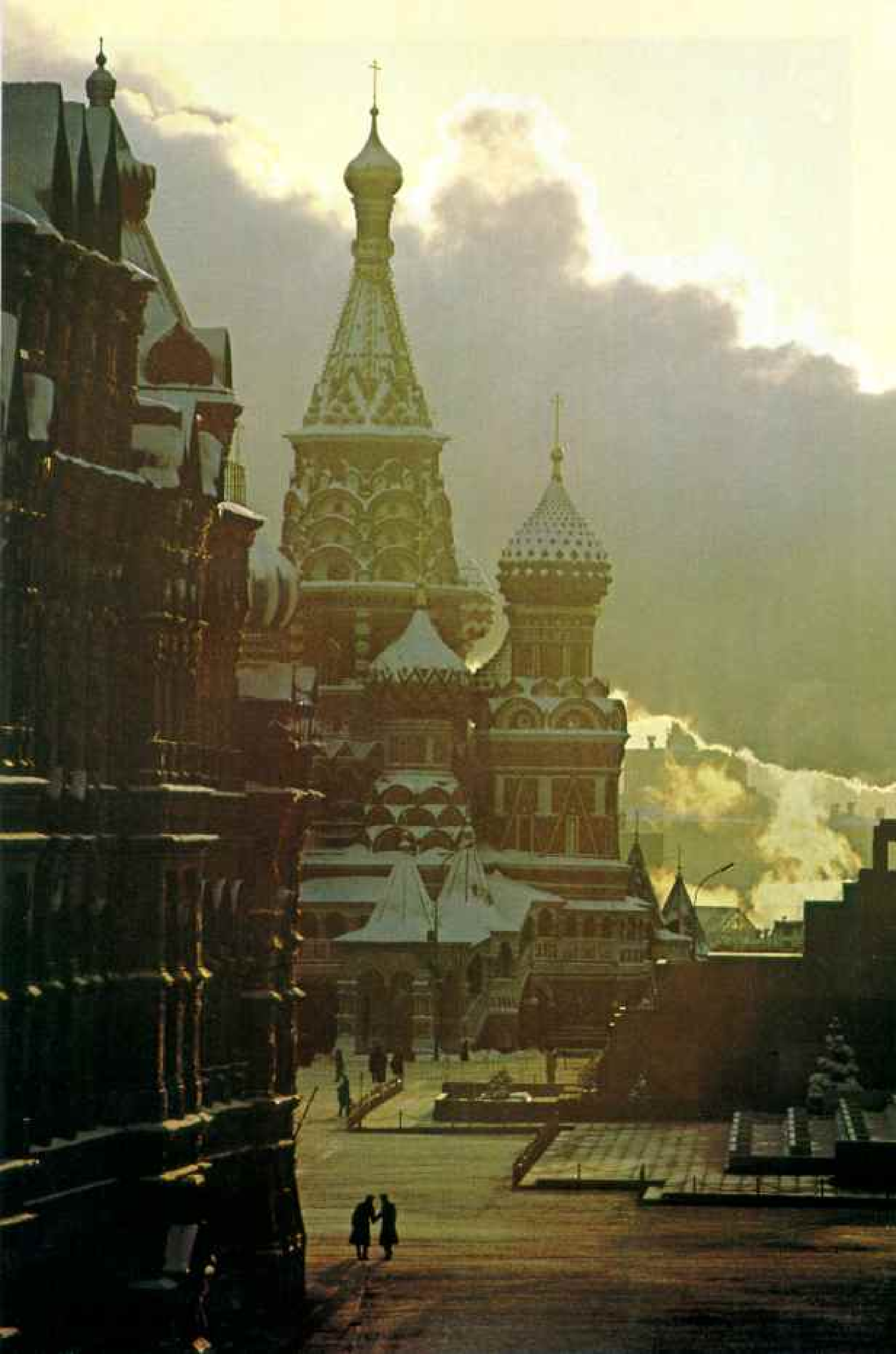
On October 19 Napoleon began his retreat over the same ravished path he had come. The great column, stretching over 50 miles, soon passed again over the battlefield of Borodino. It "was covered with the debris of helmets, cuirasses, wheels, weapons, rags of uniforms—and 30,000 corpses half-eaten by wolves!"

The great column was constantly harassed by Cossacks and partisans. One Russian officer remembered the sight of Napoleon passing with his Old Guard: "I shall never forget the easy gait and the impressive bearing. . . . In their tall bearskin caps, blue uniforms with white straps, and red plumes and epaulettes, they looked like poppies amidst the snowy fields. . . ." The proud sight was not to last.

Now the snow became heavier, and at the River Berezina, near Minsk, the Russians planned to trap the army. They knocked down the bridges, fortified the banks. Napoleon, in a rare burst of energy, found an undefended crossing, threw up two bridges using lumber ripped from village houses.

For two days the army crossed; on the third came panic. Under Russian fire, stragglers, wounded, and camp followers fought to cross. An officer recorded what happened then: "The strongest threw into the river those who were weaker, and . . . trampled underfoot all the sick whom they found in their way. . . . Others, hoping to save themselves by swimming, were frozen in the middle of the river, or perished by placing themselves on pieces of ice, which sunk to the bottom. Thousands and thousands . . . were lost."

Finally the last bridge was set afire to prevent the Russians from crossing. The officer



*"**This is how to pass** over a bridge under the enemy's nose," Napoleon boasted at the Berezina River during his humiliating retreat from Moscow, after five fruitless weeks waiting there for the tsar to parley. The exhausted French Army, numbering perhaps 50,000 plus thousands of noncombatants and wagonloads of baggage,*

MUSÉE DE L'ARMÉE, PARIS

"looked like a caravan, a wandering nation," to one observer. The Russians destroyed bridges, but French troops located a ford, threw up two bridges in 20 hours using timbers from houses in Studënka, diverted Russian attention elsewhere, and got the bulk of the army over. Still, thousands died in the final panic to cross.

would remember, always, the terrible cries and groans from those left behind.

THERE WAS SNOW, a bitter wind, the river frozen solid when I reached the place of that crossing, the village of Studënka. There are about 50 houses, a hundred inhabitants, mostly old. The young go off to study and to work in the larger towns nearby. The village seemed little changed from Napoleon's time: houses with pretty Russian window frames, horse-drawn sledges bearing timber and hay, an old man carrying buckets of water on a yoke. And that great silence, save for the wind, of the Russian countryside.

Villagers remembered World War II, for the Germans had come this way too. They recalled the sound of gunfire at night as Germans and partisans fought, and how, when the German soldiers retreated, they set fire to the houses.

They all knew of Napoleon and his passage, and some had unearthed souvenirs as they tilled their small plots. The Bacturas were one such family. "I was digging to plant," Madame Bactura said, "when I saw metal. We dug carefully. We found a saddle, stirrups, then a big saber. When we lifted it, the blade disintegrated. But the handle, when polished, began to shine." These were given to a museum.

One object they had kept, a metal toy soldier, three inches high. They placed it proudly on the kitchen table. They thought it a memento of Napoleon's passage, perhaps a token given to a soldier on his discharge. To me it looked more recent; never mind—concerning great events, a souvenir is a souvenir. As I left, the family pressed on me bread, salt pork fat, a handful of salt. I could not help thinking that Napoleon's starving soldiers, passing here, would have killed for such a gift.

At Studënka the army, what remained of it, had escaped. But now terrible frosts set in, with temperatures of 30 and 40 degrees below zero. Russian officers, to save their feet, stuck them in the fur hats of French grenadiers, which littered the road. The French built shelters with the frozen bodies of their comrades, stacking them like logs.

On December 14, the Grande Armée de la Russie recrossed the Neman. It numbered only 30,000. Napoleon was not with it; he had departed for Paris. He confided to an aide: "Perhaps I made a mistake in going to Moscow, perhaps I should not have stayed there long; but there is only a step from the sublime to the ridiculous, and it is up to posterity to judge."

Napoleon did not consider himself finished. He raised a new army, was defeated at Leipzig in 1813, raised another, and in

PAUL DELAROCHE, MUSÉE DE L'ARMÉE, PARIS

Brooding in defeat, *Napoleon prepares to abdicate after Paris capitulated to Russian, Prussian, and Austrian forces on March 31, 1814. His generals had refused to continue fighting. But his elite Old Guard, loyal to the end, wept openly during their final review in Fontainebleau's Courtyard of the White Horse* (**facing page**)*, as their commander embraced the eagle standard and bade them adieu.*

1814 began a chesslike defense of France against the armies of Russia, Prussia, Austria, Great Britain. But Paris was not Moscow; on the arrival of the enemy, it quickly surrendered and was occupied. Napoleon was exiled to Elba, a small island off the coast of Italy.

It was to be "a separate principality which he shall possess in full sovereignty and property" for the rest of his life—a lilliputian empire. For ten months he busied himself organizing the island, then slipped away back to France. His mother encouraged him: "Go, my son, fulfill your destiny, you were not made to die on this island." Sister Pauline gave him her diamonds. The soldiers sent to arrest him embraced him.

Emperor of the Isle of Elba *was the only title permitted Napoleon in exile for ten months off Italy's coast. From time to time he lived in the villa of San Martino* ***(above)****, as he reorganized Elba's government, drilled troops, entertained his visitors . . . and plotted his return to France.*

A FEW DAYS BEFORE the 166th anniversary of the Battle of Waterloo, I entered a restaurant on the old battlefield in Belgium and was surprised to find, perched on a barstool, in full uniform, a soldier of the First Regiment of Grenadiers of the Imperial Guard.

The grenadier was Gérard Vandeville, a postal worker from Soignies. He told me he belonged to a Napoleon marching club in his town, and that there were perhaps 50 such groups in Belgium. His group marches about 15 times a year, adding a festive note to small-town celebrations. "I enjoy the marching, the uniform, the re-creation of history. Come back Thursday, the anniversary, and you'll see more of us."

And so on the anniversary I traversed the battlefield to the sound of fife and drum with costumed soldiers, the "last regiment" of Waterloo. We went from monument to monument, placing flowers on each. At one a small crowd had gathered. There were French flags and the flags of the Walloons, Belgium's French-speaking people.

There were impassioned speeches, cries of "*Vive la France!*" "They want some link with France," the mayor of a small town said. "But it is too late. Napoleon could have done it in 1815, but now it is too late."

Indeed, Napoleon could have done it, almost did. I stood where he stood and tried to imagine the scene on the morning of June 18, 1815. Two armies on two ridges, 1,500 yards apart: 100,000 infantrymen, 28,000 cavalrymen, 13,000 gunners serving 400 cannon. One man remembered the sound of the two armies preparing to fight as the "distant murmur of the waves of the sea, beating against some ironbound coast."

Wellington, as was his wont, waited. Napoleon had to attack before his enemy was reinforced. But the emperor was not at all the same man who had commanded the army at Austerlitz.

"After his return from Moscow," wrote one officer, "those who saw most of him noticed a great change in his physical and moral constitution . . . I did not find the

same consistency in his ideas or the same strength in his character . . . only inconsequent leaps of imagination." He would at times lose control of the battle, allowing generals to make mistakes he could not correct.

Now he waited for the sun to dry the rain-damp ground: Cannonballs stuck in wet ground; bounced and rolled and killed and maimed on dry ground. At 11:30 the great cannonade began. Wellington had placed his men behind the ridge, so the projectiles whistled past over their heads.

Three great attacks followed: At 1:30 four divisions were thrown against Wellington's left center; somehow they were deployed in an outdated formation that exposed too many to cannon fire. They were bloodily repulsed.

At 3:30 Ney led 5,000 cavalry against Wellington's right center. "Not a man present who survived could have forgotten in after life the awful grandeur of that charge," one British officer would write. The British had drawn themselves up into 20 great squares, bristling with bayonets. The French cuirassiers, with their shining breastplates, helmets, and swords, came at a trot, then a gallop—then balked. Through a blunder, no infantry or artillery had accompanied them. Without cannon or muskets to blast holes in those stalwart squares, the cavalrymen could only circle them, taunt, threaten.

The last great attack would come at 7 p.m. It was at about this time that a dark mass could be seen off to the northeast. Napoleon put out word that it was Marshal Grouchy with his reinforcements; in truth, that general had ignored the pleas of his officers to march to the sound of the cannon, and so missed the main battle. After cannonading erupted from the dark mass, the French knew the truth. It was Blücher's Prussians, coming to reinforce Wellington.

Napoleon now personally led forward, for a time, nine battalions of his cherished Imperial Guard, his last reserve. British officers watched coolly as the great column, 80 men abreast, marched steadily toward them, a river of blue coats, great bearskin hats, shining bayonets.

When the French drew near, the British officers ordered soldiers concealed amid standing corn to stand and fire. The musket fire tore into that great blue column. The guard hesitated, turned, retreated. "*La Garde recule!*—The Guard recoils!" The cry swept through the French Army.

Wellington sensed the moment, waved his hat forward. The British and their allies, with a cheer and bayonets, charged. The French Army broke, swept southward in retreat, Napoleon among them. Still, as Wellington said, it had been the "damndest near-run thing you ever saw in your life."

The implacable spirit of the British and the bloodiness of the battle were caught in letters home. One officer wrote: "Poor Major Heyland . . . was shot through the heart, and poor Ford was shot through the spine of his back but did not die for a short time after he was carried away. Poor Clarke lost his left arm, and I am much afraid Browne will lose his leg, he is shot through the upper part of the thigh and the bone terribly shattered. There are eight more of our officers wounded, but all doing well except little Thornhill, who was wounded through the head."

Napoleon returned to Paris, offered a new provisional government his services as a mere general. The government rejected the offer. He thought for a time of leaving for America, but was unable to arrange a guarantee of safe passage. America was spared the emperor's energies.

Three weeks later at Rochefort, Napoleon surrendered himself to Captain Maitland of H.M.S. *Bellerophon*, handing him a letter for the prince regent of Great Britain. It asked for asylum: "I have finished my political career, and I come, like Themistocles, to sit at the hearth of the British people. I put myself under the protection of . . . Your Royal Highness, as the most powerful, constant and generous of my enemies." The British government had another plan.

THE ROYAL MAIL SHIP *St. Helena* sounded her whistle and slipped away from the dock in Cape Town, South Africa. The 30 or so passengers waved to a handful of well-wishers below; crewmen coiled the lines; the island song came over the loudspeakers: *My heart is drifting southward, to my home down in the sea; to the isle of St. Helena, where my loved one waits for me.*

The tiny island—47 square miles—lies

Napoleon's Waterloo: *Irrevocable defeat struck at last on June 18, 1815, some 15 weeks after Napoleon had returned to France to rally former troops and much of the populace. The allies branded him "a disturber of world peace" and moved five armies to France's borders. Napoleon took on the Duke of Wellington, who deployed 68,000 troops along a ridge near Waterloo, Belgium. Marshal Ney impulsively*

FELIX PHILIPPOTEAUX, VICTORIA AND ALBERT MUSEUM, LONDON

ordered the cavalry to attack without the usual support of infantry and artillery in "some of the boldest charges I ever saw," a Briton recalled. Their appearance was "enough to inspire a feeling of dread—none of them under six feet; defended by steel helmets and breast-plates." That evening the British would cook meat in that armor. The formidable British squares—here Scottish Highlanders—had held.

1,200 miles from Africa, 2,000 miles from South America, and is even more isolated today than in Napoleon's time. In his day, sailing ships regularly resupplied there; today only the R.M.S. *St. Helena*, a converted Canadian coaster, provides a regular link with the outside world. The ship plies every month or so from Avonmouth, England, to Cape Town and back.

She was a smart ship for her size and trade. At night the officers wore "Red Sea rig": black trousers, cummerbund, crisp white shirt open at the collar, rank displayed on the shoulders.

The passengers included a young American Mormon who had come to microfilm the island's genealogical records, a retired police superintendent from Rhodesia ("Don't you dare mention that other name, I'll punch you!"), an elegant Englishwoman of mature years who excelled at whist ("Queen Mum," the others would soon call her), a retired British officer ("Major Michael"—he wore the tie of the Royal Artillery and, when anyone said anything amusing, would allow the monocle in his left eye to pop out and fall the length of its black cord), a chief justice, the new governor and his lady.

We were five days at sea. We saw flying fish, a spouting whale, but no other ships.

ON THE FIFTH MORNING the steward's knock came before dawn. I stuck my head out the porthole and saw St. Helena: Steep-sided, black against the dark blue sky, it stood like a fortress or a prison. How Napoleon's heart must have sunk.

We went ashore as in his time: Launches brought us to the stone steps of the landing, waited, bobbing, until the sea paused at just the right level; then we stepped ashore. Half the island seemed there, along with a band. They laughed when Major Michael, in trilby hat and clutching a cane, bobbled slightly on the wet landing. Queen Mum, for safety's sake, was fitted into a harness and swung ashore by crane.

The new governor was installed that very day. He wore a white uniform, plumed sun helmet; was sworn in by the chief justice in wig and scarlet robes. Then, to the music of two tiny bands, he reviewed his troops: island policemen, Boy Scouts, Girl Guides, church groups, saluting each in pukka fashion. I had to think of Lowe, the governor in Napoleon's time and his jailer. He too represented the crown, was a stickler for detail.

My host was M. Gilbert Martineau, a French diplomat, author of books on Napoleon, and custodian of the French property on the island. He lives in Longwood, the house that Napoleon occupied. I had a cottage nearby.

*"**How that red rain** hath made the harvest grow!" Lord Byron wrote of the fields where 63,000 men fell in the Battle of Waterloo. This farmstead (**facing page**), La Haye Sainte, was a British stronghold until Ney overwhelmed it with cavalry, infantry, and artillery. But Napoleon sent no reinforcements; the approach of Prussian forces panicked the French into retreat. Ney, Napoleon's "bravest of the brave," is today represented in a popular French miniature (**above**).*

"I spend six or seven months a year on the island," he told me. "A person without an interest in Napoleon would not like the job. St. Helena is part of the past. But all my life I've thought of Napoleon as a hero. When I was a boy, there were huge paintings in my bedroom with scenes of his life. I knew everything about Napoleon. My great-grandfather served in his wars.

"I do my writing, do my work, take a walk in the garden by moonlight. I have to answer letters from all over the world; 100 to 150 letters every mail. There is always a student doing a thesis who writes to me for information. I also receive love letters from women—to Napoleon. I'm like a spider in the middle of a web."

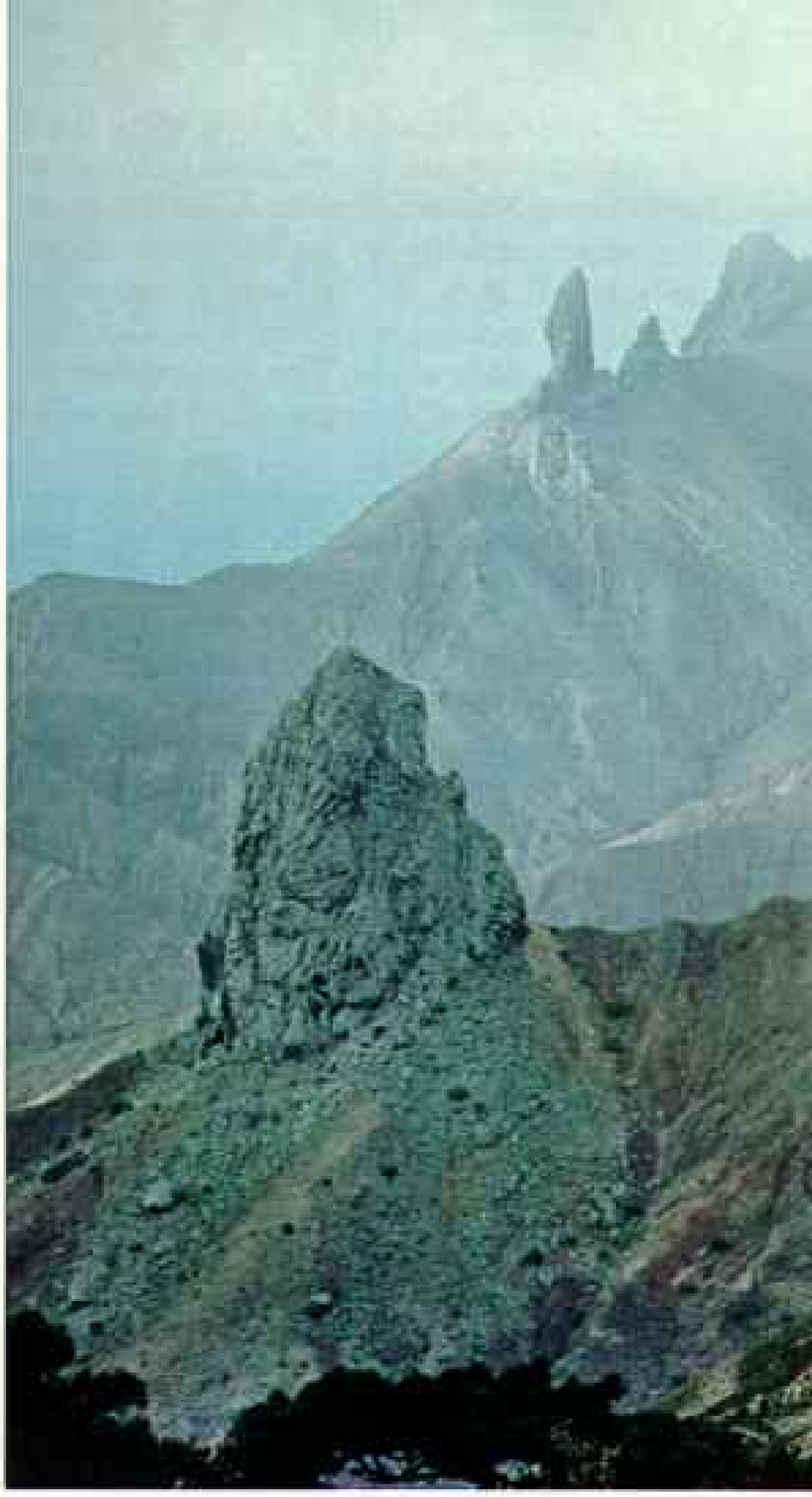
He spoke of Napoleon's exile from an admirer's point of view. "They gave him a house, they gave him servants; but it's not a house, it's a hall, a shack. Full of rats in those days. On the most unhealthy part of the island. Windy, wet. Money became so short he had to sell his silverware to pay his expenses. Conditions were frightful. One toilet for 30 persons. No water facilities; it was carried in buckets. The meat came up from Jamestown, the port; sometimes it arrived rotten.

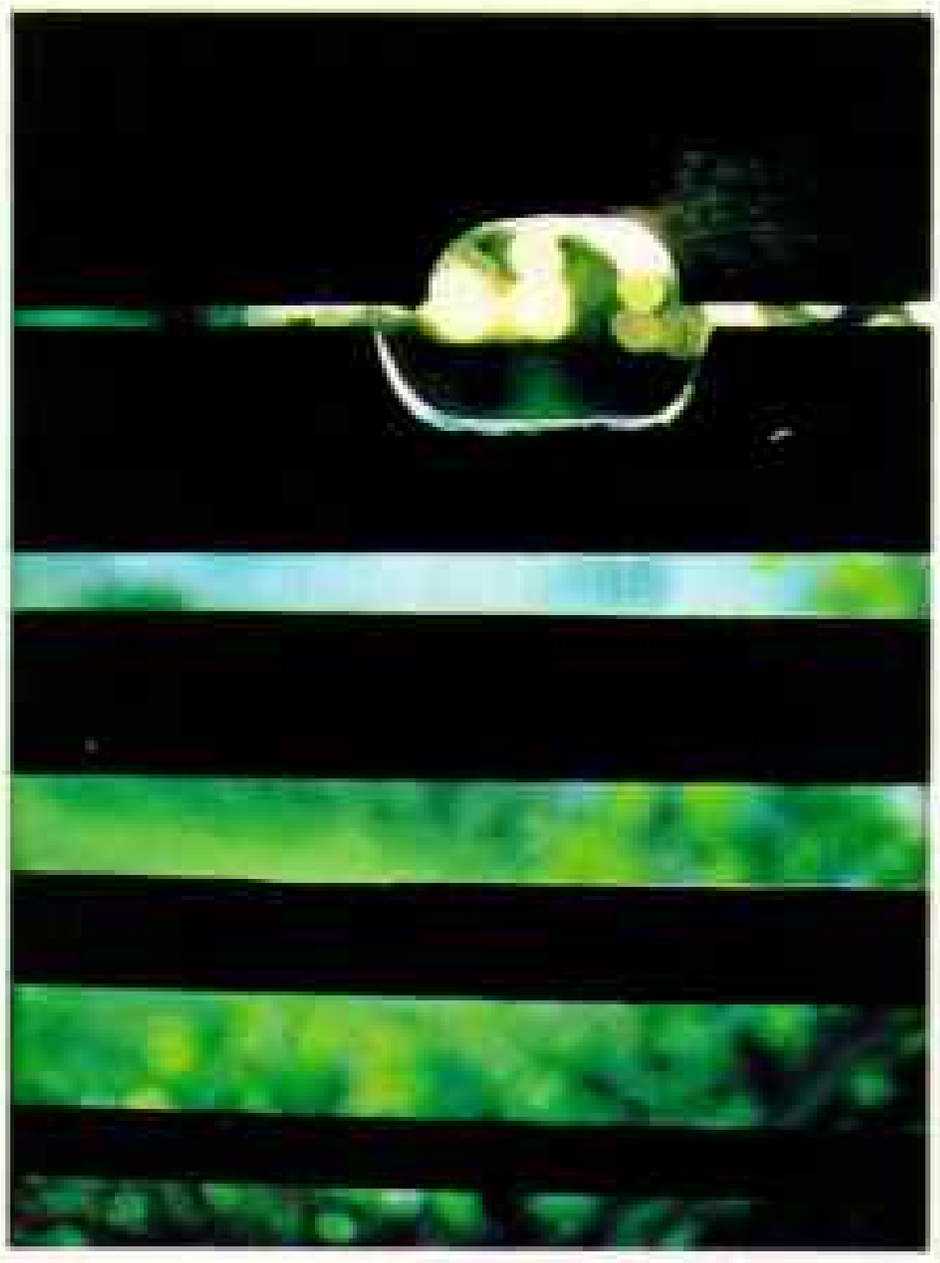
"During the first years he worked rather well, writing, dictating. Then he became bored so that he seldom worked. The worries, certainly, made things worse.

