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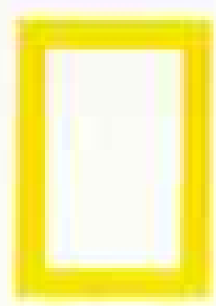

NATIONAL GEOGRAPHIC

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Search for Columbus

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What forces shaped Columbus and spurred him to brave treacherous seas to seek the Indies? Old manuscripts hold a key to the mystery of the great mariner.

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COVER: Maneuvering off the Spanish coast, reproductions of the Pinta, Santa María, *and* Niña *prepare to sail in the transatlantic wake of Christopher Columbus. Photograph by Bob Sacha.*

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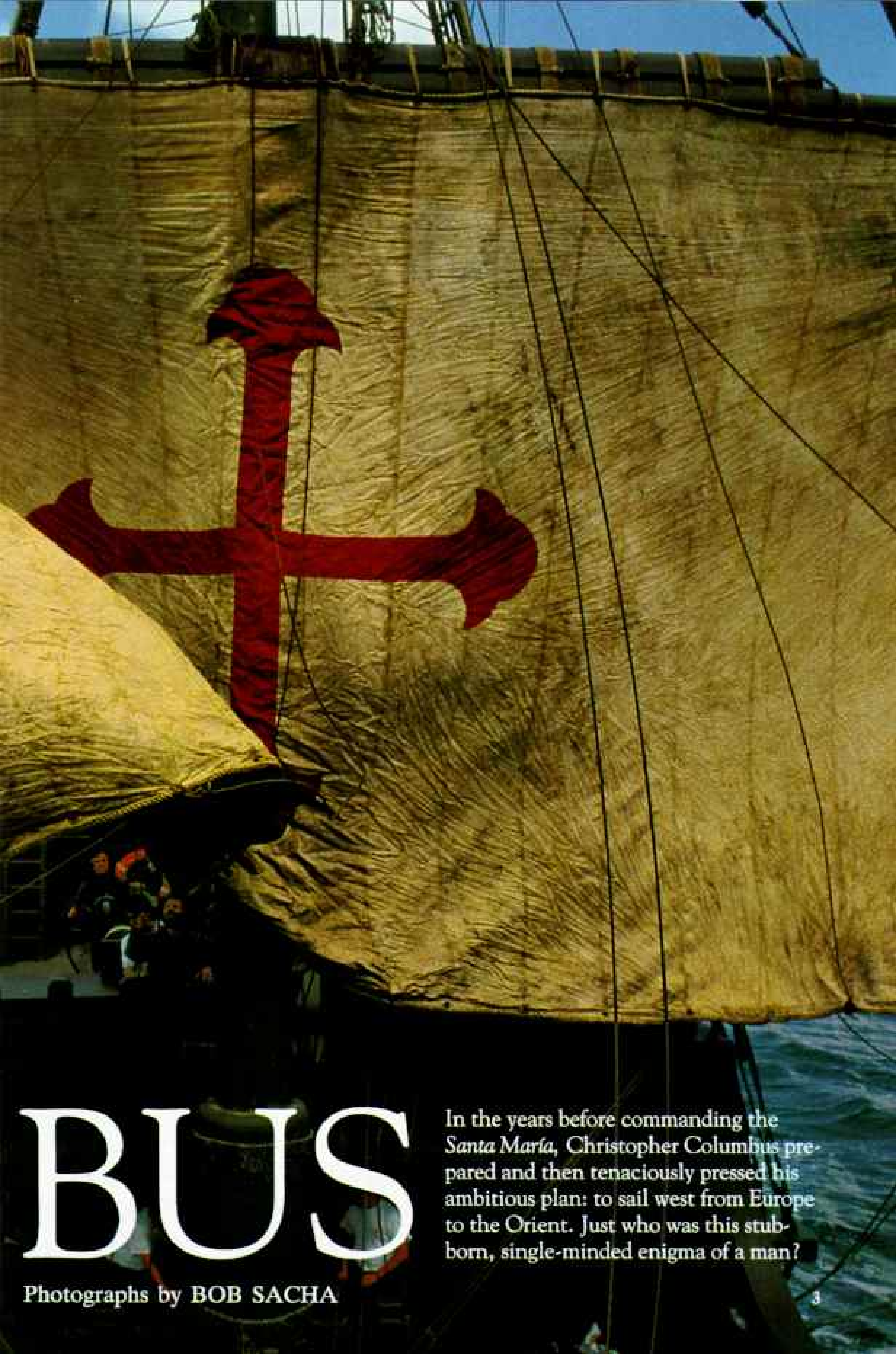
Search for COLUM

By EUGENE LYON



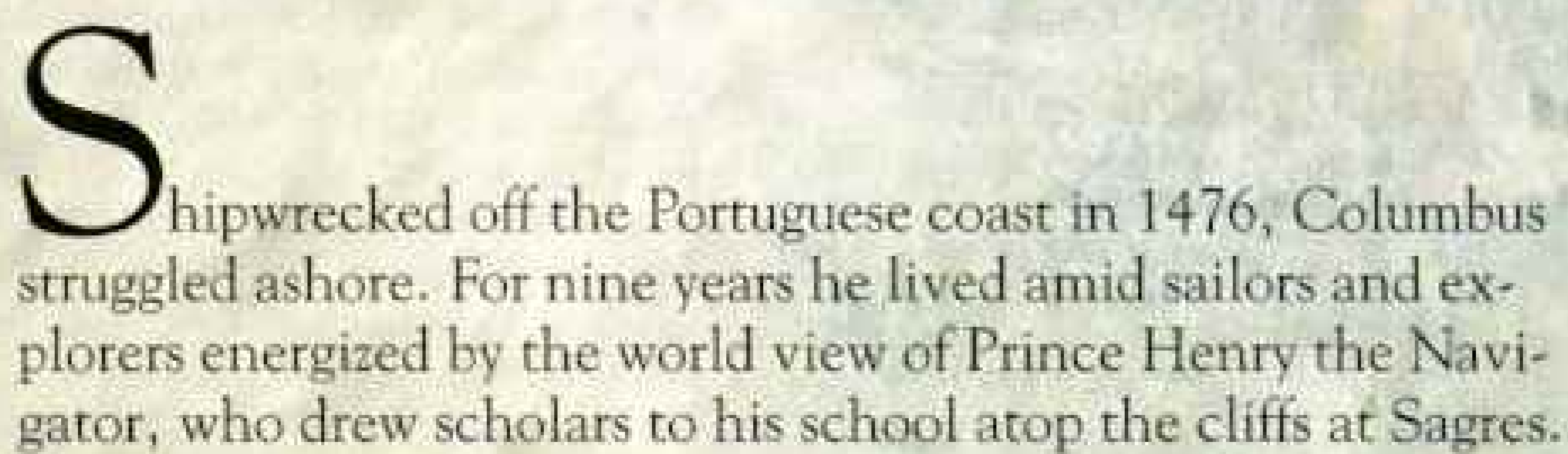
BUS

In the years before commanding the *Santa María,* Christopher Columbus prepared and then tenaciously pressed his ambitious plan: to sail west from Europe to the Orient. Just who was this stubborn, single-minded enigma of a man?

Photographs by BOB SACHA

Salt air and sailing ships seduced a teenage Columbus. By the early 1470s he set sail along European trade routes, working as a commercial agent aboard ships similar to this copy of the *Santa María.* He chartered and stocked boats, hired sailors, and managed

money. A man on a mission as well as a mariner, Columbus believed God "granted me the gift of knowledge . . . [and] revealed to me that it was feasible to sail . . . to the Indies, and placed in me a burning desire to carry out this plan."



Shipwrecked off the Portuguese coast in 1476, Columbus struggled ashore. For nine years he lived amid sailors and explorers energized by the world view of Prince Henry the Navigator, who drew scholars to his school atop the cliffs at Sagres.

A CLOUD OF SWALLOWS wheeled around Seville's great Gothic cathedral, roused by the clangor of its bells. In the dim interior a shaft of sunlight bathed the draped sarcophagus of Christopher Columbus, borne on the massive carved figures of four kings. Spain, itself an infinite tangle of ends and beginnings, was the fitting place to begin an inquiry about Columbus, at the spot that marks the finish of his unique career.

Gazing at the tomb, I wondered at the controversy that swirls around this man, perhaps even more today than when he lived. The events of his remarkable life, as well as the results of his epochal voyages, still spark lively, often bitter debate. Even his final resting-place is hotly disputed: Do his bones lie here in Seville or in a lead coffin across the sea?

I faced a difficult task. How could I, across a gulf of five centuries, probe the nature of this historic figure? How could I explore the restless, questing mind of the man who sought to reach the East by sailing west?

As a historian who works with original documents, I would have to follow a widely scattered paper trail. The Columbus documents, though many are contested, include more than 2,500 notes penned in the margins of books he owned; some 80 letters, notes, and memorials; copies of the log from his first New World voyage; volumes he compiled; and his will. Most of the books and manuscripts reside in Spain, but there are important Columbus materials in Italy, France, and the United States.

Most scholars agree that Genoa was the birthplace of Christopher Columbus, yet even this gives rise to emotional debate. Some believe his signature in code reveals Portuguese ancestry. Others declare him Scandinavian (a "Spanish-Jewish-Norwegian prince," says one enthusiast). Ibiza, in the Balearic Islands, has its partisans, and there are a host of other claimed Columbuses: Greek, Galician, Swiss, Catalonian, even Armenian and Chinese.

Just as ancient mariners set out to find new lands, historian EUGENE LYON voyages through Old World archives in quest of new insights. His most recent article for the GEOGRAPHIC was "Track of the Manila Galleons" in September 1990. BOB SACHA's photographic explorations include the world of "America's Ancient Skywatchers" in March 1990.

Surely, to find the nature of the man, I would have to fix with certainty the place and time of his birth. A solid clue came as I searched the archives of the Dukes of the Infantado in their Madrid palace. Here, I knew, priest-historian Bartolomé de las Casas' copy of Columbus's log had been found in the 18th century.

After examining many tightly packed bundles, or *legajos*, on shelves that filled a small room in the Infantado *palacio*, I felt a stir of excitement. In a slim bundle I came upon a creased and folded binder fastened with knotted string. On its cover was traced in pencil: Genealogía de Colón—Genealogy of Columbus. Inside, a chart described the succession to the Columbus estate, the

subject of lawsuits for more than 200 years.

My eye fell on the circle enclosing "Cristóbal Colón, first Admiral," one of the mariner's many titles. In the circle above was "Domingo Colombo," a reference to Christopher's father—Domenico Colombo as his name appears in official Genoese records. Here was a link placing the Columbus family in Genoa. But I would have to go to Italy to test the evidence.

In Genoa I was greeted by Aldo Agosto, a noted Columbus scholar and director of the provincial archives. He led me upstairs to the Sala Colombiana, a small room that holds many original Columbus family documents. They have survived the losses and traumas of five centuries, including Louis XIV's 1684

Christopher Columbus slept here (we think). Although the exact location of his childhood home is unknown, his family lived somewhere near the towers of the Porta Soprana, one of several city gates in Genoa, Italy.

Christopher's father, Domenico, worked primarily as a master wool weaver. But he also kept a tavern, dabbled in real estate, and was a partisan for the mighty Fregoso family, who, when in power, gave Domenico a gatekeeper's job. Patronage, Christopher must have realized, pays off.

Pinched between the mountains and the sea, the people of Genoa prospered as mariners and middlemen—bankers, agents, and traders—

who apparently treated Columbus well. He directed his heirs "to work for the honor, welfare, and increase of the city of Genoa."

naval bombardment of Genoa, when notary records were largely destroyed by fire.

More than 60 documents recount the story of the Columbus family, beginning with the youth of Domenico, whose name I had seen in Madrid. He was apprenticed to a Flemish weaver at 11 and rose to become a master weaver. In the boisterous, enterprising spirit of Genoa, he also worked as cheese maker, tavern keeper, and dealer in wool and wine.

Domenico Colombo married Susanna Fontanarossa, the papers attest. Their firstborn was Cristoforo, in 1451; later came Giovanni Pellegrino, Bartolomeo, Giacomo, and daughter Bianchinetta.

As a youth, Christopher was already at work with his father. He first appears in the notarial record of September 1470; later that year, at "greater than nineteen years of age," he obligated himself for a quantity of wine. By 1472 Columbus had learned his father's trade, for in that year he is called *lanaiolo*, a worker in wool.

Dr. Agosto next showed me the Assereto document, named for the man who in 1904 recognized its importance. It involves a 1479 lawsuit over a sugar transaction on the Atlantic island of Madeira. In it young Christopher swore that he was a 27-year-old Genoese citizen resident in Portugal and had been hired to represent the Genoese merchants in that transaction. Here was proof that he had relocated to Portugal.

Then I saw a document that clearly identifies Genoa's Columbus as Spain's celebrated Admiral of the Ocean Sea. In 1496 three of his Genoese cousins agreed to share the cost of sending one of them, Giovanni, to serve "Lord Christopher Columbus, Admiral of the King of Spain." Giovanni captained a ship on Columbus's third voyage and acted later as his aide.

Columbus himself alludes to his birthplace. In 1502 he wrote from Spain to directors of Genoa's Bank of San Giorgio, offering an endowment to relieve the city's poor of the tax on food and wine. "Even though my body walks here," he wrote poignantly, "my heart is always there."

There exist many other contemporary testimonies to his origin. After seeing the primary documents, I was convinced; wherever he may have gone thereafter, Christopher Columbus, son of the weaver Domenico Colombo, began his life in 15th-century Genoa.

WHAT EARLY INFLUENCES helped form the mind of Columbus? We find little about him during the Mediterranean years. One writer believes he was illiterate until 1494. At the other extreme the Admiral's son Ferdinand says of his father: "He learned his letters at a tender age and studied . . . at the University of Pavia."

The University of Pavia has no record that Christopher Columbus ever studied there. But Aldo Agosto has suggested that he may have attended a monastery school in a district of Genoa called Paverano, thus giving rise to the word "Pavia." Antonio Gallo, a Genoese who knew the family, wrote that the boys learned their few letters in their youth. A tantalizing bit of evidence in this regard came

years later, in 1509, when Columbus's brother Bartholomew gave his nephew Ferdinand an instruction book on handwriting; possibly Christopher and Bartholomew had used it as youngsters. Recent study of Columbus's papers by noted handwriting expert Charles Hamilton strongly suggests that he learned to write while young.

Columbus may have acquired the rudiments of Latin—a language he later used widely, if imperfectly—in Genoa. It appears, however, that he was only semiliterate; certainly he did not then learn to write Genoese.

His Genoese heritage helped greatly to shape Columbus and his view of the world. I took a taxi to the best place from which to see Genoa, its hilltop citadel, the Castelletto. From that vantage point one can grasp the nature of the city and the destiny of her people: Compressed between surrounding hills and the shore, Genoa spills down to the Ligurian Sea. Blocked in by such powerful rival cities as Milan and Florence and with little fertile hinterland, the people of Genoa were forced to seek their livelihood upon the Mediterranean Sea.

In the 15th century the Republic of Genoa was a lively, turbulent place, its atmosphere harsh but stimulating. The Genoese had no king, but selected powerful men as doges to rule them. Sporadic warfare between prominent families often led to bloodshed.

Throughout his life Columbus displayed many of the same traits as his fellow Genoese. They were a stubborn, acquisitive people, prospering through hard work and thrift, diligent in details, jealous of time. They created business enterprises far beyond the confines of their city. As Columbus himself would become, the Genoese were true cosmopolitans. They often married abroad and learned other languages, coexisting readily with other peoples.

Rich, powerful Genoese men needed Columbus—and he needed them. The ancestors of Giannetto Fieschi (left) rented a house to the Columbus family; years later, Christopher hired a Fieschi to command a transatlantic caravel. Wine maker Paolo Spinola (above) descends from a family of shipowners who once engaged Christopher as a commercial agent. So did Giacomo Centurione Scotto's family, who controlled one of Genoa's most prominent and prosperous merchant banks.

During the late Middle Ages, trade from Genoa expanded rapidly into nearby Corsica, Sardinia, and Sicily (map, page 21); Genoese merchants sought the wheat, salt, wine, and wool of Iberia. They spread through western Europe and the Levant and built trading centers near Constantinople, on the Black Sea, and on the Greek island of Chios. They traded on the Danube and in Kiev.

At Tunis, an entrepôt in northern Africa, they traded for gold. As Columbus himself said, "Genoese . . . and all the people who have pearls, precious stones and other valuable things, take them to the end of the earth . . . to convert them into gold." Gold was, for the Genoese, the ultimate store of wealth.

A centuries-old event in the hills above Genoa, the annual sheepshearing was probably witnessed by wool weaver Domenico

Colombo and his sons. Although Christopher trained as a wool carder, he soon left the family business.

Exotic African and Eastern products—sugar, spices, and slaves—always attracted the Genoese. As militant Islam closed the roads to the riches of the East, Genoese merchants gradually looked westward to the Atlantic. It was inevitable that some of these enterprising traders became explorers: Both activities share a common element of risk taking.

In the Mediterranean and later in the Atlantic context, the same Genoese family names appeared time and again: Cattaneo, Rivarolo, Spinola, Pinelli, Di Negro, Doria, Centurione. One of these clans, the Di Negro family, may have given Columbus his start as a seafarer.

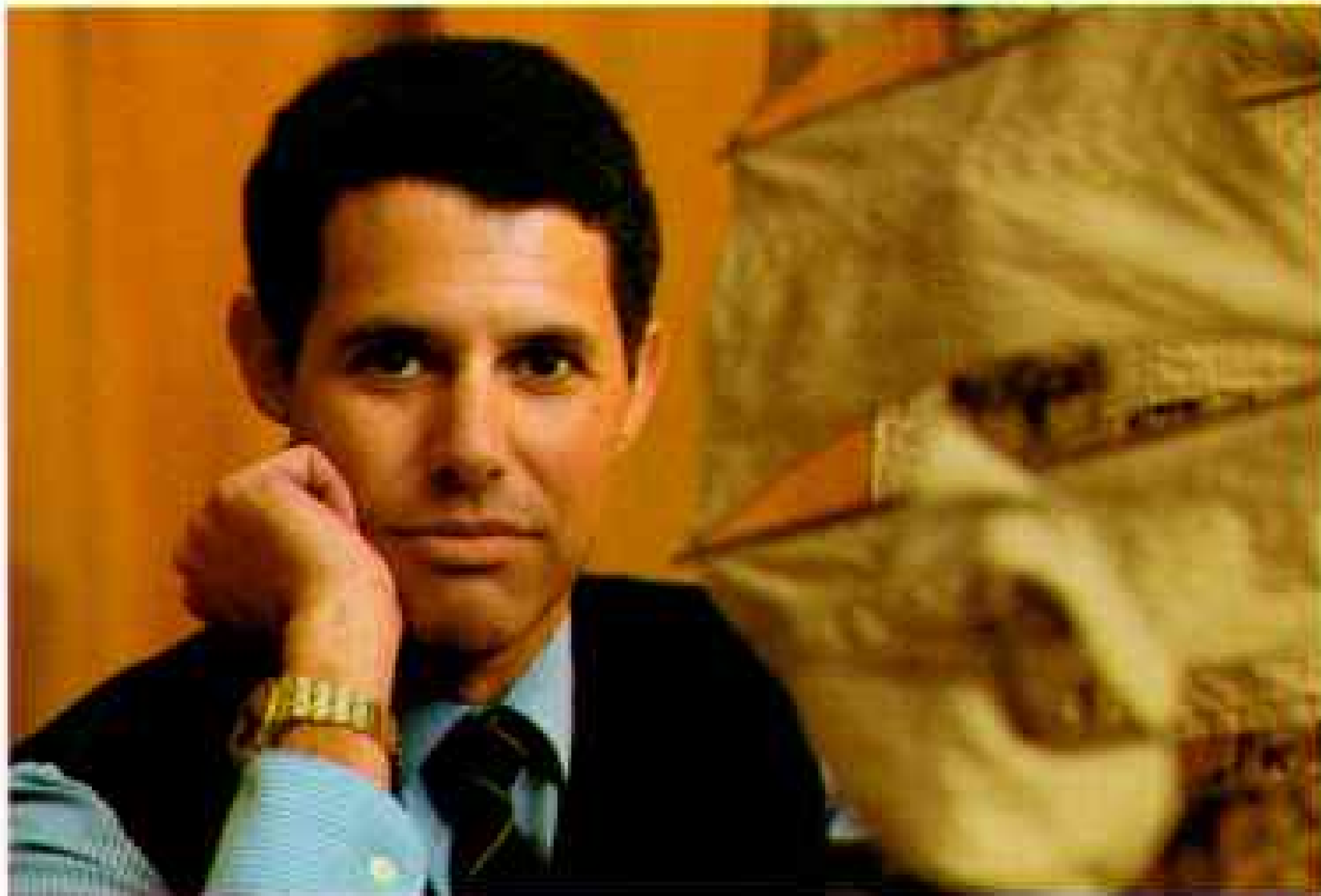
"From a very early age," he states in a 1501 letter, "I entered sailing upon the sea and have continued it until today." It is possible he had already undertaken one or more voyages by the year 1470; after 1472, he was evidently committed to the life of the sea.

Columbus first sailed the Mediterranean, and his career is only understandable in light of this experience.

His log, letters, and notes reveal a wide familiarity with that part of the world. He knew Marseille and may have been involved in the wine and wool trade with Spain's Castile. He knew the coasts of Aragon well and visited or sighted Sicily, Sardinia, Corsica, and the Balearic Islands. He voyaged to Chios off the coast of Asia Minor, likely in 1475. Beyond, the young Genoese could not fail to note, lay the East.

In a letter written in 1502 to King Ferdinand and Queen Isabella of Castile, Columbus outlined detailed sailing directions between Cádiz and Naples, for both summer and winter. In the letter he might have been describing himself: "For this navigation there are noted men, who have so committed themselves to it that they know all the courses, and what storms they may expect, according to the season of year in which they sail."

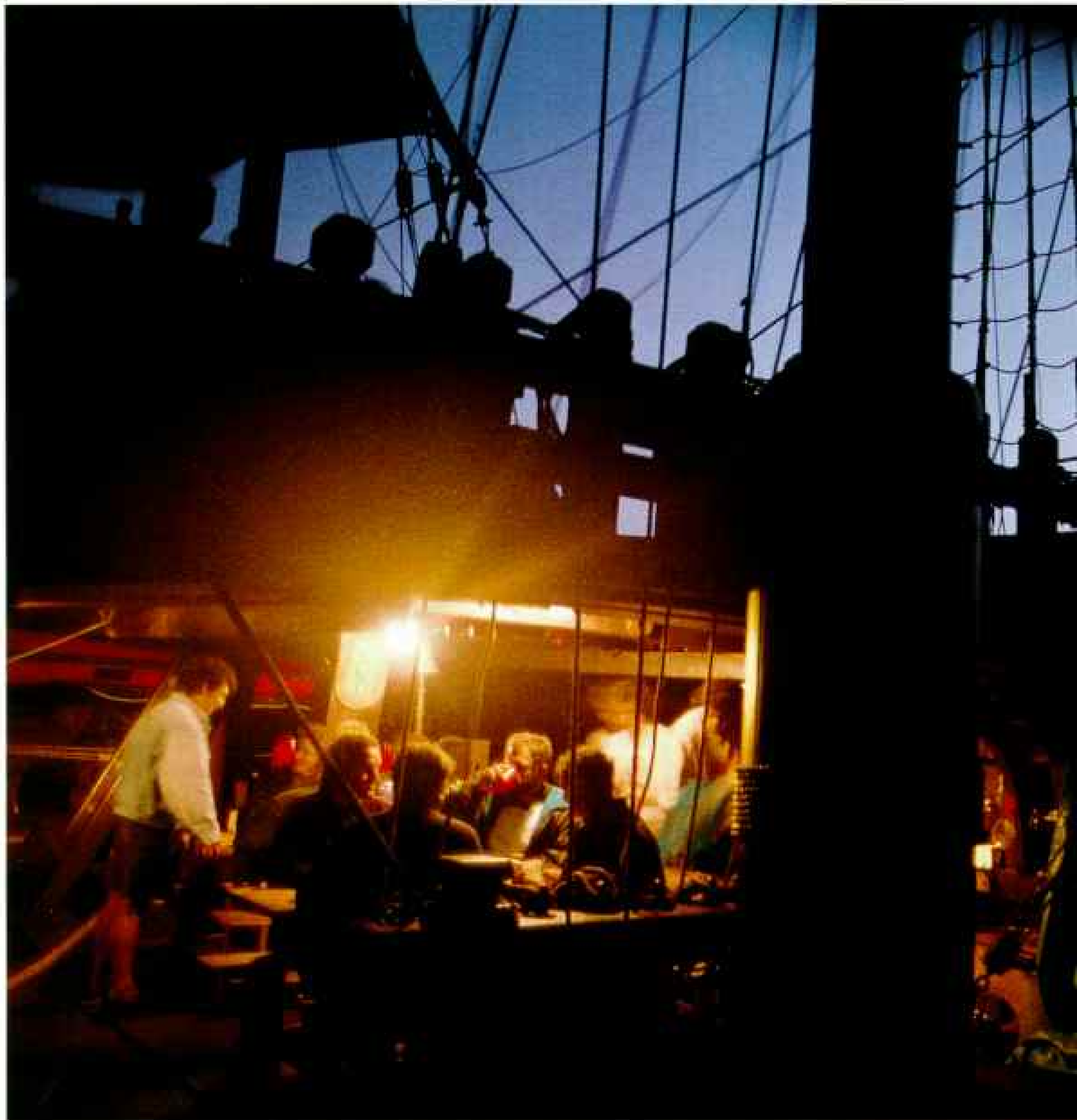
Many testimonies describe his profound understanding of weather and prevailing winds. He correctly predicted storms. He practiced using the sounding line and the mariner's compass. He mastered reading



"People think I was obliged by family tradition to join the Spanish Navy, but that's not true," says Columbus's direct descendant and namesake, Lt. Comdr. Cristóbal Colón XX. "I joined because I love the sea." Sailor, helicopter pilot, model-ship builder, and father of Cristóbal XXI, Colón believes that despite our extensive knowledge of the earth, the spirit of discovery is not dead. "Nothing is as thrilling," he says, "as discovering untouched places for yourself."

With a mother lode of imagination, artists have attempted posthumous portraits of Columbus (above), but his actual appearance remains a mystery. His signature too poses a puzzle: Atop Greek and Latin letters spelling Christoferens, "bearer for Christ," sits a cryptic pyramid of letters. Is it a Christian invocation? Or, as one scholar argues, the beginning of a Jewish prayer? No one knows. We do know that the cursive script Columbus used for correspondence matches the printed style of marginal notes in his books, says handwriting expert Charles Hamilton. In Columbus's copy of Imago Mundi *(below), he noted that each degree of longitude along earth's Equator equals 56⅔ Roman miles—an error that led to his underestimating earth's circumference by about 25 percent.*

PORTRAITS OF COLUMBUS (TOP) FROM BETTMANN ARCHIVE, CULVER PICTURES, AND BETTMANN/HULTON; PALAZZO COMUNALE DI GENOVA (ABOVE); PHOTOGRAPHED BY TOR EIGELAND AT BIBLIOTECA COLOMBINA, SEVILLE (RIGHT)



charts and calculating the complex time-speed-distance equation that is basic to dead-reckoning sailing. All these things and more he undoubtedly learned in the Mediterranean Sea.

MORE THAN ALL ELSE, the Mediterranean years sharpened the natural powers of observation Columbus displayed throughout his lifetime. It was here that he raised his eyes to the skies, a vast theater across which there wheeled a multitude of stars and planets. He believed, in this century before the Copernican revolution, that the earth, fixed in space, was surrounded by the other heavenly bodies, which revolved around it. He studied the constellations and how to mark the passage of the sun through the 12 houses of the zodiac. The young seaman noted the errant track of meteors and watched for special arrays, or conjunctions, of the planets visible to the naked eye.

These phenomena aroused Columbus's natural curiosity about the earth for, as he later said, navigation is an "art which inclines him who follows it to wish to know the secrets of this world."

Daylight disappears—and so does dinner aboard the Santa María, a reproduction of Columbus's transatlantic flagship. Sailing along the coasts of Europe and Africa in similar square-rigged vessels, Columbus lived life at the whim of the winds, often finding himself becalmed for days, with plenty of time to read, think, dream, and scheme.

Columbus learned basic seamanship not from books but from practice: to set the anchor properly, use a quadrant, estimate speed and distance, and read the winds. Standing on Santa María's quarterdeck, crewmen furl the heavy canvas sails.

THIS REPRODUCTION AND OTHERS PICTURED WERE BUILT BY THE SPANISH GOVERNMENT.