"Do you realize that once he didn't leave Longwood for nearly two years! He was protesting against the way there were soldiers everywhere with telescopes, watching him. And Lowe had decided there were only a few little parts of the island where he could ride by himself; the rest of the time he had to be escorted by a British officer.

" 'Rather than do that,' he said, 'I would rather stay indoors.' And when he didn't go out, Lowe decided he had to show himself to an officer twice a day. Like a prisoner. He said no. He locked the doors and said, 'I will not allow them to come inside my house.' For the last two years not an Englishman went into that house, not one except for the doctors assigned to treat him.

"No doubt, there was deterioration by loneliness. I think that he gave up at the end. The body was opened. They found a little hole the size of a finger in his stomach. I





*"**Death is nothing;** but to live defeated and inglorious is to die daily," Napoleon wrote in 1804, as if in premonition of his final 5½ years of exile in the British colony of St. Helena. At odds with the governor, he often stayed indoors at Longwood, dictating his memoirs, sleeping on a camp bed (**right**), and staring out a peephole in the shutters (**left**). On October 4, 1820, he rode out for the last time to picnic with an English neighbor on the lawn of his estate, Mount Pleasant (**above**).*

don't know if it was an ulcer or a cancer."

And so Napoleon died on May 5, 1821; his last words, "*France . . . armée . . . tête d'armée . . . Joséphine.*" He was buried on the island. In 1840, at the request of the French government, his remains were transported to Paris, where they lie today in that great tomb in the Invalides.

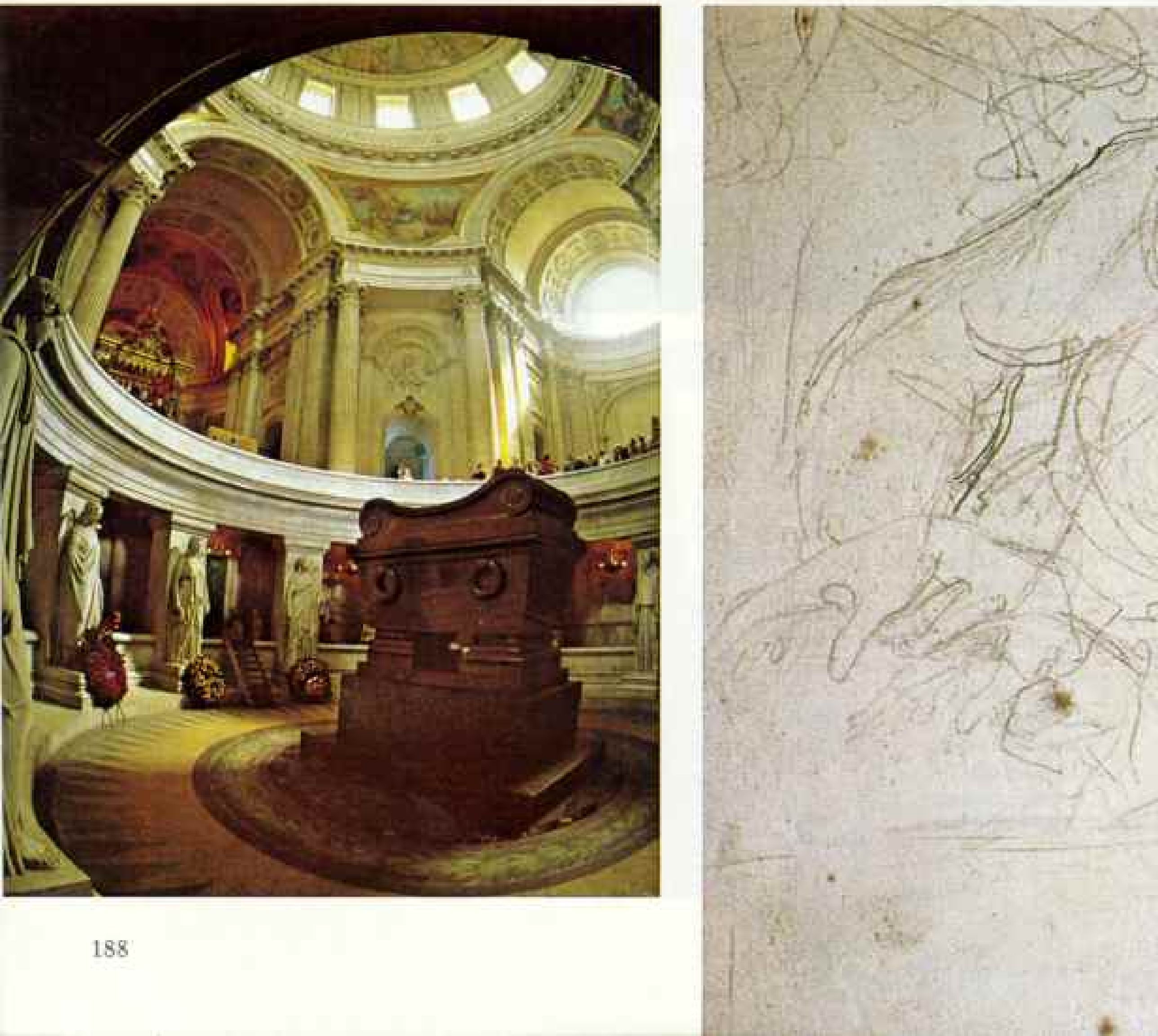
There on May 5 each year, the anniversary of his death, there is a memorial Mass, the roll of drums, men with bemedaled chests. Gathered are the descendants of the Bonapartes and admirers of Napoleon.

There is Prince Napoleon, descendant of Jérôme, tall, stately, head of the Bonaparte family today, a veteran of the Foreign Legion and the French Resistance; there is Count Walewski, direct descendant of Napoleon and Polish beauty Marie Walewska, an electrical engineer, rumpled, kindly; there is Prince Napoleon Murat, descendant of Caroline and Murat, a film producer, as spirited and elegantly tailored as his cavalry forebear.

There, in the adjacent museum, lie the weapons and trophies of the Grande Armée, and personal things of Napoleon.

But I had felt closer to Napoleon on St. Helena. I would remember the hill with the cottage close by Longwood: the trees bent by the wind, the red and yellow birds, and how when the rain came the hibiscus would close; and the mist, cutting off the mountains and the sea; and then the murmur of

"Noble, classical, and peaceful" *was the face described by an English physician and sketched by an observer when the emaciated Napoleon died on May 5, 1821. His body was later returned to his beloved Paris, where it lies at the Invalides in a*



the wind through the scrubwood. Napoleon had said: "A great reputation is like a great sound. . . . Laws, institutions, monuments, nations perish, but the sound endures and echoes down the generations."

I liked to walk that hill, to find some solitary place and look down on the sea that stretched on and on until it met the sky. "I feel the infinite in myself," Napoleon said.

Indeed, his achievements were staggering. "He has given us the example of all that man can do with force, and everything he may dare with genius," an old enemy conceded. "The mightiest breath of life which ever animated human clay," another said.

He had carried the ideas of the French Revolution throughout Europe, given France its structure of government, stirred nationalism, promoted liberalism, developed mass armies, ruled most of the Continent for a decade. He had envisioned a Europe united under one law, one rule, "composed of one and the same family."

Following Napoleon, I had liked him at first, disliked his later actions, finally felt pity. In those early letters, when he and all about him seemed young, he had written: "What is the future? What is the past? What are we? What magic liquid is it that shuts us in, and hides from us the things that we ought most to know? We move and live and die in the midst of miracles."

The greatest miracles are life and love: It was a pity he turned his back on both. □

sarcophagus of red porphyry amid 12 figures of his victories. Each year Bonaparte descendants and other admirers gather on May 5 to lay wreaths, to celebrate a memorial Mass, and to hear taps played for the man who overwhelmed an age.

MUSÉE NATIONAL DE MALMAISON

EGYPT'S DESERT OF

By FAROUK EL-BAZ

PROMISE

Photographs by GEORG GERSTER

Breakers of dunes *wash across the Great Sand Sea in Egypt's Western Desert. Elsewhere in this devastatingly arid region, reservoirs of groundwater may herald a rebirth of agriculture.*

Nestled in vast depressions close to the

Date palms and olive trees surround the mosque and village of El Qasr in the Dakhla Oasis.

water table, oases support human habitation.

Seeking refuge from the eternal sun, a

Like icebergs of chalk, eroded remnants of an ancient seafloor anchor on the sands near Farafra.

geologist finds shade enough for a morning break.

Time, wind, and thieves have ravaged

The necropolis of El Bagawat lies near the ancient temple of Hibis in the Kharga Oasis.

the tombs of a 1,600-year-old Christian cemetery.

Arid Egypt looks to a green

"A DATE PALM is the only creation of God that resembles man," said the old man at the Ein Gomah well. He waited for me to ask why. "Unlike other trees," he said, ancient eyes a-twinkle, "a date palm gives more as it grows older."

This was a prelude. I had visited Ein Gomah twice before, and knew that the irrepressible Sheikh Mehedi was building up to giving us a date tasting. The shady grove of date palms where we stood was perhaps Mehedi's most prized possession, as it had been his father's and grandfather's.

Here in Egypt's far-flung Western Desert, dates are important ingredients in human diet. When fine and abundant, dates can be sold for much money. They are packaged at a factory in nearby Bawiti, the capital of this cluster of villages in the oasis called Bahariya; then they are trucked to Cairo some 285 kilometers (180 miles) away. When inferior, dates are fed to cattle.

Sheikh Mehedi walked to his palms and gathered cluster after cluster, in spite of my plea to stop. He knew well that my party could not possibly eat all he offered, but generosity to visitors is still the rule in the desert. He carefully selected ripe dates and offered them with polite insistence. His sons, cousins, and their children all followed suit.

As on earlier visits to Mehedi's date grove, I was impressed with both the vigor and self-reliance of this 80-year-old man. The wells here were drilled, the soil was tilled, and the fruit groves were nursed under his unstinting supervision. The harsh realities of the desert were written on his weather-worn old face, but his smile and spirit reflected the feelings of hope that have begun to permeate through this dry outland of the world.

Mehedi spread huge rag rugs on the ground, and as we waited for heavily sugared dark tea to arrive, I counted 17 men and children that Mehedi had sired. He and his relatives bombarded me with questions.

"We hear that you intend to bring water from the Nile all the way out here to irrigate our lands. Is that true?"

"Aside from the Nile, people say that there is an even larger river that flows underground in the Western Desert. How do we find this great river and tap its waters?"

"I have heard that there is a huge sea of oil beneath the desert that the foreigners have been keeping a secret. Now that the United States likes Egypt, they are going to tell us where it is. When do we drill for this oil and transform Egypt into a rich nation?"

I was astonished at how informed Mehedi was in this place without a radio, where news spreads only by word of mouth from travelers. He knew that his country needed to become more self-sufficient. "It is my hope," he said, "that Egypt will learn to use the Western Desert for the benefit of all Egyptians, particularly to grow food."

That same goal was what had inspired me to study this desert in the first place.

IN EGYPT, 42 million people utilize only 4 percent of the land. The rest is desert, and the Western Desert covers more than two-thirds of this (map, pages 200-201). It extends from the Nile westward to Libya—hence its onetime name, the Libyan Desert.

To most Egyptians the desert remains a mystery. Few are familiar with its place-names. Fewer still venture into it.

In 1923 an Egyptian official named Ahmed Hassanein became the first outsider to cross the Western Desert. He journeyed from the Mediterranean south to El Obeid

bounty in the sands

in central Sudan, later describing his travels in the September 1924 NATIONAL GEOGRAPHIC. His camel caravan crossed 3,540 kilometers and discovered the two "lost oases," Uweinat and Arkenu, at the southwestern frontiers of Egypt. The expedition won him the Founder's Medal of the Royal Geographical Society.

After the publicity of Hassanein's journey, Prince Kemal el-Din followed suit in 1924-25, leading an expedition of half-track vehicles into the desert. He enjoyed the trek so much he repeated it the following year.

The motorcar swiftly replaced the camel as the ship of the desert. Using Fords, Ralph A. Bagnold and a select team of British officers explored vast tracts of the Western Desert in the 1930s, reaching its remotest corners. His explorations provided most of the basic data not only on this desert, but also on the laws governing the movement of sand by wind and the formation of dunes everywhere. During World War II Bagnold led an Allied force over these desert routes to raid and harass Italian troops in Libya.

More recently, photographs taken by U. S. astronauts and unmanned-satellite images have provided a new method of exploring the desert. These clear, cloudless views of extensive areas reveal many large regional patterns impossible to detect from the ground. From space, moreover, subtle or gradual color changes on the desert surface show up distinctively.*

It was these photographs that prompted me to return to the land of my birth. As a geologist I was excited by the wealth of new data they promised. Over the past six years, working with geologists from Cairo's Ain Shams University, I have made 12 journeys into the Western Desert, studying its varied features and learning from its inhabitants. Often we have been joined by archaeologists, botanists, and geographers.†

The late President Anwar Sadat became personally interested in the results of the first journeys. Each time I met with him, he would inquire about the desert's development potential. Then, in the spring of 1978 he took nearly two weeks to see the desert for himself. He did so to bring *El Thawra El Khadra*—the Green Revolution—to the desert and thereby help ensure that Egypt will have a future.

TRAVELING in the Western Desert, I often feel I am on another planet. It is so desolate that I have driven more than 300 kilometers between signs of life. After joining me for such a drive, an American colleague exclaimed: "This is a real desert! Now I know why some people call the U. S. Southwest a jungle."

There are a few places in the Western Desert, such as Sheikh Mehedi's date grove, that also resemble jungles. Yet even in the oases, lush greenery is very rare. Seldom in Egypt does an oasis fit the image most people have. For one thing an oasis is typically quite big. Usually it is the low or central region of a vast depression in the desert floor. Several of these pock the Western Desert.

Deposits from wadis—dry stream beds—cover the centers of these basins with fertile soils. Groundwater there is relatively close to the surface. Therefore, agriculture becomes possible and settlements spring up around wells. In Egypt an oasis can contain

*One such Landsat mosaic by NASA covered much of Egypt and was reproduced in the March 1977 NATIONAL GEOGRAPHIC.

†Another trip of the author was described by Rick Gore in his global survey of deserts for the November 1979 NATIONAL GEOGRAPHIC.

PAINTING BY LLOYD K. TOWNSEND
COMPILED BY HAROLD A. HANSEN
NATIONAL GEOGRAPHIC ART DIVISION

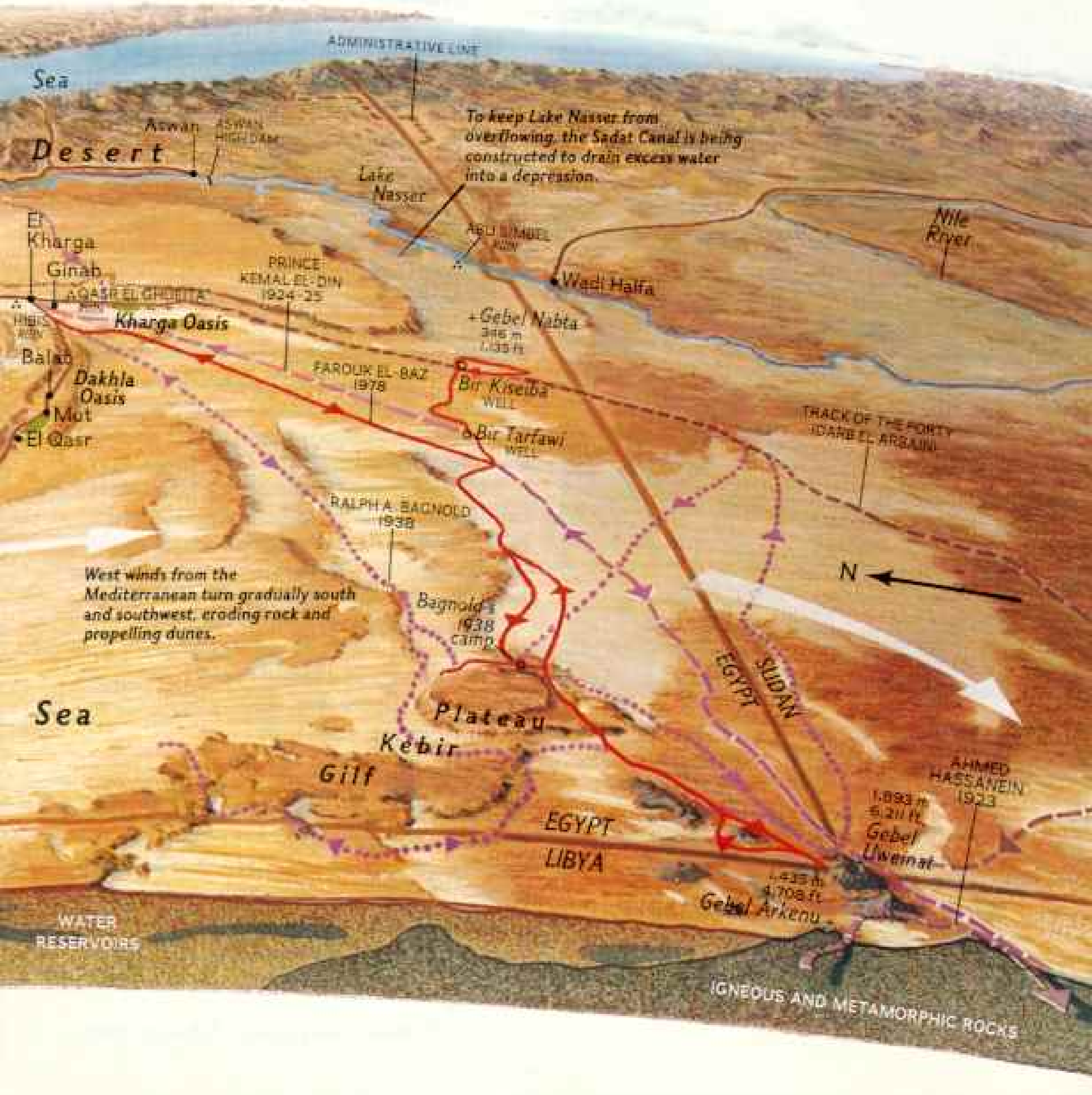
THE FORBIDDING Western Desert **(below)**, *driest part of the vast Sahara, comprises some two-thirds of Egypt's land. In parts of this hyperarid desert, generations pass without a rain.*

Yet with the discovery of reservoirs of additional underground water south of Kharga, Dakhla, and Farafra Oases, the late President Anwar Sadat announced last year a five-year plan

to expand desert agriculture by 500,000 acres. This could increase Egypt's farmland by 5 percent.

Though it is not known whether the water, which may be 25,000 years old, is replaceable, sufficient quantities exist to support such increased farming for at least a century. Approximately 35,000 acres in the oases are presently under cultivation.

Author Farouk El-Baz, science adviser to President Sadat and director of the Center for Earth and Planetary Studies of the Smithsonian Institution's National Air and Space Museum, used photographs taken from space to plan a dozen journeys through the desert. Together with other scientists he studied the region's geology, botany, and archaeology. His 1978 route, along with the routes of earlier explorers, is shown below.



many green villages separated by miles of barrenness. The major oases are named Faiyum, Siwa, Bahariya, Farafra, Dakhla, and Kharga.

The largest and most spectacular of the Western Desert's depressions is Qattara, which plummets 133 meters (436 feet) below sea level—one of the lowest points in Africa. A treacherous *sabkha*, or sandy marsh of water-saturated salt, covers about 5,800 square kilometers of its floor. The best of desert vehicles gets hopelessly stuck in such quicksand. The rest of the floor is relatively negotiable. Where it is not covered by sand and pebbles, clay and bare rock form a bumpy pavement. The ovenlike heat within the depression makes its crossing practical for only a few months of the year.

Egypt has big plans for this hostile depression. Under study is a grand scheme to dig a 75-kilometer (45-mile) canal that would bring water from the Mediterranean Sea to Qattara. As with other Western Desert depressions, a steep scarp marks Qattara's northern edge. So as Mediterranean water falls over this edge, it would drive turbines to generate electricity. The water would then gradually evaporate, and in time the depression would fill up with salt.

As much as 5.7 billion kilowatt-hours of electricity could be generated annually from this project. That is more than the output of the High Dam at Aswan. Does Egypt really need such a grandiose scheme? Those in favor argue that the country has no better way to develop the 88 billion kilowatt-hours of electricity that they envision the country consuming in the year 2000.

Advocates speak of side benefits: tourist appeal, fishing, industrial development, and even an improvement of weather in the area with the creation of such a large body of water. Adverse effects might include saltwater invasion of the sweet groundwater that underlies other parts of the desert.

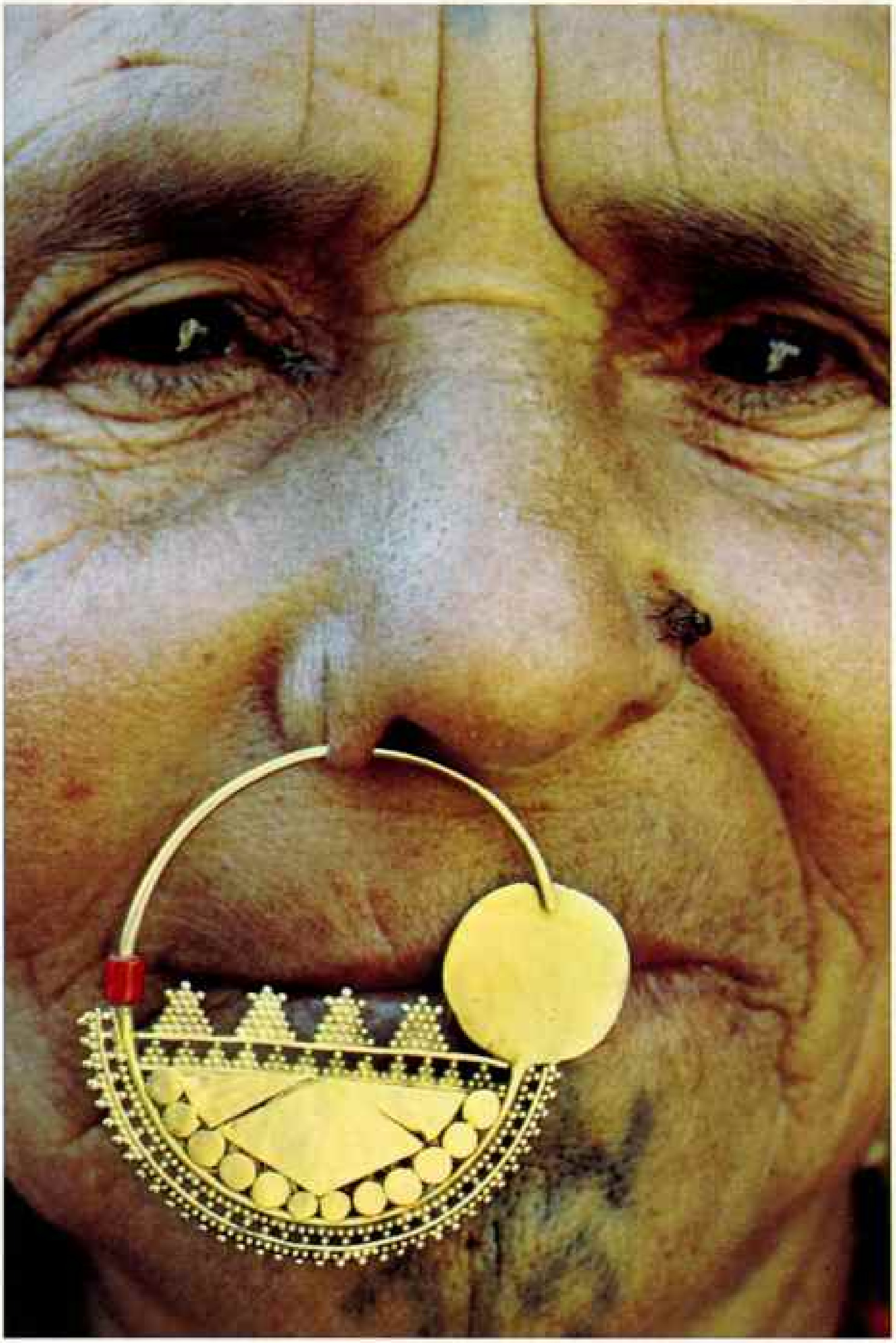
The only people immediately affected by the Qattara project would be the 150 inhabitants of Qara on the western border of the depression. Qara is so remote that visitors rarely reach it. During the days of the slave trade, according to legend, runaway captives escaped from a Cairo-to-Marzuq (in Libya) caravan and founded the old village in this secluded place, high atop a mesa overlooking the depression.

Twin plagues *of sand and salt frustrate desert farmers. Irrigation of soil with poor drainage leaves pools of water near Mut in the Dakhla Oasis (***above***). Evaporation by relentless sun renders the former farm a salt-encrusted wasteland.*

*At El Kharga (***facing page***), a river of sand advances to smother houses, fields, and groves of date palms.*

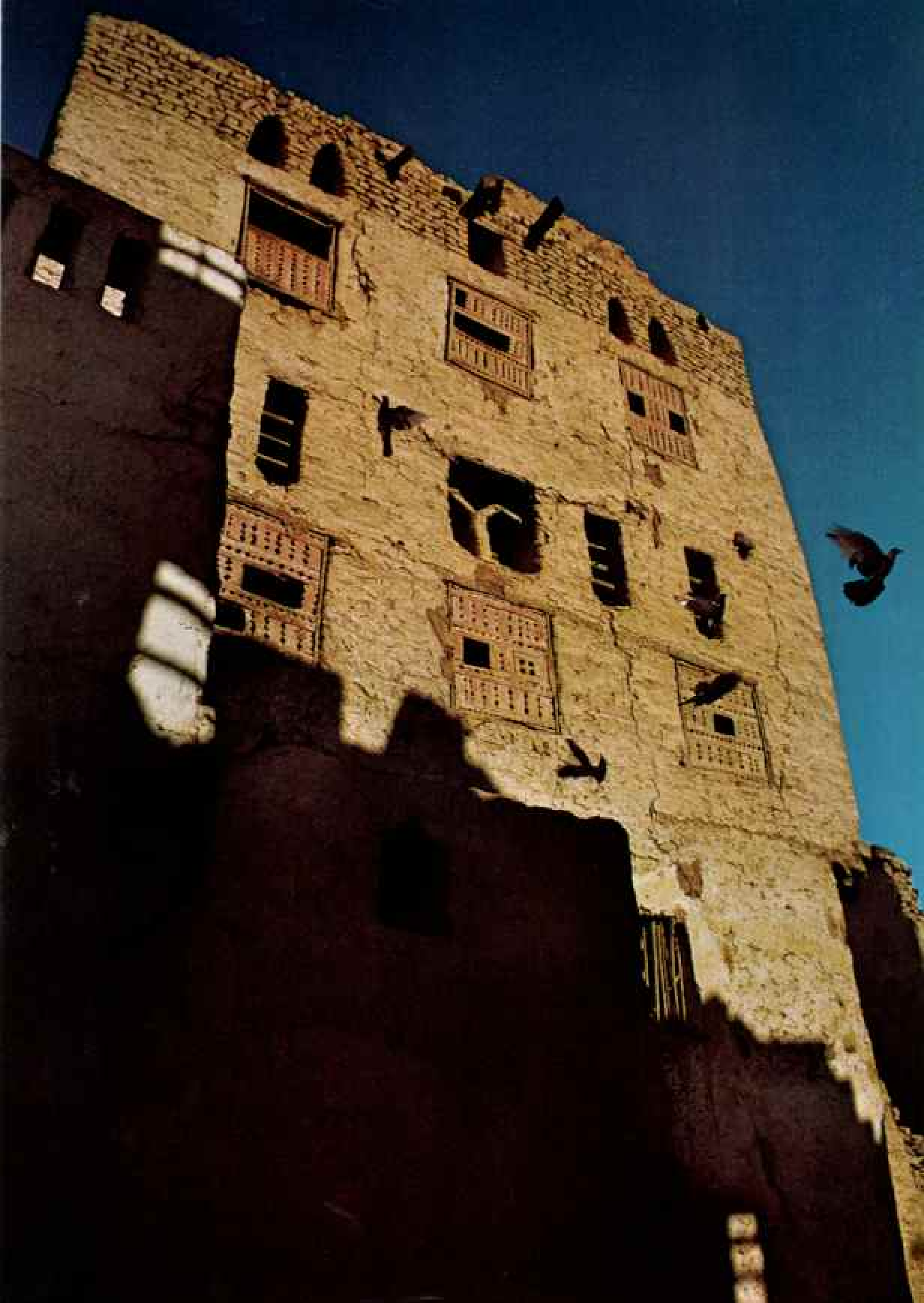
SOUTH OF QATTARA begins the domain of sand. Beyond the depression more than 20 belts of dunes flow southward toward Sudan on a course that roughly parallels the Nile. However, this mighty river has nothing to do with dune orientations. In this sea of sand the wind controls all.

I have often sat nearly mesmerized,



Pride of the past *shines from the face of an old woman at Mandisha in the Bahariya Oasis (**above**). Serene despite flies, she wears marks of beauty: a qatrah, or gold nose pendant, and a chin tattoo. Such ornamentation, of southern Saharan origin, is now spurned by the young as an anachronism.*

*Despite sweltering heat, a dwelling in El Qasr (**right**) remains 20 to 30 degrees cooler on the inside. Its mud-brick structure serves as an insulator. Perforated shutters allow breezes to circulate—and dwellers to see without being seen.*



watching the wind move sand southward across the desert. As the wind gusts, it hurls the finest sand particles upward. The heaviest, largest particles remain earthbound, forming a protective armor of large grains across the surface. It is the mid-size particles that become agents of the wind, bouncing across the surface, accumulating into dunes.

A dune is a curiously dynamic creature. It can form behind any impediment—a bush or rock—or simply as the child of wind currents. Once formed, a dune can grow. It can change shape and move with the wind. It can even breed new dunes. Some of these offspring may be carried on the back of the mother dune. Others are born and race downwind, outpacing their parents. Some dunes in the Western Desert move as much as 100 meters a year. When dunes grow to mammoth size, they may slow to such a creep they could almost be called dead.

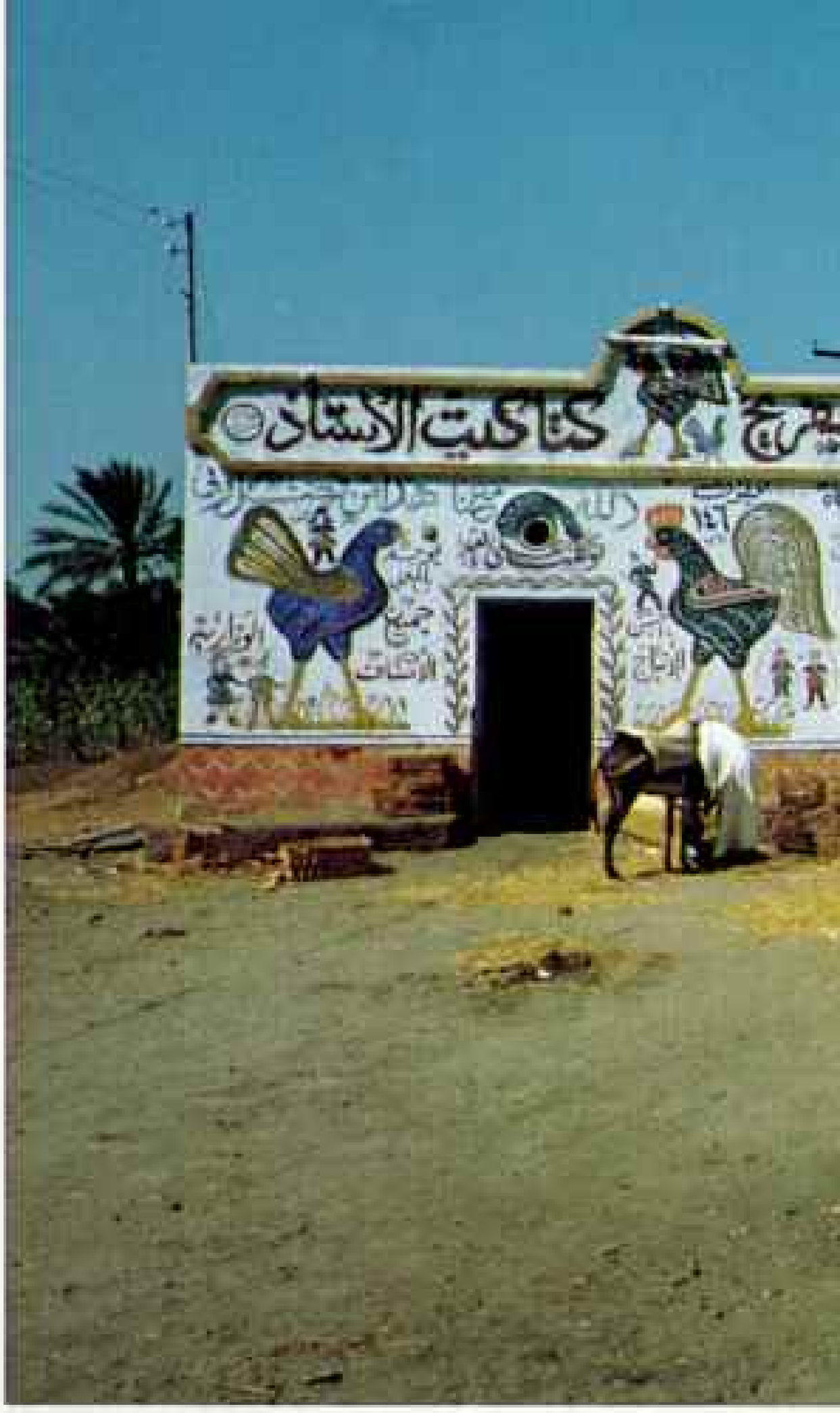
THE VARIETY OF DUNES is staggering. Some are dwarfs only a few meters high. Others are monstrous and uncrossably steep, towering to heights of 200 meters (660 feet). Some dune belts could by themselves stretch from New York City to Washington, D. C.

Where there is a limited supply of sand and steady winds blow from one direction, crescent-shaped, or barchan, dunes are often found. Groups of barchans may join up to form complex patterns, such as doughnut shapes. Where the wind changes directions seasonally, it may force the sand into so many extensions that the dune resembles a star. Or a strong wind can blow all the sand into a dome dune.

Where there is a lot of sand and the prevailing winds shift slightly in direction, longitudinal dunes may form. The crests of these dunes are sharp, and they may meander in snakelike patterns.

Longitudinal dunes cluster to form dune fields. The Great Sand Sea in the western part of the desert is a magnificent example. It covers five times the area of Massachusetts. Its many shifting longitudinal dunes ride on top of much larger, more stable, and gently sloping whaleback dunes.

Though land vehicles now make their way through the mighty dunes of the Great Sand Sea, it long remained the domain of the



Chickens galore *await the villagers of Faiyum Oasis* ***(above)****, where an arrow points the way to a hen house whose sign translates as "The Professor's Chicken Breeding Laboratory." Women cradle a jug of water freshly filled from one of the village taps.*

Elsewhere in fertile Faiyum, supplied in part with irrigation water from a canal to the Nile begun 3,800 years ago, women sort dates ***(right)****. Prime varieties are used both for local consumption and export. The remainder are fed to cattle.*

In the village of Bawiti, men use muscle power to run an ancient olive press ***(left)****, a scene that could have been viewed thousands of years ago.*

Welcoming the soul *of a dead official, shown as a bird with a human head, the goddess Isis (center, top panel) offers water. On the lower panel of a tomb discovered near El Qasr in the Dakhla Oasis and constructed during the Roman occupation that began in 30 B.C., locally grown crops represent food for the eternal journey. From left: a grapevine, a date palm, an olive tree, and wheat.*

camel. Still, many camel caravans met their end among these towering mountains of sand. It is said that an army of Cambyses II, King of Persia, was swallowed up by the dunes without a trace.

Walking into these dunes is more awesome than wading into an unknown ocean. The silence can be profound. Colleagues tell me their ears almost hurt from the quiet.

No man would try to live near the dunes. Closer to the Nile, however, farmers have been fighting a losing battle with the sand for centuries. At Kharga Oasis (page 203), dunes submerge new roads and telephone lines and encroach upon fields and whole villages.

Near the ghost village of Ginah, I met Sabir Ibrahim, a Bedouin tending a herd of camels. He told mournfully how Ginah had been completely engulfed by sand. The inhabitants had attempted to halt the advance of sands from the north, but their efforts were dwarfed by the power of the dunes. Sabir said that in 1971 the government had built a new Ginah a short distance away to resettle the farmers.

"What did a new village do for those poor devils?" Sabir exclaimed. "It is now threatened itself by other dunes. The desert is not made for permanent villages. Only the style of the Bedouin is suited to the desert."

That is no longer true. Satellite images now show lines of moving dunes and reveal safe, sand-free corridors between them.

Farther south in the Kharga Oasis, we stopped at Qasr el Ghueita, a Ptolemaic temple built before 220 B.C. The local guardian of antiquities, Haj Taha Rashidi, gave us tea.

"It is said that you are studying all the sand dunes in the Western Desert so that you can melt them down with rays from space and rid us of their constant threat," said Haj Taha. "Is that true?"

I explained to him that no such rays exist, and that the sand problem is best combated by locating dunes, studying their rates and directions of movement—and then avoiding their paths. Thus our research team has mapped, classified, measured, sampled, marked, and even dissected dunes.

How do you dissect a dune? Carol Breed

and our research team used a technique developed by one of her colleagues in the U. S. Geological Survey, Edwin D. McKee.

First, they selected an appropriate dune near Bahariya. To keep the loose sand from collapsing while trenches were dug, the surface had to be wet. Water was supplied by a fire truck from the nearby El Gedida iron mine. To lessen the impact of water spray on the fragile dune surface, they placed a cheesecloth over part of the dune's side and held it down with rocks. To speed up the wetting, they punched holes in large wash-basins to dribble water across the dune's side until the sand was soaked.

They dug several trenches and took photographs of the exposed layers of sand that had been laid down over the years by the wind. Then they put cheesecloth on the side of a trench and painted it with latex. When it

dried, the sand stuck to the cloth, so that a profile of the layers could be peeled away. They removed this peel and carefully packed it away for laboratory investigations. This surgical procedure took most of the day. "There must be gold in this sand," a local laborer murmured.

The gold in the sand was the record of its deposition. The team would be able to deduce how past winds had blown and shifted. Changes in wind patterns are usually cyclic. So knowing the wind's history gives us a critical clue about where it will be aiming the dune in the future.

THE WESTERN DESERT is the driest part of the Sahara. There, the sun could evaporate 200 times more rain than actually falls. In some places generations pass without a rain.

During an evening with the mayor and elders of Farafra Oasis, we questioned them about a rainstorm that we had heard about in October of 1979.

"No, the rainstorm did not reach us here, but we know that it did rain some nearby."

"Was there any evidence of running water or ponds in low ground?"

"Not really. The rainwater soaked through the dry ground almost as it fell."

"When did it last rain here in Farafra?"

"It was in 1973. Before that, 1945. In January, when Ahmed was born." The old man pointed to the smiling Ahmed, who sat with us, dressed in a long, blue-striped *galabia*, or robe, and white *tagiya*, cap. "It was a downpour. It destroyed many of the old homes and filled our village streets with mud."

Thus, rains are memories of old men in this desert. To them a storm is that of sand or dust, and weather is the howling wind.

Indeed, the landscape of Egypt's Western Desert displays the lashings of its relentless wind everywhere. Millennia of wind have striated the surfaces of exposed rocks, making them look as though some giant rake had gouged across them. Where the wind cuts, rubs, and sandblasts more deeply into rocks, it has carved a plethora of smooth-edged hillocks. The most striking of these are called yardangs, which in final form are aerodynamically stable structures, resembling upside-down boat hulls, each with its prow end pointed into the wind.

Swiss photographer Georg Gerster, who accompanied me on several trips, quickly saw my fascination with the shape and orientation of yardangs. "I will bring you something to help you with your yardangs," Georg promised one day as we were measuring and pacing with compasses in hand.

Sure enough, on our next journey to Farafra, Georg had added several pieces of luggage. When we reached an alluring yardang field, he unveiled his present—a kite.

The kite measured two square meters. Three men had to hold it down while Georg attached his camera. Then as the kite soared over the yardangs, Georg shot his pictures by remote control. We hailed his contraption as an easy, inexpensive, and portable way to take aerial pictures, especially in such an out-of-the-way place.

THE REMOTE MOUNTAIN Gebel Uweinat has long intrigued me. Apollo-Soyuz photographs of this massif, which straddles the borders of Egypt, Libya, and Sudan, revealed features similar to those I noticed in the Viking spacecraft images of Mars. In 1978 I organized a journey to this nearly unknown place, whose legendary existence had been confirmed by Ahmed Hassanein 55 years earlier.

Reaching Uweinat is no small feat. Fortunately, I was helped by the Geological Survey of Egypt, which provided six jeeps, two tanker trucks for fuel and water, and a 12-ton lorry with food and supplies. Some of us traveled in two Volkswagen Type-181 vehicles, provided by the National Geographic Society to geologist-archaeologist Dr. C. Vance Haynes of the University of Arizona for desert research, which he had been undertaking in the Western Desert. Our party of scientists, drivers, mechanics, laborers, and cooks numbered 33.

Most of our route south of Kharga was on unmarked trails. The only maps covering the whole route are based on descriptions by the earlier explorers, describing vast regions with such terms as "big hills," "soft ground," "open sand plain," and "bad going."

We had to locate our path better than these maps permitted because we planned to sample the surface periodically and compare its brightness with color variations in space photographs. So I called on the

National Aeronautics and Space Administration for help.

NASA lent us a battery-powered transmitter, which we installed in a vehicle. We sent signals up to the Nimbus 6 satellite as it passed over us two or three times a day, and it relayed our message via a station in Alaska to NASA computers in Maryland. They plotted our latitude and longitude. Back in Washington, D. C., I was able to view the satellite markings of our tracks and to coordinate our field-sample sites with the satellite photographs.

Somewhere in the totally barren stretch around Bir Kiseiba, our sharp-eyed lead driver Ayed spotted a camel caravan. As we drew closer, I leaned out of the jeep to take pictures with a long telephoto lens. I soon realized that the lens might look like a gun and quickly retreated.

The caravanners, five lean and tall Bedouin, greeted us. They had come from deep within Sudan. There they had loaded their camels with a sodium salt called natron. Natron was used in mummification long ago. I asked the caravanners how their cargo would be used today.

"Do you chew tobacco?"

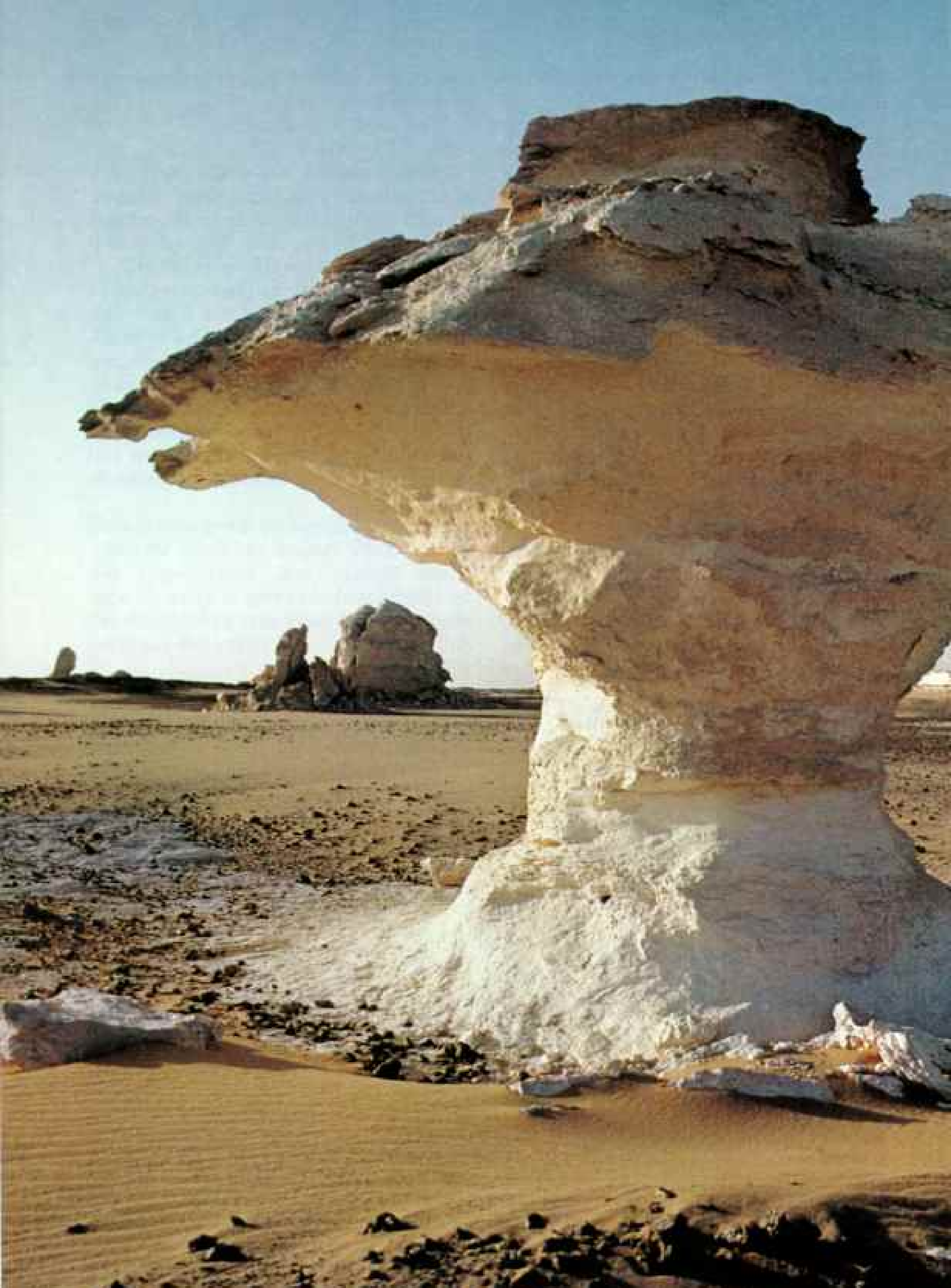
"No," I answered.

"Well, if you did, you would find a piece of natron in every pouch packaged in Egypt. A small bite is said to tenderize the tobacco and remove its bitter taste. They tell me it is very good. I don't chew tobacco either."

These sturdy men had been traveling 26 days along the Track of the Forty. This route connects Kharga to El Fasher in Sudan and is so named because camel caravans take forty days to travel it. Forgotten caravanners had erected cairns of black rocks along the track, but the mummified bodies and sandblasted bones of camels that had not survived the journey made better markers (below).