Cut the bark on these evergreen shrubs and out oozes an odoriferous, transparent resin called mastic. Cultivated on Chios, a mountainous island in the Aegean Sea, mastic shrubs were valued by the ancient Greeks, who prescribed the resin to purify blood and treat rheumatism. Columbus visited Chios at least once, sent by Genoese traders eager to cash in on this lucrative crop. Today mastic is used in varnishes, dental adhesives, and perfumes.

CHRISTOPHER COLUMBUS had left the Mediterranean behind when events occurred that would irrevocably link him with Atlantic exploration. In 1476 the Spinola and Di Negro families organized a trading venture to England. Five vessels sailed from Genoa, passed through the Strait of Gibraltar, and entered the broad Atlantic. Near Europe's extreme southwest point at Cape St. Vincent, they were attacked by French pirates.

In the bitter battle, ships from both sides were sunk, including the one the Genoese agent was on. Although many drowned, Columbus reached shore, near Lagos in Portugal. Soon the young sailor made his way to Lisbon, where a new and important stage in his life began.

Lisbon's Praça do Comércio, where exploration caravels and spice ships once moored, still bustles with maritime life; beyond, the Tagus estuary widens out into the Atlantic. But time has erased virtually all traces of Columbus. A significant part of the 15th-century

THE EARLY VOYAGES OF
CHRISTOPHER COLUMBUS

Typically kept on a short leash during his years as a commercial agent, Columbus sometimes ventured far offshore. He became a keen observer of winds, currents, and climate—invaluable knowledge for his transatlantic journeys.

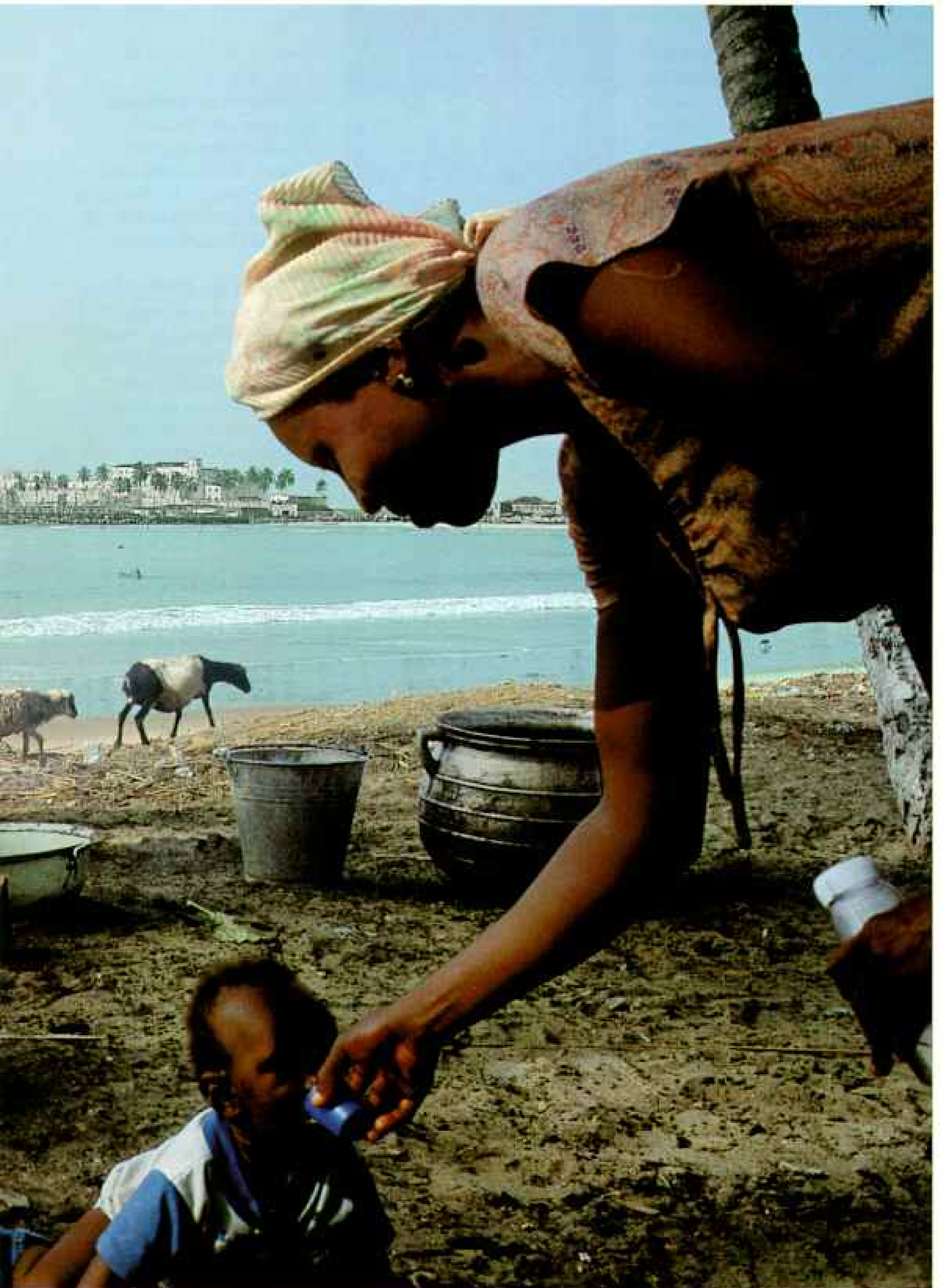
Portuguese archives, as well as the Genoese quarter near the waterfront, was destroyed in the catastrophic earthquake of 1755.

In Lisbon, Columbus naturally established himself among the Genoese. He joined in a stimulating atmosphere of ocean exploration. A long rivalry between Portugal and Castile was continuing along the African coast and in the Atlantic. Maps displayed newly discovered islands: Madeira, Porto Santo, the Azores, the Canaries. There were also imaginary ones: Antilia, St. Brendan's, and Brazil.

Many sailors felt about the Atlantic as had 12th-century Arab geographer Al-Idrisi: "No one knows what is in that sea, because of many obstacles to navigation—profound darkness, high waves, frequent storms, innumerable monsters which people it, and violent winds. No sailor dares to penetrate it; they limit themselves to sailing along the coasts without losing sight of land."

So the Atlantic became known by the Arab name, Sea of Darkness. A 1367 chart depicted a giant figure with arm upraised, warning

Life in the torrid zone—the equatorial region medieval geographers claimed was too hot to inhabit—was not so torrid after all, Columbus



confirmed in a 1480s voyage. Today on the shore opposite Elmina, a Portuguese fort in the 15th century, Ghanaian women prepare palm oil.

against voyaging westward.

Despite such fears and encouraged by the remarkable Prince Henry the Navigator, the Portuguese proceeded to develop their seaborne enterprise. At Sagres on Cape St. Vincent, land's end in Portugal, Henry held symposia on navigation and cartography to pursue his goals: an eastern sea route to the Orient and exploration of Atlantic isles. His vessel of choice was the nimble, shallow-draft caravel, altered to carry square sails before the steady Atlantic winds. By 1420 the Portuguese had planted their first settlements in the Madeiras. Twelve years later, exploration of the Azores began.

Meantime, the Portuguese were pushing down the west coast of Africa. By 1470 they reached the Equator; the next year they found gold in Guinea (present-day Ghana). Castile soon challenged Portugal by disputing the claim to Guinea and settling the Canary Islands.

By this time Columbus was ready to advance his career. He courted Felipa Moniz Perestrello, whose father had been an Atlantic island colonizer before his death. When they married in 1479, commoner Columbus moved up into a noble family with access to the Portuguese court.

The young man from Genoa was sent by

the Centurione and Di Negro families to Madeira as factor to handle their affairs. I found evidence that Columbus and his bride lived there for some time—not on Porto Santo, as popularly believed: When he later passed through the islands on his third New World voyage, he was welcomed as a former resident on Madeira but enjoyed no such greeting at Porto Santo, where he also put in.

Columbus was on Madeira in 1478, when the sugar transaction occurred that required his return to Genoa to testify. In the lawsuit he declared that he had a personal fortune of "more than 100 florins." Clearly the young factor had married well and risen in the world of trade.

By 1480 the couple had returned to Lisbon, where their son Diego was born. There, Columbus acquired from his father-in-law's widow the charts and documents describing the Atlantic voyages. These excited him, stirring his developing interest in ocean exploration.

Perhaps among those papers he discovered a copy of a letter by Paolo dal Pozzo Toscanelli, respected Florentine geographer and mathematician, dated June 25, 1474, that was to be sent to Portugal's king. Another copy was found in the 19th century, at the back of one of Columbus's books and containing Latin errors typical of him. Charles

Gold fever grips a laborer (below) shoveling and straining mud from the banks of Ghana's Ankobra River. Crowned by a golden galaxy, Chief Nana Yaw Asante (opposite) owns part of the river and leases stakes to prospectors. Columbus caught the fever too. "Anyone who has [gold]," he wrote, "can do whatever he likes in the world. . . . even bring souls into paradise."

Hamilton firmly believes that the text is in Columbus's handwriting.

The letter displays Toscanelli's knowledge of travels to the Orient by Marco Polo and others and describes how one might travel to the East by sailing west from Europe. First, he said, you would reach Antilia (mythical) and then the rich island of Cipangu (Japan). It would then be a fairly short sail to the Asian mainland and its spices and precious stones. Further, the letter tells of the great prince of Cathay (China), the Grand Khan, who had sent emissaries to the Pope seeking teachers of the Gospel. These themes are repeated in later writings of Columbus.

With the letter was a map incorporating Toscanelli's theories. Columbus probably possessed a copy. The Toscanelli map and letter either began or confirmed Columbus's interest in the idea of sailing west across a relatively narrow Atlantic directly to Asia. These documents must have been among the mariner's most prized possessions.

COLUMBUS BEGAN to collect evidence of what might lie beyond the western horizon. He sought sailors and island residents who could contribute to his growing store of rumor, conjecture, and data. He placed this material in what he called his "papers."

We know that he heard, and evidently believed, the tale of the island of Antilia and its Seven Cities. Supposedly, in the time of Henry the Navigator, a Portuguese ship was blown off course to the island, where the crew found remnants of settlement by an Iberian archbishop and six other bishops. Columbus also heard reports of other islands to the west of Madeira and the Canaries.

From one Martín Vicente, a Portuguese pilot, he learned that, some 1,400 miles west of Cape St. Vincent, the sea had yielded a piece of wood carved by human hand, which must have drifted from the west. A similar piece had been found on Porto Santo.

An avocation helped Columbus grow as a cosmographer: With his brother Bartholomew, who had come to Lisbon, he began to produce and sell marine charts. Other maps available in this marine entrepôt kept him abreast of new discoveries and settlements.

Prior to 1492, Columbus sailed extensively in the Atlantic, where he learned open-ocean navigation. In addition to the Madeira journeys, Columbus tells us that he made a voyage to Porto Santo in command of two ships. He continued his interrupted 1476 trip to England, sailing there "with the Portuguese." On that or another trip he went to Galway Bay in Ireland. There, he reported, two bodies with "strange features" had washed ashore in two small boats. In a secondary source Columbus says that in February 1477 he traveled a hundred leagues beyond Tile (Thule), where he noted the immense tides. Perhaps he had reached Iceland.

The difficult northern navigation certainly appears very familiar to Columbus: "The trade and traffic from Spain to Flanders continues substantial. They are great sailors who sail this route. . . . In the month of January . . . it is rare that there are not some strong ENE and NNE winds. These . . . are savage, cold, and even dangerous."

In the log from his first voyage to the New World, Columbus displays his experience in the wintry Atlantic: "We will return from the Indies with the westerly winds, which I have observed firsthand in the winter along the coast of Portugal and Galicia."

His long passages southward were especially useful. Genoese trade with Portuguese Guinea and the new Castilian colonies in the Canary Islands involved Columbus in more than one trip from Lisbon to the African coast. He displayed knowledge of the Cape Verdes, the Canaries, and the Portuguese fortress of São Jorge da Mina (Elmina) on the Gold Coast.

These African expeditions further prepared Columbus for his enterprise of the Indies. They involved him directly in long-distance navigation and the outfitting of vessels for such voyages. They exposed him to the landscape and products of the tropics.

Now he knew, despite age-old beliefs, that the torrid zone was inhabited. This had wider implications: No place on earth was forbidden. Man could travel to, even settle, any part he could reach. His southern voyages involved Columbus in trade and barter with indigenous peoples—black Africans and Canarian Guanches. He also became acquainted with the slave trade, in which Genoese, Portuguese, and Castilians were active.

On his long African passages Columbus, like other dead-reckoning sailors, grappled with the problems of time and distance on the open sea. He says: "In sailing frequently

Upholding religious tradition, a Holy Week penitent places a medallion of metal flowers on a crucifix in Savona, Italy. In the 15th century religious brotherhoods carried such crosses through the streets during annual festivals honoring their patron saint. Columbus —a fervent Catholic—may have participated as a member of a wool workers fraternity.

from Lisbon to Guinea southward, I noted with care the route followed, and afterwards I took the elevation of the sun many times with quadrant and other instruments."

Perhaps the most important insight gained by Christopher Columbus was his discovery concerning the great oceanic wind system. Along the Portuguese coasts and in the Madeira Islands, he had experienced the strong west winds that brought flotsam ashore from the direction of the sunset. Then, on voyages to Africa and the Canary and Cape Verde Islands, he felt the steady northeast trades. In this, Columbus reasoned, lay the secret to an Atlantic round-trip: Drop down south to go westward with the trade winds, and return at a higher latitude with the westerlies.

At last, Columbus felt ready. He determined to petition John II, the Portuguese king, for ships and men to undertake the Atlantic voyage. In late 1483 or early 1484, he approached the king, offering to find Cipangu and India. The king called in experts, including astronomers and mathematicians, to judge the proposal. They turned the Genoese down, calculating that the Atlantic distances involved were far greater than he had estimated. Nonetheless, John II secretly sent a vessel to test Columbus's theory; it returned without reaching any shore.

LIFE SOON TOOK another turn for Columbus. With his wife's death in the early 1480s and the rejection of his proposal, he abandoned his career as merchant-navigator to follow his plan, now an obsession. He would seek support from the rulers of Castile and Aragon. When he left Lisbon, Columbus owed money to several Genoese merchants. Later, moved by conscience, he asked his heirs in his will to satisfy his debts anonymously.

In spring 1485 with his son, Diego, Christopher Columbus arrived by ship at the small Andalusian port of Palos de la Frontera. He intended to leave young Diego with his late

Hooded Christians assemble beneath Moorish arches of the Mezquita—a mosque converted to a church in Córdoba, Spain. In

1488 Columbus fathered an illegitimate son, Ferdinand, in Córdoba. The affair, he confessed in his will, "weighs heavily on my spirit."

wife's sister, in nearby Huelva. This would free him to pursue his enterprise at court.

As to Columbus's appearance at the time, accounts agree: Plainly dressed, he was tall and heavyset, of ruddy complexion, with an aquiline nose set in a long face. His eyes were gray-blue and could sparkle with emotion. Although the widower was only 34, his hair already was white.

His accent immediately marked him as a foreigner to Castile, but Columbus could be eloquent when the force of his enthusiasm burst through the barriers of language. Beneath an outwardly cordial manner, tempered with gravity, there lay concealed a massive pride and a quick, fierce temper.

By now his spoken Genoese was probably tinged with a sailor's patois. He may have already acquired Castilian on voyages to Cádiz or Barcelona. Virtually all his writings not in Latin are in Castilian. But many Portuguese usages dot his notes and letters, showing that Columbus had also learned that language in Lisbon or at sea with Portuguese mariners.

In need of shelter until he could settle his son, Columbus heard that a local monastery, Santa María de la Rábida, housed travelers. He and Diego walked the short distance from Palos to the monastery, carrying their personal possessions. In later years he must surely have considered his arrival at La Rábida providential.

A serene and lovely place, the monastery stands on a pine-covered eminence, overlooking the junction of the Tinto and Odiel Rivers where their estuary flows out toward the open Atlantic. This was a house of Franciscan friars, and its guardian, Antonio de Marchena, was to be a figure of supreme importance to the career and mission of Christopher Columbus.

Marchena belonged to the Observantines, a group with an apocalyptic agenda: Looking to the end times, when all the world would be converted to Christ, they hoped to recover Jerusalem's holy places from the Muslims. Significantly, these tenets became ruling motives in the life and writings of Columbus.

The Genoese mariner and the friar became fast friends. Columbus received spiritual and intellectual counsel from Marchena, an educated man and dedicated cosmographer, and possibly accepted help in composing and reading Latin and Castilian. More important, the friar had access to the power structure at court.

Columbus's religious beliefs must have intensified during his time at La Rábida. He is reported to have been regular in prayer and at Mass and to have possessed and used a Book of Hours, reciting it like any churchman. Some later writers have expressed doubt about the sincerity of his faith, but it was not questioned by clergymen who knew him. Even beyond personal piety, Columbus began to believe that his plan for Atlantic navigation was divinely supported, that it was somehow connected with God's purpose for the world.

Antonio de Marchena wrote a letter on his behalf to Hernando de Talavera, the queen's confessor. The letter asked the right to petition the royal council, which made recommendations to the crown.

The itinerant court was then at Córdoba, more than a hundred miles away. Columbus made his way to the city and found it a crowded, bustling military camp, the advance base for the war to regain Granada.

THE LAND to which Columbus had come was not yet the Spain we know today. The marriage in 1469 of Ferdinand of Aragon and Isabella of Castile united several Christian kingdoms. As their court moved around the land, the monarchs gained control over local nobles and authorities and built an army that would one day be Europe's most powerful. These were kingdoms on crusade against Islam. This 700-year battle, the *Reconquista*, had shaped a warrior people, created a dominant language—Castilian—and fostered ardent Catholicism. Christian rulers had pushed the Moors southeastward until they occupied only the Kingdom of Granada.

After submitting his petition, Columbus began a seven-year struggle for approval. He appeared repeatedly before Isabella and Ferdinand, making presentations to the royal

Empire Plaza in Lisbon commemorates the seafaring glory days of Portugal—but not of Columbus. In 1488 his plan to sail west to the Orient was again spurned by King John II, after Bartolomeu Dias discovered a route east around Africa. Dejected, Columbus returned to Spain on his search for a sponsor.

council and before learned commissions.

Offering the monarchs what he believed was the key to the riches of the Indies, Columbus was met with skepticism, even ridicule. The *letrados*, the advisers, disputed his belief in a relatively short Atlantic crossing, just as the Portuguese had done. Finally, in 1487, Columbus was dismissed.

Although he was given hope of future support, he felt personal rejection. With the bitterness of humbled pride, he swore that he would seek out authorities to confound his enemies. Another of his enduring traits was persistence: "I plow ahead," he said, "no matter how the winds might lash me."

In Córdoba, which became his home base, Beatriz Enríquez de Arana, the orphaned daughter of a farming family, caught the widower's eye. They became lovers, and in August 1488 Beatriz bore him a son. Columbus named him Ferdinand, for the king. But it seems the ambitious man would not compromise his advancement by marrying a commoner; although it weighed on his conscience, he would never give her his name.

A contemporary, Andrés Bernáldez, describes how Columbus made his living at this time: "There was a man from the land of Genoa, seller of printed books, who traded in this land of Andalusia and principally in Seville, who was called Cristóbal Colón."

As a bookseller Columbus was participating in a veritable revolution. By 1480

Fierce winds warp ancient sabina trees on Hierro, westernmost of the Canary Islands. Such westward-bowing trees may have provided Columbus with proof that the trade winds of the Atlantic were reliable enough to drive him speedily toward the riches of the East.

European printing presses—more than a hundred—were publishing scores of titles. Columbus also acquired his own small book collection.

SEEKING COLUMBUS'S THOUGHT through the works he owned, I returned to Seville's magnificent cathedral to visit the Biblioteca Colombina, which holds ten of them. There the director, Father Juan Guillén Torralba, seated me in a small chamber and carefully placed before me a printed book bound in leather.

The rumble of traffic outside, the close heat within the room—all distractions faded as I opened the small volume. It was perhaps the most portentous thing I would ever hold in my hands: the *Historia rerum ubique gestarum*, or *History of All Things and All Deeds*, by Aeneas Sylvius (later Pope Pius II), printed in Venice in 1477. Christopher Columbus had cherished this book and studied it over many years. Leafing through the pages, I saw that they were covered with marginal notes.

At the end of the printed text were five additional handwritten pages, including Columbus's copy of the Toscanelli letter. On the last of these pages was a finely drawn, delicately tinted planisphere (page 35), with the Equator and other major dividing lines traced on its surface. As I puzzled out the Latin notes on the sphere, I felt a surge of excitement.

Here, I was certain, Columbus had placed his master plan on paper. His notation on the right side refers to the *sinus sinarum*, the sea of China. Combined with the note on the left, he indicates that the Far East is also the Far West. Never, I thought, could I come any closer to the mind, and driving vision, of Christopher Columbus.

Others, of course, had preceded me. One of them, the distinguished Italian interpreter of Columbus, Senator Paolo Emilio Taviani, has deduced that these five pages were once separate from the book. Researchers have also concluded that they were precious remnants of Columbus's original "papers," sewn into the end of one of his favorite books.

These pages evidently hold the earliest surviving writings of Columbus. On one he lists the Old Testament books and prophets on whom he relied. He tells of "the Holy Spirit, which with rays of marvelous brightness comforted me with His holy and sacred Scripture, in a high, clear voice." The Scriptures spoke strongly to him: passages about the East, the conversion of heathens, the recovery of holy Jerusalem, and the approaching end times, when Christ would come again.

Columbus's papers also refer to Flavius Josephus's *De Antiquitatibus*, stating that

King Solomon's treasures came from "Ophir, now called the Land of Gold, in India." The text describes how, from a kingdom on the Sea of Tarshish, he received silver, "elephants, peacocks and apes." There was something familiar about the quotations; then I recalled that the narrative of Columbus's fourth voyage to the New World and a letter from his later years repeat, almost word for word, the same themes—the search for King Solomon's mines, the gold of Ophir, the valuables from the Sea of Tarshish, the riches of India. To the end of his days Christopher Columbus would seek these treasures.

PRESUMABLY, the master seaman owned only a few books because he preferred compendiums like the *Historia rerum* and Pierre d'Ailly's collection of geographic tracts called *Imago Mundi*. These enabled him to avoid tackling lengthy and difficult works directly, for he apparently felt his way slowly into the world of knowledge.

Those works Columbus had, he read minutely, covering the margins with more than 2,500 notes. He underlined many passages, often drawing a pointing hand for emphasis. All but two of the marginalia are written in Latin or Castilian. Some are cryptic, and a few, like his signature, appear to be in code; many scholars have been struck by this secretive aspect of his nature.

Following his forebear's footsteps, Cristóbal Colón XX signs the register at La Rábida, a Spanish monastery. Here in 1485 Columbus was befriended by Friar Antonio de Marchena, who became his contact with the royal court. Clergymen liked Columbus, whose ideas, notes, and sketches—such as the planisphere (right) showing the Far East as the Far West—were often heavily influenced by Scripture.

Opinions differ widely about authorship of the notes. German paleographer Fritz Streicher claimed that only about 220 could be attributed to Columbus. On the other hand Italian scholar Cesare de Lollis believed that nearly all were his. Charles Hamilton agrees.

I found many connections between the marginalia and other Columbus writings. Cross-references exist. Other unifying factors include language, handwriting style, and consistent Latin errors. The notes were clearly created by one dominant mind and form a coherent whole.

Many reflect his curiosity about astonishingly diverse topics: the Evil Eye, fine horseflesh, the Colossus of Rhodes, the death of Attila, medicine and disease, chameleons, the Punic Wars, Amazons, the Greek origin of Latin words, Icarus, Plato, St. Paul, Alexander the Great, one-eyed Scythians, birds of Egypt, and the precious stones and metals of the Orient. One entry affirms his staunch Christian belief in life after death. Underlining Pliny's skeptical statement that mortals could not become immortal, he declares in the margin: "This is untrue."

His belief in the value of personal experience and practical experiment is also displayed. The notes disclose his struggle to measure, comprehend, and master the secrets of the earth. He was obsessed with time; he repeatedly measured the length of days, months, and the solar year.

Columbus calculated and recalculated the days until the end of the world. Among the *Historia rerum* endpapers is a chart entitled "An account of the Creation of the world according to the Jews." It recounts the years from the time of Adam "until now, the year of the birth of Our Lord of 1481." Columbus determined later that there remained 150 years to bring earth's godless multitudes into Christ's fold.

Vital clues to his vision of the universe are given, and the writings reveal his debt to early geographers, especially Ptolemy, a second-century Alexandrian. Both believed in an immovable, spherical earth at the center of the universe. Ptolemy divided the globe

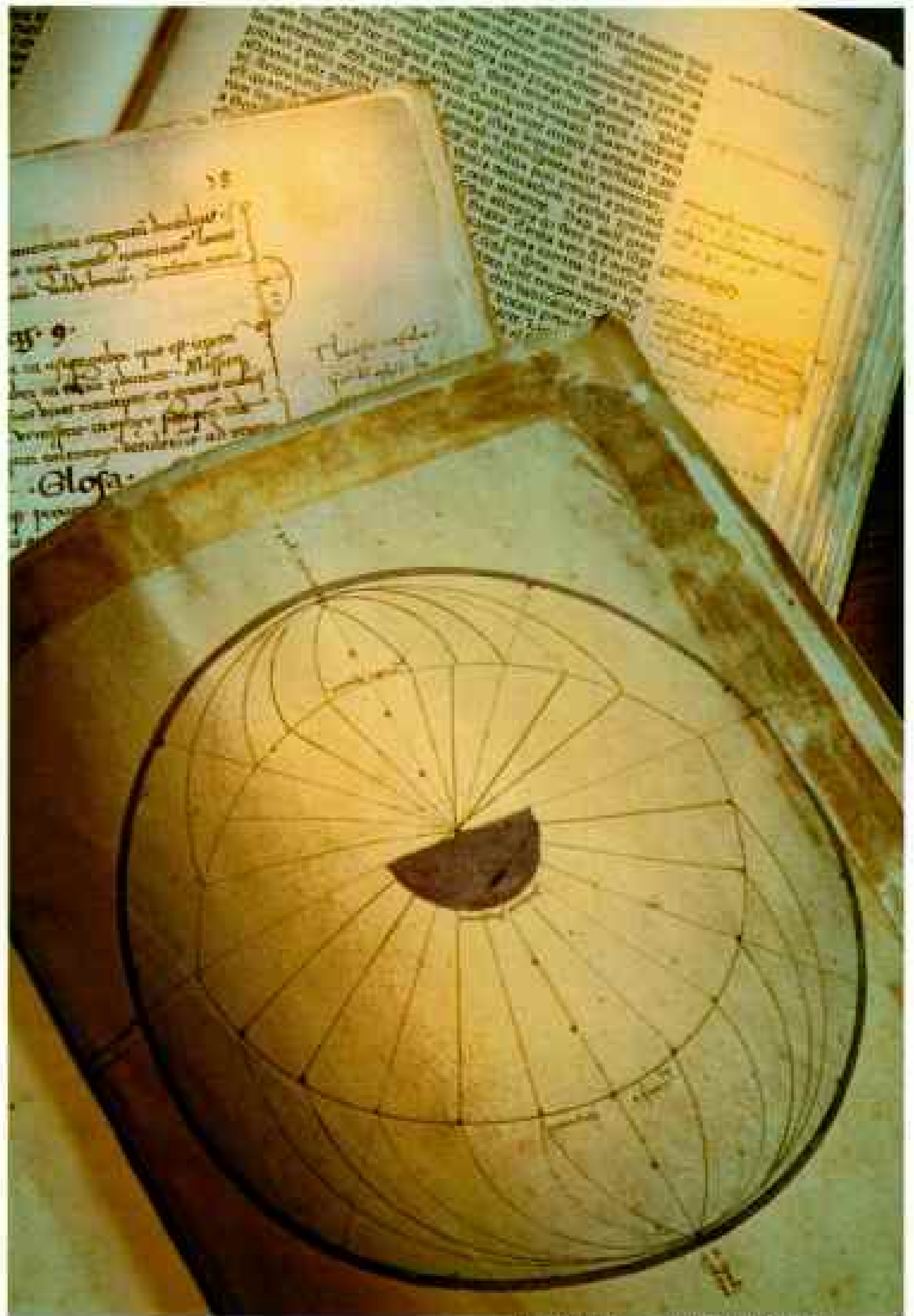
into seven climate zones. So did Columbus. Ptolemy's earth featured one great island of Eurasia, with an incomplete Africa appended, surrounded by the Ocean Sea. Completely missing from Ptolemy's world and Columbus's were the Americas and the vast Pacific Ocean.