From Bir Tarfawi we drove west toward the Gilf Kebir Plateau and Gebel Uweinat. Vance Haynes and archaeologist Bill McHugh asked us to stop at a site. As a geologist I found these sites nondescript and dull. But as the *(Continued on page 216)*

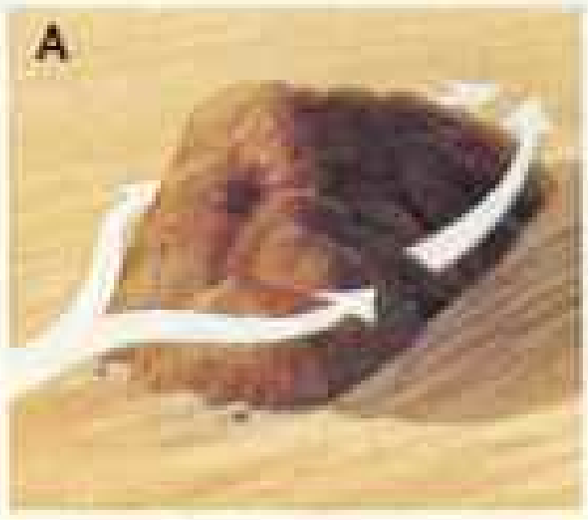
Grisly signpost, *a naturally mummified camel is one of many that mark an age-old caravan route called the Track of the Forty, for the forty days it takes to make the journey from deep in Sudan to Kharga. "When you travel for a distance and you don't see any bones," says the author, "you worry, because then you are lost."*

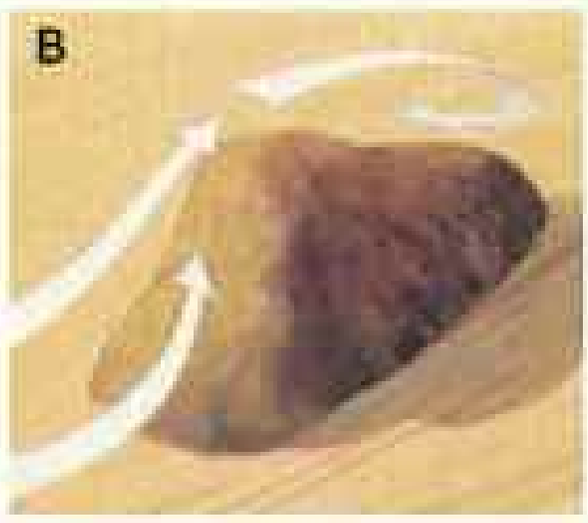


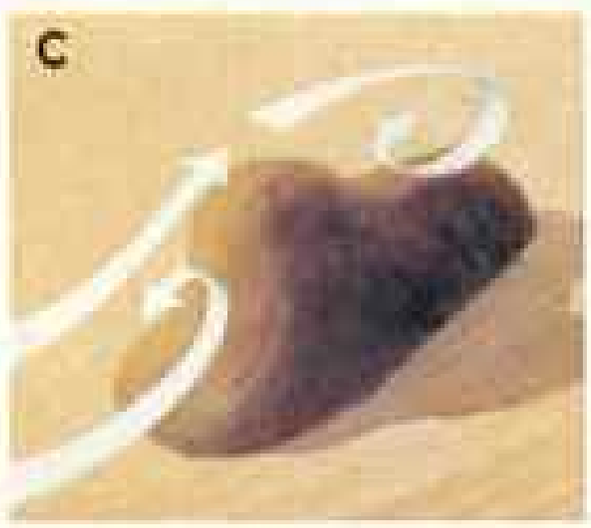
Birth of a sphinx?

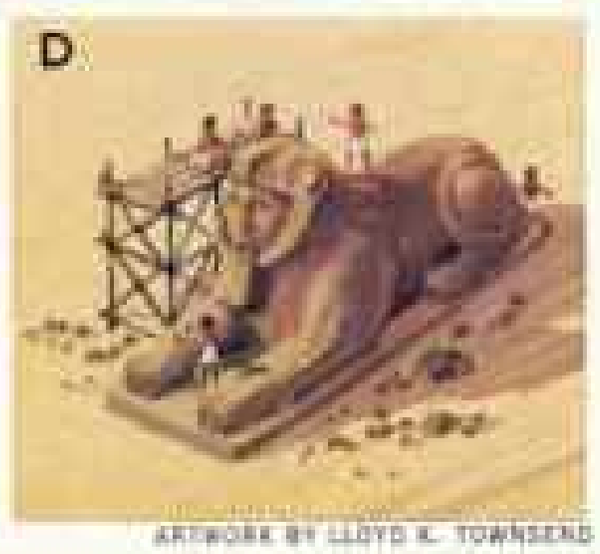
*SWIRLING WINDS fashion a mound of chalk into a mushroom shape near Farafra (**left**). But winds from a constant direction can create sphinx-like yardangs, like one near Dakhla (**below**). Some geologists theorize that the first sculptor of the famous Giza Sphinx was the wind.*

To illustrate: A steady wind shaped a yardang (A). Turbulent wind flow over the top gradually eroded its rear (B), and abrading of weaker rock carved a chin (C). Human sculptors finished the job (D). Scientists continue to study the wind's role in shaping the Giza Sphinx.





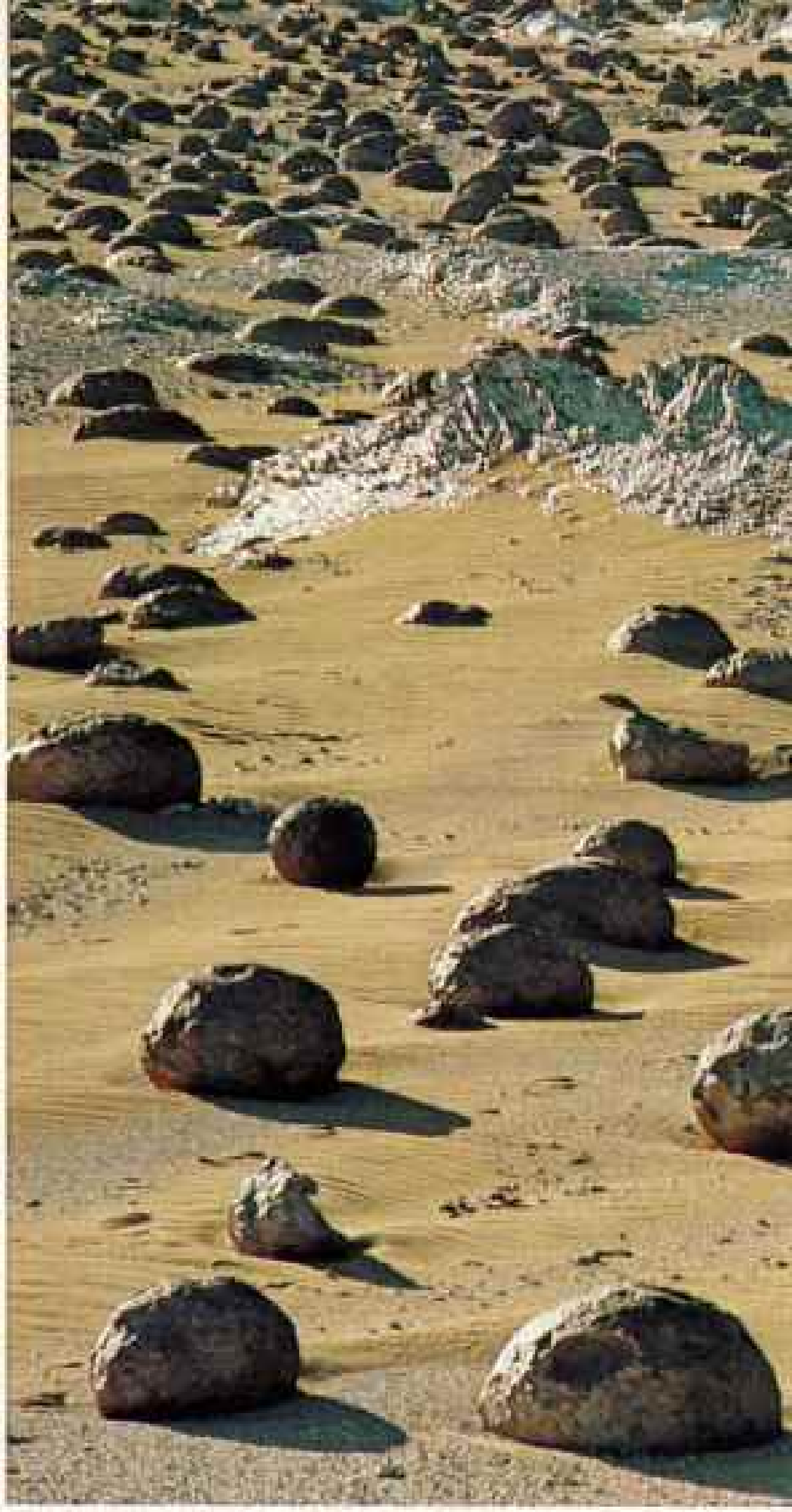




ARTWORK BY LLOYD K. TOWNSEND

Phalanx of dunes *flanked with sheer sides, the Great Sand Sea covers an area five times the size of Massachusetts. Somewhere in this formidable region may lie the graveyard of a Persian army sent to attack Siwa in 524 B.C. According to Herodotus, a violent sandstorm arose over the 50,000 troops, "so they disappeared from sight."*

*Elsewhere the desert floor wears varied coverings: near El Gedida iron mine, a veneer of marine fossils (**left**); near Farafra, nodules of chert and oxidized iron (**center**); near Kharga, a sprinkling of small pebbles (**far left**).*



Random harvest *of erosion, silica nodules stipple the sand and exposed limestone of the Kharga basin. The wind-resistant rock formed when the desert was covered by a sea some 20 million years ago.*

archaeologists began their work, I changed my mind.

Their nimble fingers first produced stone blades. Pieces of ostrich eggshell turned up, along with black pebbles charred by fire.

Bit by bit a panorama of life unfolded. The blades must have been shaped by human hands. There certainly would have been no ostriches here if the land had not been covered by grass. For the humans to build a fire and cook the eggs, there must have been firewood and, hence, trees. The spot must once have been fertile.

At another spot Drs. Haynes and McHugh dropped to their knees and found more eggshell pieces, which were later carbon-dated as being more than 8,000 years old. There was nothing, however, to indicate a prolonged human settlement. "These must have been pastoral nomads," said Dr. Haynes. "They stopped for lunch, just as we ought to."

We ate quickly, for we had no shade. Lunch in these parts was frugal—dry bread, cheese and sardines, and a sip of warm, iodine-scented water.

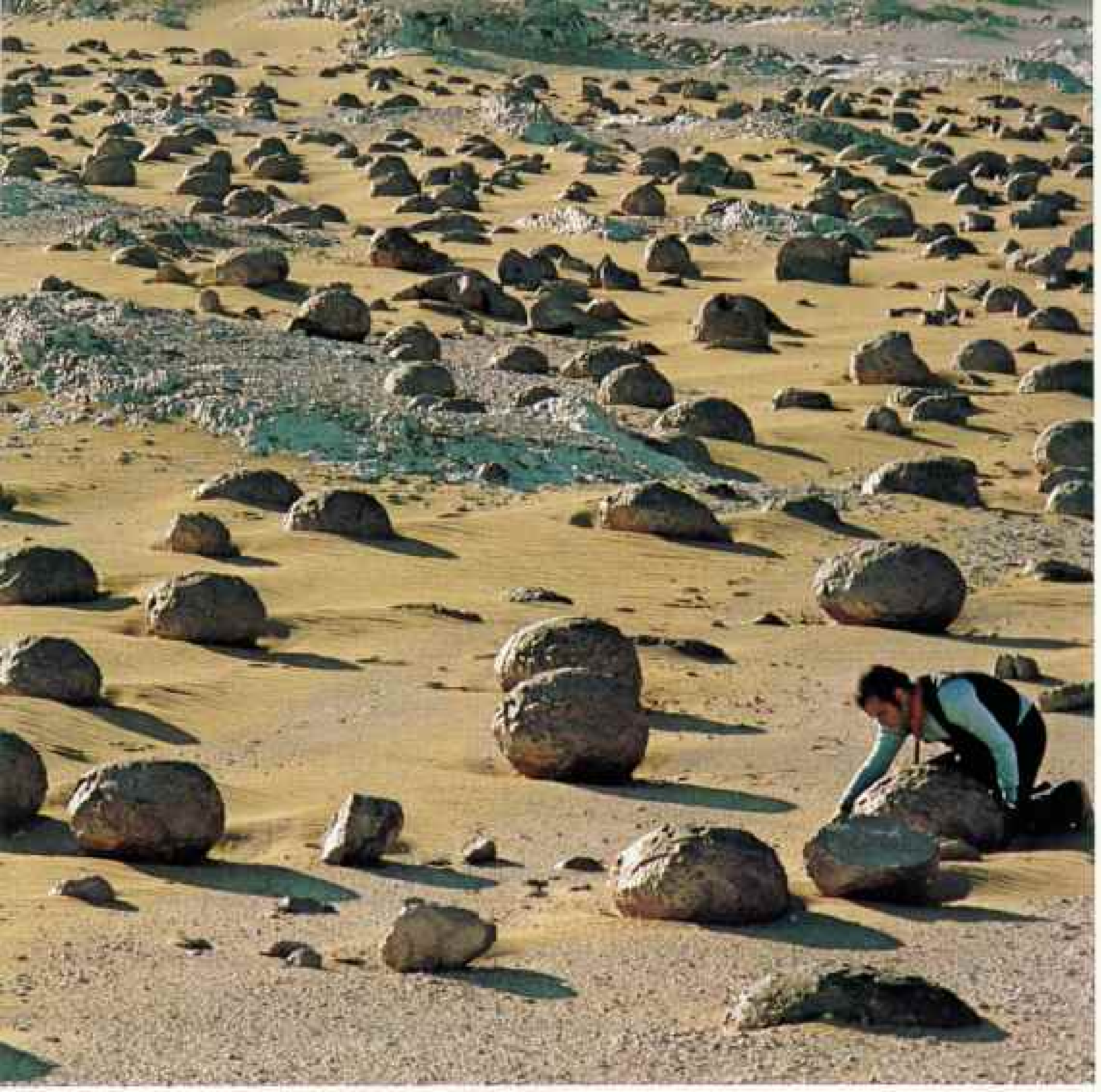
AS WE REACHED the eastern edge of Gilf Kebir, we saw that the desert had kept a record of previous explorers. Earlier we had found the narrow 1925 tire tracks of Prince Kemal's automobiles. Here along a nearby dune we located the remains of Bagnold's 1938 camp, now nearly submerged in the dune. Wooden boxes remained half buried. The sides facing the wind had been blasted paper thin. Exposed nails were also well sanded down.

Even the rocks here were pitted by the wind. Laden with dust, the wind can act like an air drill, actually tearing off grains of rocks. Once such pits form, sand grains lodge in them. Wind gusts twirl the sand around, enlarging the pits. Viking spacecraft photographs showed many pitted rocks on the surface of Mars. Could these pits have been formed in the same way? Some geologists think so.

All around us the wind had sculptured large and small features that most of our colleagues at home would ascribe to water action. Yet the wind has long been the dominant sculptor here; on Mars it has been the only one.

When we finally reached Uweinat, we found a different setting. That imposing 1,893-meter-high mountain has known water recently and frequently. Like the Gilf Kebir, it is cut by numerous wadis. Loutfy Boulos, our team botanist, was elated. At last he had some work to do—sampling the flora that managed to survive on their floors, thanks to the occasional flash floods.

We also explored Uweinat's caves and



rediscovered the petroglyphs proudly described by Ahmed Hassanein. As he had written in the 1920s, the animals were crudely drawn, but not unskillfully carved. He noted the preponderance of lions, giraffes, ostriches, and gazelles, but the lack of camels. He knew that the camel came to Africa from Asia around 500 B.C., so he suggested that these petroglyphs were carved before that date. Later Belgian archaeologist Francis Van Noten dated the petroglyphs as early as 6000 B.C.

Apparently the Western Desert has known many alternating cycles of wet and dry. Man has been here much longer than we once imagined. Over the past decade an international team of archaeologists with the Combined Prehistoric Expedition has combed some 60 sites in the southeastern part of this desert. Some of the axes they have discovered may be as much as 200,000 years old.

At a site near Gebel Nabta, on the shore of a dry lake, lie remnants of an 8,000-year-old neolithic village. Its dwellers dug a well 2.3 meters deep. Excavation has revealed a dozen oval houses, each 4 meters across, arranged in two rows. The houses were built of straw and contained grinding stones and storage bins. Barley grains have been unearthed, as have cattle bones. So these people not only practiced agriculture but were also early domesticators of animals.

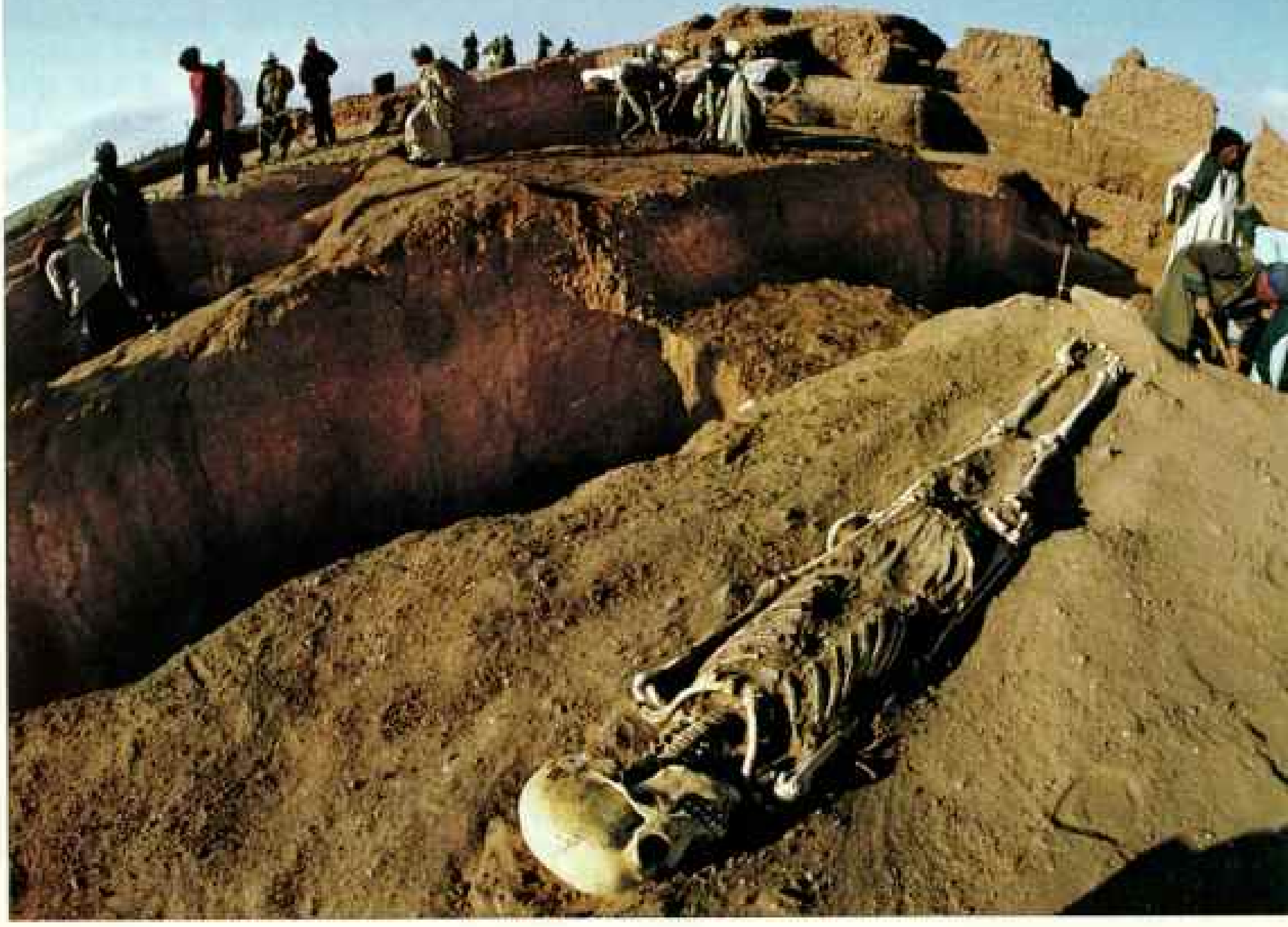
On perhaps my most memorable Western Desert journey I was accompanied by Mahmoud El-Prince, the governor of the New

***Solitary slab** in the pebbled wasteland near Bir Kiseiba (**left**) was later overturned to reveal two small stones used for grinding grain 8,500 years ago.*

*At another site nearby, the team of U. S., Polish, and Egyptian scientists of the Combined Prehistoric Expedition uncovered fragments of ostrich eggs (**right, top**) and thousands of beads made from them. In a re-creation of the technique, rough-cut disks on a string are filed smooth (**right, middle**) on a grooved stone.*

"Perhaps ten inches of rain a year fell here then," says American group leader Dr. Fred Wendorf of Southern Methodist University, "creating a savanna where bead-making nomads herded cattle, grew grain, and hunted ostriches, gazelles, and warthogs."

*Near Balat in the Dakhla basin workmen of a French archaeological team probe the ruins of a town (**below**) that flourished during the VI Dynasty, 2345-2181 B.C., perhaps to provide agricultural tribute to the pharaohs. The mounds in the background form the superstructure of a governor's tomb. The skeleton of an adolescent female dates from a much later time.*



Valley Governorate. The New Valley is the name optimistically given to the oases of the Western Desert, in the hope they might one day repeat the miracle of the Nile Valley.

"Where did all this sand come from, anyway?" asked the governor. I told him that we did not know for sure, but that I believe it probably came from southern Egypt and Sudan. During much wetter climatic periods, the Nile and other streams had eroded sandstone rock and had carried the grains northward toward the Mediterranean Sea. Over the past 200,000 years, as the climate has grown drier, the prevailing north winds have driven the sand back southward to cover the rocks from which it originated.

AFTER LEAVING the belt of sand dunes in Kharga, our party drove for hour after hour across ancient river floodplains, flat playas, and other clayey soils. The governor, an agricultural engineer, was astonished. Repeatedly he told the driver to stop so that he could inspect the ground. "This is good soil!" he declared. "There must be hundreds of thousands of acres that could be put into agriculture. If we could just get the water!"

A discussion of the underground water that has been recently found beneath the Western Desert naturally followed. This water is a topic of heated debate in Egypt. Some scientists think the reservoir, like the Nile, is being replenished by rainwater in more humid parts of Africa. This rainwater supposedly then flows underground to Egypt through Chad, Sudan, and Libya.

Others argue that the reservoir contains only ancient water that is not being replenished. Water from wells at Kharga, for instance, has been dated to be around 25,000 years old. Moreover, outcroppings along the southern and southwestern frontiers of the Western Desert show this region is underlain by impermeable rocks, which would inhibit the water from moving underground toward the New Valley.

There is simply not enough data. And so the controversy of whether the water beneath the Western Desert is a buried Nile rages. I told the governor my own conclusion that whether or not it is being replenished, enough water has been proved to exist under the desert to let Egypt expand agriculture vigorously for at least a hundred years.

"Then we should not develop much here. A hundred years is such a short time," said Governor El-Prince, the son of a land of 5,000 years of recorded history.

"It all depends on how the water is used," I replied. "For instance, growing rice would be folly. A kilogram of rice requires 3,000 times its weight in water. But there are many more appropriate crops that consume very little."

Indeed, U. S. and Israeli scientists are developing strains of desert plants that could produce substitutes for industrial oils, rubber, and gasoline.

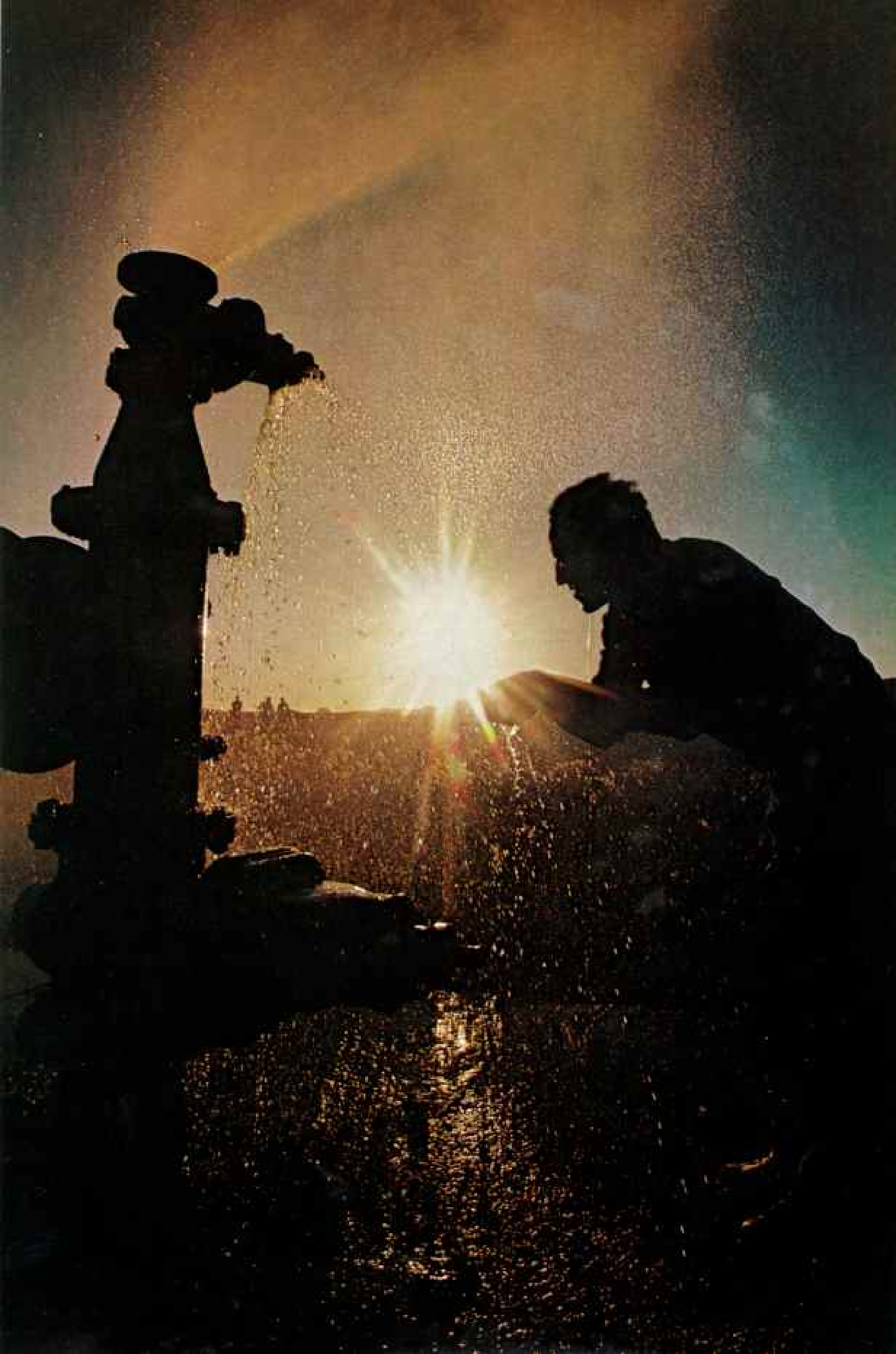
Evening after evening we sat with the governor under the stunning star canopy of the jet black sky to ponder the New Valley's future. We envisioned ranches where palms, fruit trees, grape arbors, olive groves, or newly bred arid-land crops might shade drought-tolerant grasses for grazing sheep and cattle. We talked of jobs that could draw young people from the overcrowded cities along the Nile.

Near the end of our journey we sat close to Abu Simbel on the shores of Lake Nasser. The governor remarked that we had never discussed one important item: petroleum.

I explained that the dearth of data about this vast desert had delayed any significant exploration. The situation is changing, I told him. One U. S. oil company is evaluating seismic studies in the Great Sand Sea west of Farafra. His face beamed.

I knew the smile. It was the same hopeful glee I had seen on Sheikh Mehedi's face on the northern fringes of the desert. As Mehedi would say, this ancient desert, like old men and date palms, is about to give more. □

Gusher of hope *for the future, water trapped in an underground reservoir spurts from a well near Farafra. Although some scientists argue that the water is ancient and irreplaceable, others contend that it is being replenished by water migrating underground from wetter parts of Africa. "If you have enough water to last a century, should you use it or not?" Egyptians wonder. The author's answer: "I would."*



Hummingbirds: The Nectar Connection

By PAUL W. EWALD
DIVISION OF BIOLOGY, UNIVERSITY OF MICHIGAN

Photographs by ROBERT A. TYRRELL

CALYPTE ANNA, MALE, 3¾ INCHES

HOMING IN on a stoplight-bright patch of California fuchsia blossoms, an Anna's hummingbird prepares to feast on nectar (***left***). In exchange the hummingbird unknowingly will carry pollen to fertilize another fuchsia.

Bird and flower are a perfect match. The hummingbird's long bill can probe deeply into the fuchsia's narrow tube of petals, the corolla (***above***). As the tongue touches bottom, pollen from the plant's male organs, the stamens, sticks to the bill and chin feathers. When the bird drinks from the next fuchsia, it deposits the fertilizing pollen on the blossom's female organ, the pistil, and receives from its stamens a fresh load of pollen, thus continuing the cycle. The blossom's design usually excludes other nectar feeders, such as bees, which are less efficient pollinators since they light on many kinds of flowers and would waste the fuchsia's pollen on competing species.

All of the more than 300 species of hummingbirds feed primarily on nectar and therefore serve as important pollinators. In southern California photographer Robert Tyrrell and I, with support from the Harry Frank Guggenheim Foundation, have studied several species and their host flowers.

CALYPTE ANNA, FEMALE, 3½ INCHES

STOICALLY bearing the burdens of motherhood, a female Anna's hummingbird incubates her coffee-bean-size eggs, normally two to a clutch (***above***).

During seasonal blooming, females arrive at nectar patches that males aggressively defend from rivals. After mating, the female leaves her mate's territory to seek her own source of nectar and build a nest of plant fiber and lichens bound with spider webbing.

Initially, she has time to patrol her nectar stake. But after two weeks her eggs hatch and the nestlings demand more of her time. As competitors invade her territory, she must scrounge insects and rob the nectar supplies of others for her young. Her own requirements call for a daily ration of nectar greater than her body weight.

After four weeks the fledglings of the closely related Costa's hummingbird are ready to leave the nest (***right***). Duller plumage helps females blend more effectively into the dry, shrubby chaparral, fraught with potential predators such as scrub jays and gopher snakes.

CALYPTE COSTAE, FEMALE. 3½ INCHES

SPECIALIZATION enhances the odds for flowers in the chaparral. Tree tobacco, an Argentine import, has leaves armed with toxic nicotine to deter plant-eaters. But during late summer its blossoms provide welcome flasks of nectar for Anna's hummingbirds (**below**). A rufous hummingbird feeds from another wild flower, *Penstemon labrosus* (**below right**). The flower's upper lip has been bent back to illustrate how the stamens give the bird a dusting of pollen.

A black-chinned hummingbird shows how woolly blue curls (***right***) compensate for shallow corollas with extra-long reproductive organs. As the bird rises to blot up the last droplet of nectar, it bumps the stamens and pistil.

Often hidden in such life-giving exchanges are tiny mites that also drink the flowers' nectar. For a continuous food supply, they must find a way from blossom to blossom. How? The hitchhiking mites race up the bills of feeding hummingbirds, stow away in their nostrils, then race down into the next flower—intriguingly effective adaptations in an interdependent community. □

CALYPTE ANNA, MALE, 3¾ INCHES

ARCHILOCHUS ALEXANDRI, MALE, 3¼ INCHES

SELASPHORUS RUFUS, MALE, 3½ INCHES

Golden offerings drowned with Santa Margarita off the

SANTA MARGARITA

Treasure From the

JONATHAN BLAIR

Florida Keys in 1622 hang on wooden figures from 18th-century Spain.

Ghost Galleon

By EUGENE LYON
Photographs by
DON KINCAID

ASIAN silk and porcelain shipped from Manila continued to Europe on the New Spain fleet.

GULF OF MEXICO
WRECK SITES
ATLANTIC OCEAN
Havana
Jamaica
Dominica
NORTH SEA
New Spain Fleet
Tierra Firme Fleet
NEW SPAIN
Jalapa
Mexico
Vera Cruz
Cartagena
Portobelo
Panama
NEW GRANADA
MILES AT EQUATOR
Manila Fleet
Acapulco
THE GREAT SOUTH SEA
EQUATOR
South Sea Fleet
Quito
Guayaquil
Paita
Trujillo
Lima
Callao

RICHARD SCHLECHT

SHATTERED by a hurricane's rage, the Santa Margarita sinks with a cargo of New World wealth. Heavily armed against the Dutch, the ship had sailed with Spain's Tierra Firme fleet on its summer trade circuit through Caribbean colonies. At the Portobelo fair the Spaniards had exchanged European goods for silver, transported from Peru to Panama by the South Sea fleet. Gold and tobacco came aboard in Cartagena, copper and indigo at Havana. Now, weeks behind schedule and with cargo vital to Spain's economy, the 28-ship convoy must depart at the peak of the hurricane season. On the second day the storm strikes and destroys eight ships over a 50-mile-long path. Margarita and her sister galleon Atocha go down in sight of each other, three nautical miles apart.

DAWN AWOKE THE FLEET to gale winds. These raked down from the northeast against the Gulf Stream current, stirring confused cross seas. Most of the passengers and soldiers aboard *Santa Margarita*, even the experienced sailors, were soon seasick.

At first the fleet kept its sailing order: 28 vessels bound for Spain, carrying riches from the New World. As the day wore on, however, the wind rose to hurricane strength and the ships lost sight of each other amid towering, foam-whitened waves.

Santa Margarita's pilot, Diego Roman, ordered sail reduced to no avail. With a great crack her mainmast broke; men struggled to cut it away. Finally the overstrained whipstaff and tiller splintered, leaving the ship helpless. At the mercy of wind and sea, in a night of fear, the treasure-laden galleon was swept onward. A midnight wind shift pushed her northward toward the reefs and shoals of the Florida Keys.

As the terror of certain shipwreck grew upon *Santa Margarita*'s people, they begged chaplain Ortiz and two Jesuit priests to confess them, so that they might not die in a state of sin. The chaplain then led them in a litany to Our Lady of Carmen, patroness of those who risk their lives upon the sea.

Sunrise disclosed a frightening sight. Great rolling combers foamed over the Florida reef, then grew even steeper in the shallows beyond. The pilot ordered the last desperate expedient: dropping all the ship's anchors. Even though her stout hawsers held, the anchors dragged, and the galleon was impelled, inexorably, toward a wide shoal. Bernardino de Lugo, *Santa Margarita*'s captain of infantry, looked about him and saw, struggling in the waves one league away, her sister galleon *Nuestra Señora de Atocha*. While he watched, it sank.

Suddenly the *Santa Margarita* struck hard and fast on the shoal. Those aboard clutched rails and stanchions as, slowly but surely, powerful waves broke the vessel apart. Lacking physical strength, the passengers and young cabin boys could not survive. Seamen had a better chance to find

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The author: Dr. Eugene Lyon, a historian specializing in Spanish Florida, told of the wreck of the *Nuestra Señora de Atocha* in the June 1976 NATIONAL GEOGRAPHIC.

boards, casks, and spars to which to cling. The soldiers were kept together by their captain's firm example and shouted orders.

As winds and seas dropped, 68 survivors floated amid the wreckage. Most were picked up that day by a passing vessel from Jamaica, but one, the pilot's aide, Jusepe Geronimo, floated five days on a hatch cover before his rescue. More than 120 people had drowned.

Old World Research, New World Search

It was 358 years later, in May 1980, in Spain's Archive of the Indies in Seville. As a professional historian, I was working among thousands of bundles of fragile documents from Spain's colonial past, researching the reconstruction of a 16th-century ship. A *portero* drew the curtain of the readers' room, touched my shoulder, and motioned me outside to the telephone.

Bleth McHaley Curtis was calling from Key West. "Gene," she said, "we've found the most marvelous things—five gold bars, seven silver ingots, and more than 5,000 silver coins. There is a hundred-pound clump of coins . . . a great section of ribs and planking . . . we've opened up another ship, another whole ship!"

Melvin A. Fisher, longtime salvor, had found substantial treasures southwest of Florida's Marquesas Keys in the 1970s. These were identified as having come from the ill-fated *Nuestra Señora de Atocha*. Now, still seeking *Atocha*'s main treasure of silver ingots, he also sought other ships—most particularly, the *Santa Margarita*.

Eternal optimist that he is, even Fisher did not foresee that his divers eventually would recover from this newfound wreck more gold than has ever been salvaged from a Spanish galleon in modern times. With other artifacts, the total value may reach 20 million dollars. Nor did Fisher anticipate the trouble that this vessel, like the *Atocha* before it, would cost him.

The *Santa Margarita* was known in Florida treasure lore as a "ghost galleon," reputed by different rumors to lie in many places: off Palm Beach, in the keys, off the west coast of Florida.

The 630-ton galleon, built of oak in Vizcaya for the Indies trade, sailed from Cádiz with the Spanish guard fleet of 1622, commanded by the Marquis of Cadereita. By that time Spain had need of strong fleet defense. In closely guarded monopoly she was sending cloth, books, ironwork, mercury, wine, and other European goods to her Indies. A massive flow of gold, silver, jewels, and agricultural products then pulsed back to Spain to enrich private merchants and the Spanish crown.

But the newly organized Dutch West India Company posed a powerful naval threat to Spain's ship bridge across the Atlantic. Against such enemies the *Santa Margarita* carried Capt. Bernardino de Lugo's infantry company, 60 extra muskets, pikes, lances, and 18 bronze cannon.

The guard ships made their New World landfall at the end of May. They then began the round of Caribbean ports, arriving at Portobelo on July 1.

In wondrous variety, governmental, commercial, and religious transactions were inscribed on *Margarita*'s manifest. At Portobelo silver from the New World's rich mines was loaded. One hundred thirty-three silver ingots and 28,552 pieces of eight came aboard, part of the king's fifth of silver mined principally at Potosí. Royal revenues from court fines and the sale of papal indulgences were loaded, and funds sent to ransom Spaniards held captive by Turks.

Private persons sent finely wrought silverware. A merchant named Gaspar de Rojas came aboard at Portobelo with 84 silver ingots. All were happy to leave the port, for it was a sickly place where fever and dysentery had swept through the crew.

Next, the whole fleet sailed to Cartagena, the port of tobacco, slaves, and gold. In 1622, a total of 2,789 blacks entered Cartagena, survivors of tortured voyages from the West African slave pens. The taint of the traffic in human flesh touched *Santa Margarita;* she carried slave license fees to the crown. In Cartagena, also, 13,000 pounds of tobacco, the newest royal monopoly, were stacked in the lower hold.

But the most compelling things that passed over *Margarita*'s gangway in Cartagena were the many gold bars and disks that were loaded into the official chest of silver master Gutierre de Espinosa. The glittering gold came from the rich Nuevo Reino de Granada—modern Colombia.

On August 3 the fleet left Cartagena, but it was delayed by calms and didn't arrive at Havana until August 22, well into the dangerous hurricane season. As the *Santa Margarita* loaded more silver and gold, chests of indigo, and five tons of copper in crudely cast flat pigs, the Marquis of Cadereita, his pilots, and other fleet officials conferred about a sailing date for Spain.

Some feared that the risk of storms was already too great; others pointed out that the cost of wintering in Havana could be ruinous. In the end the urgent economic needs of crown and commerce prevailed. Lorenzo Vernal, chief fleet pilot, predicted favorable conditions if the weather was fair on the day of the new moon. On the day before that, Sunday, September 4, 1622, the sky was clear. The commander decided: The fleet would leave that very day.

Golden Galleon a World of Its Own

The ships with their cargoes and the people who sailed from Havana reflected their nation and their time. *Santa Margarita* was a microcosm of maritime culture and commerce, religious belief, and social structure. As a compact, seagoing community, the ship carried its own chaplain, quartermaster, boatswain, notary, storekeeper, artillerymen, caulker, cooper, and carpenter.

The galleon sailed below strength, with only 73 soldiers besides Captain de Lugo. Many of her crew had deserted or fallen ill in Caribbean ports. Juan de Uribarri, a young cabin boy who remained ill in the Havana hospital, was bitterly disappointed; he had eagerly awaited return to his native Bilbao. Two young noble brothers from Asturias, Don Roque and Don Antonio de Velasco, served as ordinary soldiers aboard to gain military experience.

Fourteen passengers had signed on board the *Margarita*, including Don Francisco de la Hoz Berrio, governor of Spanish Venezuela. There were the two Jesuit priests, Jusepe de Arriaga and Claude Colin, and citizens of Lima and Cartagena. The passengers brought a wealth of personal jewelry: gold chains of varied design, emerald rings, brooches, and religious medallions.

Formally shown on the ship's manifest were 419 silver ingots, 118,000 silver coins, 1,488 ounces of gold in 34 bars and disks,

TUP NICALIN

Undersea divining rod, *an electromagnetic detector aids the search for Margarita's payload, emitting one signal in the presence of iron and another for nonferrous metals such as silver, gold, and bronze.*

A diver for Treasure Salvors, Inc., a company headed by salvage veteran Melvin A. Fisher, sweeps the seafloor beneath a boat equipped with blowers, called mailboxes, that disperse the overburden of sand where the detector senses metal.

Treasure hoard *of bars, coins, disks, and chains* ***(left)*** *represents only a third of the gold so far gleaned from Margarita. With her gold, silver, gems, and historical artifacts, the galleon's value may reach 20 million dollars.*

"She could well be remembered as the 'gold-chain wreck'," says photographer-salvor Don Kincaid, who found the first of 43 chains totaling 180 feet. As personal jewelry, chains might have escaped taxation. Most had links that could be unhooked and used as coinage. Tax dodging was rife: Contraband, unmarked by royal seals or unlogged on the manifest, accounts for most of the ship's gold bullion.

With sand carpeting blown off, a hole in the coral bedrock rewards a diver with a gold bar ***(above)****.*

Guided by reports from the wreck's survivors, 17th-century salvors returned most of Margarita's silver to the Spanish crown and merchants. Much of Margarita's gold and the entire cargo of Atocha eluded them—and the ships drifted into legend as "ghost galleons." Tracing leads unearthed from Spanish archives by author Eugene Lyon, Treasure Salvors located Margarita in 1980, after almost a decade of hard-fought salvage of Atocha's riches.

silverware, and the copper, tobacco, and indigo. Hidden aboard were sizable amounts of contraband silver and gold. As she left Havana, the *Santa Margarita* was, in fact, a floating treasure-house.

At sunset on Sunday the fleet had gained the necessary easterly position and turned northward to catch the homebound Gulf Stream. But the outlying winds of an unforeseen hurricane—small but powerful—were then entering the Straits of Florida.

By dawn Monday gale winds buffeted the fleet; by dusk the howling hurricane had scattered the vessels. Through the night those aboard prayed for their lives. Tuesday morning the stricken *Margarita* lay grinding apart on the shoal. Mercifully, by Tuesday afternoon the southern sky had cleared, and the sun burned down on settling seas littered with floating planks and spars supporting the galleon's few survivors.

Among those who were lost were pilot Diego Roman and the silver master, Gutierre de Espinosa. The quartermaster, notary, and carpenter were gone; for all his prayers, the chaplain had drowned. One of the Asturian brothers, Don Roque de Velasco, had been taken by the sea; the other, Don Antonio, had survived.

The governor of Venezuela was gone, and all other passengers. Gaspar de Rojas had drowned, together with his ingots and coins. The royal silver did not arrive that year, nor the merchants' shipments.

The lost galleons, *Margarita* and *Atocha*, lay some six and ten miles, respectively, southwest of a low circle of wind-racked mangrove islands in Florida's lower keys. Efforts to recover the treasure began at once, but were largely futile until a powerful Havana politician, Francisco Nuñez Melián, obtained a contract from the crown to search for and salvage the galleons.

In early June 1626, Melián's crew, using a bronze diving bell, found the main ballast pile of *Santa Margarita*, six miles off the atoll then called Cayos del Marquéz—"keys of the marquis"—named for the 1622 fleet commander.

Melián's eager salvors immediately brought up 199 silver ingots and more than 30,000 silver coins, with silverware and copper pigs. After retreating to avoid hostile Dutch ships, Melián returned to the keys and brought up 151 more silver ingots, more silver pieces of eight, a large anchor, eight bronze cannon, and more copper and silverware. Of the total of 350 silver ingots, 67 were discovered to be contraband.

Salvage auditor Juan de Chaves later told of arduous salvage work in perilous currents under a pitiless sun, amid occasional heavy squalls. One diver, Juan Martínez, died at the wreck site in August. Chaves watched his men, collected the treasure they had brought up, and discovered many coins they had hidden. Once he cut out all their pockets to discourage further thievery.

Dutch Disrupt Early Salvage Try

The 1627 diving season began less auspiciously. On Thursday, June 10, the salvors reached the wreck site just after dawn. They moored their longboat securely as morning light turned dark waters to translucent blue, and set to work. By the salvage master's hand-held sundial it was eight o'clock when lookouts cried "Sail! Sail!"

The Dutch enemy had reached the Marquesas. Cutting their mooring lines, the Spaniards escaped to Havana, and no further treasure was found that year.

Now Melián petitioned the crown for a reward for his services: a governorship. Meantime, he, merchants, heirs, and the crown began a legal battle over ownership of the treasure. In 1628, 37 more silver ingots and some 3,000 coins were recovered. Still, much treasure remained on the bottom.

Before the 1629 season began, Francisco Nuñez Melián was appointed governor at Caracas, and left the salvage of *Santa Margarita* and the search for the *Atocha* in other, less successful hands. In 1644, while Melián was reviewing his troops, he was thrown from his horse and killed. An audit of his accounts of the *Santa Margarita* salvage was sent to Spain to repose finally in the Archive of the Indies.

Spain's decline continued apace. Eventually she lost her possessions in the Western Hemisphere. All but forgotten, the remains of the 1622 silver galleons lay buried beneath the sands off the Florida Keys.

In 1971, 327 years after Melián's death, Mel Fisher, following leads I had furnished him from the *Santa Margarita* salvage audit, located *Atocha*'s great anchor and many

TWICE ACTUAL SIZE (ABOVE)

Shrill toots *can still be piped from a gold boatswain's whistle* ***(top)****, here backed by a five-and-a-half-foot gold chain with links as big as a thumb's first joint.*

Colombian emeralds blaze from one of three gold rings ***(above)****.*

An eight-inch gold plate with neo-Moorish design ***(left)*** *may have been destined for a noble's home.*

treasures. Over the years Fisher's company, Treasure Salvors, Inc., underwent great expense and fought lengthy legal battles in seeking and holding the finds. Mel and his wife, Dolores, suffered personal tragedy in the loss at sea of their son Dirk and his wife, Angel.

In January 1980, Mel called a meeting in Key West to brainstorm the location of *Atocha*'s still missing mother lode, and to aid in the search for the *Santa Margarita*'s remains. There his associates listened to the Spanish archival evidence and the hard-won knowledge of years of search.

The documents were equivocal: Bernardino de Lugo's statement placed *Margarita* one league west of *Atocha*—just over three nautical miles. Jack Haskins, a modern salvor and skilled researcher, had shown me another letter in Seville, from one Capt. Aguilar y Guzmán, stating that the *Margarita* sank to the east of the *Atocha*.

As if to point up the contradiction, Mel Fisher's searchers had years before found magnetometer contacts both east and west of the *Atocha* wreck site. Mel ordered both to be explored. Urgency impelled him, for he feared that rivals might beat him to *Santa Margarita*'s treasure.

A well-financed competitor had moved in and had begun operations near where Fisher was recovering scattered remnants from the *Atocha*. In an incident strangely reminiscent of the Dutch harassment of Melián's men three and a half centuries earlier, five shots were fired from the other craft; another time the competing vessel almost ran down Mel's *Virgalona*. Treasure Salvors' attorney, David Paul Horan, got a preliminary injunction against the intruders.

Fisher then contracted with salvor Robert Jordan to search for and salvage treasure from the *Atocha* and *Margarita* wrecks. Treasure Salvors would pay for food and fuel for Jordan's boat, *Castilian*, plus $100 a day and a percentage of any treasure recovered—2 percent from *Atocha* finds, 5 percent from *Margarita*. If Jordan found any other wrecks in the area, a new contract would be drawn, giving Jordan 50 percent if he financed the salvage operation or 33 percent if Treasure Salvors did. In the meantime, the company would search and salvage with its own boats, *Virgalona* and *Swordfish*.

Modern Salvors Follow Electronic Trail

Winter weather in the keys, often stormy, was cooperative in 1980. After a few days of fruitless magnetometer search west of the *Atocha* site, Jordan took the *Castilian* to the eastern area; soon, at the edge of a wide sandbank, the instrument registered a concentration of targets. Jordan positioned his craft and found a small grapnel anchor, then a six-foot-wide copper caldron.

Now Don Kincaid, the marine photographer who had found the first *Atocha* treasure, came aboard *Castilian* to help direct the search. An electronic trail led the ship northward. To the crew's excitement, they next struck a place where ballast stone covered the seafloor, and they found Spanish pottery, remnants of indigo, and a clump of

Marking social status *more accurately than time, a brass sundial* ***(right)*** *probably sank in the pocket of a gentleman passenger. When the imprecise iron compass it once enclosed read north, time could be gauged by the shadow of the folding gnomon, here showing 2:30 p.m. Baroque images adorn bronze mortars and pestles* ***(left)*** *used to prepare drugs such as pain-killing opium.*

four encrusted silver coins. These they cleaned that night at the Marquesas anchorage; the coins turned out to be Spanish pieces of eight, minted in the reign of Philip III—the same vintage as the majority of those from the *Atocha*.

This shipwreck, however, seemed to differ in one respect: Much of the material lay exposed on the bottom. Perhaps covering sand had been washed away by the waves of a recent storm.

Treasure Salvors filed for the new shipwreck site with the U. S. District Court and, as March turned into April, things altered dramatically. As Don Kincaid described the change: "From a 350-year-old detective puzzle it became deadly serious. . . . It turned from fun into a curse. The reason: We found gold."

In shallow water along rocky outcrops northwest of the first finds, *Castilian*'s divers suddenly found three large, heavy gold bars. One bar was more than eleven inches long and weighed over five pounds. Back at the dock the joyous divers broke out magnums of champagne and used one of the bars as a golden swizzle stick. And everyone wondered: Which ship was this? Could it be *Santa Margarita*?

"Gold," said Mel Fisher once, "shines forever." To which one could add, it also seems to stir men to the depth of their beings. Robert Jordan would soon assert that he had found a new wreck site that entitled him to a new contract and 50 percent of the treasure. Fisher refused, convinced that this new wreck was the long-lost *Margarita*.

On April 12 two more gold bars were found. *Virgalona* and *Swordfish* intensified their hunt, as potsherds, bones, and lead sheathing came up. Except at slack tide, vicious currents ran across the wreck site. As the 17th-century Spanish salvors had discovered, this made the divers' task difficult. On May 9 *Castilian* turned in a rich variety of artifacts: broken pottery, hundreds of clumped and single silver coins, a nine-pound silver bell, silver plates, a sword, and a fragmented mariner's astrolabe.