Columbus made a rough measure of east-west distance by calculations in hours and degrees. He knew that 24 hours of 15 degrees apiece would encircle the earth, but he clung to an outdated yet common misconception that the size of a degree was 56⅔ Roman miles. Consequently, he underestimated earth's circumference by some 25 percent.

Columbus eagerly sought scholarly support for his theory that Asia lay a relatively short sail west. In the *Imago Mundi,* he found an assertion from one of the apocryphal books of Esdras that the world was six parts land and one part ocean (actually more than 70 percent is water). D'Ailly quoted another statement: "According to Aristotle the end of the inhabited lands to the east and the end of the inhabited lands to the west are quite close and between them is a small sea, navigable in a few days." Columbus repeated this verbatim in the margin; one can almost see him nodding in agreement.

Thus, although as a practical navigator the Genoese knew his leagues and miles well, his foray into theoretical cosmography was a dismal failure. He clung stubbornly to underestimating the length of a degree and overextending Asia eastward. But, of course, without these errors, Columbus might never have made his momentous voyages.

Columbus's geography was colored by fantasy and legend. In one book he writes of wild men at the ends of the earth "who eat human flesh; they have corrupt and horrible faces." Perhaps he expected to find what he had seen painted on parchment charts: Arabs riding camels, Christian king Prester John sitting on his throne in exotic lands. He hoped to see the Grand Khan, China's Mongol ruler, unaware that the Mongol dynasty had ceased its reign more than a hundred years before.



PHOTOGRAPHED AT BIBLIOTECA COLOMBINA

In 1488 Columbus made another visit to Portugal, again seeking support from John II. The timing was abysmal: The court was celebrating the return of Bartolomeu Dias with two caravels from his voyage around the Cape of Good Hope, thereby opening the eastern route to India.

The urgency was all too clear: The Genoese would have to find funds for his enterprise in Castile or go elsewhere. He sent his brother Bartholomew to England to present the project to Henry VII and contemplated approaching the king of France.

A turning point came early in 1492 when Boabdil—the last of the Moorish rulers—surrendered the keys to Granada. Columbus was an eyewitness: "On the second day of January . . . in the great city of Granada, I saw the royal banners of Your Highnesses placed by force of arms on the towers of the Alhambra, the citadel of that city, and I saw the Moorish King come to the city gates and kiss the royal hands of Your Highnesses." The long war against the Moors had ended; now the energies of the kingdom could be directed outward.

At this critical juncture Columbus's repressed pride broke through; he made extravagant demands that almost destroyed his chances for a royal agreement. He asked for the hereditary positions of Admiral of the Ocean Sea as well as Viceroy and Governor of lands that he might find, and requested a percentage of all revenues from these new territories.

Again his plan was rejected, then reconsidered, and finally approved. On April 17, 1492, he signed a contract with Castile that gave him the titles he had asked for and one-tenth of all revenues from his discoveries. But Columbus never lost sight of the crusading

Last stronghold of the Moors in Spain, Granada's towering Alhambra stymied King Ferdinand and Queen Isabella, who were determined to drive out the Muslims. Consumed by this holy war, they had little interest in Columbus and his incessant pleadings for patronage. But when the Moors surrendered in 1492, the monarchs, seeking new ventures, surrendered to Columbus.

aspect of his journey; he intended that the forthcoming Indies revenues should primarily be dedicated to the recovery of Jerusalem from the Muslims.

Now, after years ashore, the sailor could return to his element: "I left the city of Granada on Saturday, May 12, and came to the town of Palos, where I outfitted three very good ships." On Friday, August 3, just before dawn, the *Niña*, *Pinta*, and *Santa María* sailed downriver to the sea. As the rising sun struck their sails, they were under way to the Canary Islands to catch the winds that, Christopher Columbus knew beyond all doubt, would carry them by way of Cipangu to Cathay and to India.

Ultimately, on four fateful voyages from Spain and back, Columbus reached and explored the Bahamas and the Greater Antilles, encountered the great South American landmass, and coasted the Caribbean side of the Isthmus of Panama.

The islands and mainland he sighted did not resemble his vivid dream geography. Refusing to accept that his Indies were not Asia, he continued to seek the Grand Khan and the source of Solomon's riches. Exploring Cuba, he made his crew swear that it was the Asian mainland. On the coast of South America he thought he had found the "earthly paradise." Certain that Hispaniola was the "end of the East," he said: "Either it is Ophir, or it is Cipangu." He would go to his grave believing all of it.

ON RETURNING from his first voyage, Christopher Columbus was showered with honors. He rode out on horseback with King Ferdinand and enjoyed the unique favor of sitting in the presence of the king and queen. He was now to be titled "Don." Far indeed had the weaver's boy come; up, as Columbus himself wrote, "from nothing."

His triumph was uneasy and short-lived. Opposition grew at court, where many disdained him as a foreigner. And the brilliant navigator proved to be a harsh and questionable administrator: Rebellion flared in the colony he had planted on Hispaniola during his second voyage (see the article about La Isabela beginning on page 40), and he was returned to Spain humiliated, in chains. The crown already had opened the exploration of the Indies to other captains.

Columbus labored for restoration of his awards and benefits; all these he had carefully documented in his *Book of Privileges* to assure that they would be passed on to his sons and their descendants. Gradually he regained a degree of royal favor, and revenues

"They that go down to the sea in ships, that do business in great waters," reads Psalm 107, "[the Lord] bringeth them unto their desired haven." But the Niña, Pinta, and

he had been promised began to trickle in.

The last part of the Admiral's life was plagued with illness. On his first voyage he noted the "sore eyes" that later disabled him. He may have contracted malaria and typhus, and probably suffered from Reiter's syndrome, which combines eye and urinary tract disorders with arthritis.

Columbus was sustained by his firm religious faith. He resolved to give up science and "cleave to the Holy and Sacred Scriptures," for he was convinced that prophecies had been fulfilled by his voyages to the Indies. "God," he said, "made me the messenger of the new heaven and the new earth. . . . He showed me where to find it." With the help of clerics, he began to write his *Book of Prophecies*, which foretold the coming world unity.

No longer able to follow the court as it moved from city to city, he retired to a modest house at Valladolid. In the spring of 1506, at age 55, Columbus complained, "This illness now works me without pity." Cardiac complications had probably set in; his body was swollen with dropsy. The end was near. His testament reveals a conscience not yet at rest. He ordered Diego to "provide for Beatriz Enríquez, mother of my son Don Ferdinand, so that she might live decently, as a person to whom I am so greatly indebted."

On May 20, 1506, Christopher Columbus died, and was buried in Franciscan robes. Perhaps now the striver, the bearer for Christ, had found the paradise at the east end of the earth.

His body was removed to a monastery, the Cartuja of Seville. Yet his spirit was restless

***Santa Maria* never reached the Orient, chancing instead upon another world. That fact eluded a devout and driven Columbus, forever famous for what he forever denied.**

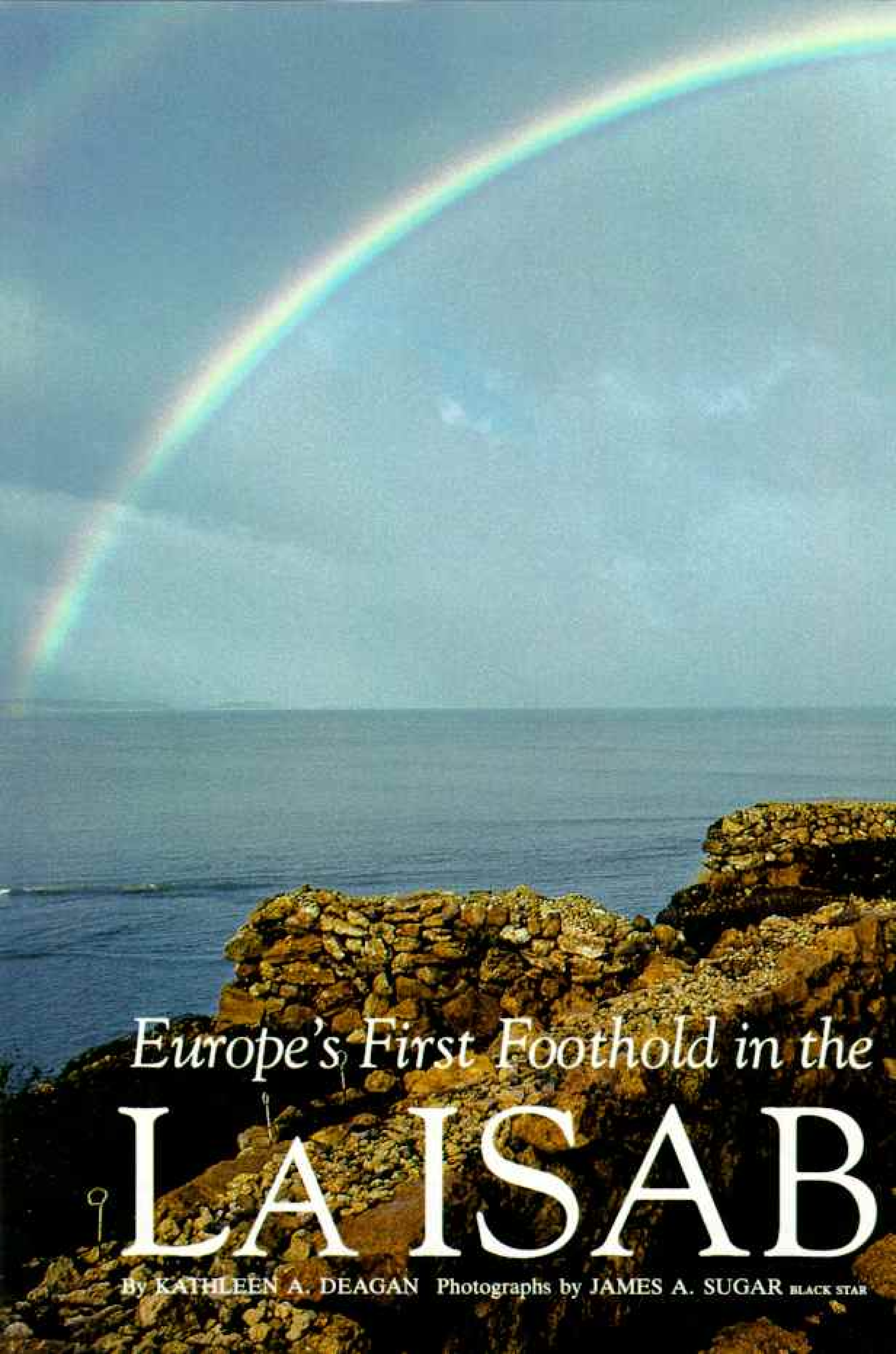
even in death. His bones were shipped to Santo Domingo about 1540 to rest with honor in the cathedral. His presumed remains were moved to Havana in 1796 and thence again to Seville in 1899. But were they? The argument still rages; some claim that the wrong bones were moved from Santo Domingo and that he still rests in his beloved island of Hispaniola. So even the Admiral's honored dust still arouses passionate debate.

WHO THEN WAS Christopher Columbus? A man both of and beyond his time, he bestrode the boundary between ages, possessing a nature rich in contradictions.

This most singular sailor was in fact an empirical mystic, within whom the temporal and the spiritual warred. A plebeian who rose to noble state, he inwardly disdained the citadels of power while ardently seeking their privileges. Not highly educated, he deeply admired learning. Believing that his God would open for him the sea road to the earthly paradise, he felt empowered on his mission by the Holy Spirit.

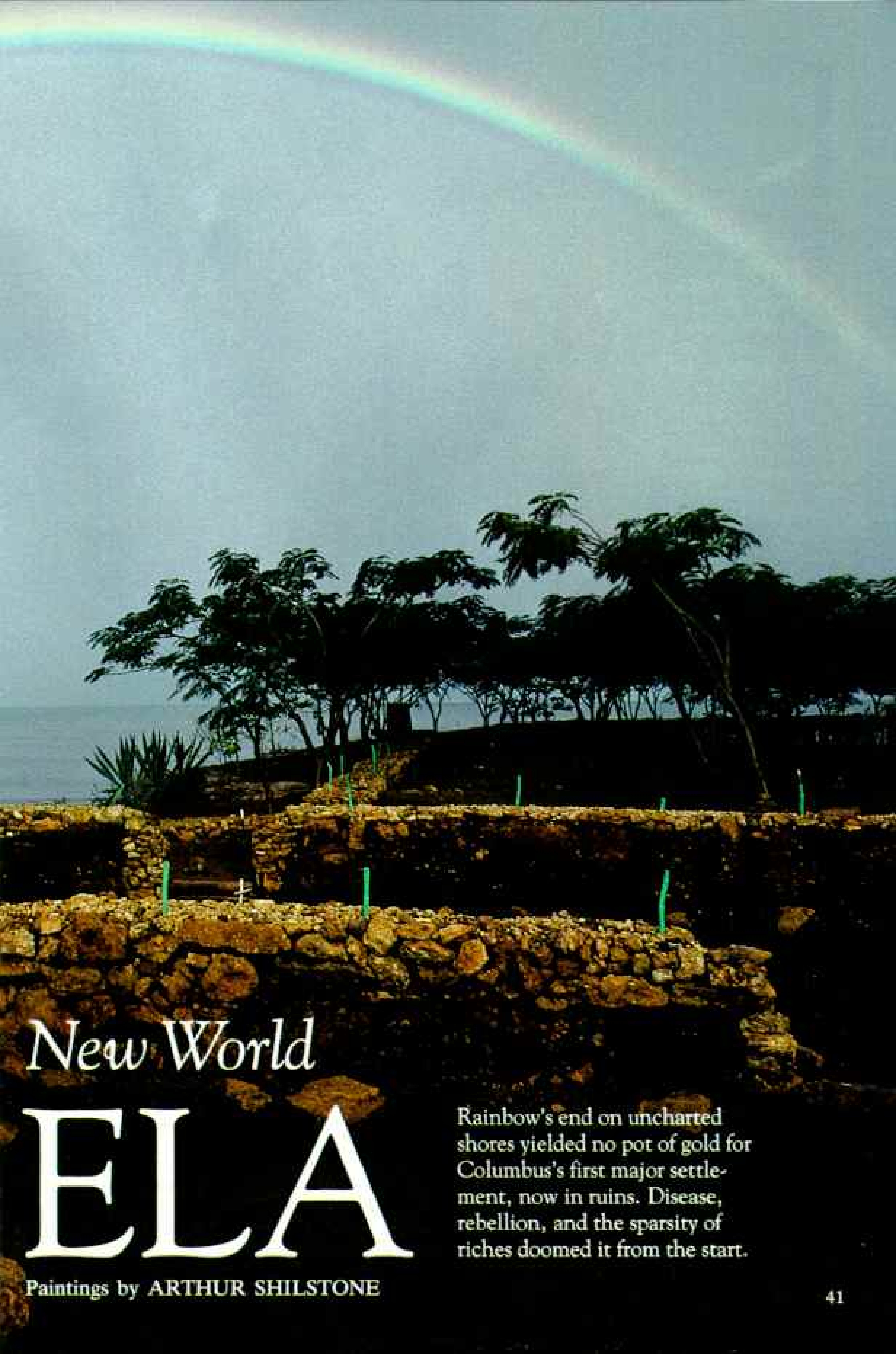
At the end he had triumphed over his detractors to conquer the Sea of Darkness. While pursuing one vision, he inadvertently realized another: the outreach of Europe into a hitherto separate, but henceforth vastly wider world.

Truly this uncommon commoner Christopher Columbus began a process that, in words from a passage in one of the books of Esdras, "shook the earth, moved the round world, made the depths shudder, and turned creation upside down." □



Europe's First Foothold in the LA ISAB

By KATHLEEN A. DEAGAN Photographs by JAMES A. SUGAR BLACK STAR



New World
ISABELA

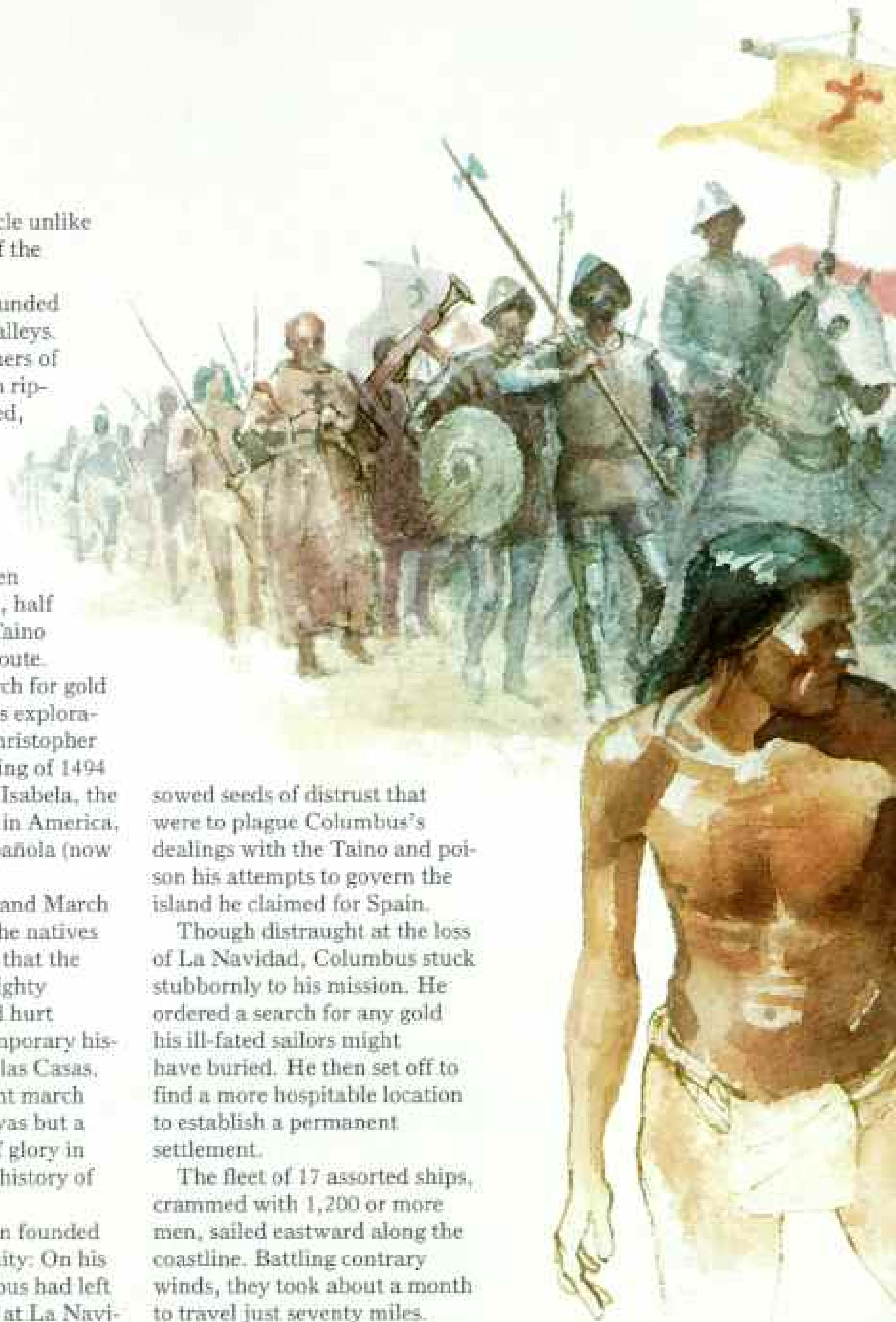
Rainbow's end on uncharted shores yielded no pot of gold for Columbus's first major settlement, now in ruins. Disease, rebellion, and the sparsity of riches doomed it from the start.

Paintings by ARTHUR SHILSTONE

It was a spectacle unlike any ever seen west of the Azores.

Trumpet blasts sounded through mountain valleys. Drums echoed. Banners of Spain and the church rippled above a helmeted, armored parade of adventurers flanked by ferocious hunting dogs.

Perhaps most terrifying of all were men on horses—half man, half beast to the eyes of Taino Indians along their route.



In the endless search for gold that characterized his exploration of the Indies, Christopher Columbus in the spring of 1494 led his men from La Isabela, the first European town in America, to the interior of Española (now Hispaniola).

His impressive Grand March "fairly astounded" the natives and convinced them that the Europeans "were mighty enough to attack and hurt them," wrote contemporary historian Bartolomé de las Casas.

Yet this triumphant march into the mountains was but a flickering moment of glory in the short, miserable history of La Isabela.

The town had been founded in the wake of calamity: On his first voyage, Columbus had left 39 men on Española at La Navidad, a fort hastily erected near the wreck of his flagship, the *Santa María*.

Returning from Spain on his second voyage in 1493, Columbus found the fort burned and all his men dead. Taino Indians told him some had died of disease; others had been killed battling hostile natives.

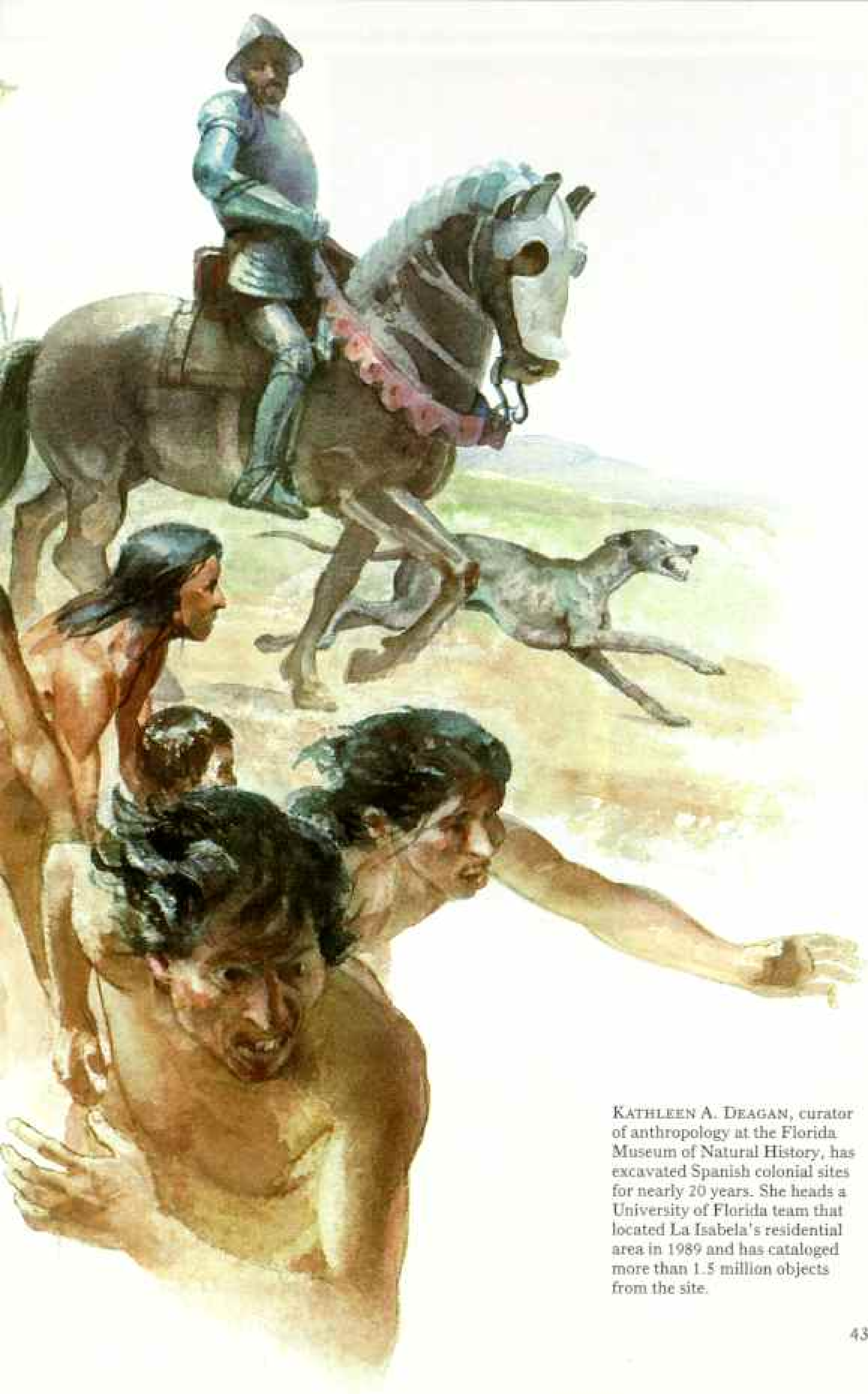
The La Navidad debacle sowed seeds of distrust that were to plague Columbus's dealings with the Taino and poison his attempts to govern the island he claimed for Spain.

Though distraught at the loss of La Navidad, Columbus stuck stubbornly to his mission. He ordered a search for any gold his ill-fated sailors might have buried. He then set off to find a more hospitable location to establish a permanent settlement.

The fleet of 17 assorted ships, crammed with 1,200 or more men, sailed eastward along the coastline. Battling contrary winds, they took about a month to travel just seventy miles. They finally anchored in a lovely bay, open to the northwest. It was fed by a river and was pierced by a promontory Columbus described as a "well-situated rock" on which to build.

Visible in mountains nearby was a pass leading to what the explorer believed was an interior glistening with gold.

Almost immediately, construction began on La Isabela, named for Spain's queen and Columbus's benefactor. Before its abandonment, the town would function barely five years and sorely test its founder, the Viceroy and Governor of the Indies and Admiral of the Ocean Sea.



KATHLEEN A. DEAGAN, curator of anthropology at the Florida Museum of Natural History, has excavated Spanish colonial sites for nearly 20 years. She heads a University of Florida team that located La Isabela's residential area in 1989 and has cataloged more than 1.5 million objects from the site.

The Admiral's fragile empire

"A most beautiful island," wrote Columbus of Española. After opening a route inland with his Grand March, he again set sail to explore (map inset). Coasting Cuba, he was convinced it was the Asian mainland and made his men swear in agreement—under threat of having their tongues sliced out.

In 1496 Columbus sent a letter from Spain ordering his brother Bartholomew to cut through to Española's south coast and establish a new town, which became Santo Domingo.

Continued expansion spelled disaster for the Taino, who were soon decimated by the Spaniards and their diseases. Taino culture survives in ornamental ceramic faces (top left) and carved shell beads (left).

Traces of the island's Taino-European-African heritage echo in the faces of Estella Maria Peralta and her granddaughters (far left), who live in El Castillo, a village near the La Isabela site.

Brilliant splash of silvery beads (opposite) greeted 20th-century archaeologists excavating La Isabela's storehouse. These tiny globules of mercury were brought to the settlement by Columbus.

Mercury, an essential element in the smelting of gold, was stored in wooden casks, which were probably left in the storehouse after La Isabela was abandoned. As the wood rotted, the liquid metal flowed into the soil, to be discovered and collected 500 years later by José F. M. Cruxent of Venezuela's Universidad Nacional Experimental Francisco de Miranda. He has been excavating the site for the National Park Service of the Dominican Republic since 1987.

For Professor Cruxent—and for me, leading a University of Florida archaeological team that joined him in 1989—the shimmering droplets reflect the hopes and failures of Columbus's first town.

One of the early parties sent to find gold reported it "in more than fifty streamlets and rivers," wrote the physician who accompanied Columbus's second voyage, Alvarez Chanca.

"Never yet, since the creation, has such a thing been seen or read of; for on the return of the ships from their next voyage, they will be able to carry back such a quantity of gold as will fill with amazement all who hear of it."

Despite such promising

MAR DEL NORTE
(ATLANTIC OCEAN)

From La Navidad to La Isabela, December 6, 1493–January 1, 1494

From Spain to La Navidad, September 25–November 28, 1493

La Isabela (established 1494, abandoned 1498)

La Navidad (1492-93)

Magdalena

Esperanza

Santa Catalina

Santiago

Valle de Cibao

The Grand March (March 1494)

Santo Tomás

Concepción de la Vega

MARIEN

CIGUAYO

MAGUA

XARAGUA

MAGUANA

HIGUEY

ESPAÑOLA
(HISPANIOLA)

Bonao

Route established by Bartholomew Columbus

Santo Domingo (1502 to present)

Nueva Isabela (Santo Domingo) (1496-1502)

Cuba

La Isabela

AREA ENLARGED

Hispaniola

Jamaica

Voyage to Cuba and Jamaica, April-September 1494

From La Isabela to Spain, March-June 1496

Caribbean Sea

CENTRAL AMERICA

SOUTH AMERICA

The Second Voyage of Columbus 1493-96

The Taino Indians numbered close to a million in 1494. Thirty years later they had been virtually annihilated.

■ Spanish fort

MARIEN Indian province

NGS CARTOGRAPHIC DIVISION

JAMES DUINE AND JAMES A. SUGAR

accounts and a few tantalizing Taino gold artifacts, Columbus's expeditions into the region around La Isabela produced little gold to enrich the coffers of Spain.