Young Diver Finds Old Wreck

Virgalona was renowned in the company as a treasure finder. A few days later Mel's tall, red-haired son Kane brought the venerable workboat to a likely area, put on his scuba equipment, and went overside. The young diver, who had found the *Atocha*'s first silver bar, was astounded to see six silver ingots evenly spaced in two rows resting directly on bedrock. That was not all that met his eyes in the clear green water: He saw a great section of a wooden ship. It was 23 feet long, with ribs and planking capped by ballast stones, copper pigs, and a conglomerate of encrusted artifacts.

Working the surrounding area, divers uncovered a gold bar, two more large silver ingots and one small one; silver bowls; an inkwell and sand shaker; a candlestick and plate; and a silver spur. With great effort they hauled up a 105-pound mass of silver coins still welded into the shape of the wooden chest that long ago rotted away.

One especially precious prize was a table-cut emerald set in a gold ring. Beneath the green stone floated a bubble in seawater forced in over the years beneath the ocean. "The world's most expensive carpenter's level," Mel Fisher called it.

As soon as I returned from Spain, I hastened to Key West. In Mel's preservation laboratory near the copy of a galleon that Treasure Salvors used as an office and floating museum, the silver ingots were hefted from the water. I bent to compare their markings with those of *Margarita*'s manifest. Five of the silver ingots matched!

Written on the manifest in the notary's archaic rolling script, there unfolded the historian's true treasure, the cultural wealth of the Indies. As I found ingot number 4,718,

centuries dropped away, and I experienced a surge of empathy with the lost galleons of 1622. The ingot had been shipped at Portobelo, intended for Seville and the Brotherhood of the Holy Cross; it was sent by the merchant, Gaspar de Rojas. Cut into the blackened surface of the bar were Rojas's RX mark and an S topped with a Jerusalem cross. The sunken vessel found by Treasure Salvors was the *Santa Margarita*.

Treasures and Troubles Multiply

In late May, Bob Jordan filed the wreck site in his own name before a federal judge. Then he loaded *Castilian* with supplies and fuel—at Fisher's cost—and sailed again for the Marquesas.

Near the center of the *Santa Margarita* site, on May 25, *Castilian*'s divers hit a bonanza. Their excitement built as they recovered 11 large gold bars, four smaller ones, and part of a large gold disk: fifty pounds of bullion! They also found five two-escudo gold coins, six small silver ingots, two pigs of Cuban copper, a quartzite stone cannonball, and 581 silver coins.

The next day *Castilian*'s captain pulled her anchors and left the wreck site. He paused briefly at Key West harbor, but did not turn the treasure over to Mel Fisher. Instead he went up the keys, docked at the home of a financial backer, and turned the gold and silver over to a U. S. marshal.

David Paul Horan had earlier successfully turned back the claims of both state and federal governments to the *Atocha* treasure. Now he faced another urgent challenge. For two days Horan slept little as he prepared the necessary motions to recover the *Santa Margarita* treasure, at least until the dispute was resolved. These were successful; Judge William O. Mehrtens approved the transfer of the gold and silver to Treasure Salvors.

In the next few months the state of Florida moved to claim the new shipwreck. Fisher was free to work the wreck site, but the legal cases went on.

To add further to Fisher's problems, on May 28 his galleon museum, ravaged by shipworms, sank alongside its pier in Key West. The salvor had then to locate new offices, fight the legal challenges, and further fund his operations. Work on the *Santa Margarita* continued.

Bones of the ravaged galleon *hold clues to the art of 17th-century Spanish shipbuilding. Unexpected survivors in these rough shallows, 22 feet deep,*

JONATHAN BLAIR

Margarita's oak timbers may have lost protective sand cover during a gale-force storm in the winter of 1980. Guiding a tethered camera platform, a diver photographs the remains of the ship's starboard stern structure, 16 feet wide and 23 feet long, overlaid with a mapping grid.

July began gloriously for the salvors. When *Swordfish*'s anchor dragged, Larry Beckman swam down and discovered, lying on bare bedrock, a bronze cannon. Twin decorative dolphins rode its great tube. On *Santa Margarita*'s arms list it appeared to have been the galleon's heaviest gun, at some two tons. There, at a critical time, Spain had lost a part of her defense arsenal.

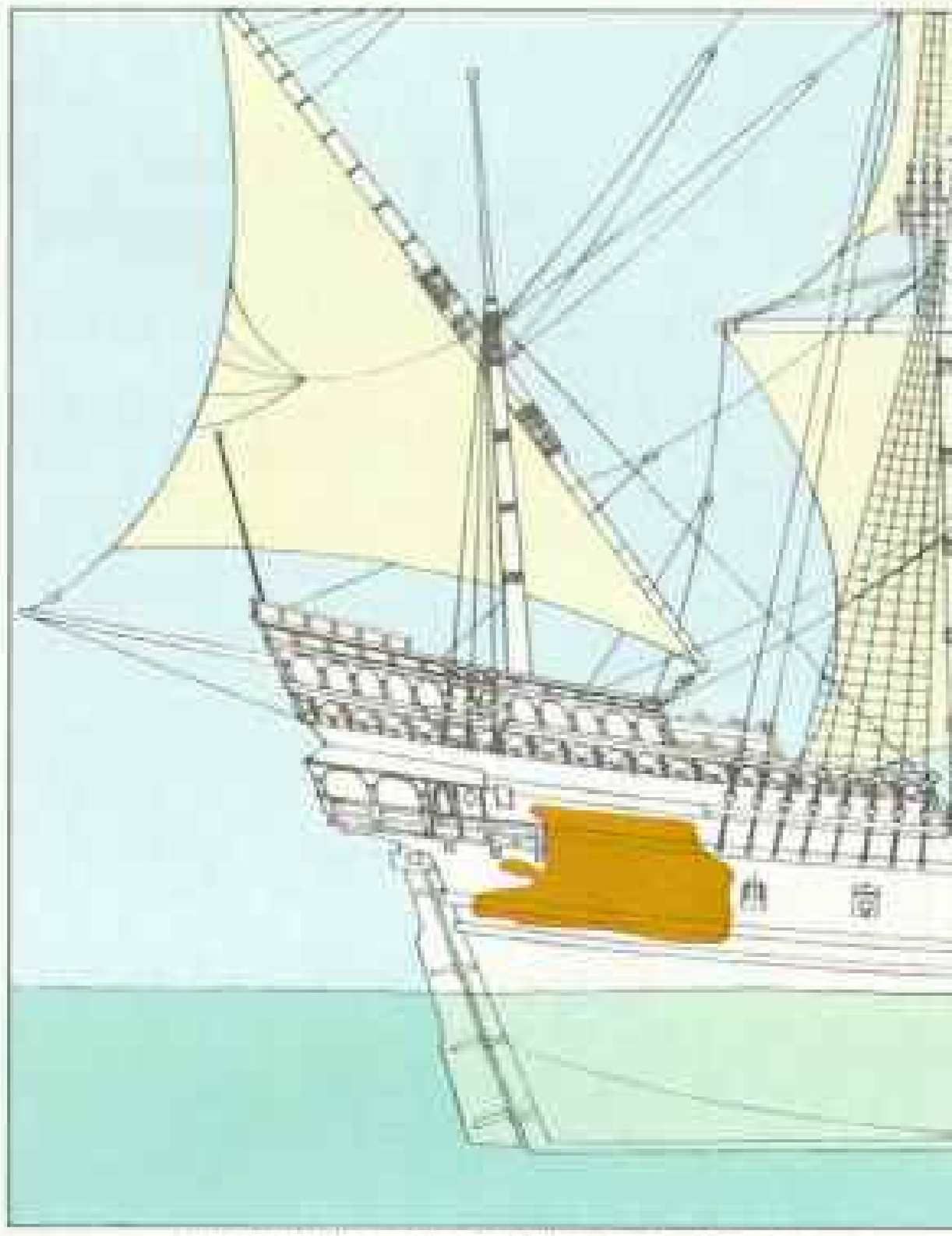
Reward at End of the Trail

July 8 could fairly have been named "the day of the gold chains." Divers had followed an artifact trail to a large clump of cannonballs; two silver ingots and many coins were found amid rich shipwreck material. As Pat Clyne fanned around one ingot with his hands, a large gold chain popped up, then another and another, all attached in a tangled golden mass. Stuart Preater, Pat, and Don Kincaid brought up 15 chains in all—the largest had 149 great ornate links. *Virgalona*, moored nearby, later uncovered six bars and a disk of gold.

R. Duncan Mathewson, Treasure Salvors' marine archaeologist, began an intensive study of the *Santa Margarita* wreck site and the artifacts recovered from it. He compared Francisco Nuñez Melián's records with the present site in order to discover how the ship broke up. The grapnels may have been lost by Spanish salvors; one might even have been the anchor abandoned when Dutchmen threatened Melián's salvage in 1627. Comdr. John P. Cryer, a company stockholder who had once plotted the course of the lost 1622 galleons, noted the spots where gold chains had been found. He voiced a chilling thought: Some chains might represent places where drowned Spaniards had come to rest.

The wreck site displayed a wider range of ceramic types and metalwares than the *Atocha*, but to the archaeologist the single most exciting find was the large section of the ship itself. It was among the oldest and largest remnants of a Spanish ship found in the Western Hemisphere. As such, it could provide much physical evidence about 17th-century Spanish ship construction.

Duncan Mathewson readily got Mel's permission to delay the raising of the hull structure until it could be properly mapped in situ, in preparation for its later raising and

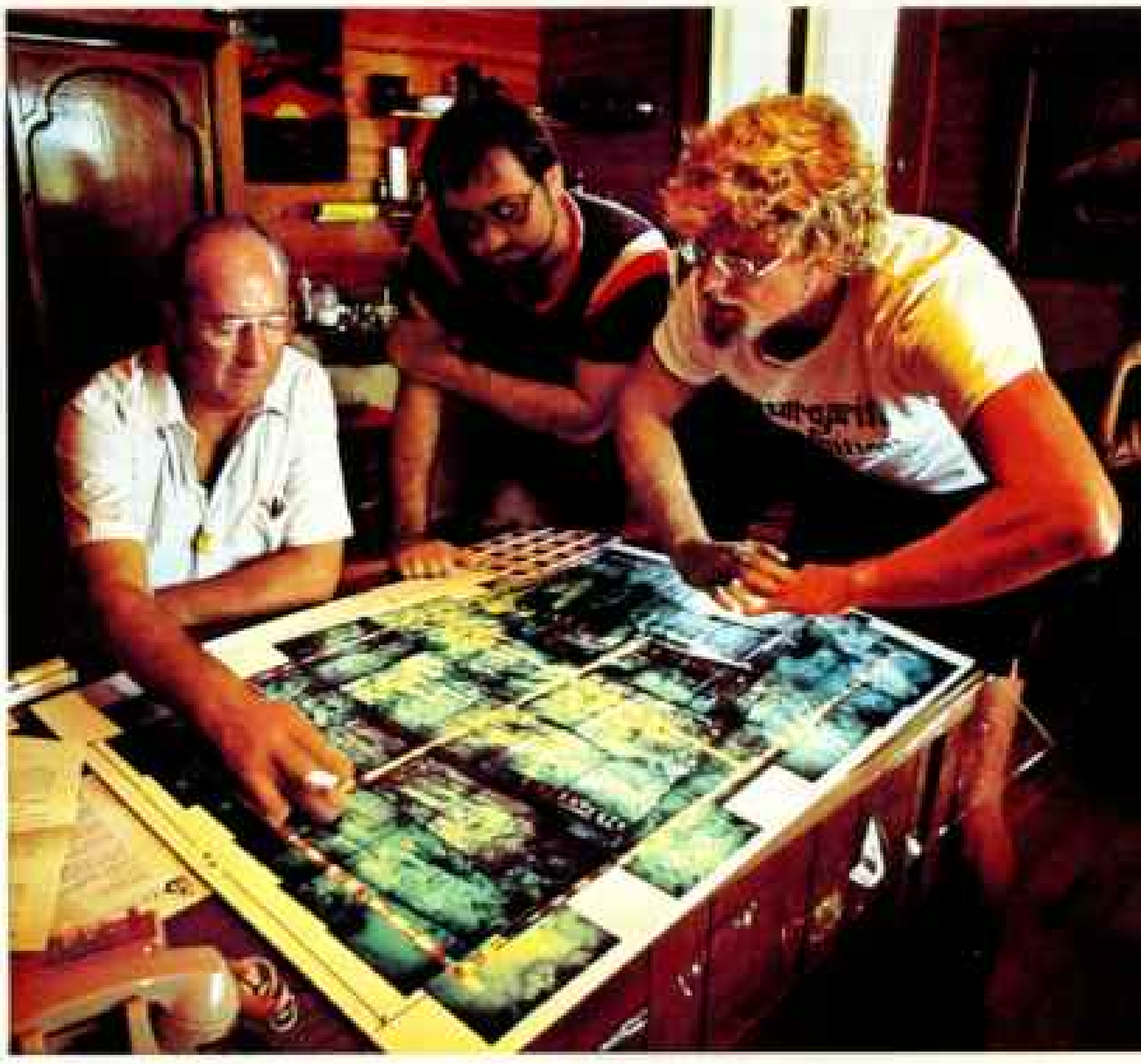


DRAWN BY SHELDON STEPANOFF, NATIONAL GEOGRAPHIC ART DIVISION
BASED ON PRELIMINARY DRAWING BY WILLIAM D. MUIR

conservation. Then Duncan and Dr. Ray McAllister of Florida Atlantic University joined Don Kincaid in gently fanning the sand around the timbers for artifacts and photographing the site. Just beneath the structure they found pig bones, several chili peppers, and two pieces of shoe soles, relics that spoke of the living beings once aboard the *Santa Margarita*.

Perhaps the most valuable single item turned up while Dick Klaudt of *Virgalona* was working a sand crater's edge. As the boat's tubular "mailboxes" deflected the prop wash downward, digging the crater deeper, a round object emerged and struck the diver a glancing blow on the forehead. Before it could vanish down current, Dick grabbed and found himself holding a golden plate (page 237). The eight-inch plate, an artifact of exquisite beauty, displayed an intricate pattern of neo-Moorish design.

Syd Jones, captain of the *Swordfish*, spotted a treasure mass on the ocean bottom on August 23. Lying together were nine more gold bars and eight chains. To him the pile of metal links looked like a "hive of golden bees." The next day the divers found part of



Wrenched *from the stern, the recovered hull section probably fit near the captain's walk, as shown in this diagram (***left***). Heavy cannon, breaking free on the gun deck just forward, may have hastened breakup of the ship as it rocked against the shoal.*

*A mosaic (***right***) of 54 photographs of the section —eyed by Mel Fisher, left, diver-photographer Pat Clyne, center, and archaeologist R. Duncan Mathewson—will guide reassembly of the raised timbers. A grander mosaic continues to emerge as discovery and research resurrect a portrait of colonial Spain from Margarita's grave.*

an ivory box lid, decorated with delicate, incised figures of mythical animals. Research later disclosed similar designs on an ivory gift box from Portuguese Ceylon. Thus far did the network of Spanish imperial trade extend.

Two days later *Virgalona* docked in Key West with her cockpit lined with barrel hoops and swords. There was a harquebus, a memento of Bernardino de Lugo's company of soldiers; a 50-pound clump of silver coins; and an ingot of silver. With a wide grin, skipper Mo Molinar poured from a sack a stream of 25 two-escudo gold coins into the cupped hands of Dolores Fisher.

Ghost Galleon a Golden Reality

By the late fall of 1981 it was evident that the *Santa Margarita* had yielded a very great treasure. It had been recovered along a scattered path more than 4,000 feet long.

The gold bullion alone—in 56 bars, disks, and bits—weighed more than 118 pounds. Mel Fisher and his crew had also found 180 feet of gold chains and 56 gold coins. It was the largest amount of gold salvaged from a Spanish galleon in modern times. The divers had recovered perhaps 15,000 silver coins and 18 silver ingots, with many other valuable artifacts.

A diver from Treasure Salvors' newest craft, the *Dauntless*, had found one of the most enthralling of them all—an elegant, well-preserved brass pocket sundial. It must be much like that used on the wreck site by Melián's salvors in 1627.

In artifact value, the treasure is worth perhaps 20 million dollars when legal obstacles to its distribution or sale are overcome. But the knowledge that will be gained from the shipwreck—in ceramic dating, ship construction, and Hispanic culture generally—may well prove to be of more enduring value than the bullion.

Mel Fisher's greatest ambition, like that of Francisco Nuñez Melián, thus far remains unrealized: the finding of *Atocha*'s mother lode, more than a thousand bars of silver still somewhere on the bottom. His search for it will go on. But, in strange coincidence, Fisher's greatest gain, like Melián's, has come from that tragic ship *Santa Margarita:* a golden argosy uncovered, and a ghost galleon no more. □

NOMADS

By GALEN ROWELL

THEY ARE CALLED GOLOGS—literally "heads on backward" in their native Tibetan tongue and a symbolic term for rebels. Handsome, warlike, independent, the Golog tribe of Qinghai Province in western China is virtually unknown to the outside world.

I encountered the Golog family at right during a mountaineering expedition in June 1981 to the remote Anyemaqen region of Qinghai, an area closed to foreigners until 1980. With Chinese permission we visited other portions of the Golog homeland seldom if ever seen by Westerners.

Numbering between 80,000 and 90,000, the Gologs inhabit the Golog Tibetan autonomous zone of the People's Republic of China. During the 1950s and '60s Golog tribesmen fiercely resisted Chinese domination of their homeland and killed thousands of Communist troops before finally conceding to a truce. Even today the Gologs enjoy greater freedom within their borders than any other ethnic minority I have encountered in my China travels.

The Gologs are no strangers to war and invasion. In the seventh century A.D., legend records, the Tibetan king dispatched his fiercest warriors, ancestors of the present-day Gologs and neighboring Khampas, to guard the country's mountainous northern frontier against Chinese invasion. When the Tibetan kingdom eventually collapsed, the Gologs stayed in their mountain retreat, defiant of outside authority. But they held fast to their Buddhist faith and a language little changed over time. Today it is unintelligible to most Tibetans.

Suspicion of outsiders remained a Golog trait. Visiting the region half a century ago, the noted American botanist and explorer Joseph F. Rock, whose articles appeared in the NATIONAL GEOGRAPHIC, described the Golog tribe: "Such hostile and unfriendly people I have never met anywhere in the world; it seems that a smile never crosses their coarse features."

The portrait at right seems to bear Dr. Rock out. I met the family encamped on the mountain pastures of their Snow Mountain Commune, a seminomadic community. From here two other mountaineers and I set out to climb Anyemaqen (Amne Machin), a peak sacred to the Gologs.

OF CHINA'S WEST

Photographs by the author and HAROLD A. KNUTSON

HAROLD A. KNUTSON

PAINTED BY DOROTHY MICHELE NOVICK, COMPILED BY DONALD L. CRERICK NATIONAL GEOGRAPHIC ART DIVISION

GALEN ROWELL

ON THE KNIFE-EDGE OF ETERNITY, my two climbing partners brave a blizzard of ice on our final assault of Anyemaqen, a peak named for the Tibetan mountain god, Maqen Bomra, and worshiped by the Gologs. The pair traverse a sheer ridge with a 2,000-foot drop-off on the far side. We picked up speed to escape the ice storm and reached the summit a few hours later—the first Westerners to stand on the 20,610-foot peak (a Japanese team climbed it earlier the same year).

After the climb, I led five of our 15-member American expedition on the 120-mile trek around the base of Anyemaqen. We followed in the footsteps of thousands of Gologs, who in times past made the trip as a religious pilgrimage. We walked the circuit in the traditional clockwise direction in ten days, accompanied by Golog guides on horseback and a string of yaks to carry our tents and supplies (pages 260-61).

Appreciating Anyemaqen from such close encounters, we understood the jubilation of Dr. Rock, who wrote upon first spying it: "I shouted for joy as I beheld the majestic peaks of one of the grandest mountain ranges of all Asia."

RAMPART OF DEFENSE for the Gologs, the snowy Anyemaqen Range nourishes the Huang (Yellow) River, whose main channel nearly encircles the heights during its mighty 2,900-mile surge to the Yellow Sea. Dr. Rock found the whole region "one great zoological garden," filled with blue sheep, gazelles, bears, wolves, and deer—a richness of animal life touted to me by the

GALEN ROWELL

Chinese authorities in Beijing (Peking). The Chinese also spoke of dense virgin forests. In fact, we saw almost no wildlife and found that most of the Anyemaqen region lies well above timberline and has no forests at all. Here at 13,000 feet, yaks graze verdant reaches. Golog herders live in the black tent of woven yak hair; the white cotton tent protects supplies.

UNEXPECTED WONDER of a smile transforms the faces of a girl and woman standing before their black yak-hair tent, pitched on the path of pilgrims around Anyemaqen peak. The fact that we were following the route of a pilgrimage may have accounted for the openness of our reception here, so

HAROLD A. KNUTSON

different from anything Dr. Rock encountered and, indeed, unusual for us. For while our expedition was generally accepted, it was rarely welcomed. Our Golog guides, for example, more often hindered than helped us. Although superb horsemen, they nonetheless managed to lose their mounts most mornings, just as we were getting under way.

"A LAND CUT OFF from all the modern world," wrote Dr. Rock in 1930. But no more, as we see during a visit to this yak-hair home ***(right)*** *in the Snow Mountain Commune. Near the tent, anchored by ropes and capable of withstanding 70-mile-an-hour winds, the pile of sheep wool at left will probably go to market, since we saw no weaving among the Gologs. The pile of deer antlers at center will be sold to the Chinese to be ground into powder and taken for its claimed aphrodisiac and medicinal properties. A carcass of a Himalayan fox dries on a tent stay, and mountain sheepskins are piled at far right.*

The world steps inside as well. The felt hat of a matron ***(below left)*** *is of Chinese manufacture; her necklace of turquoise and fossilized coral comes from Tibet. Her cabinet holding bowls and cups, set against the tent wall, was imported, too, since the Gologs have few forests to supply wood.*

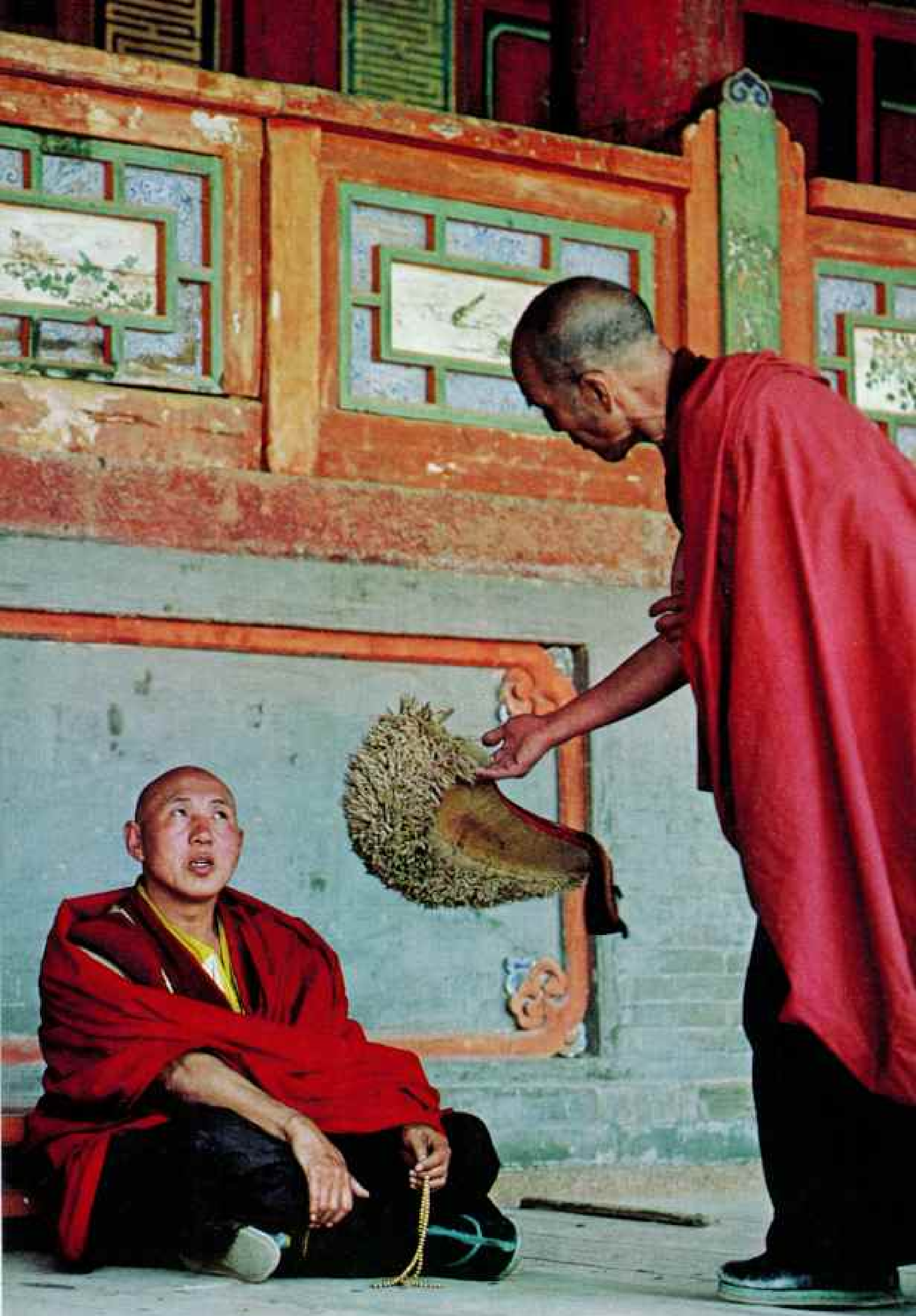
That same shortage accounts for the wide use of yak dung as fuel in a Golog-designed earthen stove ***(below)****, as clean and efficient as any I've ever seen. Yet even in summer the family drawn to this hub of warmth wears sheepskin-lined wraps against the omnipresent cold of high altitude.*

HAROLD A. KNUTSON (ABOVE); GALEN ROWELL

WITH EACH GUST of wind, hundreds of bits and pieces of cotton flags printed with prayers automatically waft petitions to heaven from one of several rock-piled Buddhist shrines set along the pilgrims' route around the base of Anyemaqen. In a gesture of reverence, my Golog guide, Chong Hun,

SALEM HOWELL

dismounted from his horse and led me three times around the shrine. Then, to my astonishment, he unsheathed his knife and advanced toward me. But it was for another act of worship. He cut a lock of my hair, a lock of his own, and another from his horse and bound all three to a pole as an offering to the deities.