It was a bitter disappointment for Columbus's men, many of them veteran Spanish soldiers from the conquest of the Moors. They had been inspired by the Admiral's vow to present King Ferdinand and Queen Isabella with "as much gold as they need."

After 500 years, stones yield the tale of Columbus's "well-situated rock."

Standing watch on La Isabela's shore, the remnants of the Admiral's house—America's oldest surviving European construction—lie encircled by a wall (left) that was uncovered by Professor Cruxent.

Experts had long assumed the modest 18-by-48-foot home had been built entirely of cut stone, but recent discoveries show the long walls were made of hard-packed earth, coated inside and out with thick lime plaster.

The west wall has been lost to erosion of the cliff below it, but

the others have been spared by the centuries—and from an unfortunate mistake some 40 years ago. Dominican Republic leader Generalissimo Rafael Trujillo had ordered the area prepared for the arrival of dignitaries.

As part of the cleanup, tractors accidentally pushed parts of the site into the sea. Fortunately for Columbus's house, its position at the edge of the cliff protected it from the tractor's blade.

Tiles from the Admiral's roof, stacked near the ruin by archaeologists (below), are linked to a major find across the bay. There, Cruxent excavated a beehive-shaped kiln used to make bricks, tiles, and pottery.

That discovery shattered centuries-old beliefs about Columbus's town. The kiln and the artifacts around it revealed that, in addition to the main site, Columbus established another settlement nearby. Before the kiln was found, researchers believed that European ceramics had not been produced in the New World until decades later.

An artist's conception of La Isabela (above), based on years of excavations, shows Columbus's house dominating the shore, far right. To the left stands the colony's church, where the first holy bell rang in the Americas. Beyond it are houses thought to belong to expedition officers, a hospital, and, at far left, the 113-foot-long storehouse.

A Research Project Supported In Part By Your Society

At the rear of the site, excavations funded by the Society, the National Endowment for the Humanities, and the University of Florida have revealed La Isabela's residential area, along with refuse worth more than gold to archaeologists.

America's welcome: disaster and death

"One-third of our people have fallen sick within the last four or five days," wrote physician Chanca, shortly after construction of La Isabela began. Medicines, brought from Spain in glass vials unearthed at the site (below), were of little help. Dr. Chanca blamed hard work and an unhealthy climate; historians add intestinal parasites as well as venereal and other infectious diseases as possible culprits.

Despite raging illnesses, the Admiral pushed relentlessly to continue building the town and planting crops.

His men rallied their strength—but in a direction Columbus never dreamed of. The men, especially some Spanish nobles who were far more interested in riches and adventure than in hard work, were incensed by the Admiral's demands. Less than a month after La Isabela was settled, Columbus had to put down a revolt led by the expedition's chief accountant, Bernal de Pisa. Columbus jailed Pisa and hanged several followers.

One possible victim of execution—buried facedown with his hands behind his back—was uncovered at the site by physical anthropologist Fernando Luna Calderón of the Museo del Hombre Dominicano. The remains of other Spaniards in the town's cemetery were found with arms folded across the chest in the traditional Catholic rest (below).

Despite Columbus's best efforts, La Isabela became a lightning rod for disaster. The struggling community was repeatedly brought to its knees by epidemics, a fire that leveled two-thirds of its buildings, and a hurricane that destroyed several ships in the harbor.

Bloodshed and rebellion

Columbus pledged to Spain's Catholic monarchs that he would convert the Indians to the "holy faith," but his legacy was one of distrust, subjugation, and bloodshed.

The peace between the Europeans and the Taino was shaky at best when, in 1494, Columbus sent a group of men led by Alonso de Hojeda to reinforce the inland fortress of Santo Tomás. At a river crossing Hojeda seized a Taino chief and two companions. Accusing them of stealing clothing from some Spaniards, he cut off an ear of one of them (above) and sent the other two in chains to La Isabela.

After this incident the Taino retaliated against acts of violence—and against intolerable taxes. For example, a fee of three ounces of gold every three months was levied on Indians over the age of 14 in gold-mining districts.

Defense against Indian attack was provided by such late medieval weapons as hand cannon and crossbows. Excavations uncovered iron cannonballs (top right) as well as part of a stone mold used for making lead or iron shot. Archaeologists also found fragments of chain

mail and metal tips from dagger scabbards (below right).

The colony was soon threatened from within. In 1496 Columbus's brother Bartholomew began to relocate able-bodied men to Santo Domingo, which had a better harbor and was closer to the richer gold deposits of the south coast.

Infuriated over harsh rule by the brothers, emboldened by their absence, and desperate from near famine, the mayor of La Isabela, Francisco Roldán, rallied supporters to insurrection in 1497. Colonists and natives stormed the storehouse (below), looting weapons. Abandoning the town for the western part of the island, they allied themselves with the Indians there. Columbus, returning from Spain in 1498 to find his domain split and his support dwindling, had no choice but to recognize the settlement of Roldán and his followers as legitimate.

JAMES QUINE AND JAMES A. EUGAR

Enchained by ambition, the Admiral is recalled.

His dream of a New World empire sinking on the horizon, a chained, humiliated Columbus was rowed out to a caravel bound for Spain in 1500.

Ferdinand and Isabella had been very disturbed by reports of Columbus's excesses—charges that he ruthlessly ordered the execution of Spaniards who rebelled against him, refused to give supplies to those who displeased him, and enslaved Indians against the express orders of the king and queen.

Just as alarming were rumors that he intended to hand the Indies over to the government of his native Genoa.

The Spanish monarchs sent a royal investigator to Española. He wasted little time in imprisoning and deporting Columbus.

Aboard ship the caravel's master offered to unlock Columbus's chains. But the Admiral insisted on keeping them, wearing his "great injury and great injustice" like a badge of honor.

His gesture had the desired result. Horrified at news of their Admiral in chains, the king and queen ordered his release, but they did not restore his duties or his title as Governor.

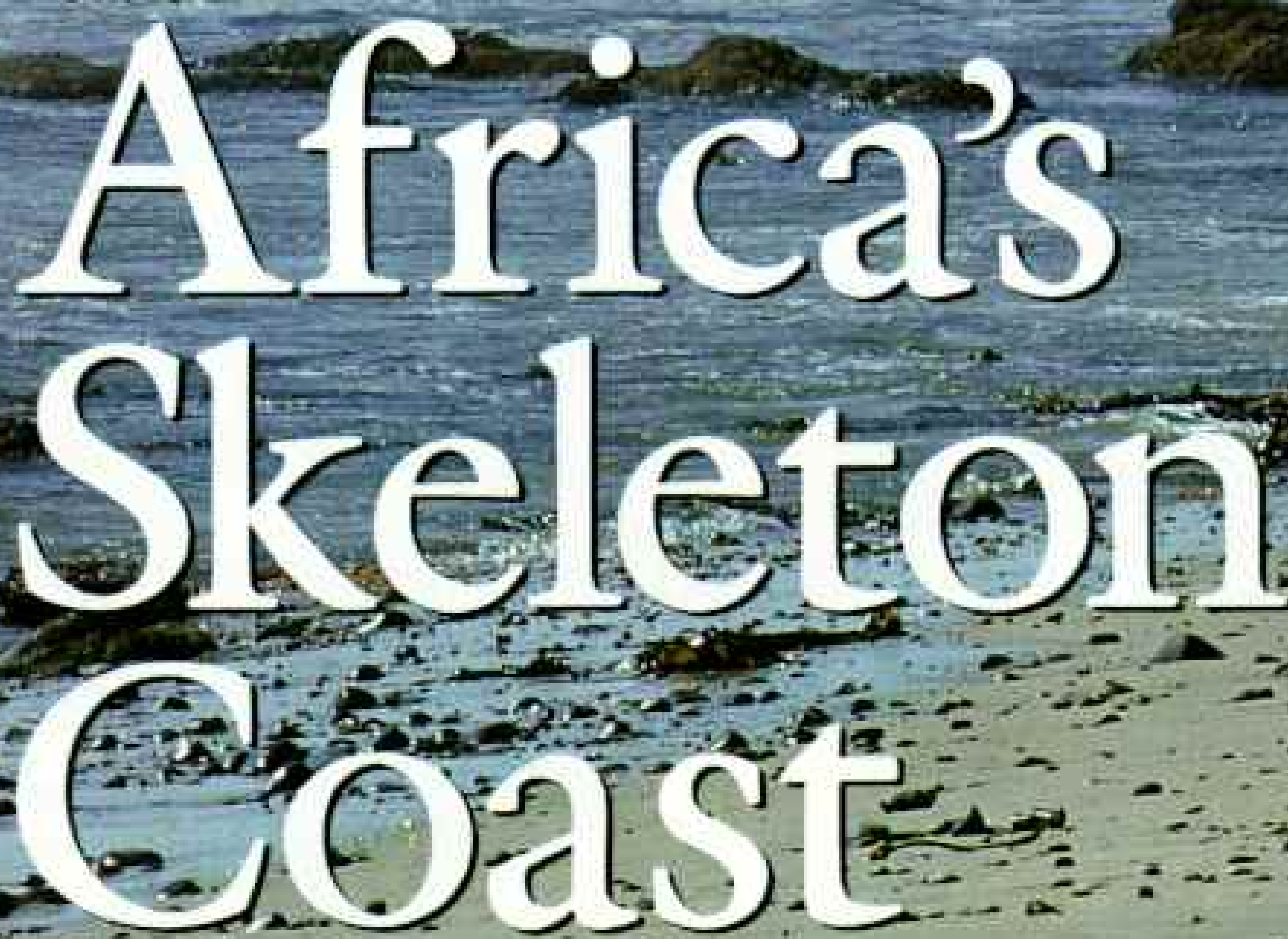
By the time of Columbus's greatest humiliation, La Isabela was a dismal memory, abandoned two years earlier in favor of Santo Domingo. So complete was the colony's failure that it was considered cursed: Natives reported seeing the ghosts of starved, work-worn Spanish gentlemen who in greeting lifted off their heads along with their hats.

Columbus's career as a colonizer was over. He again sailed to the West, but the aging Admiral was by then only one of several adventurers exploring the Indies.

In his last days, perhaps gazing on a crucifix like one found at La Isabela (above), a still defiant Columbus insisted that he had a God-given right to govern all the lands he had discovered.

"I presented [to Spain] the Indies," he wrote in his will. "I say presented, because it is evident that by the will of God, our Sovereign, I gave them, as a thing that was mine." □

Africa's Skeleton Coast

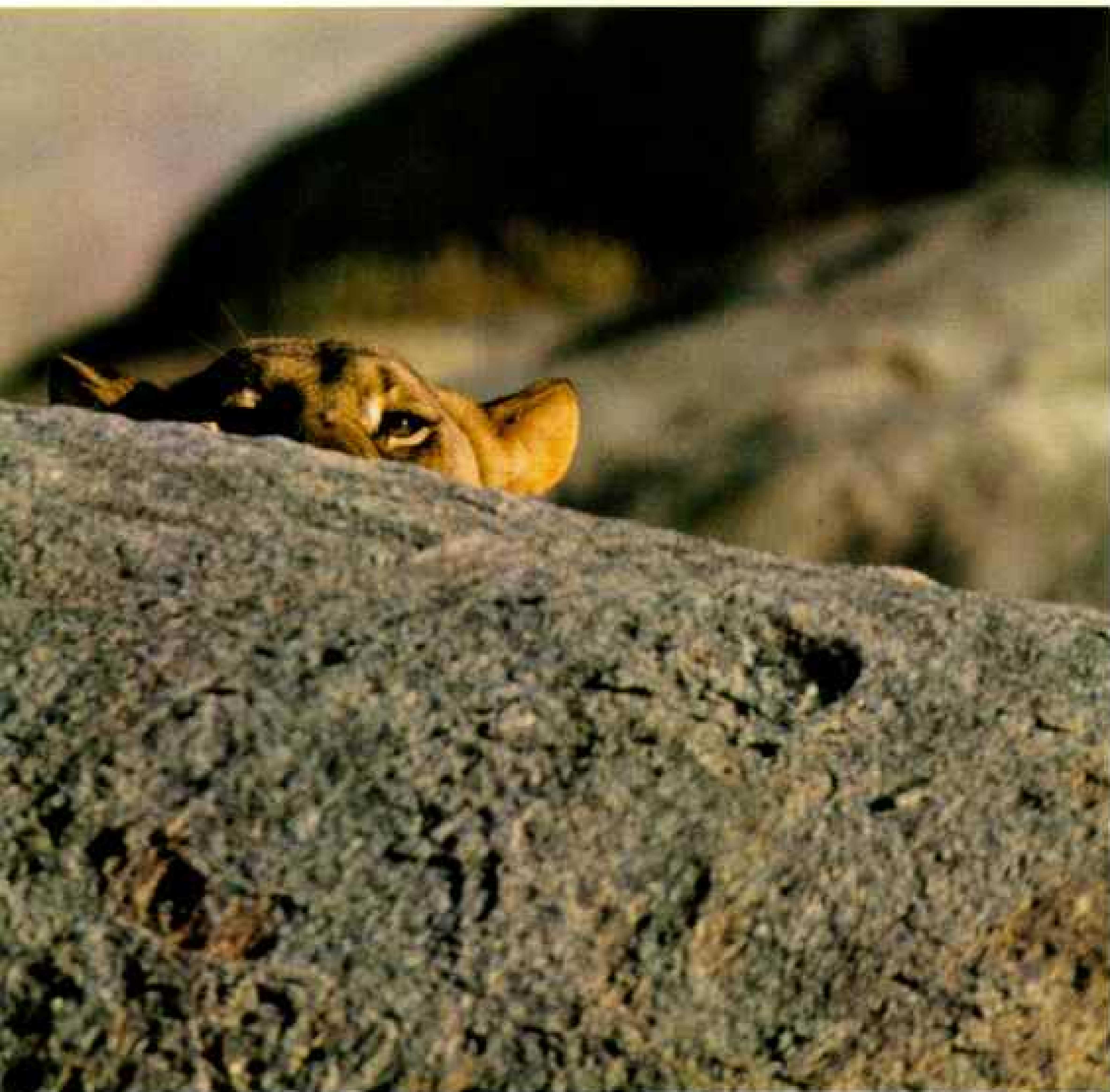


Article and photographs by DES and JEN BARTLETT

Where desert and ocean collide in a land of the unexpected, a lion feasts on a pilot whale stranded on Namibia's desolate shore.

Churning with chocolaty silt as it races to the Atlantic, the Hoarusib River slices through dunes of the Namib Desert in Skeleton Coast Park. Such

riverbeds can remain bone-dry for years, swollen only rarely by rains to the east. Meanwhile, underground seeps and springs help sustain desert-wise wildlife.



Wary eyes help the fittest survive in the Namib. Morning sun warms a sand dune, home to a male Angolosaurus lizard (left). It pokes its head out to make sure the coast is clear of predators—mainly birds of prey—before emerging to forage for green naras shoots and windblown detritus that collects on the dune. An alert lioness guards a seal she killed on the beach and dragged far inland for a solitary meal away from jackals. Lions also prey on gemsbok, ostriches, even giraffes. Yet the park's lions have long been besieged. Now all are gone. Some were killed outside park boundaries by livestock herdsmen; others were forced to leave by drought.

Keen students of nature and renowned for their thoroughness in recording it, the Australian-born Bartletts have been living on the Skeleton Coast and filming it for eight years. Their interest was piqued by reports heard during the six previous years they spent filming Namibia's Etosha National Park, about a hundred miles inland.

Giraffes drift through a cloak of fog, the Namib's great wet equalizer. Rain falls so seldom that it counts for virtually nothing, but coastal fog forms

most nights and floats as far as 60 miles inland. Condensation from the mist nourishes everything from insects to giraffes, which feed on moistened tree leaves.

Desert canteen, a prickly naras fruit full of pulp and nutritious seeds gives sustenance to a black-backed jackal (above). Elephants, hyenas, ostriches, and many other creatures also feed on the naras plant, endemic to the Namib. Like a botanical divining rod, its roots reach deep to unfailingly locate a water reserve. Nama-speaking peoples, whose ancestors frequented the coast, made multiple use of the naras. Prehistoric cultures also depended on the plant, documented by the common presence of its seeds in archaeological excavations.

Food awaits a spider whose web has snared both a moth and water droplets condensed from fog. When a shower falls during the December to April wet season, blossoms erupt on succulents such as the lithops, one of which is pollinated by a fly (left). Lithops also use fog's moisture, which trickles off rocks and seeps down to the roots.

ALL WE COULD SEE at first was a boiling cloud of dust, storming across the desert like some frightful dervish running amok. Then we realized that there was an elephant ahead of the dust cloud. The elephant was trying to charge us.

From the front seat of the Drifter, our lightweight aircraft, Jen spoke into the intercom. "It's Flop-Ear!" She identified an aging, normally placid bull with a folded left ear. He was actually charging the engine noise from our plane, in which we were soaring a thousand feet above and far beyond his tantrum. We were deeply concerned. What was wrong with him? Upon landing we learned that everything was a target for Flop-Ear. The old fellow was again in musth, the period of sexual aggressiveness that can drive males into a frenzy. He had even repeatedly charged a truck.

It had taken five years of cautious flying and careful distancing to accustom these elephants to our aircraft. As a result, normally we can cruise unnoticed, enjoying the magnificent sight of elephants dwarfed by the vastness of the desert—something few have ever seen.

Elephants in the desert? In northwest Namibia, an area known as the Kaokoveld, such apparitions are not mirages. Neither are giraffes that haunt the barren plains and black rhinoceroses that ascend steep, rocky slopes. Foraging for seasonal grasses, mountain zebras and antelope keep a wary eye out for lions, whose far-reaching tracks extend all the way to the seashore, where they hunt or scavenge seals and other marine mammals.

Here, too, much more diminutive creatures, ingeniously adapted, live among, and even within, the seemingly sterile dunes. Some of the mounds glisten with a rose tint from garnet sand, and some even roar when an avalanche of sand slowly cascades down their steep slopes.

In all, the Namib Desert stretches 1,300 miles along Africa's southwest coast.* We have seen and marveled at the survival techniques of creatures great and small while filming the lesser known northern Namib, which covers some 19,000 square miles. Imagine an area of sand and rock nearly as big as Lake Michigan, and you can understand why we need two Drifter planes and a pair of rugged ground vehicles to find the wildlife.

*See "The Living Sands of the Namib," by William J. Hamilton III, GEOGRAPHIC, September 1983.

Though that wildlife ranges from the coast eastward through the Kaokoveld's immense interior, the animals are protected only within a small strip, 300 miles long and less than 25 miles wide, which comprises Skeleton Coast Park. It was named in part for the dozens of shipwrecks whose bones litter its shore. We have imagined those early sailors, falling to their knees on this bleak and forbidding coast in thanks for their deliverance, only to discover the slow, painful death that confronted them inland.

Today, even amid such isolation, the northern Namib's wildlife is still at risk from poachers difficult to track over the wide terrain. Conflicts also arise between wild animals and domestic livestock raised by many of the 50,000 indigenous people that dwell in the Kaokoveld. The few rangers, known as nature conservators, from Namibia's Directorate of Wildlife, Conservation, and Research, have their hands full. Once wildlife crosses a park boundary, it becomes vulnerable to the dangers well-known elsewhere in Africa, and, sadly, even here.

The Namib has existed for perhaps 55 million years; it is one of the world's oldest and driest deserts. Rainfall in the park averages a little more than half an inch a year. What sustains this ecosystem is a series of rivers—rivers that are nearly always dry. In the distant past they carved their way hundreds of miles from the interior highlands westward to the Skeleton Coast. Today, only if enough rain falls in the highlands do some rivers occasionally flow. This is by no means an annual event, and when it does happen, the rivers' largesse usually trickles into the sand well short of the coast.

But water remains trapped under the sand, turning the dry riverbeds into what scientists studying this country often call "linear oases." Following these life-giving channels, wildlife seeks out permanent springs—elephants can tap new sources by digging with their trunks—and feeds on the riverine vegetation sustained by subterranean water sources.

How much water flows down the channels and how much it varies from year to year

For two rewarding decades, Australian photographers and filmmakers DES and JEN BARTLETT have reported for the NATIONAL GEOGRAPHIC on wildlife, ranging from whales and elephants to beavers and snow geese. This article was eight years in the making.

Rusted ribs of doomed ships helped christen the Skeleton Coast. The trawler Suiderkus *(above) ran aground in 1977. Cormorants nest on a wrecked fishing boat, the* Montrose. *The graves of dozens of modern-era wrecks are known, but those of countless earlier vessels sunk by perilous winds, fog, and currents were never recorded.*

strongly affect wildlife behavior. We learned this the hard way. When we reconnoitered the area in 1981, we didn't realize that a prolonged drought inland had pushed hundreds of animals toward the Skeleton Coast, where some grazing and water sources remained. We saw herds of 40 gemsbok and a pride of a dozen lions concentrated at water holes and along a narrow strip of coastal gravel plains. We were sure that we could film these creatures within a reasonable time.

When we returned nearly three years later, ready to film, the drought had broken. The game was no longer trapped at the coast but had dispersed far and wide, wherever rain had fallen extensively east of the park. That is how we found ourselves on an eight-year quest.

And so here we are, based on the shore of Möwe Bay in Skeleton Coast Park, in a small cabin framed by granite outcrops. Several

heavy fishing nets, strategically draped, help to block the wind that constantly assaults us. Our only neighbors are four park staff members who patrol the desert.

A dirt road ends at Möwe Bay, and at the other end, 280 miles south, lies the nearest town, Swakopmund, which we visit every few months for supplies and repairs. Along that road we must haul all our petrol, bottled gas for cooking and freezers, and countless staples. However, we use solar panels to run a refrigerator, light the cabin, and charge batteries. Three times a day, a nature conservator sends out weather information by radio, thus linking this little outpost to the rest of the world.

To home in on the remarkable desert-adapted elephants was our highest priority. Only in West Africa, on the fringe of the Sahara, do any other elephants in the world exist in such an environment.

Although elephant tracks are sometimes seen on the Namib's pinkish gravel plains, we longed to find the animals where they had never been filmed—trekking through the sand dunes like some lost caravan from a bygone century.

An aura of myth surrounds these elephants, which were once thought to have larger feet and longer legs than others of their kind. Although they are not a subspecies, some researchers believe that these elephants do represent an ecotype, differing from other elephants in their specialized adaptation to the desert's demands for survival.

Tackling a morsel that fights back, Suri, the Bartletts' pet suricate—a member of the family that includes mongooses and meerkats—is held at bay by a ghost crab. On the beach, scavenging crabs find an occasional bonanza of dead seals, part of the natural mortality of marine life nurtured by coastal upwellings.

Before our sojourn on the Skeleton Coast, we had worked six years in Namibia's Etosha National Park, which lies just east of the Kaokoveld.* We knew well the behavior of Etosha elephants, but that did nothing to prepare us for the capabilities of the desert dwellers. One of these is that during the dry season, desert-dwelling elephants need to drink only every three to four days.

We learned that from P. J. Viljoen, a South African zoologist who has spent more than five years tracking these elephants. "Slang" (his nickname means "snake" in Afrikaans) told us of once following a group to a water hole.

"It was completely dry, but it didn't faze them a bit," he recalled. "They didn't mill about; they immediately headed off in a new direction. They knew where the next water hole was, even though they hadn't visited it for a year. I followed them until they reached it—38 miles away."

Thus, these elephants are driven into perpetual motion to find the desert's far-flung resources, making it no easy task for us to find them. Over the decades their numbers have dwindled alarmingly. In 1970 there were about 300, but by the time we arrived 14 years later, ivory poaching and legal trophy hunting had helped diminish their numbers in the western Kaokoveld to only 70 animals.

To find the elephants and other wildlife, we make month-long camping trips from Möwe Bay into the desert. Our eventual goal is often the dry beds of both the Hoanib and Hoarusib Rivers. The Hoanib is the only river that fans into a broad floodplain east of the sand dunes. About once in ten years—last in 1984—it breaks through the dunes to reach the sea. We also investigate the gravel plains that some elephants occasionally cross between the Hoanib and the Hoarusib, as they search for sustenance.

On a typical trip we each climb into separate Drifters and fly for about an hour toward an area where we plan to film. Sometimes it's

*See "Etosha: Namibia's Kingdom of Animals," by Douglas H. Chadwick (with photographs by Des and Jen Bartlett), in the March 1983 NATIONAL GEOGRAPHIC and "Family Life of Lions," by Des and Jen Bartlett, December 1982.

A thin desert haven

Bare bones of protection, Skeleton Coast Park has guarded wildlife since 1971, but only within a 25-mile-wide strip. Its animals range far to the east, where many have been shot by poachers or herdsmen. Much of the Kaokoveld and the Etosha region served as a game reserve from 1907 until 1970, when then ruling South Africa removed protective status from vast areas to create ethnic homelands. A new game reserve may soon be added in the northwest Kaokoveld.

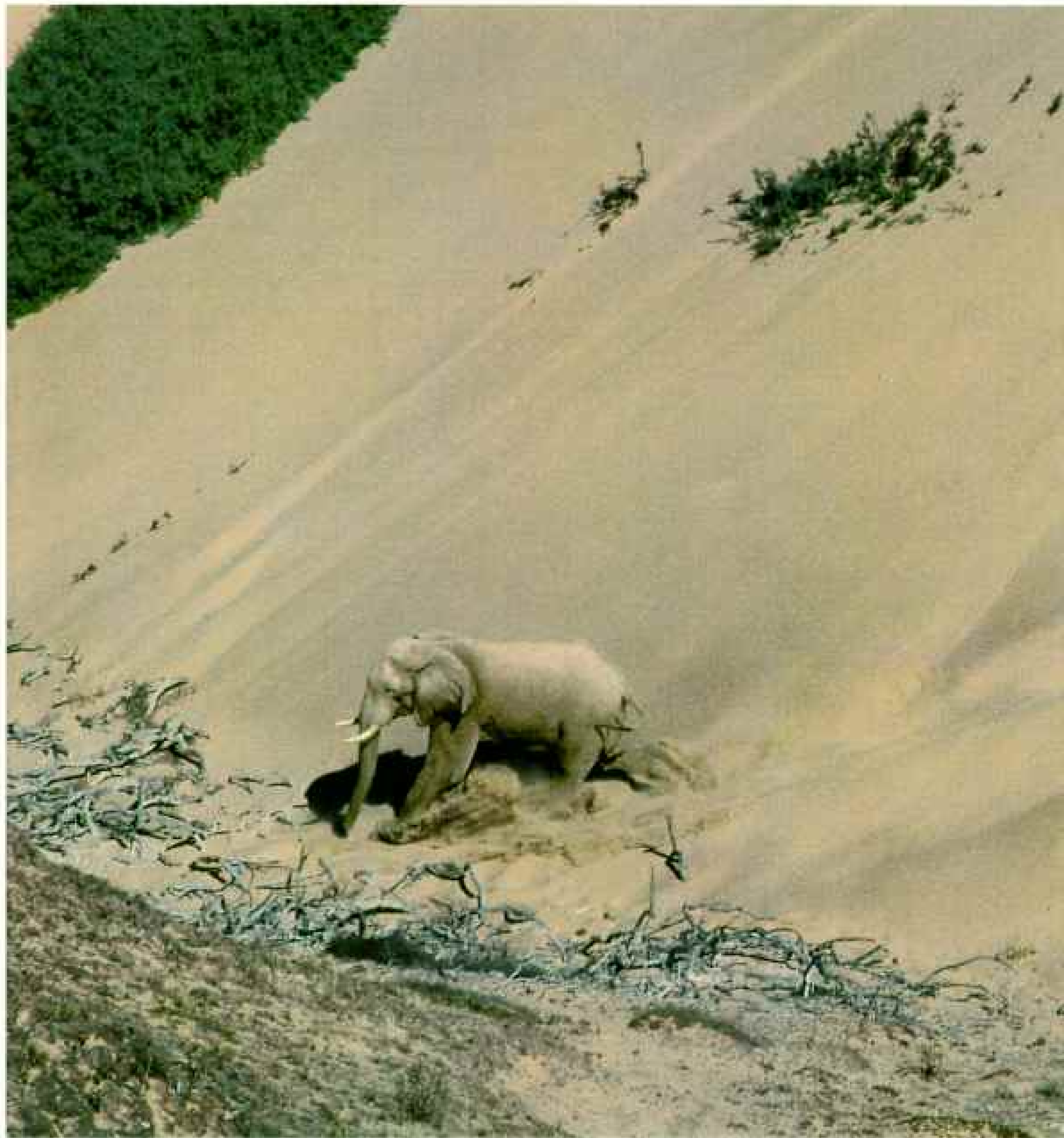
Warm, moist air is chilled when it meets the cold Benguela Current just offshore. Fog results and drifts onshore—a vital water source.

The Skeleton Coast takes its name from the doomed ships, crashed aircraft, and bleached whale bones that litter the area.

Ganias, a tiny permanent spring within the park. Because no one should ever camp near a water hole—its precious contents belong to wildlife—we land two miles away, leave one plane there, and fly back in the other (each is a two-seater) to Möwe Bay. We then drive our pair of four-wheel-drive vehicles back to the desert camp, a rough six-hour trip. If necessary, we return to Möwe Bay and retrieve the second Drifter. All told, we figure we've flown the equivalent of twice around the world in our little lightweight planes.

Elephants sometimes visit another water hole, Auses, which offers a perfect desert setting for photography. However, they find its water too brackish for drinking and use it only for bathing. Next to the water hole, we discovered deep furrows in the slope of a large dune—wondrous evidence that the elephants sometimes slide down the dune to reach the water below. We had to catch them in the act. To make a blind, we used ropes to haul plywood sections up a steep rocky ridge overlooking both the dune and the oasis.

Would the elephants come that way? Again



and again, for 18 maddening and fruitless months, we kept checking. The desert was always there. The elephants never were.

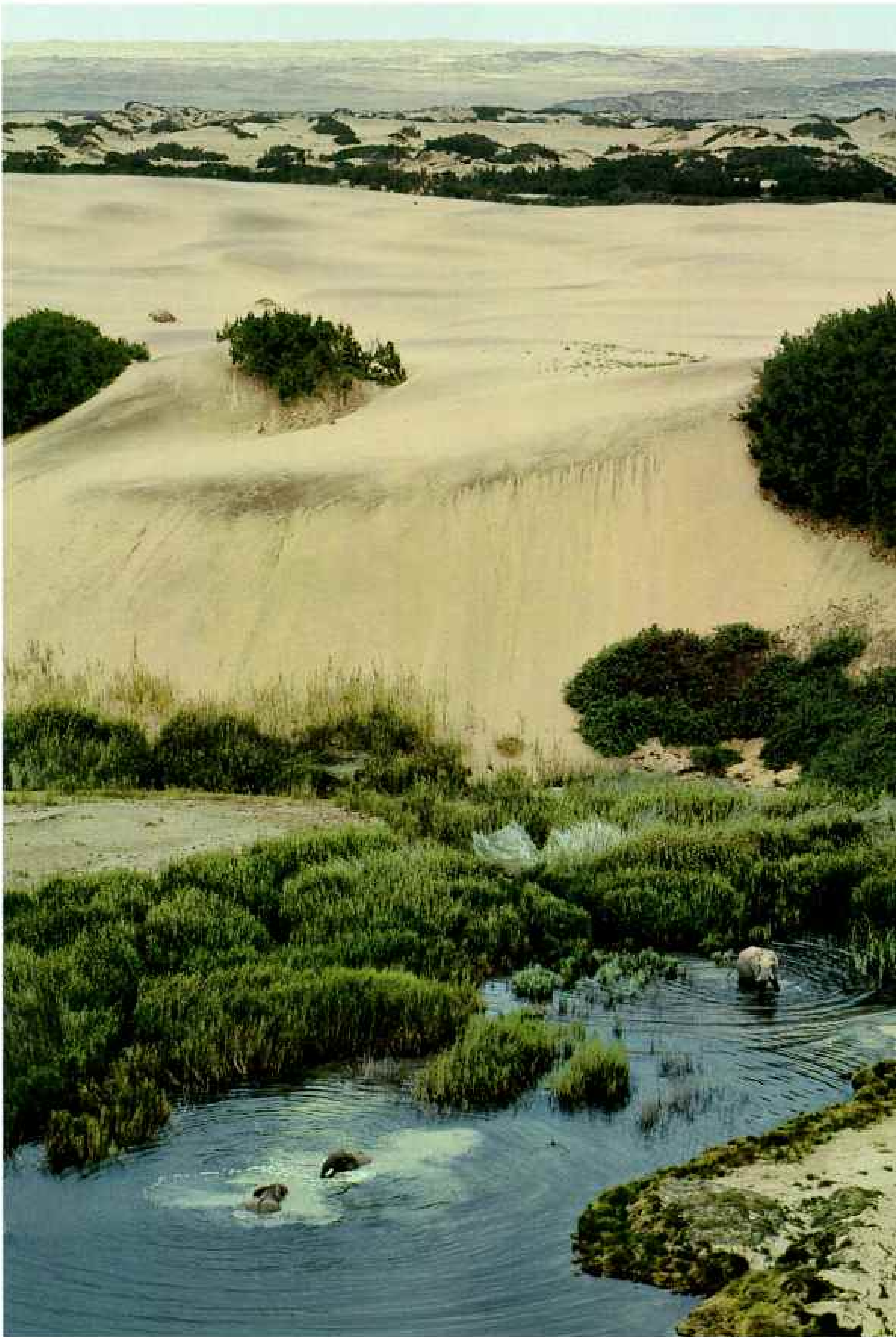
Then one day it finally happened. We were struggling once more over the sand, hauling 60-pound backpacks full of camera gear up to the blind. Fifty yards above it, Jen took up her usual post just below the ridge's pinnacle, scanning the dunes beyond. Suddenly she gave a hand signal, clambered down, and said quietly, "I think they're coming."

Over the shimmering horizon, two big bull elephants materialized, hurrying across the dunes in our direction. One behind the other, the two giants approached the edge of the slope. We expected an orderly descent.

"Good Lord," said Des in amazement, "they're starting to run!"

Approaching the water, all semblance of elephantine dignity evaporated. Each in turn lumbered over the rim and plowed downslope, half-sliding with rear legs bent, skating on their front legs, sand flying everywhere. At the bottom they charged into the water, splashing and carrying on like six-ton children. It was an incredible sight, one that lingers late at night

Exhilarated by the proximity of water, a pair of elephants charge down a dune. With hind legs bent and forelegs straight, the bulls raced to the bottom and plunged into a nearby water hole, called Auses, for a boisterous splash. These desert-adapted elephants travel as far as 45 miles a day and can go without water for three or four days. Their knowledge of the land has accumulated over many generations, as echoed by an elephant included in a rock engraving carved perhaps thousands of years ago.



as we doze beneath the stars and contemplate this strange and wonderful land.

HOW LONG have elephants roamed the Namib? Many sites have yielded rock engravings and paintings, some of them crafted thousands of years ago, that depict elephants. Western explorers reported elephants in the Namib as early as 1793. Today a few desert-dwelling elephants of the northern Namib may occasionally move inland and make contact with other elephants that live in an area of slightly higher rainfall. But those we observed and filmed did not—they were completely at home in the desert's unforgiving environment.

These sandblasted creatures are tough. A terrible drought did slow their birthrate during the early 1980s—only seven calves were born between 1979 and 1984, and only two survived. But during that same period very few adults died from the conditions, which claimed as many as 80 percent of the other desert mammals, including mountain zebra, kudu, even hardy gemsbok and springbok.

Elephants can handle environmental stress. The toll humans take is another matter. During the long drought, many subsistence herdsmen became desperate and turned to poaching for ivory and meat. Military personnel and government officials also slaughtered the elephants for sport. In 1982, 152 carcasses were found strewn over the Kaokoveld; few had died of natural causes.

In 1989, with the severe drought a memory and antipoaching measures increasing, we photographed nine youngsters following their mothers across sand dunes. Now there are some two dozen young, and, thanks in part to better protection, the desert-dwelling elephants in the western Kaokoveld number about 80.

The elephants' woes are bad enough, but the poaching depredations suffered by black rhinos have provoked desperate countermeasures by wildlife officials. Like other animals of the Namib, the rhinos sometimes follow the dry riverbeds westward as far as the Skeleton Coast Park, but they are generally found well east of the park on less protected land. At least 250 rhinos roamed the Kaokoveld until the early 1970s. By then poachers, primed by world demand from people who still believe in rhino horn as a medicinal panacea, had gone on a rampage that left only about 65 rhinos standing.

Now the animals literally are caught on the horns of a dilemma. To help save their lives, a

Permanent desert resort, the Auses water hole (left) attracts elephants only to bathe—they normally drink from a less brackish spring. To some researchers these desert dwellers represent an ecotype because of their special adaptations. Also, they are perhaps the world's tallest elephants, and their huge feet and long legs may aid long-distance trekking. Seasonal flooding turns parts of the Hoanib floodplain into lush pasture where a bull and younger adults find grass. Elsewhere, acacia seeds sprout, having been softened in an elephant's gut and dispersed in its dung.

In an extraordinary gathering of elephants, a herd treks to the next water hole. Since 1970, when their numbers were estimated at 300, they have been decimated by poachers. After one bloody campaign between 1980 and 1982, 152 elephant

carcasses were found in the Kaokoveld. At about the same time, a drought reduced the birthrate, which has since rebounded. With some two dozen calves, the population in the western Kaokoveld stands at about 80 and is slowly rising.

ROBERT CAPUTO

Desert housekeeping keeps Jen busy sweeping away tracks made by the couple's two four-wheel-drive vehicles and two lightweight aircraft, called Drifters. The planes weigh only 750 pounds fully loaded, distributing their weight on three oversize tires. On this gravel plain, where the Bartletts camped beside a well-used track, easily compacted soil can be indelibly scarred by drivers. "One truck left its tracks on this plain in 1964—and they're still here," says Jen.

The filmmakers use their versatile motor pool to make forays between the desert and the coast. From the interior, a one-hour flight—or a six-hour drive—leads to their windblown cabin at Möwe Bay. There they recharge their batteries, physical and mental. Solar cells energize their movie cameras and inspire ray-catching mimicry by their suricate. Adding to self-reliance, Swiss chard and many other vegetables thrive in their small sand garden.

controversial technique renders them valueless to poachers: In two high-risk areas rhinos have been tranquilized and their prized horns cut off and safely stored away. Among the project's participants, conservationist Blythe Loutit and her husband, Rudi, chief nature conservator, say that the dehorned rhinos have shown no marked behavioral changes and that two calves have been born to hornless rhino females. Working independently, with support from the National Geographic Society, ecologist Joel Berger of the University of Nevada is investigating how fast the horns grow back and how horn loss may affect breeding.

BACK AT MÖWE BAY, after a month camped in the desert, we try our hand at surf casting in the nutrient-rich waters of the Atlantic. To have fresh fish on the menu is a great treat—steenbras, galjoen, or kabeljou. Sometimes we barbecue the catch and accompany it with vegetables from our tiny sand garden. Swiss chard, lettuce, tomatoes, and a host of herbs seem quite happy with the cool coastal climate. We enrich the sand with compost, kelp, and cormorant guano.

Just offshore flows another natural source of abundance, a permanent force without which much life on the Skeleton Coast would be impossible. The Benguela Current sweeps northward along the coast, bringing waters from Antarctica. Prevailing winds create a constant upwelling of cold bottom waters that sustain great pastures of marine life. The Benguela also brings a vital source of water to the desert: fog.

When warm air from farther out to sea sweeps in across the cold Benguela, fog forms. This fog drifts onshore most of the year. In the dead of the desert night, on leaves, rocks, grass, even on the bodies of living things, that fog condenses. Thus, lives that may not be able to wait for thunder to roll over Etosha and for dry riverbeds to heave with a lifetime flood—those myriad lives have another chance.

Nearly everything depends on fog and dew, from plants to massive mammals. A rocky slope or gravel plain, black and barren as the moon, takes on a soft green hue after a fogbank drifts over it and drenches lichens. Fog helps nurture one of the Namib's most unusual endemic species, the bizarre Welwitschia plant. Actually a dwarf tree, a Welwitschia can survive the desert's rigors for 2,000 years, its two leathery leaves torn into a disheveled tangle of windblown strips.

At the other extreme, giraffes are so water-conservative that they have never been observed in the act of drinking in the northwestern Namib. These animals frequent the lower Hoanib, where fog condenses on the leaves of the acacia trees they feed on, helping fulfill their water needs.

When a searing hot spell strikes and the tongue of the land is really hanging out, the fog disappears. After the heat subsides, on the first evening of the fog's return, the desert is a busy place. On one such night we were camped in the dunes near the Hoanib, a hundred yards from a colony of dune ants. We arose several times at odd hours to see what they were up to. Ants of this species are normally most active by day and in their holes by night. But many from this colony were outside digging furiously. Later we found them still outside and all nearly motionless. Fog had condensed on the ants themselves, and they were drinking the droplets from one another's bodies—one of the desert's unique rites of survival.

Fog also plays a role in the mysterious cycle of what is possibly the Namib's most important insect, the harvester termite. These termites can be seen on those rare occasions when they emerge in swarms from their underground network to forage. Their voracity is astonishing. Mary Seely, director of the Desert Ecological Research Unit at Gobabeb, told us that in spite of all the large grazing animals, such as antelope, more than 80 percent of all grass on the Namib plains is eaten by termites. And termites, in their countless millions, offer a vital food source to a host of predators: birds, lizards, scorpions, even meerkats and jackals.

FOG AND WIND define much of this country. From April to August comes the dreaded east wind, the harshest side of the desert's personality. When a high-pressure system forms in the high country to the east, that air, cold at first, begins to flow westward down to the coast. As it sinks, it heats rapidly by compression and quickly gains speed. By the time it reaches us—well, we might be enjoying a brisk morning of 40°F, and two short hours later it can be 105°F with a gale-force wind.

Like a cyclical blast furnace, the east wind usually blows off and on for a week or ten days.

Aerial tactics allowed the Bartletts to travel from the coast, where Des makes a self-portrait with a wing-mounted camera, to an ostrich nest cut off by a flooded river. Jen, on the ground in the second Drifter, prepares to take off. To haul a

maximum load, Des has removed the rear seat and fitted a platform to carry 255 pounds of food, camping gear, camera equipment, and, in one box, two suricate passengers to share in the adventure.

Generally it lets up at night, although we once were forced to collapse our tent and pack up at 2:30 a.m. in a raging sandstorm.

And yet, while we suffer the phenomenon as if it were a biblical visitation, there are creatures out in the dunes that can't wait for strong winds to blow. Near the top of each dune on the sheltered side there is a steep area of cascading sand called the slip face. This zone, accounting for less than one percent of the dune field's surface, is where life concentrates. Lizards and beetles and other insects dive in and out of the sun-broiled sand to regulate their body temperature and seek food. Their diet requires wind because they feed on detritus—a seed, a dead fly's leg, a leaf—desert leftovers that the wind picks up and redistributes. Always it accumulates at the base of the slip faces.

The creatures that recycle this debris are called detritivores. During a strong wind, with plastic bags taped over our cameras for protection from sand, we have watched the denizens of the slip face in action. As the midmorning sun warms a dune, a large sand-diving lizard cautiously pokes its head out and waits, wary of predators such as goshawks. Then it emerges in full, soaks up the sun, and eventually moves away to search for detritus and shoots of the naras shrub. At any hint of danger, the reptile streaks back to its slip-face haven and dives into the soft sand with a curious figure-eight-like movement.

TO INVESTIGATE such intriguing sand dwellers requires specialized desert-driving techniques. First, we learned to avoid certain types of soil that contain a layer of gypsum, easily compacted by a vehicle's weight. Driving in sandy riverbeds and on the dunes avoids leaving permanent tracks that scar the desert; the wind can wipe the trail clean within an hour. There, however, to avoid bogging down in the deep sand is a constant challenge.

We've had our share of exasperation, and we've learned a few tricks. First, deflate the tires until they bulge. (We plug an electric air

Desert birds are tough birds. On guard against jackals and hyenas, a male ostrich takes its turn brooding a communal clutch. As many as three females contribute eggs, an average of eight each, then the dominant bird and her mate take over. Its nest scraped under a rocky sunshade, an endemic Gray's lark feeds its hatchlings insects that emerge after a storm. Most birds wait to nest until rain ensures ample food.

pump into our cigarette lighter to reinflate the tires once on firmer ground.) We also carry wooden planks to shove under our wheels when they get stuck.

On the slip faces of the dunes, the residents that receive the scientific spotlight are the tenebrionid beetles. Some are black, some mostly white—inviting much study about their thermoregulating abilities. By night, some tenebrionids stand on their heads in the fog, allowing water to condense on their bodies and trickle into their mouths. By day, their specially adapted legs help them swim through the sand, carrying them down to escape excessive heat and up to the surface to find detritus on windy days.

It was a windy afternoon that almost did in one of our precious Drifters. The little aerial chariots weigh only 350 pounds when empty. If they're parked on the ground unsecured and a sudden wind should spring up, they can practically become airborne even with the engine off.

That's what nearly happened to Jen. She

had landed alone on a gravel strip, but no sooner had she stepped out than the wind rose and the plane started blowing backward. Jen, who might weigh 120 pounds after a full meal, hung on for dear life—for an hour and a half, waiting for Des, who was stuck in the sand in the Ford far away.

The 30-mile-an-hour wind twice forced the plane over onto one wingtip, and Jen was petrified that the aircraft would cartwheel and be destroyed. It was getting late. Where was Des? At last the wind blew plane and pilot backward into softer ground where she could dig small holes for the wheels, turn it tail into the wind, and tie it down.

Time for a drink of water, she thought. We recycle half-gallon cardboard wine packs by filling them with drinking water to carry on board the Drifters. She found a pack and, with a desert-dry mouth, held a plastic cup under the spigot.

And out came a stream of warm red wine. We're still not quite sure how the metamorphosis of water into wine occurred, but there was nothing spiritually uplifting about the result. Jen heaved the stuff as far as she could.

TO LAY A BEDROLL under the stars in the Namib, knowing that the desert's seeming emptiness is so full of life, can truly bring peace of mind. It can also bring a rude awakening.

One chilly May night a few years ago, we camped among the dunes three miles from a water hole, parking our vehicles in the Hoanib riverbed. We unrolled sleeping bags next to the Land Rover, using it as a windbreak. The fog crept in around eight o'clock and cleared by midnight. A half-moon's light bathed the desert as we fell asleep.

A little after 5 a.m., Des awakened. "Listen," he said softly, and from the direction of the water hole the roaring of a lion pierced the night. It sounded like a male; he kept it up intermittently for more than half an hour but received no answering roars. Silence fell. We dozed.

"What's that?" Jen sat bolt upright. The moon had set; it was pitch black. A menacing growl came in reply, and there was a quick movement close to our bedrolls. "Lion!" we shouted in unison. Des found a flashlight and shone it on a big male lion regarding us coolly a very short stone's throw away. Jen offered a wise suggestion: "Let's get into the Ford." The lion finally sauntered off to the northeast, roaring defiantly.

At first light we found the lion's tracks exactly one yard from the feet of our sleeping bags. We were lucky. A few months later, conservationist Garth Owen-Smith told us he had had a nearly identical experience with the same lion in another area where we have often camped. Except that that time the lion had bitten through Garth's bedroll and bloodied his heel. Garth saved himself by firing a shotgun over the lion's head.

Such incidents, though dramatic, are misleading. They are small skirmishes in a long-standing conflict between man and lion, and in Skeleton Coast Park the lions seem to have lost. When we first arrived, at least a dozen lions lived there.

Now there are none.

COEXISTENCE between lions and Africans trying to make a living from the arid land is still uneasy at best. Sandwiched between Skeleton Coast and Etosha parks, east of the desert where a bit more rain falls, the indigenous Herero, Himba, and Damara peoples herd their cattle and goats. They keep their livestock mainly along the dry riverbeds, near springs often used by wildlife.

When food near the coast becomes scarce, lions head up the riverbeds and meet herdsmen coming down. Sometimes a cow dies. Sometimes lions die. The law of the land says that outside the park if a lion or other predator threatens people or their domestic animals, that predator may be killed.

Here, a man's only wealth is his livestock. We understand that. We're also heartsick at seeing lions we've known for years fall victim one after another.

We knew the male lion that invited himself to our bedside on May 17, 1986. We had first sighted him on February 9, south of the mouth of the Hoanib, although we had been seeing his tracks since mid-1985.

This male's predecessor, formerly the only male in the park, had been fatally shot in March 1985 when it moved south along the beach into a less protected recreational area. Conservation officials decided the risk to humans in this area was too great and ordered the animal destroyed. So we rejoiced the next February when we first spied the newcomer. "It's a lion! Right by the road!" Des exclaimed as we drove within sight of the sea one day.

Equally exciting, a few days earlier in the same area we had seen signs of a lioness. We knew her well; she had been born at the mouth of the Hoanib. She had killed a seal on the beach and dragged it two miles inland determined to feed in peace, away from coastal jackals, leaving a long track behind. We hoped that the Hoanib lioness and the new potential mate would pair up.

By June 1987 they had. The lioness had already been radio collared by a nature conservation team. Patrolling in our Drifters on June 4, we picked up her signal and found both lions together on an ostrich they had killed.

Nearby, the lions' tracks revealed their teamwork. The female had hidden behind a small mound where she lay in wait. The male had circled around and suddenly appeared on the other side of the ostrich, which fled in the opposite direction, straight at the lioness. With a few bounds she caught it and quickly made the kill.

Two days later, Philip Stander, a research assistant who had been working with Etosha's lions, immobilized the male with a tranquilizing dart and fitted him with a radio collar like that of the lioness.

Five days later we discovered that the pair had killed another ostrich well outside the park. Then we lost their signals forever. Five weeks later both lions were dead.

They were traveling far from the park up the Hoanib, probably farther than the lioness had ever been. But we think the male lion knew this country, knew of a spring up the Hoanib called Dubis, where they were heading. Meanwhile, a herdsman had moved his livestock, women, and children a little way downstream from Dubis to a narrow point on the riverbed where he had dug a well.

And that was where, on July 17, 1987, the herdsman killed the male lion instantly and severely wounded the female.

She lingered five days until nature conservators Steve Braine and John Paterson found her and ended her suffering. A field autopsy revealed that the lioness had been pregnant and would have delivered four cubs within a few weeks.

We had known that lioness since she was a cub, back in April 1981. She had had her first litter three years later. We knew her favorite routes through the desert, where she hunted, where she rested. And the tragic litany continues. A third male that we first saw in the park

By licking its eyes clean, a nocturnal gecko may also glean a bit of condensation to ease thirst. Dune ants—normally active by day—leave their nest before dawn to drink droplets that condense on their bodies from fog.

Too much water from a sudden rain makes frantic work for harvester ants (bottom). Their larder of grass seeds was soaked, and they had to bring it out grain by grain to dry.

A lone bull seems to have the lush floodplain of the Hoanib all to himself in February. A few weeks earlier, rains far to the east caused the river to flow, greening these multiple channels where the river spent its brief force. By April

wild sorghum will tower ten feet tall, and more elephants will arrive to feast on the rich seed heads. Such riverbeds serve as linear oases for the region's animals, which follow them far from park boundaries, and into harm's way.

Last days of a king: A lion stakes claim to a giraffe killed by a lioness and her three young inside the park in the Hoanib riverbed. Two months later, farther upriver, this male was fatally shot by a herdsman. Without better protection, the future of lions in the park may lead nowhere, like the trail left by a seal killed on the coast by a lioness and dragged inland.

August 7, 1988, was shot more than 60 miles inland on July 4, 1990, again close to the Dubis spring. Four months later another lioness we had often seen was killed, along with one of her offspring.

Saddened by the loss of the lions, we hope that in the future this tragedy can be replaced by something positive, both for the local inhabitants and the wildlife. A lion will threaten livestock, but it will also attract tourists. And even to the remote Namib, tourists are beginning to find their way. The herdsmen must get part of that tourist dollar.

A pioneering attempt at ecotourism is already under way up the Hoarusib beyond

the park, at a tiny cluster of huts called Purros. There, Garth Owen-Smith and his colleague, anthropologist Margaret Jacobsohn, have started a project to involve the local people in protecting the land and its wildlife.

Previously visitors photographed only the Himba in their village life. Now, the Himba are told, people come to photograph the wildlife that they are helping protect, and each month the Himba share the proceeds of a tourism tax. With wildlife now safer in this area, 20 giraffes have been transferred from Etosha to Purros, where poachers had wiped them out 20 years ago.

In 1983 Garth and nature conservator Chris Eyre helped institute the auxiliary game-guard system, a homegrown boost to conservation in the Kaokoveld. Himba, Herero, and Damara leaders chose local tribesmen as game guards, who are paid to notify authorities of illegal hunting. Earlier, under their own laws, tribal leaders had banned hunting. Already these efforts are helping species such as elephants and black rhinos hold their own.

In 1907 the German colonial government proclaimed much of the Kaokoveld and Etosha region as a game reserve. In 1970 the South African government (which controlled Namibia, long known as South-West Africa) eliminated much of the reserve status to create ethnic homelands, largely out of barren desert. The Skeleton Coast's wildlife was cut off, its protection limited to a symbolic shoreline strip at the lower ends of the life-sustaining rivers.

But amidst this long-disheartening situation, something positive is in the offing—a new game reserve, which the Namibian government seems likely to approve. Located in the region's northwestern corner, the 5,800-square-mile sanctuary would provide tourism income for the Himba people who live there. The Himba would also help manage and protect the reserve. One day a circle may close, when rhinos from Etosha are relocated into the western Kaokoveld, with the Himba helping protect them from poachers.

This dream, we all hope, is now just around the corner. □

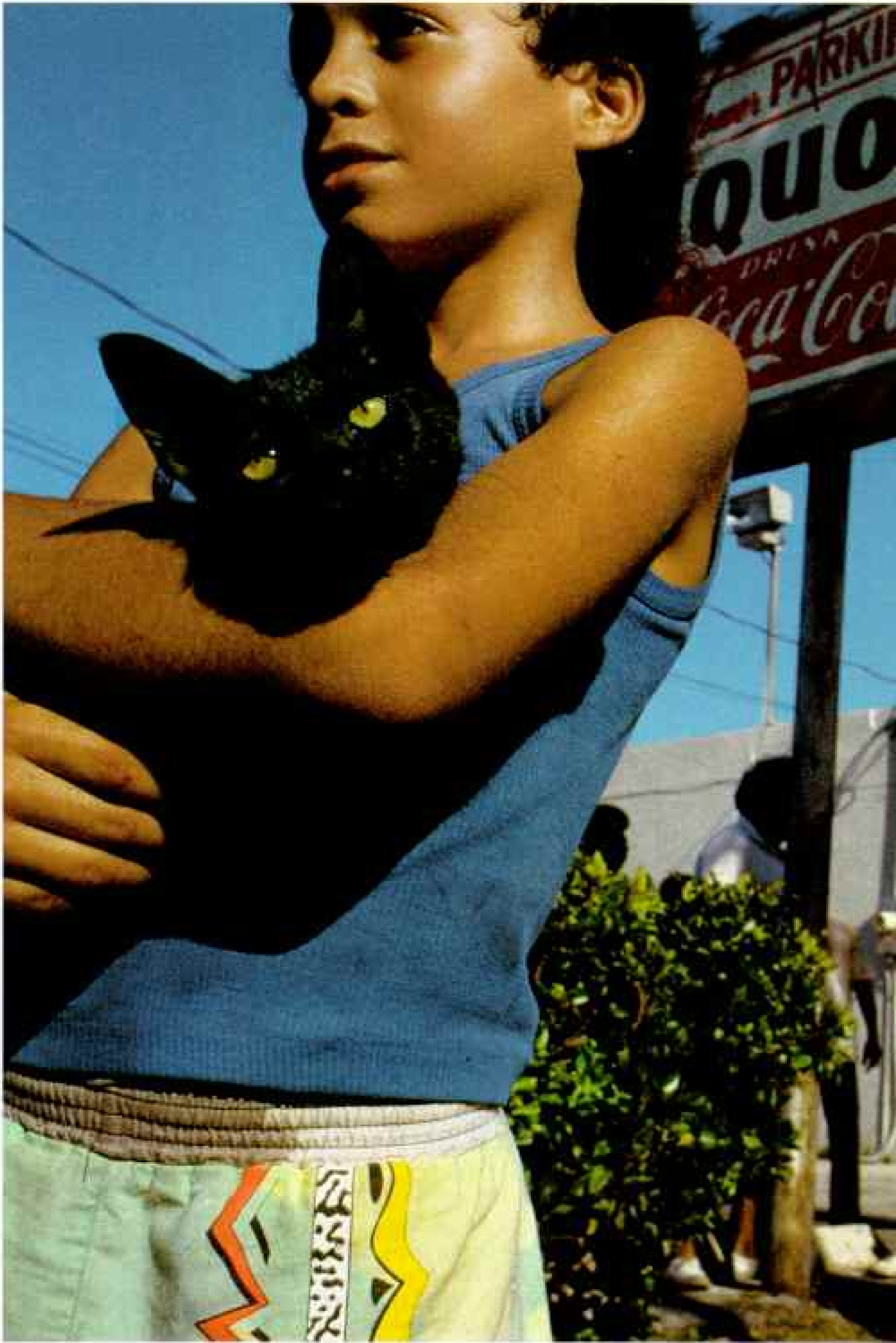
Refugees have transformed this subtropical city, setting a new challenge: how to build a community from a kaleidoscope of cultures.