BOTH BY GALEN ROWELL

DAY OF DEVOTION DONE, worn prayer wheels **(above)** *collect near wheels still hung for spinning at Kumbum Monastery. With each turn, such wheels send inscribed prayers heavenward. During their Cultural Revolution the Chinese abolished prayer wheels in Tibet in an effort to curb the Buddhist faith. Nevertheless, this traditional way of copious praying continues.*

Fingering beads of his rosary, a young Buddhist monk **(left)** *ponders questions of doctrine from his teacher, who withholds or offers the ceremonial cap of wool according to the answers. Kumbum Monastery near Xining, capital of Qinghai Province, is venerated as the sometime home of the Panchen Lama, a Tibetan religious leader second only to the Dalai Lama.*

*GLEAM OF SILVER and flash of color create a fashion parade when a Golog woman (**left**, at right) strolls down a street in the town of Da He Ba. More interesting going than coming (**below**), the woman wears a Tibetan-style woolen mantle studded on the back with silver cups of graduated sizes and overlaid with a heavy band of turquoise and coral beads—the whole weighing more than ten pounds. She braids her hair in 108 strands, a number that holds mystical significance for Tibetan Buddhists.*

BOTH BY HAROLD A. KNUTSON

DUSTED BY SUMMER SNOW, tethered yaks and their tenders wait amid our tents and supplies for the breakup of camp and the next move on the trek around Anyemaqen. As in Tibet, the yak constitutes a mainstay of the Golog economy, providing transport for goods and humans, meat, butter, lard, hair for rope and woven fabrics, hide for boots and clothes, as well as dung for heating and cooking. Naturally animals of such value are maintained in large herds, as I saw on the high plateaus, where huge areas of pasture are kept as trim as golf greens by yaks and sheep—a major reason for the decline of the wildlife that would feed on the same grasses.

After breaking camp, we walked out of snow, into rain, and, finally, a glorious glimpse of summer, with wild flowers strewn across a field under the eaves of a jagged peak ***(left)****.*

BOTH BY GALEN ROWELL

BOTH BY DALEN ROWELL

*RESISTANCE or integration: Which will the Gologs choose? The copy of a Soviet AK-47 automatic rifle, slung on the back of a tribesman (**left**), is said by Chinese authorities to be an economic necessity, needed for hunting and the protection of Golog herds from wild animals. The government even furnishes ammunition for that ostensible purpose.*

*Yet a symbol of past Golog hostility to that same government remains, in the form of a Communist military-style hat worn by a Golog youngster (**above**). Though available in department stores throughout China, many such hats were left from the bitter fighting between Golog and Chinese forces in the 1950s and '60s. Even today no rail link exists between Tibet and the rest of China, since Golog and neighboring guerrillas routed the Chinese construction crews sent to build the line through Qinghai.*

To me the boy symbolizes his people's dilemma: how to preserve their cultural heritage while living within the Chinese Communist system.

Having met the Gologs, I offer no predictions. □

Strange World of Palau's Salt Lakes

By WILLIAM M. HAMNER

Photographs by
DAVID DOUBILET

FROM SHADOWS at the shore, I drift slowly underwater toward the center of the salt lake, passing through a living wall of golden jellyfish. The gleaming medusae, big as softballs, are everywhere—between my swim fins, around my arms, beneath my beard, bouncing insistently against my face mask. I cannot feel their mild sting. They have no tentacles, no food in their transparent stomachs.

How do these swarming creatures feed, I wonder. Why do they congregate in such astonishing numbers?

I rise effortlessly through the pulsing mass and peer over the top of the school at photographer David Doubilet. He can see my head but not my body, which is hidden in the horde of jellyfish. We grin foolishly at each other and shake our heads, silently expressing wonderment at the exquisiteness, the profusion, of these living things that have no need or knowledge of mankind but that, strangely, we feel a need to know.

My wife and I were back in the Palau Islands, in the Western Carolines, to record,

Waters boil with jellyfish *in one of Palau's marine lakes, enveloping the author in a harmless swarm. Surprises hide in each of some 80 such lakes in this Pacific archipelago.*

GENUS MASTIGIAS

Marine Lakes of Palau

*BUCKED HIGH above sea level by volcanic forces more than 20 million years ago, ancient living reefs form the lake-dimpled limestone islands of southern Palau. Rain and decaying vegetation have combined to form humic acids that seep through the limestone, carving out fissures, caverns, and tunnels, and deepening the lakes. Eil Malk (**left**) cradles the largest of these marine lakes, mile-and-a-half-long Metukercheuas Uet, at right center. During a two-year study funded by the National Science Foundation, the author, a marine biologist, explored this and other lakes ranging down in scale to swimming-pool-size ponds.*

Shielded from wind by high bluffs, many of the seawater lakes form stable, small-scale models of oceanic systems, each, in essence, a naturally formed marine laboratory.

Part of the United States-administered Trust Territory of the Pacific, the Palau Islands took the name Republic of Belau in January 1980. The northernmost coral reefs and islands are not shown.

Gateway to the secret garden *of Soft Coral Lake, a six-foot-high tunnel linking lagoon and lake blooms with luxuriant bouquets of Dendronephthya. Unlike most corals, these do not require sunshine for growth. Instead they*

thrive on a rich diet of zooplankton swept through the blackness of the tunnel during changes of the tide.

amid this untouched beauty, some of the strangest biology in the Pacific. It is found in the interior saltwater lakes that spangle the southern archipelago of the newly self-governing Republic of Belau. Peggy and I had recently completed a two-year survey of these Palau lakes on a National Science Foundation grant. Now, on assignment for NATIONAL GEOGRAPHIC, we could enjoy these remarkable underwater ecosystems freed from a tight research schedule.

Jungle Dotted by Oceans in Miniature

Early in our stay, David and I flew over the islands. Leaving volcanic Babelthuap behind, we droned south above a maze of limestone islands, remnants of ancient coral reefs now elevated a few hundred feet above sea level.

We saw scalloped shorelines and lakes like silver coins dropped on the green shag of unbroken jungle. These were the interior sinkholes, now filled with seawater, that form the marine lakes of Palau. Their waters shone cobalt blue, lettuce green, or ale brown, or were streaked with swirls of greenish gold. This color spectrum derives chiefly from variations in the algae that form the bases of the lakes' aquatic food chains.

With limited water exchange to lagoon or open ocean through underground cracks and tunnels, every Palau salt lake is a mini-variant of the surrounding sea, an isolated marine ecosystem with its own physical, chemical, and biological properties. Each of the 30 or so large salt lakes, as well as perhaps 50 smaller ones, thus presents a unique natural experiment in the organization of food webs—the interdependence of life forms—in a marine environment.

Palau lies near the Equator, and seasonal changes are slight. Nor are the lakes subjected to the great winds and mighty currents that in the open ocean stir up animals and plants. Here an oceanographer can return repeatedly to the same water mass and study organisms and populations unchanged by short-term climatic events.

Over the ages Palau's limestone islands have been sculptured into typical karst topography—jagged ridges and escarpments, fissures, caverns, collapsed domes, and underground channels. When I first dived into sea-flooded caverns that lead off some of the

lakes, I found stalactites still hanging from the ceilings of caves now submerged. These dripstone columns, of course, could only have been formed millennia ago in dry caves where trickling water evaporated to leave behind the carbonate pillars.

Some Palau lakes support formidable residents—oceanic sharks and New Guinea crocodiles. In others we found the dominant animals to be minute crustaceans swarming in incredible profusion. We dived amid dazzling shoals of jellyfish. In the absence of their usual predators, bizarre tiny fish and shrimp acted like carnivores of the open sea.

Each morning we set out from the mariculture laboratory on Malakal Island, three miles from Belau's capital city of Koror, in a launch fast enough to take us in an hour to the day's chosen island. Native Palauans were our guides and helpers.

Typical was our venture to Ongeimel Tketau Uet, called Spooky Lake by our guides, on the island of Eil Malk. We nosed our boat right against the shore and tied up to a tree. All Palau's limestone islands have vertical bluffs, often undercut, as here, by waves and scraper-toothed grazing fish.

Lake Outing Is No Holiday

We clambered up to the first shelf of the forest floor and set out through steamy jungle and over razor-backed ridges. We all wore heavy boots, gloves, and protective clothing—no bare arms or legs. Saw-toothed pandanus leaves slashed at us; sharp, loose limestone rolled under our feet. The Palauan poison tree, whose black sap blisters skin and swells eyes shut, menaced us constantly.

We went heavy-laden: In addition to our

camera gear, lunches, spare clothing, and technical supplies, we carried nine diving tanks, at 37 pounds apiece, and a four-man inflatable rubber boat weighing 50 pounds.

At last, drenched with sweat and streaked with dirt, we stumbled down to the shore of the lake, bordered with spectral mangrove roots. Pulling off our boots, we jumped fully clothed into the cooling water.

Black looks greeted the query, "Who's going back for the second load?"

With all the gear assembled, we paddled our rubber boat into open water. Wary of saltwater crocodiles, we slapped the surface with our oars, making lots of noise. If any crocodiles lived there, the racket would pique their curiosity: In isolation they are quite unafraid of man. No reptilian snouts breached the still surface. How nice! We returned to shore and put on our diving gear.

In the center of the lake, we dropped slowly down the boat's anchor line. At the surface the water was blue, clear, and cool—sweet to the taste. Recent rainwater floated above the salt.

A few feet deeper and the water shone bright green with algae. Lower still, and abruptly the water turned bright red, brilliant magenta, then black! In the dark we turned on our lights: The water here actually was quite clear, but no daylight reached it, though we were only ten feet below the surface. The algae and reddish material above us had totally absorbed all the sunlight.

We sank deeper into the dark clear water. Warning bells rang in my brain! The air from my regulator began to taste like rotten eggs. We had reached anoxic water, where oxygen was absent, replaced by dissolved hydrogen sulfide. This deadly gas was

MUSSELS, SPONGES, BRACHIOPODS, SHRIMP, POLYCHAETES, GRANDIS, 1 INCH

Dye fans out *from a convoluted 325-foot-long tunnel joining Katbakku Lake* ***(left,*** *center) with a lagoon. Tidal waters rush forcefully through the 12-foot-wide conduit, mixing with rainwater at the surface. In other lakes, where water percolates gently through tiny fissures, a layering results. In Spooky Lake's stratified waters a glass shrimp perches on algae-carpeted mussels* ***(above)****. Free of predators in this habitat, it has lost the timid nature of its ocean-dwelling kin. This one boldly crawled over the author's face mask.*

Suspended above a mystery, *the author's wife, Peggy, swims in clear brackish water over a foggy layer of unknown composition in Jellyfish Lake* ***(above)****. In Spooky Lake* ***(left)*** *similar clear and cloudy levels descend to the plankton-rich green layer surrounding Peggy's head and the bacteria-tinted red layer obscuring her legs. Beneath that lurks a toxic hydrogen sulfide layer, devoid of light, which quickly tarnished the divers' brass scuba fittings.*

To sample these strata, Dr. Hamner weighted a clear plastic bucket to create a "hole in the ocean" and siphoned water from a cone-shaped sampler into collecting bottles in the bucket ***(right)****.*

SEA ANEMONE, FAMILY STICHODACTYLIDAE, 2 INCHES TALL

Like a parachutist *in mid-fall,* Mastigias papua *swims in a quiet lagoon* ***(right)****. In one of the three lakes dominated by jellyfish,* Mastigias *is victimized by a sea anemone* ***(left)*** *that attempts to engulf its meal like a sock stretching over a foot. Though they probably share a common ancestor, three distinct forms of* Mastigias *have evolved in the lakes as a result of their isolation from one another. For unknown reasons, the jellyfish in all three lakes migrate from shore to opposite shore twice each day.*

creeping into our mouths and into our face masks through the seals around the edges, and through my mustache where the mask didn't fit tightly.

We headed quickly for the top, through the red, green, and blue layers, gulping fresh air when we broke the surface. We were still healthy, but the brass fittings on our diving gear had turned black, tarnished in the sulfide waters. We had plunged into a weird chemical vat, where hydrogen atoms reduce carbon compounds to methane, sulfur compounds to hydrogen sulfide, and nitrogen compounds to ammonia—gases all highly toxic to oxygen-dependent organisms.

Only bacteria can live in these primordial waters. They derive energy from biochemical processes that don't involve oxygen. Adapted to a planktonic existence, they float in delicate balance just at the lower limit of oxygenated waters. They occur in such dense concentrations that the pigment in the bacterial cells tints the water a brilliant red.

Tiny Copepods Enjoy Life at the Top

In biological organization, some Palau lakes are surprisingly simple. Spooky Lake, for instance, supports in its brilliant green waters only one herbivore, *Oithona nana*, a tiny copepod of teardrop shape with an eye in the middle of its head and two long feathery antennae. This animal feeds on floating algal cells. Like swarms of midges, these minute planktonic crustaceans occur in astronomical numbers. No carnivores inhabit this particular lake to eat the copepods. A model of simplicity: algae feeding copepods in a two-species, two-step food chain.

Another lake holds *O. nana* and a large population of a single predatory fish; here—understandably—the copepods are fewer. A third lake, rich in phytoplankton, supports two competing herbivores and two carnivorous predators. Is it algal production, competition, or predation that controls each population? Or are all three responsible?

The surface of the salt lakes is at sea level. Tunnels and fissures connect them to the sea. Rising tide in the ocean forces seawater into these channels and thence to the lakes.

The degree of tidal mixing allowed me to divide the 30 large lakes into two groups, the well mixed and the stratified. This classification corresponds to the ocean's two major water masses, the well-mixed coastal waters that support rich fisheries and the stratified and relatively unproductive open seas. The marine lakes of Palau thus exhibit in miniature the physical and chemical processes that "drive" the oceans.

Some lakes fill through narrow fissures that retard the flow and limit exchange between lake and sea. In these lakes the influx from the ocean is too feeble to mix the water column, and these bodies stratify sharply, with fresher rainwater above and saltier, heavier water below. Freedom from wind—steep bordering cliffs and dense forests form a shield—fosters this stratification, keeping the lake waters layered like a pousse-café.

In other lakes, where drainage channels are large enough for divers to swim through,

the flood tide races in with great force, mixing the waters on every tidal cycle. Lakes thus fed and drained cannot stratify, the surface layer of rainwater being quickly mixed on ebb and flow of the tide.

The large rock tubes that admit and expel these great volumes of water are dangerous to divers. On the rising and falling tides, vicious currents race through them.

Black Corridor to a Golden World

Among the tunnels we explored, I remember especially the one leading into Kaibakku Lake. At slack tide we entered with diving lights from the sea end. Tied together by safety lines, we trailed a long guide rope moored to a rock outcrop near the opening. The tube ran straight down for 20 feet, then opened into a flattened cave only four feet high in the center. The tunnel turned. We switched off our lights. Darkness absolute!

With the lights back on, we found the tunnel unexpectedly golden. Yellow sponges, bryozoans, and encrusted oysters covered the walls. Hidden amid them was a large crab, cloaked with sponges that camouflaged it from prying eyes, an adaptation without logic in a lightless world.

In the total darkness, there was, of course, no photosynthesis, so no plants grew there. In such strong currents, animals tend to be attached to the walls, and feed on creatures already present in the water column.

Another day in another lake we spotted a black opening beneath a submerged ledge. Because a layer of silt covered bottom and sides of the hole, we deduced that this cavern had no tidal currents, no exit to the sea.

Squeezing through the entrance, we turned on our lights, illuminating a vast underwater cathedral, with ancient dripstone pillars pendent from the vaulted ceiling. Though the water was clear, our light failed to reach the far wall. We swam along, unreeling the guideline behind us. The cave stretched endlessly ahead. We circled massive stalactites and flippered onward, probing to the extent of two football fields.

Finally, with safety line and air supply running out, we called a halt. The cavern reached on into the darkness, slowly angling downward, with the floor already at 120 feet below lake level. We hurried back along the guide rope, as apprehensive as Hansel and

Gretel following their trail of white pebbles, secretly fearful that our safety line might have come untied. With relief we emerged from the cave's narrow opening.

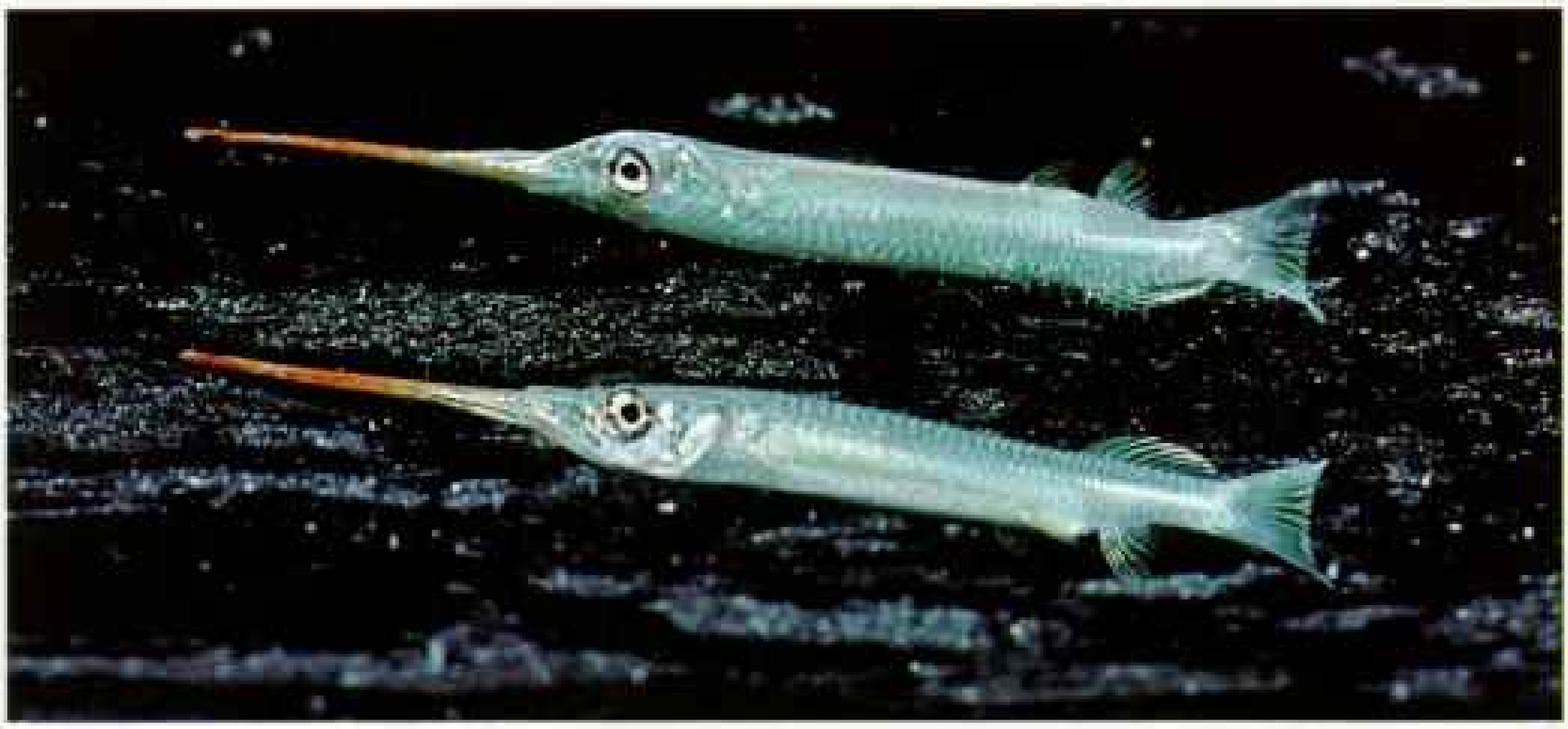
The largest lake, Metukercheuas Uet, measures a mile and a half in length and 200 feet deep. Its qualities are almost oceanic, its oxygen-rich water well mixed and blue. Delicate corals flourish in its shallows, unfractured by storms or intruding humans.

Most other well-mixed lakes are home to selective combinations of creatures, but Metukercheuas Uet is big enough to support almost the full complement of a tropical reef community. Almost, because it lacks sea urchins, parrot fish, and surgeonfish—all grazers equipped with highly efficient scraper teeth.

With these grazers absent, the underwater landscape blossoms with colonial sea squirts and weirdly arborescent sponges of

CARDINALFISH, SPHAERAMIA NEMATOPTERA, 2 INCHES LONG; HALFBEAK, GENUS ZENARCHOPTERUS, 5 INCHES

Profiles in fish life: *From the rotund cardinalfish* ***(above)*** *to the stiletto-sleek halfbeak* ***(below)****—its image doubled by reflection—Palau's lakes offer variety. Ecosystems vary from a lake where algae and a single copepod species form a two-step food chain to one with a full-blown reef community.*



brilliant hue. But these seemingly vulnerable sea creatures are not themselves entirely benign. Many manufacture toxic chemicals to discourage would-be predators. Medical chemists who extract these substances are called marine pharmacologists, and for the past several years a group of them has visited Palau each spring to collect sponges and extract chemicals for possible medical applications.

In some of the lakes, I found the fish both curious and tame. I could lie quietly at the edge of the mangroves surrounded by big-eyed cardinalfish (*Sphaeramia nematoptera*). Hungry and bold, they would nibble at my fingers.

In open water, schools of silversides would swirl around me, flirting inches from my extended hand. Nearby David Doubilet would lie motionless atop a bed of white colonial sea squirts, while gobies investigated their reflections in the lens and halfbeaks idled beneath the silvered surface.

Many lakes are devoid of large predators, and there fish move slowly and at ease, the fear-induced sudden movements of the open reef forgotten in time and isolation.

Quick Parting by Diver and Croc

Hot Water Lake, on Eil Malk Island, embodied one of the mysteries of Palau's lakes and presented the hazard of thermal stress: The surface temperature was a moderate 85°F, but about 10 feet down the temperature started rising, and at 15 feet it was 100°. Divers will soon die in 100° water, for they have no way to rid themselves of the heat above body temperature.

Our dives in Hot Water Lake were brief. Once, when Peggy and I went snorkeling to collect samples, I turned to hand her a plankton net—and she wasn't there! Instead, I almost pushed the net onto the nose of a small crocodile floating motionless at the surface. Man and reptile, both very

"**You expect** *the hound of the Baskervilles to appear," says the photographer of Spooky Lake. Mussel-shrouded mangrove roots disappear into a foggy layer, token of the mystery stirred up by a brew of lakes holding more questions than answers.*

frightened, took off in opposite directions.

Peggy remained quite unsympathetic. "After all," she said, "no one in Palau has been eaten by a croc in ten years."

Of all the richly varied life in the lakes, most beautiful and most perplexing is the large jellyfish *Mastigias*, which occurs in great numbers in three of the stratified lakes. We found its behavior highly complex for an animal so simple neurologically.

Mastigias has on the bell margin eight primitive eyes, which allow it to distinguish and avoid shadows. Each morning the jellyfish migrate from one side of the lake to the other, until finally a solid curtain of golden jelly shimmers in the sun, 15 feet out from shore, just at the edge of shadows cast by overhanging trees.

The shoal of jellyfish hangs stationary until about 2 p.m., when all turn and swim the half mile back to the opposite shore. To complicate matters, in each of the three lakes the jellyfish migrate in different compass directions—another puzzle yet unsolved.