MIAMI

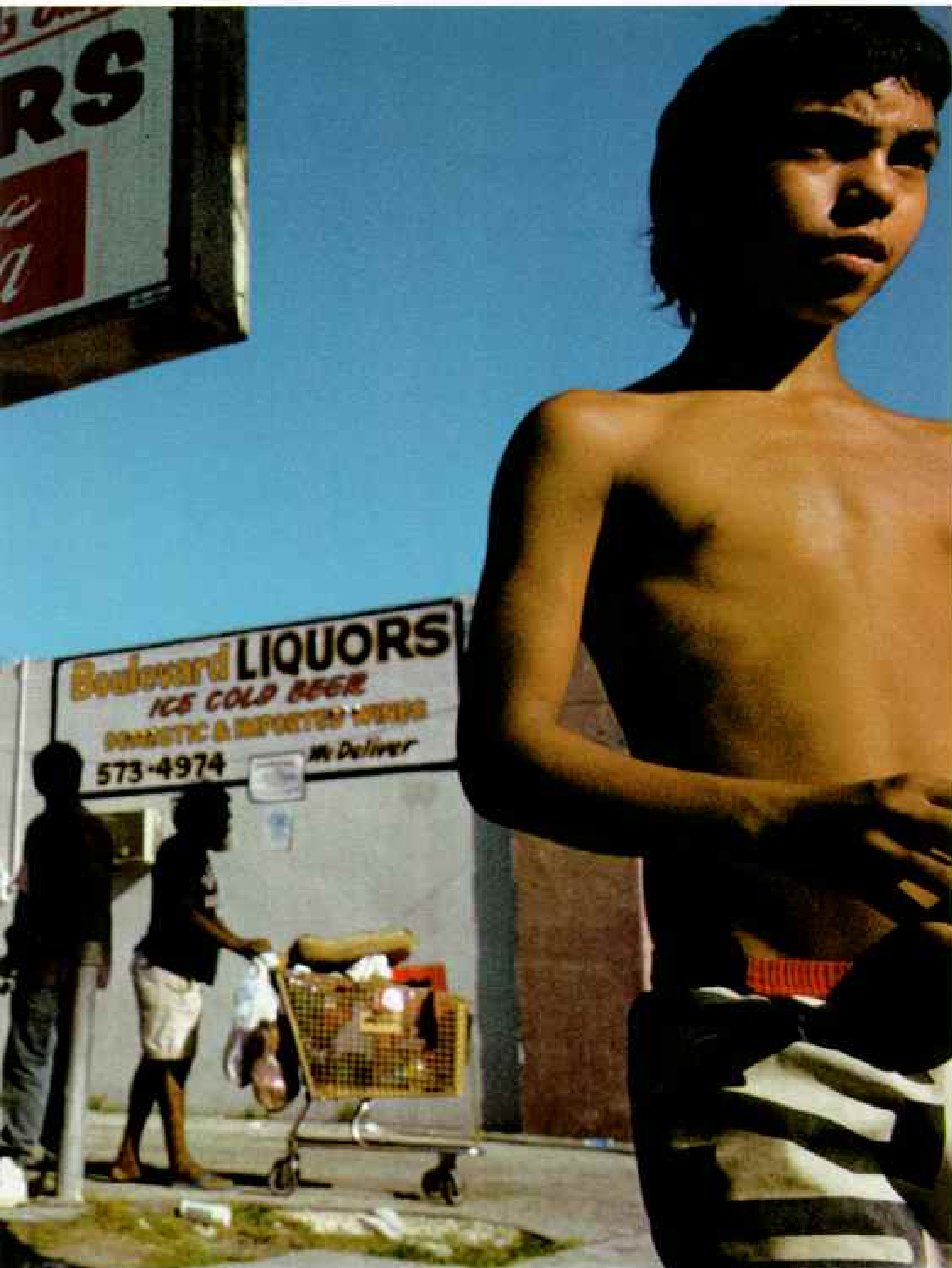
As sassy as a cruise in a convertible down Ocean Drive, south Miami Beach lured artist Laura De Pasquale from New York City. Just a few years ago this island's southernmost stretch, linked by causeway to the mainland, was crumbling. Now refurbished and fashionable, it's one of the most visible, and most visited, features of a new Miami.

By CHARLES E. COBB, Jr. NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by MAGGIE STEBER JB PICTURES



Neither the homeless man pushing his cart of possessions behind them nor a jitney bus in flames before them seem so odd to brothers Manuel and Ruben Rodriguez. They see the live street



theater of Biscayne Boulevard daily. The city's larger drama takes its plot from ethnic conflicts stirred by three decades of relentless immigration from Latin America and the Caribbean.

"I just love rhythm," says Ida Klaus, at center, taking a turn on the dance floor of a north Miami Beach community center. Displaced by a younger population, retirees who once flocked to Greater Miami

are scattering elsewhere in south Florida. But Klaus intends to stay: "I don't like being only with older people," she says. "Now that it's a mixed community, I like it much better."

Skyscrapers shot through Miami's once flat skyline during the building boom of the 1980s as the city exploded into a center of banking and commerce. Along the Miami River, container ships that carry cargo to and from the Caribbean and the Gulf of Mexico must squeeze through ten drawbridges on their way to terminals upriver.

ARMANDO CODINA'S pride crackled through the telephone. "The Museum Tower building, do you know where that is?" he asked, agreeing to meet me. "I built that."

The busy 44-year-old founder and chairman of the Codina-Bush Group has a country club project under way that includes a golf course designed by Arnold Palmer. Codina is also developing a 205-acre complex of retail, warehouse, and office space. He has built luxurious residences. His yacht, docked on a canal leading from his home to Biscayne Bay, is named *What A Country*.

Two years ago, I remarked, he was chairman of the Greater Miami Chamber of Commerce. I noted that he was the first Cuban-born person to hold that post. "Forget Anglo, black, or Cuban," he responded. "I was the *youngest* head of the chamber."

Codina is consciously a symbol of what he considers special about Miami. He left Cuba when he was 13 and for a time lived in an orphanage. He parlayed a billing service for doctors begun with an $18,000 Small Business Administration loan into his multimillion-dollar corporation. "The city gives everyone an opportunity. In this way we are a lot different than older places like Philadelphia or Boston. Miami doesn't ask who your parents are. It only asks who you are."

Think Miami, think 20th century. How appropriate that last April Marjory Stoneman Douglas arrived in a red 1967 Cadillac convertible to celebrate her 101st birthday at a Key Biscayne park. And that she picked up a cellular telephone to receive congratulations from Florida's governor.

She's older than Miami. One hundred years ago the city did not exist. She told me later there were just 15,000 people here when she first arrived in 1915. Coming to get a divorce, she stayed to work on the *Miami Herald* and became a staunch champion of Everglades preservation. "I never did like the cold climate of Massachusetts," she said.

Sun splashed and spiced by the hot tropical flavors of Latin America and the Caribbean, Miami has burst into bloom so suddenly and so effusively that it sometimes seems not to know what to do with itself.

Immigration, especially, has recast the city's culture and economics, transforming what less than 30 years ago was a sleepy southern city into an energetic metropolis. "Actually, we're a child of a city," says Miami Mayor Xavier Suarez, "and it's hard to predict when we will reach adulthood. Some days it seems the pimples will not go away."

But if Miami has youth's uncertainty, it also has its excitement. "Miami is best approached

as a great American adventure," says *Miami Herald* publisher David Lawrence, Jr. Merrett Stierheim, who heads the Greater Miami Convention and Visitors Bureau, exclaims: "We changed in a swirling, tension-filled, beautiful, exciting way. We're still changing." And says bank executive Robin Reiter Faragalli, a native: "It's like looking through a prism. Nothing is ever the same twice."

Not so long ago, going to Miami usually meant Miami Beach. Not today. It's also 91,000 acres of agricultural land, a new baseball team, yuppie tracts throughout unincorporated Dade County, and 27 incorporated municipalities.

For 1.4 million visitors, Miami is the start of a Caribbean cruise. For another nine million tourists—four out of ten from abroad—Miami is still beaches, along with shops, hotels, restaurants, businesses, and banks. More than 250 multinational corporations are based in Miami. The city is the leading international banking center in the Southeast.

"Nobody knows exactly where Miami is," Marvin Holloway, an old friend who has moved there, told me. It seems to start nowhere in particular. Municipalities crowd one another. Then suddenly, just off the expressways, the downtown sky is scraped by dazzling architectural jewels. Miami decked

Gateway to the Americas

With a population nearly 50 percent Hispanic, and a prime location on Florida's southeast coast, Miami has become an important financial crossroads, with some 250 multinational companies represented and yearly exports totaling 10.5 billion dollars. Miami proper—population 360,000—is the largest of 27 municipalities in Greater Miami, the metropolitan area within Dade County.

itself with these even as most of the country was proclaiming the city doomed, a paradise lost to drugs and riots.

Miami's sprawling neighborhoods of Cubans, Haitians, other Caribbean islanders, Nicaraguans, South Americans, blacks, Asians, and Anglos touch but hardly seem to relate to one another. A tossed salad rather than a melting pot is one way locals describe metropolitan life.

Miamians struggle to manage growth, resolve racial and ethnic tensions, and retrofit an awkward metropolitan governmental structure that coalesced just 35 years ago. "Miami has undergone more continuous change than perhaps any other U. S. city," says publisher Lawrence. "People still are not being given a breather."

Spanish is the native tongue for nearly half of Greater Miami's two million people. Parts of this conglomeration seem mini-nations: Little Havana, Little Managua. But thinking of Miami as "invaded" by foreigners or as an outpost of Latin America misses the point. While it is true that Spanish is often more useful than English, it is more true that much of Miami life is about making America home.

At the Dade County Auditorium last March nearly 1,500 people from 80 nations raised their hands to take the oath of allegiance—about the same number who do so at every twice-monthly swearing in, immigration officials told me.

Eighty-seven-year-old Digna Lopez was the oldest. She beamed when I approached her. Mrs. Lopez had fled communist Cuba 20 years ago. Now she is a U. S. citizen. "Today I love more this country than I do my own."

Twelve-year-old Jean Phillipe, Jr., smiled joyfully too. Three years ago he left Haiti to join his father in Miami. "You can benefit if you are a citizen. You've got a better chance."

Beneath a canopy of flamboyance, pretension, pleasure, and problems, dreams of something better pace the city's rhythms. "If you don't like Miami," observes historian Arva Moore Parks, "just wait a minute."

What Miami does not have, it often creates

instantly, with flair. Its skyscrapers are an example: exotic, fashioned-in-the-spirit-of-fun, upwardly mobile sculptures. A four-storied square opens in the middle of the Atlantis Building; at its center, you climb bright red stairs to a blue Jacuzzi under a palm tree.

MIAMI IS ALSO A GATEWAY for illegal drugs: Laundered money from drug profits is part of the new city's foundation, as is its role in the front line in the war against drugs.

During a recent ten-month period 40,000 pounds of cocaine were intercepted in Miami by the U. S. Customs Service. With perhaps 70 percent of the cocaine reaching U. S. streets being smuggled in via Miami, the task of drug warriors here remains enormous. "We're playing against a loaded deck," said Chief Inspector Jeffrey Baldwin of the Customs Department Contraband Enforcement Team. "Drug runners have every resource; our resources are limited."

Virtually anything can be made to contain cocaine. A shipment of plastic gears turned out to be 30 percent cocaine. If they had gotten through, the drug would have been extracted chemically. I held a "yam" of cocaine, shaped and painted to look like the tuber. Little roots had been glued on.

At Miami International Airport plainclothed "rovers" keep a sharp eye, and nose, for anything out of the ordinary. When inspectors wondered why a Mr. Gomez smelled of vinegar, it turned out he was wearing on his back a latex sheath containing six pounds of cocaine. The vinegar was to hide its smell from drug-sniffing dogs. "Behavior makes seizures," explained inspector Charles Headley. "A good inspector says, 'What's wrong with this picture?' "

Technology helps. At the warehouse of Tampa Airlines, a Colombian carrier, I met security director Rex Wheeler. Tampa flights were once notorious for contraband. Now the airline leads the way in carrier-assisted drug seizures—about 14 percent of all intercepts.

A bank of television screens monitored boxes of cut flowers from Colombia passing through an X-ray machine. Tampa has placed 26 cameras at the Miami airport and others in Colombia. Two of Rex's screens monitored a Bogotá warehouse. "The system works," he said. "We've eliminated 80 to 90 percent of the coke brought in through cut flowers."

An environmental gladiator at 101, Marjory Stoneman Douglas campaigns from her Coconut Grove home to save the Everglades. For more than four decades she has turned public attention to the vast freshwater system, crippled by human intrusions, that sustains the shrinking natural world of south Florida.

Miami is partly a victim of its proximity to Latin America. And as long as there is demand, the risks of supplying are seen merely as the cost of doing business. "You can take $5,000 to Colombia," said John Dalton of the Miami Police Department's Street Narcotics Unit, "and buy enough cocaine to make a million dollars on the street."

The drug streets are Miami at its ugliest. I burst into a crack house behind a SWAT team and the Street Narcotics Unit and traveled with the unit as they swooped down on street-corner drug dealers. This meanest of worlds is filled with emaciated bodies in "get off" houses, with sickly babies, violence, and filth. But even here there is a glimmer of hope.

"Crack may have been the slap in the face that has made cocaine unacceptable," says Jim Hall of the Up Front Information Center. Cocaine use is down, more addicts are seeking treatment, and more communities are mobilizing against pushers. "But," Jim stressed, "it's a shrinking of the outer edges. The poor continue to be heavily addicted."

Time has not eased the grief of a woman whose son died in the 1961 Bay of Pigs invasion. In Little Havana fellow Cuban refugees offer support as they mark the 30th anniversary of their attempt to retake Cuba. Three months after arriving from Cuba by raft, Ahmed Elmuza (right) had a restaurant job, an apartment, and a car, thanks to help from established exiles.

Their home in Coral Gables faces Biscayne Bay—a coast on which some of Miami's wealthiest settlers sited their homes. "Go out that cut," said Sherwood Weiser, when I spoke admiringly of his yacht, "and you're on the way to Europe. Turn right instead of left, and you're on the way to the Caribbean."

Judy Weiser raises orchids as a hobby and spends many hours as chairperson of the Coconut Grove Playhouse. She and her husband share a love of modern art. In their home Ross Bleckner, Frank Stella, Isamu Noguchi, and Ad Reinhardt are all represented. And one wall in the family room is given over to a mural depicting the final airport scene in the movie *Casablanca*.

Neither thinks of living a glittery life. More than anything, they insist, their home displays Miami's lush beauty. "We can sit in the living room or the dining room and see and enjoy it," Judy Weiser told me.

As Anglos—a word used in Miami to group non-Latin whites—they are a minority. But Sherwood Weiser was emphatic that he finds the city's diversity an attraction. "Miami would not have matured as quickly and in such a cosmopolitan way without immigration. What's exciting is that here one can participate in building a city."

Is Latinized Miami uncomfortable for Anglos? Not clear. Cuban and Anglo professionals have very different styles, says one Anglo executive. "We wear suits, they wear suits, but what we 'suits' won't tell you is that we don't like each other very much." But after a trip "I take a deep breath of tropical air and realize how glad I am to be back."

Why do many Miamians seem uncertain about the city? I expected that the answer might be fear of crime or ethnic friction. Instead I found something more subtle.

The Greater Miami Convention and Visitors Bureau surveyed residents. "We found they were searching for a sense of hometown," said a spokesperson at a press conference kicking off an ad campaign aimed at making Miamians feel better about their city. "Everybody felt Miami was better than anyplace else," bureau official Tarleton Jones told me, "but they didn't feel a sense of community."

For Miami to be selling itself to itself is not surprising. Image gave birth to Miami, and image often seems to be all the city is about. "Miami is real," says Arva Moore Parks, "but I think most people think it's not."

MIAMIANS RESENT the city's image as a drug capital. And, indeed, it is not completely fair. Sherwood Weiser frowned. "Miami is so well-known that it's easy to make it seem as if all we have are problems." He is chairman and chief executive officer of the Continental Companies, which operates more than 50 hotels around the country.

Like most of the city's prospering leadership, he is enthusiastic about Miami. He moved here from Ohio with his family in 1969. They found that if you have money, living in Miami is "like being in paradise," as Judy Weiser put it. "This is Shangri-la."

UNTIL LATE in the 19th century south Florida's mostly unsurveyed peninsula was swampy backwater. William English of Columbia, South Carolina, who bought a thousand acres along the Miami River from his uncle in 1842, may have been the first to call the area Miami. It came from an Indian word: *Mayaimi,* which perhaps referred to Lake Okeechobee and meant "large water" or, I was told, "sweet water," for the Miami River.

Miami was still frontier when Julia Tuttle, young widow of a Cleveland, Ohio, industrialist, moved here in 1891. Her father had come 21 years before; he loved the wild beauty of the bay. She had taken her children there in 1875 and brought her husband down, hoping that the balmy climate would help cure his tuberculosis.

She saw more than frontier. "It is the dream of my life," she wrote, "to see this wilderness turned into a prosperous country and where . . . vine brush, trees, and rocks now are to see homes . . . surrounded by beautiful grassy lawns, flowers, shrubs, and shade trees."

Mrs. Tuttle envisioned a railroad. She offered half her 640 acres to industrialist Henry Flagler, who was building a line to West Palm Beach. He was not interested. Then a winter freeze virtually destroyed northern Florida's

"Here they celebrate sweet 16, but I've always wanted a quince party," says Ayanidys Martinez, enjoying the kind of lavish 15th birthday party once customary in Cuba. At a theater on southwest Eighth Street, symbolic heart of the Cuban community, a revue of traditional music and dance entertains a nostalgic audience.

citrus crop in 1894-95. Mrs. Tuttle sent Flagler a bouquet of fresh orange blossoms to prove there was no frost in Miami. Flagler's railroad arrived in April 1896; three months later the city of Miami was incorporated.

Vacationers followed the railroad. Soon Miami became a winter retreat for the wealthy, who built fabulous mansions along Biscayne Bay. Later the bay itself was dredged to transform a swamp into Miami Beach.

There were 343 registered voters before Miami's incorporation. After, the city grew rapidly. "The air was electric with talk of money," wrote Marjory Stoneman Douglas of the 1920s. " 'Hundreds' became 'thousands.' 'Millions' became a common word. . . . It was all cloudy, all visionary, all on paper, but everybody making these heady millions clung fiercely to the belief that it was real."

Then in 1926 a great hurricane smashed the city. A few years later the Great Depression hit. Miami tightened its belt and still grew.

WHEN 32-YEAR-OLD FIDEL CASTRO swept into Havana, Cuba, in 1959, that event on an island 200 miles away seemed distant. Times were good. Tourism was thriving. Movie stars and millionaires were filling up the posh hotels. The "Gentile Only" and "White

"This is one way ladies from different churches can meet and become friends," says Bobbie Mickens, at far left, hosting a pre-Easter hat sale at her home on Coconut Grove's Charles Avenue. Dating from the 1890s, it became Main Street for Miami's first black community.

Only" signs at hotels were coming down; schools were desegregating. A new metropolitan form of government had been approved. Miamians little suspected how great an impact the revolution in Cuba would have on them.

In 1960 planeloads of refugees left Havana daily. By the end of the sixties, a Cuban refugee arrived every ten minutes. In the 13 years following the revolution, Miami's Cuban population rose from 29,500 to 247,000.

Today, almost half of Miami is Hispanic, nearly 60 percent of Cuban heritage. The numbers make Cubans a majority and other Latins minorities. In Miami the label Hispanic is of less use than nationality: Cuban, Nicaraguan, Colombian, Mexican.

"Cubans here have established what we call a true enclave," explained Florida International University sociologist Lisandro Pérez, who came to Miami with his parents in 1960. "It's not Cuba, but it's home."

The city has been restructured by Cuban entrepreneurship. Even the Non-Group, once an all-Anglo club that still attempts informally to influence city policies, is cochaired by Cuban-born Armando Codina.

Pepe Badia's company is Miami's largest spice producer, generating about six million dollars in annual sales. The aroma of spices filled Pepe's warehouse. "If you bring McCormick in here, they'd probably laugh. It isn't much for them; for me it is the world."

"This is a family business," he told me when introducing his father, mother, aunt, and godmother. "My parents started mixing spices in their kitchen. I rolled paper funnels, and Mom filled envelopes."

Pepe's story is typical of Cuban Miami. "The high degree of entrepreneurship," Lisandro Pérez had told me, "means that the entire range of life can be lived within the Cuban community." Pepe agrees. "When we started, there were only little shops, and when they grew, we grew." But he only agrees to a point. In 1990 he began distributing in New York and California. "Being Cuban doesn't have much to do with that."

Miami's Cubans are far better educated than most immigrants. About one-third of all employed Cubans are professionals; another third are salespeople, craftsmen, or skilled laborers. "This city is so young that it was possible for an elite from another country to become a real part of the community's establishment," points out Pérez.

One of the things this middle-class foundation means is that even the largely unskilled "Mariel boatlift" Cuban refugees dumped by Fidel Castro in 1980—who at one time made up much of the Latin prison population—have a network for employment in Cuban companies in the area.

Miami is now flooded by a new wave of

Cuban refugees. Perhaps as many as 30,000 have arrived legally on tourist visas and refuse to go home. By October more than 1,860 had survived desperate voyages on rafts or small boats—up from 467 in 1990.

Ahmed Elmuza was one of these. Last April, along with his wife and five others, he reached Miami after a seven-day journey on a raft constructed of inner tubes and mangrove tree branches. When a yacht spotted them, they feared it was a Cuban vessel until they were offered a can of beer. Then the Coast Guard showed up, and Ahmed realized the perilous voyage was over. "I started crying."

Ahmed and his wife, María, were held for four days and then released. Within a week he got a job at a Cuban restaurant. There a customer heard his story and offered him an apartment with no deposit required. Another customer gave him a 1980 Malibu. "In the short time I've been here," says Ahmed, "I see you can progress."

HAITIAN REFUGEES also flow steadily toward Miami. Some come by airplane, others crowd rickety boats that hardly seem able to cross 600 miles of ocean. But they find no welcome. In July when a dilapidated Haitian fishing boat called the *Conail* was stopped by the

NATIONAL GEOGRAPHIC PHOTOGRAPHER JODI COBB

By the ounce and by the ton, drugs stream into Miami, a major U. S. point of entry and distribution, particularly of cocaine. Checking out baggage at the airport, a cocker spaniel named Corky (below) sits when he smells something suspicious. Shipments that elude the U. S. Customs dragnet end up everywhere from bayside condos and suburban homes to apartment buildings (left), where residents on a courtyard stairway await the outcome of a police search. Cash and cops are reflected in a police car window as suspected cocaine dealers await their fate.

Coast Guard, 161 of its 163 passengers were Haitian. The other two were Cuban refugees the Haitians found clinging to a flimsy raft. The Cubans now live in New York as political refugees. All but nine of the Haitians were returned to Haiti.

As political refugees, most Cubans gain virtually automatic asylum, but a treaty between Haiti and the United States has required that Haitian refugees be interdicted at sea. Of 23,300 Haitians stopped since 1981, only 20 have been brought ashore to seek asylum. Says Cheryl Little, an attorney with Miami's Haitian Refugee Center, "Haitians have been blatantly discriminated against."

Illegal aliens allowed to apply for asylum are held at Krome Service Processing Center. Dade County and Miami officials share concern over rising tensions because of the double standard in the treatment of Haitians and Cubans. In July, Miami Mayor Xavier Suarez and Metro-Dade Commissioner Arthur Teele wrote Florida Senator Connie Mack, seeking his help in closing Krome.

Richard Smith of the Immigration and Naturalization Service (INS) responds: "We're doing what we can with a limited budget. Haitians tend to be confined longer because they're the largest group entering Miami with no documents or false documents." But, he

Eyes flashing anger and pain, a member of the Haitian activist group Veye Yo ("watch our enemies," in Creole) guards the casket of outspoken radio commentator Fritz Dor, mysteriously gunned down on a Little Haiti sidewalk last year. More and more, south Florida's Haitians are speaking out against prejudice and abuse. A prime example, they believe, is the Krome Service Processing Center (below), where Leana Guillaume visits her detained brother-in-law.

says, rules governing their parole are easing. "You will see their detention time decrease."

At Krome I was shown craft workshops, an athletic playing field, and a clinic. But Krome is a prison, and for the Haitians who make up most of its population, a puzzling, frustrating imprisonment. Jean Duvilaire, 23, had been held since last February. "We entered illegally, OK? But people know what kind of violence we have gone through in Haiti."

Marie Chapelle Clairville was put in Krome in October 1990. Her story speaks for most: "In 1989 Haiti police came to my house at 5 p.m. and took my husband. I never saw him again. Because of that I decided to leave."

I was not surprised to learn that proportionally more Haitians live illegally in the Miami area than any other immigrant group. The INS is not sure how many there are, perhaps 90,000. "I estimate that at least half the Haitian population in Dade and Broward Counties are persons the INS has never come into contact with," Richard Smith told me.

BLACKS BORN in the United States also feel unwelcome in Miami. "The Cubans get everything; we get nothing," a young black man leaning against a boarded-up building in Overtown told me. I heard this frequently.

Palm trees seem to shiver as a May storm pounds Miami Beach just before hurricane season. Such squalls brought above-average rainfall in 1991, ending more than two years of drought and replenishing

the water supply. While residents and farmers welcome the rain, visitors expect sunshine. More than ten million tourists spend six billion dollars a year here, feeding Miami's top industry.

Created by segregation, Overtown was once the heart of black Miami. During the thirties and forties its main street was known as "little Broadway." "We had our own shoemaker, dressmakers, and tailors," recalled Dorothy Fields, who grew up in Overtown. "Somewhere over there," she said pointing toward an alley, "Sidney Poitier was born."

Dorothy, who directs the Black Archives History and Research Foundation of South Florida, dreams of restoring Overtown, now plagued by crime and poverty. "For about a million dollars we can save the Lyric Theater." She hopes to see it turned into a community theater and meeting place.

It would form part of the redevelopment of a two-square-block area to be known as Historic Folklife Village, and Dorothy sees Miami tourism extending to the restored village. Nearby is Miami's Center for the Fine Arts. "When the Fine Arts was being built, a newscaster said, 'Why build here? If they make a wrong turn, they'll be in colored town.' I say they'll be making a right turn."

It is ironic that the first name appearing on Miami's original city charter is that of a black man. One-third of the signatories were black.

Black Miami feels bypassed. A study conducted by the University of Michigan found that blacks in the Miami-Fort Lauderdale area are poorer than blacks in 23 other urban centers. Affluent blacks are scarce. "Black economic disparity is the single biggest problem we have," acknowledged Merrett Stierheim of the Convention and Visitors Bureau.

Sometimes black Miami feels like a lit fuse. In 1980 one of the worst racial conflagrations in modern U. S. history took place in Miami. In the next ten years three others occurred.

While touring the U. S. in 1990, South African black leader Nelson Mandela thanked Cuba's Fidel Castro for supporting the African National Congress. In Miami that was tantamount to thanking the devil. City leaders did not receive him when he stopped here.

Many black Miamians reacted angrily, mounting a boycott against Dade County hotels. Organizers believe it has cost the county some 28 million dollars in canceled conventions. H. T. Smith, a boycott leader, handed me a leaflet. "You see, at the top, in the biggest letters, is 'respect.' We believe respect is the basis for a new relationship. It just starts with an apology to Mandela."

Some black leaders say the example of Miami's immigrant communities is a useful model that stares black Miami in the face without being recognized. Blacks have become mired in a system that promises assistance but in actuality prevents an exit from poverty, insists Urban League CEO and President T. Willard Fair. "The key is moving beyond welfare. You can be 'helped' forever, as long as you meet the eligibility requirements."

More frequently than I would have guessed, I came across tough-minded practical efforts within Miami's black community. Consider Coconut Grove, first settled by blacks, mainly Bahamians. The south part of the neighborhood is Anglo and has always been an in spot. Miami's first resort hotel opened there. In the 1960s the south Grove was a favorite of hippie artists. Now gentrification has fostered elegant eating places and sidewalk cafés.

The west Grove, which begins where Grand meets McDonald Street, is black. Many better-off blacks have left. For most who remain, income is below the poverty level.

BOTH BY JODI COBB

Villas on putting-green lots ring tiny Rivo Alto Island, with private docks fronting on Biscayne Bay. Art collector, car dealer, and owner of the Philadelphia Eagles, Norman Braman (above) recently purchased a 4.5-million-dollar waterfront estate on the exclusive island of Indian Creek Village. There a 15-member police force guards the 40 or so mansions.

The Coconut Grove Local Community Development Corporation has built 15 houses for such low-income residents. They are modest homes with patios of patterned ceramic tiles and small front-yard gardens. David J. Alexander, the organization's executive director, explained that they were able to tap into a Dade County special fund. Potential homeowners can get a mortgage loan with lower out-of-pocket costs. "Real estate, after all, is the engine of south Florida," David told me. "And our people will take care of and preserve a community if they have a stake in it."

Another 17 houses are planned. A drop in the bucket? Yes . . . and no. "It lays the foundation," David believes, for including blacks in future development. "From upstairs I can look at a pristine view of Biscayne Bay. Six blocks east, land is $260 a square foot; here it's six dollars. It's inevitable that the 'black Grove' is going to develop. The only question is, who's going to develop it and how?"

That question is asked increasingly in other Miami communities. Growth heightens countywide pressures for greater local authority. When owners of the Miami Seaquarium began pushing a 70-million-dollar plan to renovate and expand it by adding water slides, wave pools, and restaurants, residents of Key Biscayne protested. They feared increased traffic and commercialization.

In June the residents voted to incorporate the community as a new town. For the first time they have an elected mayor and council. More than the expansion of the Seaquarium was at issue, explained Betty Sime, a local leader. Key Biscayne was part of unincorporated Dade County—about half of Greater Miami resides in unincorporated Dade. Pointing to a proposed site for an 800-room hotel

"I've been referred to as a one-man urban renewal company," says developer Tony Goldman (above), singing in one of his south Miami Beach hotels. "But I'm really a team player with a vision." Seven years ago he and other entrepreneurs began to buy up and restore Miami Beach's art deco buildings. Today this once decaying square-mile area is a hot fashion-photography locale (left). Come evening, the artistic, the hip, and the beautiful frequent such spots as ESP, which hosted an Oscar-night costume party last year (below).

and condominium complex, she charged: "The county gave public roads running through the property to developers without consulting people in the neighborhood. We wanted local control."

I spoke with Dade County Mayor Stephen P. Clark. "Miami should have taken over the county," he acknowledged, "but the state legislature wouldn't let it happen."

IN A CITY where much history has been paved over—even the site of Julia Tuttle's home is now a hotel and convention center—the Miami River is an unbroken thread sewing the past to present. Ten thousand years ago Indians settled along its banks, using tools made from seashells. Surely, even then, Miami must have seemed a paradise.

Today Miamians ignore their river or curse it while waiting for one of its ten drawbridges to lower. Although only five miles long, if the river were considered as a separate port, it would rank as the fifth largest in Florida. In 1990 it handled 1.4 million tons of cargo, worth 1.7 billion dollars.

Seafood-processing plants, boatyards, and repair facilities crowd its banks. Vessels of all sorts—Cuban shrimp boats, wooden Haitian rattletraps—are squeezed into berths along with yachts and houseboats. Tugboats tow

Miami's glitz beckons vacationers on a clipper heading for the world's busiest cruise port. By boat, plane, or inner tube, growing numbers of refugees from Latin America and the Caribbean aim for the same horizon, hoping for a way through Miami's golden door.

freighters in and out; space is cramped. I watched one ship pass another, their railings touching.

Pollution too is a problem. Old sewage pipes that cross the river often back up during heavy rains, and last May a pump failure caused a sewage spill. But the problems here seem small compared with, say, the Great Lakes.

Bob Menge, an environmental enforcement officer, pulled alongside a Haitian boat where a discharge had created an oil slick. "Let me see the captain," Bob called out, showing his badge. Only the first mate was there.

"You cannot discharge anything more into the river," Bob told him. The first mate explained that they have been working on the engine. It is the first warning for this boat. "Next time the ticket is $500," Bob said. Boat owners and bankside companies know the warning is serious.

LEAVING THE RIVER, I realized that I had been in the city for a month and still had not seen Miami Beach. Perhaps it is a measure of change that the beach is not the first thing we think of as defining Miami.

The beach is still very much there, even born again. In some ways it is as "new" as Miami proper. Kosher delis have dwindled, as have the elderly. Just a third of the residents of this once favored retirement spot are 65 and older, down from more than half in 1980. Hispanic numbers have grown as dramatically.

In south Miami Beach young developers have poured millions into renovating art deco hotels and homes created in the 1930s for moderate-income vacationers. While the northern end long offered huge, self-contained hotels and resorts for the affluent, retirees on a fixed pension found South Beach's low rents perfect for their last years. But South Beach began to slowly decay. Then in 1980, Cuban "Marielitos" were dumped on the beach by the thousands, and with them came a sharp increase in crime.

"It was like Dodge City down here, cutting and shooting," recalled Louisa Pigg, who operates a small residence hotel. Tourists were warned to stay away, especially at night.

Now, says Tony Goldman, a hotel owner and developer, "South Beach is a beacon for cosmopolitan frontier people."

I agree with Tony's view that the pleasure of Miami Beach lies in the fact that you can walk around. "Miami itself is a vehicular city with no street interaction. People get uptight when confronted with others who are different. The textures are not yet woven together."

But the textures are rich. So while Miami is indeed unfinished, to me it is an example of the best prospects of America. If the city seems puzzling, chalk that up to its youth. It has hardly had time to grow. □

U.S.S. Macon: Lost

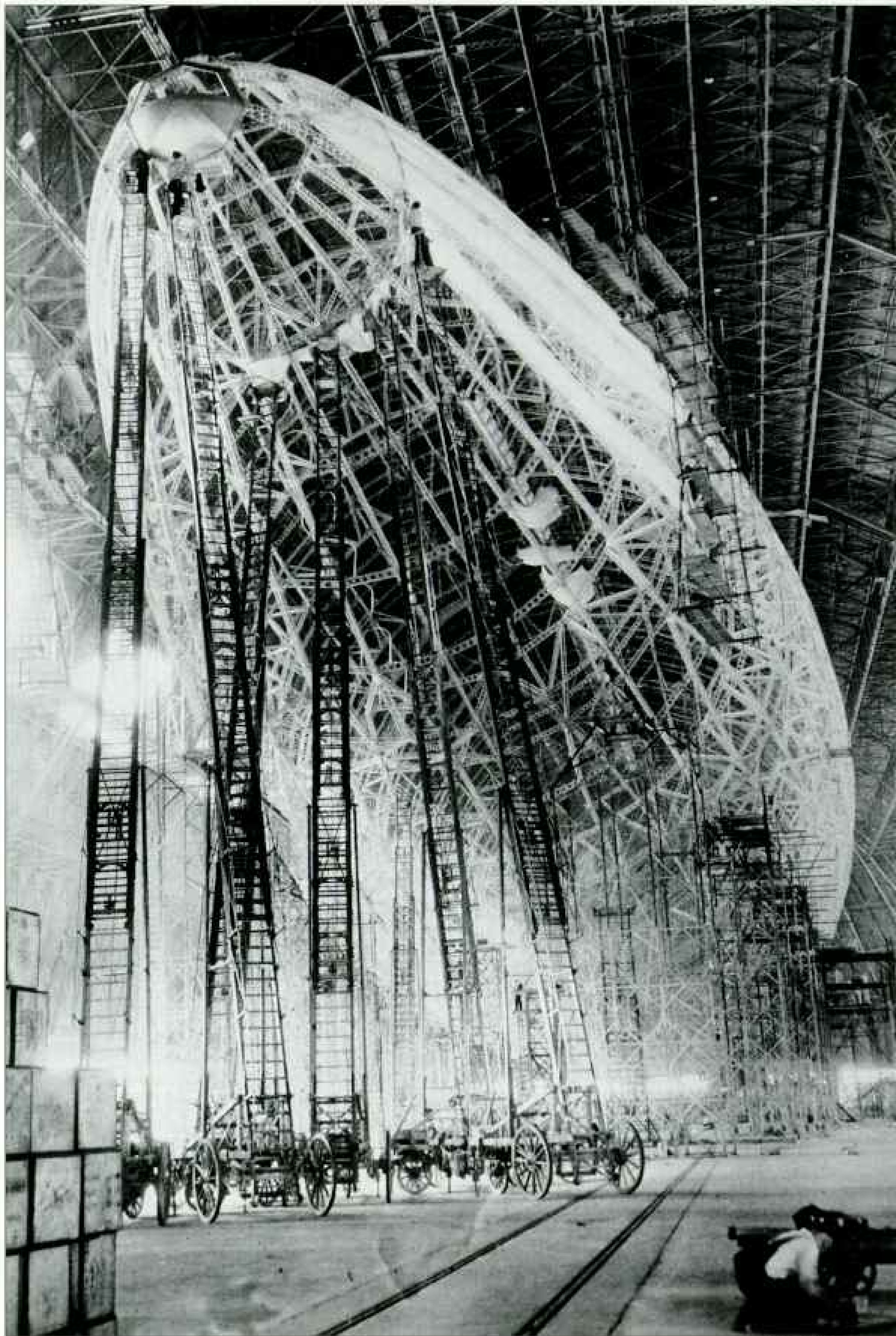
America's last queen of the skies floats majestically over Manhattan. Her loss in 1935 marked the end of an airship era.

NAVAL INSTITUTE PRESS (ABOVE); MOFFETT FIELD NAVAL AIR STATION

AND FOUND

By J. GORDON VAETH

INSIGNIA OF MACON'S SCOUT AIRPLANES, "THE MEN ON THE FLYING TRAPEZE"



HEPBURN WALKER

J. GORDON VAETH

SHE PURRED, NOT ROARED, across the landscape, and when she passed, she blotted out the sun. The U.S.S. *Macon*, built in 1933, was the largest aircraft in the world, and many said the most graceful, her silvery hull reflecting the colors of the sky.

The *Macon* was a helium-filled, aluminum-framed dirigible as long as two and a half football fields. She was a sky-based aircraft carrier, mother ship to five Sparrowhawk fighter biplanes hangared in her belly.

In the gritty years of the Great Depression, when I was a teenager obsessed with anything that flew, the *Macon* was a source of pride and wonder for Americans. Families clambered onto rooftops; farmers craned their necks to see her gliding overhead. But on February 12, 1935, under the command of Herbert V. Wiley, she was mortally damaged by a violent gust of wind and collapsed into the Pacific Ocean.

The loss ended America's brief love affair with rigid airships. Blimps were still used for antisubmarine patrols when I served with airship units as a Naval Reserve officer during World War II, but rigid airships were forsaken. After the war a few of us, still smitten with the romance of the era, kept up an "airship underground," writing, lecturing, and lobbying for their return. But we never expected to see the *Macon* again, and only cursory efforts were made to locate her grave.

MRS. F. J. TOBIN, FROM SKYSHIPS, HARMONY BOOKS

Skippers Alger H. Dresel (above, at left) and Herbert V. Wiley were the Macon's only masters. Fanfare, including commemorative envelopes (above left), followed her brief career. In the Akron, Ohio, hangar (facing page) workers atop ladders wrapped cotton-cloth skin around the stern in 1932. Three years later, headlines sounded her knell (below).

One morning in 1980 fisherman David Canepa winched up his catch of black cod off Point Sur, California, and found a mysterious two-foot piece of light metal entangled in the nylon webbing of his traps. Canepa gave it away and forgot about it. Years later, Marie Wiley Ross stopped at Jeanne B's restaurant in Moss Landing, near Monterey, and saw the aluminum fragment hanging on the wall as a decoration.

"I recognized it immediately," said the schoolteacher from Livermore, California. "I had walked among girders like that when I was a child. There was no question where it came from—my father's ship, the *Macon*."

Other fragments of the airship had washed ashore just after the wreck, but no one had tried to track them back to the sea. Now, with a tantalizing clue in hand, events quickened.

San Jose Mercury Herald

Macon Sinks Off Monterey Coast; Two Members Of Crew Missing

Down and Abandoned by Crew at Sea

NAVAL INSTITUTE PRESS

Gordon Wiley, Marie's brother, told former Navy pilot Richard Sands of San Francisco, who represents the National Museum of Naval Aviation Foundation in Pensacola, Florida. Sands contacted David Packard, founder of the Monterey Bay Aquarium Research Institute (MBARI), and he referred the matter to *Macon* enthusiast, Chris Grech, pilot of MBARI's remotely operated vehicle. Grech had tried to locate the airship by side-scan sonar but had turned up only an old shoe—and skepticism from colleagues.

By coincidence MBARI's research vessel, *Point Lobos*, docks at Moss Landing, and the MBARI facility there sits next door to Jeanne B's. Grech, amazed to find a critical clue only feet from his own desk, traced the aluminum girder back to David Canepa, who takes great pride in his fishing records. Canepa pinpointed the location, and, at Grech's urging, on June 24, 1990, the Navy sent its three-man deep submersible *Sea Cliff* to the site. It found the remains of the *Macon* within fifteen minutes, at 1,450 feet.

The dirigible had long since broken up, but the museum of naval aviation hopes to salvage one of her planes. In February 1991, MBARI sent the *Point Lobos* back to videotape the airship's debris fields, and I watched, along with marine scientists, on a shore-based television monitor linked by microwave to the vessel's camera. As a member of the Naval Airship Association, I had volunteered to help identify airship parts.

Nostalgia overwhelmed me as the camera panned across the sad remains. These colossal sky ships had held such promise and ended in such disaster. The first American rigid airship, *Shenandoah,* perished in thunderstorms over Ohio in 1925; 14 members of its crew of 43 died. On April 4, 1933, the *Macon*'s sister ship, *Akron,* was also lost in a storm, over the Atlantic, with only three survivors from a crew of 76.

Three weeks after the loss of the *Akron,* the *Macon* made her maiden voyage, under Comdr. Alger H. Dresel. The cautious Dresel was succeeded 15 months later by Lt. Comdr. Herbert V. Wiley, who had been executive officer of the *Akron* and one of her survivors. Anxious to redeem the reputation of airships, he embarked—just seven days after taking command—on a brazen search-and-locate mission. His unauthorized objective: the vacationing President of the United States.

Franklin D. Roosevelt was somewhere in the Pacific Ocean, bound for Hawaii aboard the cruiser *Houston.* Wiley and the *Macon* would find him. When spotters on the *Houston* saw two airplanes approaching at the implausible distance of 1,500 miles from shore, they were stunned. Knowing the President enjoyed his regular newspapers, the pilots dropped the latest San Francisco papers and souvenir mail for him.

Roosevelt was impressed, but the commander of the U. S. Fleet, Adm. Joseph M. Reeves, called the flight "ill-timed and ill-advised." Years later Wiley remarked to me, "They told me to show that the *Macon* could scout. When I did, they wanted to court-martial me!" They never did. According to Wiley's son, Gordon, Roosevelt himself interceded.

JONATHAN BLAIR

Clue to the Macon site, a piece of a girder, hung in Vincent and Jeanne Balesteri's restaurant. Chris Grech, at right, of the Monterey Bay Aquarium Research Institute (MBARI) led the search for the craft last seen by her escaping crew (painting, right).

Wiley's luck failed him in the late afternoon of February 12, 1935. The *Macon* was northbound in rain squalls, five miles off Point Sur and returning home to Moffett Field near San Francisco, when at 5:05 p.m. a freak gust slammed her bow to starboard. The airship lurched and rolled, and one of the rings that held the upper tail fin collapsed, its edges ripping holes in three helium cells (pages 120-22).

At Point Sur, lighthouse keeper Thomas Henderson sighted the *Macon* with his binoculars, just in time to see the tail fin fly into pieces. Out of control, the airship shot nose first to 4,850 feet, into thick clouds, dropping water ballast and fuel tanks to regain level flight. But her pressure-relief valves, designed to open automatically above 2,800 feet, began venting helium from her remaining cells. Without the lift, she dropped, hitting the water tail first.

Radioman 1st Class Ernest Dailey jumped to his death; Florentino Edquiba, a Filipino mess steward, was trapped inside. As the *Macon* foundered, the rest of the 83-man crew scrambled for life rafts and were rescued by navy cruisers summoned from nearby fleet exercises by Wiley's SOS.

For about 40 minutes the great airship floated helplessly, crumpling and settling. Then, with her nose pointed skyward, she slipped beneath the surface with a sigh of helium.

Author of the forthcoming book *Blimps and U-Boats,* J. GORDON VAETH has known many of those who built and flew the U.S.S. *Macon.*

PAINTING BY GARY KELLEY

Framing

A series of rings linked by longitudinal girders, made of four-sided duralumin sections, composed the framework.

Fin Design

Fins were bolted onto two main rings, with leading edges supported by an intermediate ring. This design had long been suspect in the loss of the *Macon*, but the attachments held.

Main Frame 17.5

This ring failed, causing the top tail fin to tear loose, ripping holes in helium cells and fatally crippling the ship.

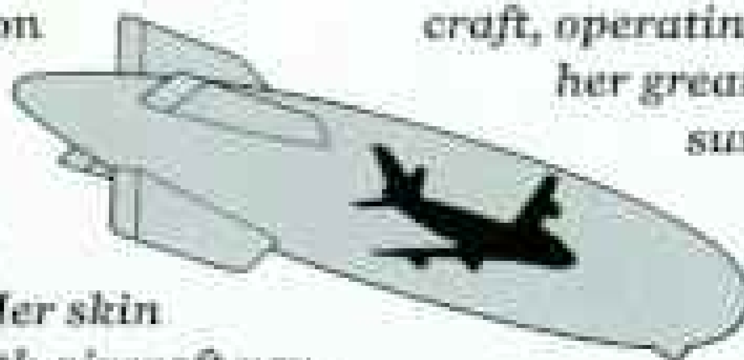
Outer Cover

Lightweight cotton cloth was painted with six coats of aircraft dope, two of them containing aluminum pigment to reflect the sun's heat and minimize its effects on the lifting gas inside.

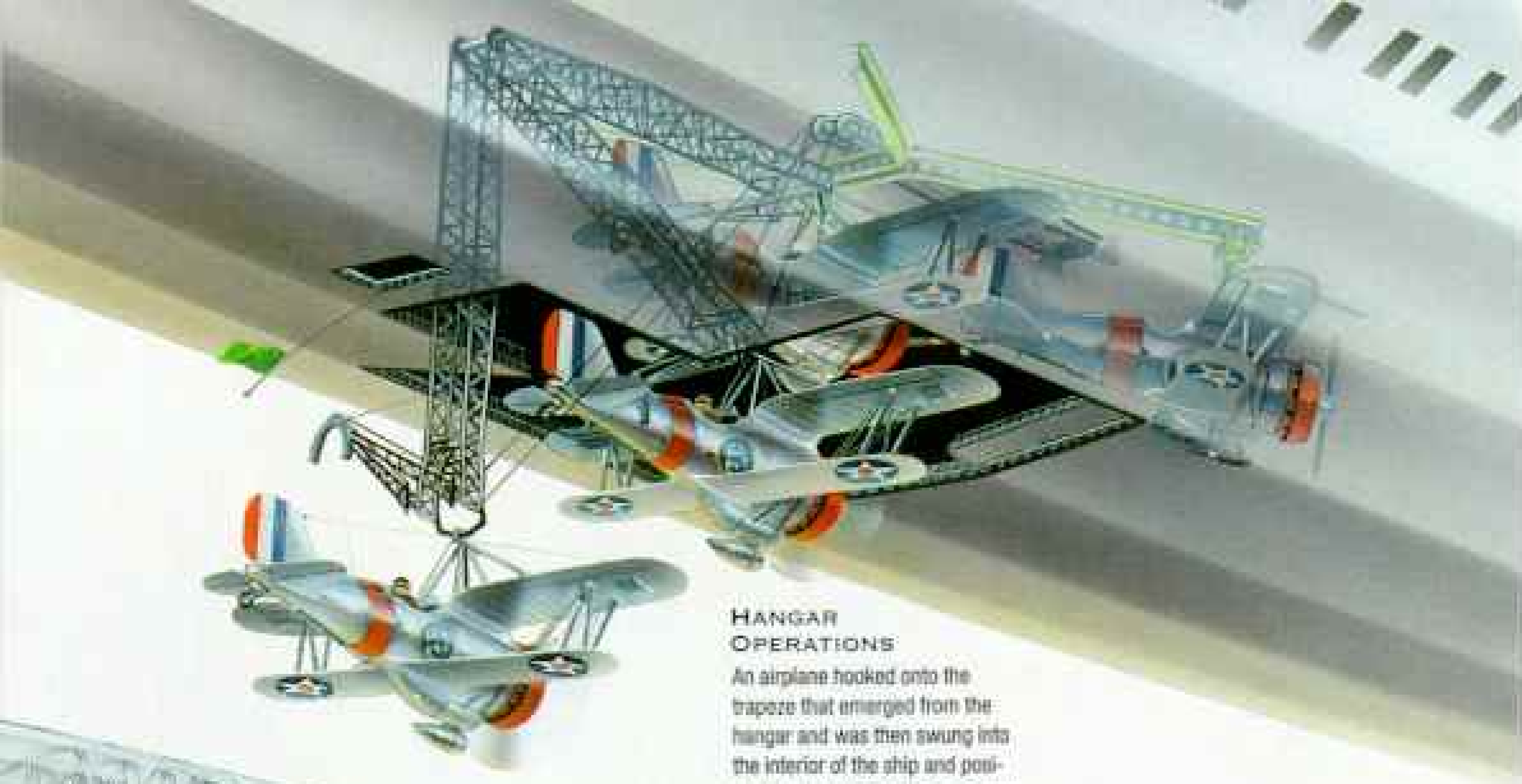
The Eyes of the Navy

An Aircraft Carrier in the Sky

This elaborate flying wasps' nest was three times longer than a Boeing 747. The U.S.S. Macon was 785 feet long, 133 feet in diameter, and weighed more than 240,000 pounds. Duralumin, an alloy of aluminum, formed her frame. Her skin was cotton cloth, painted with aircraft varnish, or dope, to make it taut, waterproof, and smooth. Twelve independently filled cells of nonflammable helium provided lift. For all her size she was a low-altitude aircraft, operating below a ceiling of 5,000 feet; her greatest lift came near the earth's surface, where air is densest.



Built by the Goodyear-Zeppelin Corporation of Akron, Ohio, the Macon and the Akron were both designed by a team of German engineers headed by Karl Arnstein.



HANGAR OPERATIONS
An airplane hooked onto the trapeze that emerged from the hangar and was then swung into the interior of the ship and positioned by an overhead rail system.

NAVAL INSTITUTE PRESS

A chief petty officer climbs to the bus-size control car via a gangway lowered from its aft end, the normal entrance to the airship. To operate a dirigible longer than a battleship, the Macon's crew of 80 to 90 moved among the gas cells on cork-covered walkways built into the keels.

Sometimes the crew was even used as ballast, to balance the ship in emergencies. The captain would send these "galloping kilos" scurrying to the nose or the stern, to regain proper trim.

MACON

U.S. NAVY

WATER-RECOVERY CONDENSERS
To compensate for the loss of weight as gasoline was burned, water vapor in the cooled exhaust gases was condensed, collected, and distributed for trim.

SWIVELING PROPELLERS
With gearing, propellers could be tilted through 90 degrees; the *Macon* was the largest aircraft ever to take off and land vertically.

LIVING QUARTERS
Enlisted men bunked to port, junior officers to starboard, and senior officers near the control car. Mess rooms and the galley were to starboard.

GAS CELLS
The 12 helium cells were made of cotton fabric impregnated with a gas-tight, gelatin-latex compound.

FUEL TANKS
Of the 110 fuel tanks carried along the keels, 30 were "slip tanks" that could be cut loose and dropped as emergency ballast.

ENGINES
Eight German-built Maybachs, 560 horsepower each, were mounted inboard along the keels, four to a side.

THE PERCH
A nonretractable trapeze allowed pilots to hook on to rest and save fuel, while waiting for the main trapeze forward.

WATER BALLAST
Water was kept in fabric bags along the side keels, to be dropped if lift was needed quickly.

CONTROL CAR
The bridge housed engine, ballast, rudder, and elevator controls as well as navigation gear.

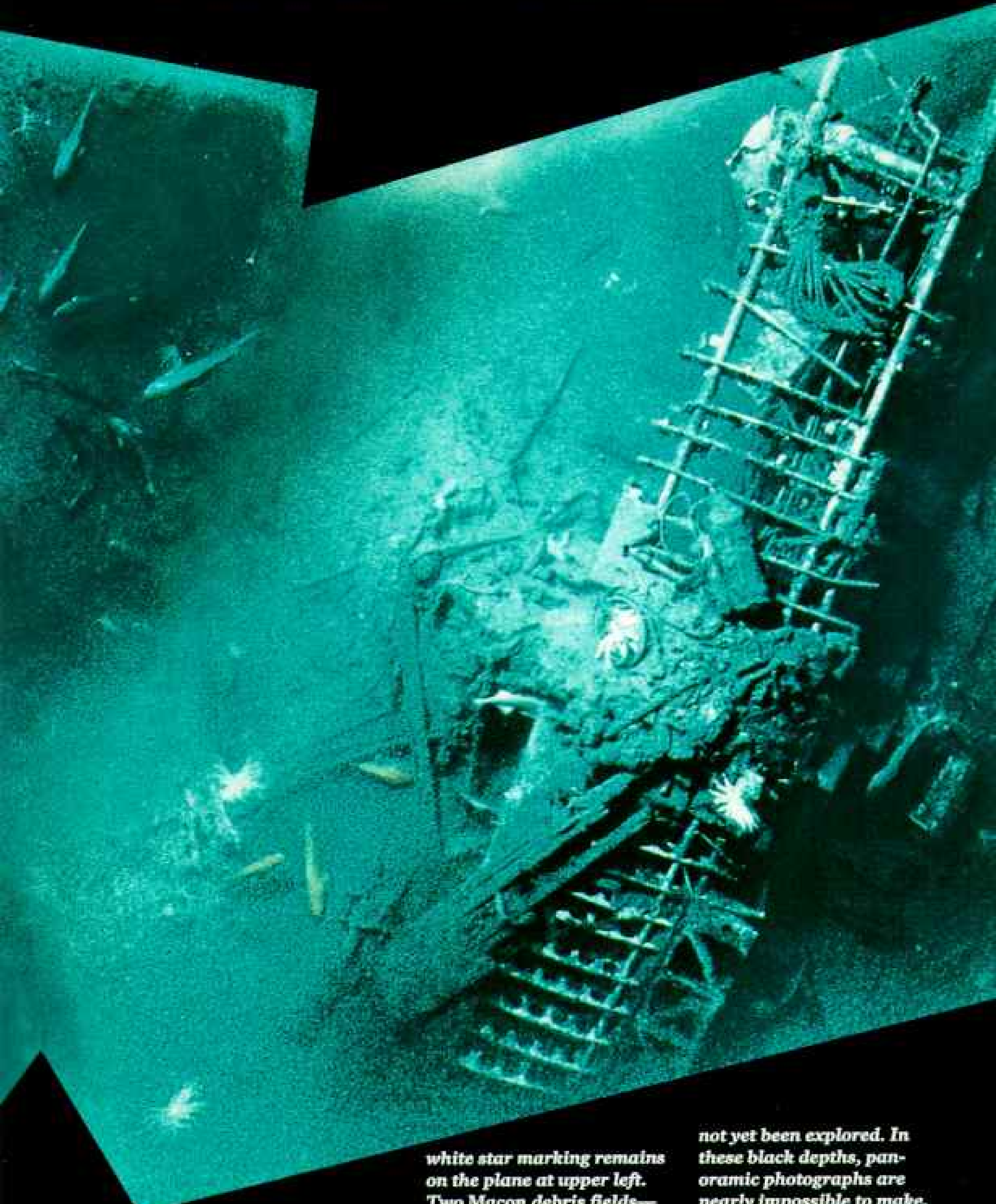
PAINTING BY RICHARD AND KENT LEECH; TECHNICAL CONSULTANT, DONALD E. WOODWARD

The *Macon*'s final mission ended in disaster (above), but no one pinpointed her resting-place until June 1990. With a video camera mounted on a tethered, remotely operated vehicle, MBARI technicians found corroded girders, crushed gasoline tanks, engines, and the mooring assembly of the *Macon*'s nose; the airship frame itself had collapsed long ago. In the flattened control car were windows, chairs, chart tables, even a lead pencil.

Stripped to aluminum bones, three of *Macon*'s four fighter-reconnaissance Sparrowhawks huddle in the Pacific at 1,450 feet, far too deep for scuba divers to explore. Only one other Sparrowhawk survives, in a museum. Salvage of the *Macon*'s planes would be difficult; if hoisted, they might crumble. Heavy silt fills one cockpit (below), where a thornyhead waits in ambush beneath the barrel of a gunsight.

CHRISTOPHER GRECH AND J. McFARLANE, MBARI

SPARROWHAWK GHOSTS
LYING SILENT ON THE OCEAN FLOOR



Silt-laden currents and saltwater corrosion have scoured away most of the wing fabric, but part of a white star marking remains on the plane at upper left. Two Macon debris fields—the bow area and the midsection—have been investigated. A third field, presumably the stern, has not yet been explored. In these black depths, panoramic photographs are nearly impossible to make. This electronically combined and enhanced mosaic image was derived from nine separate still photographs.