To test their powers of navigation, I transferred some *Mastigias* from a lake where they migrate east in the afternoon to a lake where the resident jellyfish swim west at the same time of day. So programmed were the transplanted animals to their innate compass orientation that they swam steadily eastward against the flow of the westbound crowd! Was each population reflecting a genetic behavioral adaptation peculiar to its own lake?

Mastigias does not have tentacles on the bell margin with which to capture food. Instead, each animal carries tiny algae, called zooxanthellae, that live symbiotically inside its tissues. These photosynthetic algae provide food for their host jellyfish, as they do also for reef-building corals.

Avoiding shadows, the jellyfish maximize the amount of sunshine available for photosynthesis by always swimming at the surface during the day. They rotate (counterclockwise, for unknown reasons), ensuring that algae on all sides of the bell receive equal sunlight.

But this is not all. The zooxanthellae need minerals for growth, such as nitrogen, a major component of fertilizers. Dr. Leonard Muscatine, professor of biology at UCLA, came to Palau to study the nitrogen requirements in this symbiotic relationship. He found that *Mastigias*, unlike most marine invertebrate animals—which excrete the nitrogenous compound ammonium—*absorbs* ammonium at astonishing rates. A jellyfish ammonium-sponge!

Sun Worshipers Dive for Minerals

"It's curious," Len remarked, "that these jellyfish accumulate ammonium, because the surface water of the lakes contains almost none. Are you sure *Mastigias* always stays at the surface? Maybe in the dark it swims down into the richer, deeper waters, where there is lots of ammonium."

That very night Len and I entered the water. At the surface a thousand pulsing spheres reflected the beams of our diving lights. At 15 feet, below the day range of the jellyfish, we still saw many of them, and here they were swimming upward and downward rather than horizontally. Deeper still, at 45 feet, just above the red bacterial layer, we found numerous jellyfish.

We had solved the ammonium mystery. During the day, the jellyfish cultivate their algae by swimming in full sun near the surface. At night they dive to replenish their supply of fertilizer, like all good farmers, in anticipation of the next day's nurturing sun.

There's still a great deal we don't know about Palau's marine lakes. How does a particular species of fish gain a finhold in one lake and not in another? How can so many organisms crowd into such relatively small containers? What will the anoxic sediments, undisturbed by burrowing animals, tell us of past environments? I hope other oceanographers will join us in Palau in research that may answer these and other questions. □

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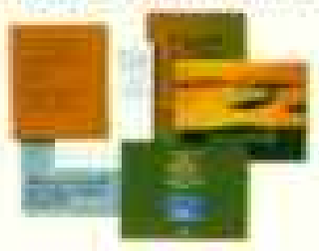

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A HUGE DIVOT made by the shovels of archaeologists borders a tee on the golf course of the Parris Island Marine Corps base in South Carolina (**below**). Here once lay the Spanish town of Santa Elena, founded in 1566 when France and Spain contended for our southeastern coast. Sometime capital of the struggling colony of Florida, the little town held as many as 400 people and 60 houses, and was guarded by three successive forts during its 21 years of troubled existence. From here, by 1570, expeditions had explored inland as far as Tennessee and north to Chesapeake Bay.

Its excavation begun two years ago by University of South Carolina archaeologist Stanley South (**below right,** above well), Santa Elena is one of the few undisturbed sites of Spanish occupation in the United States. It is beginning to yield artifacts like this small crucifix (**right**) and well barrel.

Your Society is helping reopen this lost page of America's early history. Let friends join in also.

Spanish town found beneath the links

ALL BY DAVID BRILL

Alaska

Spectacular scenery is just the beginning.

GOLD Alaska loves its gold rush history. Today its towns still teem with high-kicking, knee-slapping frontier-style fun: can can dancers, free-spirited saloons, riverboat paddlewheelers, comic opera, and even a narrow gauge railway.

ESKIMOS The unique nature of Arctic Alaska has produced a people with inner strength and captivating warmth. Their sensitive artwork, inviting hospitality, and fascinating culture are a part of Alaska you're not likely to forget.

FISHING In Alaska you rarely hear tales of "the one that got away." With 33,904 miles of shoreline, thousands of streams, and more than a million freshwater lakes thick with salmon, steelhead, or pike, even the novice fisherman can come home with "the big one."

NATURE Walk the wilderness. Hike the high country. Young or old, you'll find no more awesome sight on the continent than the wildlife of Alaska's magnificent parklands. Shirtsleeve weather and well-marked trails invite adventure.

PHOTOGRAPHS Bet you can't take just one! In Alaska, great pictures are everywhere. Here, too, you'll find a myriad of unique shopping treasures: fabulous furs, paintings, soapstone sculpture, and exquisite native handicrafts. With 20 hours or more of summer daylight, there's time for doing it all.

TOTEMS Learn the many symbols of the totems and, like a pieced-together puzzle, the tribal history and exciting legends of the Alaskan Indians come alive. The artistic craftsmanship, vibrant festivals and ceremonial dances of these native people will astound and delight you.

SNOW Untracked powder on mountain slopes, snowy meadows and bustling Alpine ski resorts. These are the Alaskan arenas of winter and spring downhill and cross-country skiing. And for the ultimate skiing experience—shooshing down otherwise inaccessible glaciers—helicopter lifts are available year round.

ELEGANCE Cruiseships and luxury hotels make "roughing it" in Alaska an option, but hardly a necessity. You can savor a fresh-caught salmon dinner with a glass of iced champagne, retire to a comfortable suite, and still awake to spectacular wilderness views.

FESTIVALS Russia ruled Alaska until 1867. Later, Scandinavian immigrants founded many of the first towns and villages. You can see Russian folkdances, onion-domed churches, and take part in a "Little Norway" spring festival.

SOURDOUGH Pioneer spunk, a tough yet gregarious spirit, and a pot of sourdough were all Alaskan prospectors needed in 1898. And so they became known as Sourdoughs. Their stories and mouthwatering recipes are still a very real part of Alaska.

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Members Forum

ATLANTIC SALMON

Atlantic salmon are more closely related to steelhead and other species of trout (*Salmo*) than to the six species of Pacific salmon (*Oncorhynchus*).

Don Haerling
Tenino, Washington

You are quite right. Author Art Lee mentioned the Pacific salmons because their behavior patterns are similar to those of the Atlantic salmon and the comparison underscores the threatened status of the Atlantic species.

Gordon Lesenger must have been more than a little horrified to read that he was wearing "knickers," since the word in Britain is used to denote an article of ladies' underwear.

Alice Ruddiman
Washington, D. C.

The term is also short for knickerbockers. We checked with Mr. Lesenger before publication, and he had no objection.

APHRODISIAS

Aphrodisias—a Roman provincial city—Never! Dr. Erim should return to his digging and to his history books.

Edward P. Chappen, M.D.
Trenton, New Jersey

Aphrodisias, like Miletus, Halicarnassus, and Ephesus, was a Greek city of Asia Minor that enjoyed a large measure of autonomy under Roman rule. Dr. Erim's failure to identify them as Greek reflects his Turkish bias.

Nicolas S. Koukotas
Mercerville, New Jersey

Inscriptions provide indisputable evidence that Aphrodisias was a provincial city of Rome—and one that enjoyed special privileges. Letters from at least eight emperors have been found, beginning with Augustus, who said, "I have selected this one city from all Asia as my own."

The article states that Aphrodisias was a Greco-Roman city and that Greek was the common language even during Roman times. Additional information on the city's Greek heritage can be found in the August 1967 and June 1972 magazine articles on Aphrodisias.

INDIAN OCEAN

I wish to thank all who helped to assemble "Crosscurrents Sweep the Indian Ocean" in the October 1981 issue. The entire article struck a happy chord, and the photograph on pages 430-31 was just supreme.

J. L. Barna
West Mifflin, Pennsylvania

One expects to find a pro-American bias in NATIONAL GEOGRAPHIC's reporting, but the anti-Russian and antisocialist tone in the article on the Indian Ocean was excessive.

The Reverend Ivan Chetwynd
Neksø, Denmark

I wish to draw your attention to the spelling of the city of Asmara, in the former colony of Italian East Africa, on the map on page 424. When was it changed to Asmera?

Dante V. Morel
Lt. Col. U. S. Air Force (Ret.)
Orlando, Florida

The Ethiopian government used the Asmera spelling for its English-language maps in 1973. The Board on Geographic Names, the organization that determines standard usage for U. S. government maps, adopted the Asmera spelling in 1975, based on transliteration of Ethiopian-language texts.

PANDA GIVES BIRTH

I was fascinated by the account of "Pandas in the Wild" in the December 1981 GEOGRAPHIC. When will Dr. Schaller know if Zhen-Zhen has given birth to a cub?

Sandy Menefee
San Francisco, California

We recently received word from Dr. Schaller that Zhen-Zhen gave birth in the fall. "We checked the den site, a hollow fir," he reported. "Heard infant squawk, but female chased us away, so we could not get a look."

ALDO LEOPOLD

High praise for Boyd Gibbons and his article on Aldo Leopold. This is one of the finest, most interesting pieces of biography I've read in a while. And the photographs by Jim Brandenburg were so well selected.

Tom Flahaven
Houston, Texas

You say "There are no monuments to Aldo Leopold, save for a bronze plaque in the Gila." Aldo Leopold has a perpetually renewing monument. The very beautiful Aldo Leopold Memorial

Medal has been awarded annually since the late 1940s by the Wildlife Society.

Fred G. Evenden
Eugene, Oregon

ACID RAIN

The NATIONAL GEOGRAPHIC article will do more toward solving the acid rain problem than anyone will ever realize. Communicating the problem to the American public objectively through the GEOGRAPHIC is almost the guarantee that everyone has been exposed to the vital information necessary for decision making. The message you gave was loud, clear, and accurate.

Robert F. Flacke, Commissioner
Department of Environmental Conservation
State of New York

For shame! I expected something better than "Acid Rain—How Great a Menace?" from a society dedicated to the truth. The truth consists of more than a few technical facts sprinkled among unfounded suppositions.

A. J. Angelino
Scotia, New York

Permit me to clarify the author's statement that the Allegheny Mountains enjoy immunity from limestone buffering. Many northern Allegheny mountain streams flow through sandstone deposits; thus the water never touches limestone until it reaches valleys far to the south. Many streams are already threatened.

Jack Cupper
Wellsboro, Pennsylvania

Sandstone is a dominant rock in the Allegheny region, but it also contains calcium carbonate that may be released into the environment as a neutralizing agent by the weathering process.

NEW JERSEY

I left New York City 18 years ago for the "scrublands" and have proudly adopted New Jersey as my home . . . thanks, Jim Hartz, for letting New Yorkers know about the home of the New York Giants!

Arnold Bombay
Matawan, New Jersey

The article states that "New Jersey [is] second only to Michigan in blueberry production." According to my *Maine Almanac, 1978*, "Maine is America's largest blueberry-growing state."

Thank you for letting me give Maine her due—unless of course the last three years have drastically changed the order of productivity.

Mrs. Roberta Butler
Wiscasset, Maine

Maine does indeed harvest more acres of blueberries, but, according to the U. S. Department of Agriculture, it is third in production of commercial fruit. Maine leads the nation in producing wild blueberries.

To me it came as something of a surprise to read in the November issue that "another of the nation's earliest inventors, Alexander Graham Bell, had invented the telephone." It has been my understanding that Bell was a Scot and later a Canadian, who in 1871 lectured in cities in the United States.

Keith H. Whyte
Collingwood, Ontario

Alexander Graham Bell was born in Scotland and lived briefly in Canada before settling in the United States, where he applied for citizenship in 1875. After his death on August 2, 1922, at his beloved summer home in Nova Scotia, his grave was marked, as he specified, "Died a Citizen of the U.S.A."

MONO LAKE

In "The Troubled Waters of Mono Lake" the first paragraph of the second column reads: "Mono basin formed three million years ago at the western edge of the Sierra. . . ." Mono Lake is on the east side of the Sierra mountains.

Fern A. Carlson
Spokane, Washington

How embarrassing for the GEOGRAPHIC to move a lake across the Sierras. Fortunately, we at least had it right on the map.

ZIMBABWE

I greatly enjoyed your article on Zimbabwe. It clearly gave an account of the troubles of the relatively new country. Plus excellent background on Rhodesia.

Charles Roth
Lynnwood, Washington

In the article about Zimbabwe, Charles E. Cobb paints a beautiful picture of the most recent African country that we of the Western world have abandoned to the Communists. In another year or two we will be getting begging letters, urging us to contribute to the relief of the starving children in Zimbabwe.

Wilbur J. Dowd
Madison, Connecticut

Letters should be addressed to **Members Forum**, *National Geographic Magazine, Box 37448, Washington, D. C. 20013, and should include sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.*

Announcing an extraordinary tribute to America's living symbols of beauty . . . the official First Day Covers of

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Covers shown smaller than actual size of 6½ by 3½ inches

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THE COMMEMORATIVE STAMPS: Designed by master wildlife artist, Arthur Singer, each of the fifty official commemorative stamps will be issued by the United States Postal Service in March, 1982.

Subscription Deadline: March 31, 1982
Original issue price: $1.95 per cover

From sea to shining sea, America is blessed with an abundance of stunning birds and flowers. A glorious, spirited patchwork of sound, color and fragrance.

In every state, nature's beauty abounds. Americans know it, and are proud of it. And with each new song a bird sings, and each new flower that blossoms, that pride is renewed and strengthened.

To forever affirm this pride and respect for the natural environment, each of the fifty states has chosen an official state bird and flower as a lasting acknowledgement of nature's bounty

. . . and a lasting part of America the Beautiful.

It is appropriate, therefore, that *The Birds & Flowers of the 50 States* is soon to be the subject of what is surely the most beautiful — and important — series of United States postage stamps in our nation's history. For, in March, 1982, the U.S. Postal Service will issue fifty different *official* commemorative stamps, to honor these living symbols of the United States.

Exquisite stamps by America's greatest wildlife artist

Significantly, each stamp in this important series is a triumph in craftsmanship and design by a man who is often called America's greatest living wildlife artist: Arthur Singer. For over two years, Singer has labored to achieve the perfection and absolute fidelity to nature this tribute deserves. Thus, as leading citizens gather in our Nation's Capital in March, they will participate in the inauguration of a commemorative stamp series without parallel.

At these special ceremonies, *First Editions* of the new stamps . . . First Day Covers . . . will be *officially* certified by the coveted, one-day-only, *First Day of Issue* postmark of our national Capital's Post Office. These will be but a small fraction of the total number of stamps eventually printed and available to the general public.

Appropriately, Fleetwood, America's oldest and largest purveyor of First Day Covers, will issue *The Birds & Flowers of the 50 States* in one complete collection of fifty official First Day Covers, each bearing a coveted First Edition stamp and postmark.

Matching works of art by the designer of the stamps

In addition, and of special importance to knowledgeable collectors everywhere, each of these official First Day Covers will bear a *matching original work of art* to enhance each stamp — created by the designer of the stamps themselves, Arthur Singer. Only rarely do First Day Covers of America's stamps bear such *original* art by the actual designer of the stamps. Thus, the First Day Covers available through Fleetwood are very desirable indeed.

For Arthur Singer has painstakingly recreated colorful, authentic stamps and cachets which *perfectly* complement one another . . . from the flame-red plumage of Ohio's cardinal to the soft pink, sweetly-scented Mayflowers of Massachusetts. This is truly a landmark collection that will be acclaimed and sought-after by collectors and nature lovers from each and every State.

So significant is this philatelic tribute, that the first fifty collections have been reserved for the Archives of each of the fifty States. In addition, identical collections are also available now to a few private citizens strictly on an advance reservation basis . . . by direct order from Fleetwood.

A single, Limited Edition

The Birds & Flowers of the 50 States will be issued *only* once — on the precise First Day of Issue, and *only* as a complete collection. The distinctive postmark will certify to you that it can *never* be issued again. The original issue price for the collection is $1.95 per Cover . . . modest indeed, especially when you consider that the only other collection of this kind — *The Flags of the Fifty States* issued in 1976 — now commands two and a half times its original issue price.

To reserve your collection, simply enclose a modest $10 deposit with your application, and you will be billed in five monthly installments of $17.50 each. Or, if you choose to use your credit card, *you need send no money now.*

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The Birds & Flowers of the 50 States deserves an honored place in your home. As constant reminders of the glorious richness of the great American outdoors . . . of nature's unique gift of beauty to each individual state. And as a legacy which will continue to inspire you, your children and their children for generations to come.

Deluxe, custom-made album and historical information included at no additional charge

Collectors who take advantage of this opportunity to acquire *The Birds & Flowers of the 50 States* will also receive, without additional cost, a luxurious custom-made collector's album to preserve, protect and display the First Day Covers.

In addition, to enhance the appreciation, enjoyment and educational value of the collection, complete and authoritative information about each state bird and flower will be printed on the back of each cover.

Subscription Deadline: March 31

To take advantage of your opportunity to acquire this important collection, your order should be postmarked no later than March 31, 1982 — the last date on which Fleetwood can guarantee acceptance of your order. Mail your application today to: Fleetwood, One Unicover Center, Cheyenne, Wyoming 82008-0001.

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On Assignment

ABDEL SATTAR YOUSEF (ABOVE) AND GORDON W. GAHAN

ALIEN SURFACES of the moon and Mars are almost as familiar to geologist ***Farouk El-Baz*** as the sands of his native Egypt. Now a U. S. citizen, Dr. El-Baz helped train Apollo astronauts in lunar geology. His interest in Mars stems from the similarity of the wind-swept planet to Egypt's Western Desert, a subject he discussed with the late Anwar Sadat, to whom he was a science adviser.

Of his close personal friend, Dr. El-Baz says, "Sadat was a man of vision and courage who could easily see through fog."

Fascination with the desert can prove difficult if not dangerous in the field, as Dr. El-Baz discovered during his dozen trips into the Western Desert. Once he and his team were headed for an oasis some 200 miles away. Darkness fell, and after 300 miles they realized they had missed their mark and had only enough water to last the night. The next morning they reached their destination after a three-and-a-half-hour drive.

Dr. El-Baz first began collecting rocks as a boy scout exploring the mountains near Cairo. He was one of the five top university geology graduates in Egypt in 1958.

"I was assigned to the science school at Ain Shams University," he recalls. "Because of my early interest in terrain and mountains, I chose geology. But what I really wanted was to be a surgeon. I may still do it someday."

RETRACING THE FOOTSTEPS of Napoleon became more realistic for Senior Writer ***John J. Putman*** than he expected. While hiking the Great St. Bernard Pass in the Alps, Putman inadvertently left the snow-piled path. Noticing markers for the trail 300 yards below, he took the easiest way to get back on course and, like Bonaparte, slid down on his backside.

To understand the life and legacy of the Little Corporal, Putman read countless books, combed archives, consulted experts—among them English historian Felix Markham—and traveled 30,000 miles to visit a dozen nations.

The assignment became an adventure in coincidence. On the trail in Alexandria, Egypt, Putman discovered that his guide was a descendant of Napoleon's aide, General Bertrand, and that living in her home was a descendant of the family of Marshal Kutuzov, Napoleon's Russian foe.

In pursuit of articles for the NATIONAL GEOGRAPHIC, the former Alabama newspaper editor has hunted antelope with Pygmies in Zaire, lived on seal meat with Greenlanders, and bathed with India's holy men in the Ganges. Putman won the 1975 Overseas Press Club of America's award for Best Magazine Reporting for his article "The Arab World, Inc."

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Look closely at the new SL-5000. It is innovative. Yet understandable. Sophisticated. Yet uncomplicated.

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And here's another stroke of Genius. The Sony Betamax gives you all the record functions on the left; all the playback functions on the right. That's one more reason the SL-5000—for all its sophistication—is remarkably simple to operate.

Now consider these advantages. The SL-5000 lets you tape one show while you're watching another. And it can be programmed in advance. Which means you're able to record even when you're not at home.

Naturally, it wouldn't be a Sony Betamax without the electronic marvel we call BetaScan. With BetaScan, you can actually see what you're looking for in fast-forward and fast-reverse, then stop when you find it.

There's more. The SL-5000 has Express Tuning to take you directly to the channel you want, skipping the channels in between. It also includes remote control, freeze frame, electronic feather-touch controls. . . In fact, almost every important feature you can think of. Plus one you'd probably never dream of, a reasonable price tag.

Of course, to fully appreciate the brilliance of the SL-5000, you have to see it in person. So stop in at your Sony dealer and ask to watch a Genius at play.

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Photographed by J.L.G. Grande. *Spanish Imperial Eagle: Genus: Aquila heliaca Species: adalberti*
Adult weight: *Average 3—3.5kg* ***Adult size:*** *Average length 79—84cm; wingspan 185—216cm*
Habitat: *Savannah and lowland forest, surviving primarily in Caceres Province and the Coto Doñana National Park, Andalusia, in Spain.* ***Surviving number:*** *Estimated 60 pairs in Spain and a few pairs in Portugal*

Wildlife as Canon sees it: A photographic heritage for all generations.

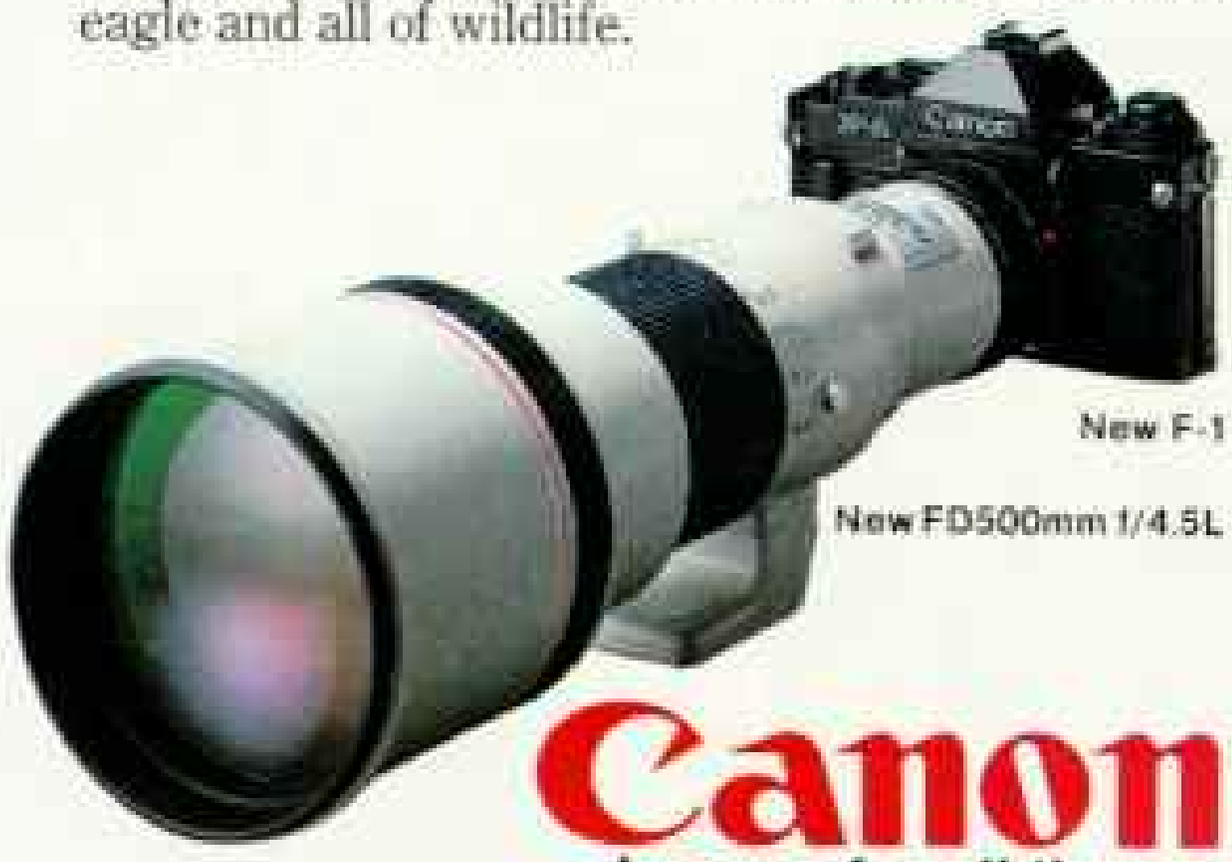
The Spanish imperial eagle is one of the world's most handsome birds. It is also one of the most endangered. And if it disappears, there is no way to bring it back.

Photography can record the Spanish imperial eagle for posterity, and it can actually help save it and all of wildlife.

As a scientific research tool, photography can provide the information conservationists need, like why a male eagle refuses to deliver the food to its nest when the nest has been disturbed and waits in a nearby tree for its mate to collect it.

Photography can also greatly influence the way people in general feel toward nature. Looking at a photograph of the eagle, who can deny the bird's magnificence? And looking at photographs portraying the bird's strong sense of family, showing how mated pairs are monogamous and the young stay in or near the nest even three weeks after fledging, who could fail to gain a better understanding of nature?

And understanding is perhaps the single most important factor in saving the Spanish imperial eagle and all of wildlife.



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