JONATHAN BLAIR, EMORY KRISTOF, AND KEITH A. MOOREHEAD, NGS STAFF, WITH CHRISTOPHER GRECH AND J. McFARLANE, MBARI

Trapeze artists, the F9C-2 Sparrowhawk pilots called themselves, men with the aerobatic skill to attach a hook mounted on the upper wing of their biplanes to a small bar under a moving airship. One *Macon* Sparrowhawk hooks on (above), while a wingman waits his turn. Once on the trapeze (right) the craft was stabilized by a saddle that pivoted down to lock over the rear fuselage. To take off, pilots released the hook and fell gloriously free.

Only 20 feet long with a wingspan of 25 feet, the planes had a top speed of 176 miles per hour.

Rear Adm. Harold B. "Min" Miller of Shawnee Mission,

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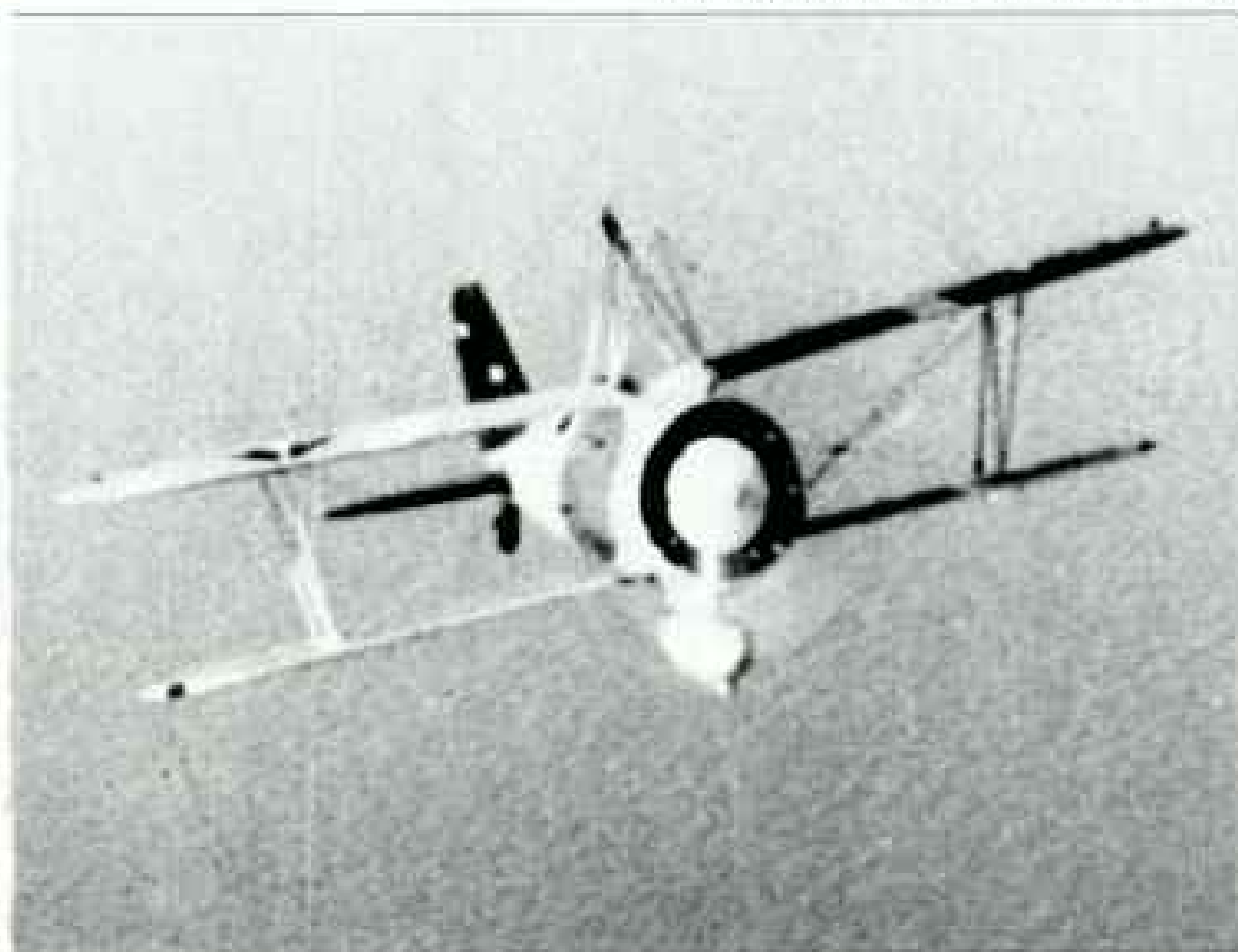
FROM THE COLLECTION OF REAR ADM. HAROLD B. MILLER



NAVAL INSTITUTE PRESS

JIM RICHARDSON, WEST LIGHT

Kansas, his portrait as a *Macon* pilot behind him (above), vividly remembers the unauthorized training mission to find President Roosevelt. Miller urged Herbert V. Wiley, commanding officer of the *Macon*, to replace landing gear with belly-mounted fuel tanks to enable the planes to fly farther and faster (bottom right). "We gave those boys on the *Houston* a real thrill," he said. "Our belly tanks looked like bombs, and some thought we were attacking the President's ship." After that, it became routine to fly over water without landing gear.

Lighter-than-air craft served in World War II, but they were blimps, smaller, frameless bags of gas, used to patrol against enemy submarines. The Navy discussed bringing blimps back into service, but rigid airships—never again.

The *Macon* at least showed what might have been. Airship plans had included surveillance around the Hawaiian Islands. Perhaps if those grand silver airships had been on patrol in the Pacific Ocean, Japan might never have risked the attack on Pearl Harbor in 1941. □

One of 1,500 left, a shy Hawaiian monk seal flashes through a coral

Last Refuge of

By DIANE ACKERMAN

sea in the Northwestern Hawaiian Islands, its only sanctuary.

the Monk Seal

Photographs by BILL CURTSINGER

IN DAYDREAMS I have seen the monk seal's face: a bulbous head covered in silvery fur, with black buttonhook-shaped eyes, a snout on which springy nostrils open full like quotation marks, tiny slot-shaped ears, a spray of cat's whiskers, and many doughy chins. On land, it drags itself with excruciating effort, or ripple-gallops like a 400-pound slug. But the water sets it free to swivel and race. Powered by twin flippers at the rear, its torpedo body can outmaneuver a shark. Books say it grows as long as seven and a half feet, but the photographs show distant and indistinct creatures. There are no cozy details—the touch, the smell, the sound, the expressions.

Monk seals, which once swarmed through the Pacific, Caribbean, and Mediterranean, now teeter on the edge of extinction. One of their last havens, French Frigate Shoals, is a horseshoe spill of islets and sandspits in the Hawaiian Islands National Wildlife Refuge.

To discover what these seals look and feel like and to record their ways, I'm flying there in a small plane with William "Gil" Gilmartin, leader of the National Marine Fisheries Service monk seal project, and Bill Curtsinger, a NATIONAL GEOGRAPHIC photographer. For a week we'll be a team, tagging new pups and checking the health of adults.

French Frigate Shoals drifts below us. Behind the thin white petticoat of its surf line, a long comet of aqua stretches into the Pacific. Most of the ocean corralled by the atoll is shallow with a sandy bottom. A few islands seem large enough to house a small building, but others are tiny as sandboxes, and from time to time they actually disappear.

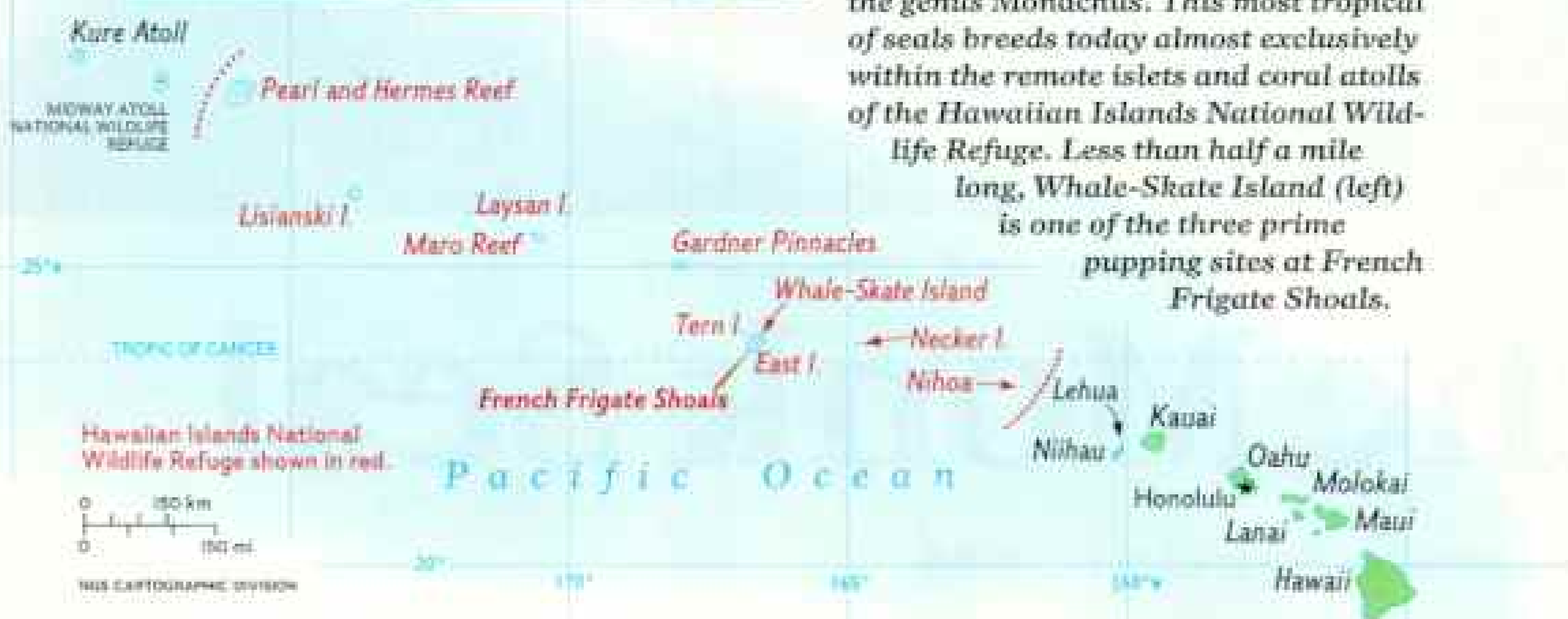
This is the fragile world of the monk seal—a "living fossil," as some have called it, a seal so ancient, rare, and shy that it seems almost mythic. It was the first pinniped ("fin-foot," for members of the seal, walrus, and sea lion order) recorded by Aristotle, the first seal spotted by Columbus in the New World. Shore loving and exploitable, monk seals soon were slaughtered in droves. The process of their extinction continues right now. The last recorded Caribbean monk seal was seen in 1952. I was four years old, growing up in a small town in Illinois, playing in the plum orchard across from my house, learning to count. I didn't know that an animal that had survived for 15 million years was at that moment becoming extinct.

We touch down, and in a cyclone of birds we come to rest at last before a long barracks. Outside it a plaque reads: "Tern Island, French Frigate Shoals. Population 4."

Soon after, Bill, Gil, and I rendezvous at the boat dock, where we use an electric crane

The monk seal's shrinking world

Undaunted in its home waters, a male monk seal (right) races after a potential mate near an undersea pinnacle at French Frigate Shoals. With the Caribbean monk seal almost certainly extinct and the Mediterranean species reduced to fewer than 500 animals, the Hawaiian population represents the best chance for the genus Monachus. This most tropical of seals breeds today almost exclusively within the remote islets and coral atolls of the Hawaiian Islands National Wildlife Refuge. Less than half a mile long, Whale-Skate Island (left) is one of the three prime pupping sites at French Frigate Shoals.



A furious face-off erupts when a male intrudes on a mother and pup near shore. Bellowing and biting, the mother repelled the advances. Pups often lose contact

to lower an orange Boston Whaler into the water. Our first stop today will be slipper-shaped East Island, seven miles southeast of Tern, which once held a U. S. Coast Guard station. The ocean heaves and rolls. After a bone-jarring, wave-leaping ride of 30 minutes, we see a bright doily on the horizon. Composed entirely of coarse coral sand and pulverized shells, East Island is only about 2,000 feet long, 300 feet wide, and it doesn't rise more than eight or ten feet above the sea. A brisk storm could dash waves right over it. Masked boobies, sooty terns, and Laysan albatrosses fly out to greet us as we pick our way among the coral heads, at last settling for a spot on the lagoon side of the island.

DIANE ACKERMAN is a poet and nature author whose most recent books include *The Moon by Whale Light* and *A Natural History of the Senses*. BILL CURTSINGER has photographed 18 articles for the GEOGRAPHIC, including the report on Lake Malawi in May 1990.

A tall pole once used as a radio antenna stands near the middle of the island, and I follow its hour-hand shadow down to the beach, where it falls across the flanks of a large monk seal.

Browner than I imagined and molting in patches, the seal looks a little like an old horsehair couch someone has left by the curb. Its belly glows a pale chamois color, and its chest is green from algae. Lying placidly with its muzzle half-buried in sand, the seal snoozes as incoming waves swirl around its face, sudsing its whiskers. After the seal inhales and exhales three times in a row, its chest stays motionless for ten minutes. Then, lifting its heavy head, it sneezes loudly with a

with their mothers during adult fights and end up in the care of other females. A pup may nurse from two or three different females before weaning.

wild twisting of the neck and settles back on the sand with a loud *harrumph.* Monk seals suffer from nose mites, which seem to give them terrible sinus problems. So they sneeze often and loudly.

Two pups appear in the surf and start playing rough-and-tumble. I assume that such play teaches them skills needed for mating or fighting. Gil isn't sure. Little is known about the courtship of monk seals. The actual mating takes place offshore and is rarely seen. In fact, the first documented instance occurred as recently as 1978.

Strolling past a low dune, we come upon six large seals lying parallel in the sand, sleeping. Their sheer size and mass are surprising.

Now a smaller seal, sleeping in the middle of the island, takes a few breaths, wakes up, and steam shovels its way closer to the water, digging a long trench as it goes. Because they feed at night, monk seals bask in the blistering heat of the day, but they do like to dig down to a cool, damp layer of sand. In many places we find "tractor paths" left by seals that have dragged themselves to the water.

GIL BENDS HIS KNEES, rounds his shoulders, and sneaks up closer to the sleeping monk seals, checking to see if any are pups in need of flipper tags. The information researchers glean from tagging helps to chart the life cycle and movements of the animals and the progress of the rehabilitation program. Turning back toward me, he points to a small dark seal right at the end of the row. Monk seals molt each year, and for a while their new fur looks slate black. This is

most likely a pup that's gone through its first molt. Opening the white tagging bucket, I remove a leather belt punch, two fraying kneepads, paper and pencil, a tape measure, and two numbered yellow plastic flipper tags. The color stands for French Frigate Shoals, the letter code tells which year the pup was tagged, the number identifies the individual. An open jaw about an inch long, each tag has a small knob at one end. Holding a tag in the air, I rehearse the best wrist action for forcing the knob through the punched hole in the seal's skin and tugging the device into place.

OK, I nod to Gil and creep up behind him. Stealthy and alert, he hunkers down like a predator and sneaks right up behind the seal, climbs decisively onto its back and grips its cheeks in both hands. Waking with a loud gargling *Baah!* the seal begins rolling and squirming as I rush in, fall to my knees behind its tail, and try to catch the twin flippers flailing around in such confusion that it's hard to tell left from right. I grab one out of midair, press it flat on the sand, while the other smacks my face. Sliding the tagging punch along the webbing between the first and second finger-like digits of the flipper, I find a good spot, press hard, and nothing happens. The seal struggles and complains. Then, leaning all of my weight into my hands, I push again and this time hear the click of metal on metal and know the punch has gone through. I remove it. The seal smacks me full across the face with its flipper, raking blood from my forehead down to my mouth. Quickly, I grab the left flipper, press it flat on the sand to get my bearings, find the inside digit's webbing, slide the punch in about an inch and a half, and bear down again with my full body weight, straining from the effort. At last, metal clicks against metal.

"How ya' doin'?" Gil calls from in front. Straddling the seal's back, he's not actually sitting on it but bracing it with his long legs, pinning its front flippers with his knees. Gripping its chins, he holds its sharp teeth away from him, which also keeps the seal oriented belly-down.

"Done!" I call to Gil. Its wet fur smells chalky sweet, as the seal complains in a loud steady basso gargle. It eyes me warily. What big black eyes and long stiff whiskers. It has a cleft in its nose just like a cat and a soft cream-colored overbite. *BAAAH!* Its resonant gargle seems to come from a great distance by way of an echo chamber.

"Under the flippers!" Gil urges.

Watching out for the teeth, I slide the tape measure under the seal's chin, under the

Beneath the notice of passing rudderfish, a seal uses a coral cave to hide from its worst nightmare—sharks. Researchers have witnessed attacks by both gray reef sharks (above) and tiger sharks. Seals are thought to rest in reef caverns after feeding at night on lobster, octopus, and fish. If pinned down by a cruising shark, a monk seal may wait out the menace by drawing air from bubbles it has exhaled inside the cave.

chest, and over the back behind the flippers.

"109.5 centimeters."

"That's it," Gil says, climbing off. The seal rolls onto one side, facing us, and paws the air with a flipper. As it does, we see four tiny nipples halfway down its fawn-colored belly, and a vaginal slit right under the tail.

Female. A precious pup. A grave threat to monk seals is how few females remain—too few for the species to flourish. This imbalance has so upset the workings of nature that males are resorting to a bizarre and ruinous behavior. On two of the main breeding islands, where the number of females is unusually low, a grisly phenomenon called "mobbing" takes place. More than 25 males may attack and try to mate with one female. This may take several hours, during which time they gore the female's back, slashing the skin off, ripping the blubber right down to the muscle, in some cases even exposing the spinal column. Savaged, the female often dies from her injuries or from shark attack.

Of all the hazards facing monk seals, the toughest to outwit may be their own rash instincts. Female monk seals would not normally be slaughtered during mating; it's only because so few are left that the species is being sabotaged by frenzied males. Therefore every female monk seal must be protected. Mobbing is so acute a problem that the monk seal project has begun testing a treatment program to calm the males. The idea is to reduce aggressiveness in the most violent offenders by injecting them with a testosterone-suppressing drug. If the experiment at Sea Life Park near Honolulu works, it could hold promise for curbing the deadliest males long enough to bring the ratio of males and females back into equilibrium.

Moving to a polite distance, we watch the newly tagged pup roll over in the sand and return to basking as if nothing very special had happened. Gil is pleased to find a female pup that's fat and healthy and full of spunk.

"How do you know which males to treat?" I ask, as we put the tagging gear back into the white bucket.

"It's important that we don't treat the dominant breeding males," he explains.

"The breeding males probably give the females some protection from the groups of attacking younger males. The program seems to be working on the test animals. The next step is to go into the field with the drug and treat about 50 males at Laysan, one of the two islands where mobbing is the worst."

FROM A DISTANCE East Island had appeared flat as a sand dollar, but its gentle dunes rise high enough to hide sleeping monk seals, and, as we continue our walk, we chance upon many more of them lying peacefully in the surf, always facing out to sea.

Are they being watchful, I wonder? Are they oriented toward incoming sharks? Or do they just relish the feel of the waves, lapping at the whiskers, skirling around the muzzle, sudsing the nose? Unlike other seals, which tend to crowd, monk seals don't form large groups. They're more solitary, and they haul out alone. Today the seals occupy all the beaches, but in the spring the mothers nurse mainly on the south side of the island, where waters are too shallow for sharks. Ten- to sixteen-foot tiger sharks patrol the waist-deep water of the north side, on the lookout for wayward pups or birds.

We approach the antenna mast, which stands like a lightning rod. On it, a sign reads National Wildlife Refuge. What is it exactly that the seals, turtles, and birds need refuge from? Predators? A changing environment? Us?

A few monk seals still inhabit the Mediterranean, but vanishingly few, and they're rarely glimpsed. Too many governments have divided up the waters of the Mediterranean monk seal to make organized research feasible. And, in any case, monk seals are rattled by human doings—motorboats, airplanes, fishing, tourists. The best hope for the entire genus *Monachus* lies with the remaining Hawaiian monk seals, which have found a remote hiding place. But even these seals are vexed by problems.

All the monk seal wants is to continue living in the ancient seas for which it's designed. But those waters are gone now. Pollutants, plastics, and fishing lines ride the waves, and hominids stomp along the beaches or race across the reefs. Occasionally a pregnant monk seal does haul up onto a fashionable beach on one of the main Hawaiian islands. Ironically, although tourists may lie happily for hours, broiling in the sun, when they see a monk seal doing the same thing they assume it's stranded or in trouble, and they chase it back into the ocean. That simple act—hazing it back to sea—may kill it and its young.

Monk seals choose a beach carefully, judging terrain and shallow water. Frightened by humans, a seal will look for another pupping spot, one with fewer people, even if it means a less ideal landscape. A female monk seal needs a shallow crib for her youngster right offshore, where she can protect and nurse it.

The islands of French Frigate Shoals do not look like a refuge. In fact, they themselves seem in need of dredging and bolstering. The refuge sign identifies not a place but

Powerless to help, biologist William Gilmartin, director of the Monk Seal Recovery Project, looks sadly at a pup certain to die after a shark attack (facing page). On a brighter mission, Gilmartin and the author tag a newly weaned pup at French Frigate Shoals. Because of nursing monk seals' extreme sensitivity to human disturbance, admission to the refuge is strictly limited.

a willingness, a stubborn protectiveness.

Below the refuge sign sits a white wooden box with a latch door. I open it. Someone has tacked up a poem—"Walk Softly"—to celebrate the sacredness of the place. Inside the door, photographs show the original Coast Guard base. Small beetles scuttle over the photographs, and for a moment the base seems to be bustling with life. The white skeleton of a spider blows across the hinge.

A MASKED BOOBY flies over, and the ocean reflects pale blue across its chest as it glides low and lands near two mother seals with their three-week-old pups. Waiting in the shallows, another mother calls to her snoozy pup, and the baby *baahs* back in a slightly higher register, then waddles into the water and darts to her, otter fast. Monk seals make quirky sounds—from stuttering grunts to high foghorns—with mothers and pups sharing the greatest range of calls. Some seals have one or more tiny patches of blond fur, which glisten in the sunlight. Such curious markings help identify individuals. Could there once have been blond or even spotted monk seals?

"Oh, look at that," Gil says, wincing. I follow his gaze to a pup that has lost one rear flipper. A shark has chewed it clean away, leaving only a thick red stump.

"God, I hope it's not a female," Gil says. "If it is, we'll have to catch her, carry her to the boat, take her back to Tern, and fly her to Honolulu. Maybe she could be treated there and used for breeding." As it turns out, the animal is a male, which vanishes silently into the sea again.

In 1991 Sea Life Park had six females in the rehabilitation program. In the late 1970s, researchers discovered that monk seals practice "fostering." When nursing mothers come too close to one another, a fight may break out, and it's likely that the mothers will exchange pups. They either can't tell whose pup is whose, or they don't care. At first glance this altruism may seem helpful. If there are few members of a population, isn't it smart for everyone to look after the young?

Shallow, shark-proof waters allow a mother and black-furred pup to swim safely as they cool off from the tropical sun. Before returning to its basking beach, the youngster investigates the engine casing of a boat. Once the mother leaves, after five to six weeks of nursing, a pup is thrown upon the sea's mercy without knowing how to feed itself. It may drop a third of its weight before learning to catch fish.

But mother monk seals can't continue nursing forever. When a swap occurs, a younger pup may end up with a mother that has been raising an older pup. That mother would already have been nursing for some time and may not have enough milk left to raise the young pup. Weaned too soon, the undersized pup would not be able to feed itself. Those are the animals the monk seal project takes to Honolulu to fatten up. Then they're released on Kure Atoll where the population is low and there are too few females. Twenty females have been rehabilitated and returned to the wild since 1984, and 15 are still alive.

"A few other small seals we collected died—primarily of heart problems of unknown origins," Gil explains as he sits down on a large blue fishing float. "In the beginning we assumed all they needed was fattening up, but some have health problems we can't deal with. In a wild population you always find some animals with health abnormalities." In a large herd, sick animals would not be missed, but in a dwindling herd, they're obvious and daunting.

When Dale Rice and Karl Kenyon counted the seals in the late 1950s, they found approximately 1,200 on the beaches of the Northwestern Hawaiian Islands, and it's believed that the total population size was two and a half times that, since all the seals don't use the beaches at the same time. By 1976, when the monk seal was listed as endangered, the beach counts had dropped by 50 percent. The French Frigate Shoals population, stable during the 1980s, has suffered a catastrophic decline in the last two years: Beach counts are down by 25 percent.

PERHAPS THERE never were many monk seals in the Pacific. This is not true of the Caribbean, where Columbus encountered tawny brown monk seals in 1494 on his second voyage and called them sea wolves. In 1707 a West Indian traveler wrote: "The Bahama Islands are filled with seals. Sometimes fishers will catch a hundred in a night." The Mediterranean monk seal gave its name to an ancient city, Phocaea, in Asia Minor, and, as late as the 15th century, was plentiful enough to fuel a commercial fishery. But how many monk seals did the Hawaiian waters support? Were there great rookeries of them or only small strongholds? Did their extinction begin many millions of years ago, when they failed to adopt the harem-keeping that other seals find so successful? We may never know.

What could be more serene than sitting on coral sand while the sun mounts the sky, the monk seals bask, and the breeze blows the

surf into a gentle lather? For a moment there's no sign of all the commotion taking place to save these last few seals.

At Sea Life Park, every day, handlers drain the water from the orphan seals' pool, hold them down on special pads, and force-feed them whole fish. Orphan pups are too young to feed themselves. We think of hunger as a universal drive and teacher, but the pups don't even understand that they must eat, and sometimes they starve.

At Kure Atoll, a constellation of sandspits to the west of the refuge, there is an enclosure where pups are fattened up and taught to feed on live fish before being turned loose.

Part of what makes monk seals so challenging to the people who work with them is how many different problems they pose. There is the mobbing, the fostering, the human interference, the entanglement in fishing nets, the reluctance of pups to feed, the dwindling populations in some islands but not in others. This morning alone, we have tagged three pups, been ready to transport a shark-bitten animal, kept a sharp eye for pups inadvertently orphaned by fostering, seen a victim of mobbing. It's animal by animal that a species is saved.

Only 16 years ago, Hawaiian monk seals were considered disposable by some officials in the National Marine Fisheries Service.

On shore leave near Honolulu, an orphaned female pup relaxes at Sea Life Park, where she fattens up. Too young to feed on her own, the pup is force-fed herring (above). Six female pups a year are airlifted here for emergency help. Most are returned to the wild with the urgent hope—in some cases already fulfilled—that they will breed pups of their own.

They insisted that the seals were a "relict species," as they put it, unsavable, a waste of time and resources. Outraged and saddened, John Twiss, executive director of the Marine Mammal Commission, argued hard for the protection of these animals and for their listing as endangered. When NMFS refused to undertake conservation programs, he pleaded directly with Congress, which gave the commission money for research and required NMFS to carry out a program to preserve the monk seal.

"It's possible that we will be successful," Twiss told me, "it's just possible."

A LARGE MALE MONK lifts its head, cocks an eye at us, snuffles, puts its head back on the damp sand, and closes its eyes. I wonder what they make of us shy humans strolling along the dunes, taking care not to disturb their slumber.

Collecting our gear, we return to the whaler and set out for Whale-Skate Island. Actually it's composed of two islands: plump, curving Whale and tiny, semidetached Skate.

As we inch our way to shore, a pup swims out to greet the orange whaler. So much shimmery orange must intrigue it. Slipping over the bow, I carry the anchor ashore, plant it, and wade back to the boat. The pup paddles toward me, and I sit down in the water, shoulder deep, to look smaller and less threatening, as it sneaks in close, twitching its nose and having a good look-see. For long seconds it stares hard, and I talk to it in a high voice (I've noticed that most animals are more threatened by low voices). Casting a few more glances over its shoulder, it turns to grab an empty bottle in the waves, tosses it in the air, nudges it with its nose. This pup doesn't need to feed itself yet, but it's never too early to practice. What feeding monk seals usually do is dive down 25 to 150 feet on the reef, find a spiny lobster, and slap it on the surface to break it, then eat just the succulent tail. Their diet also includes eels, octopuses, and some reef fishes. Popping its head up in the periscope-like way that seals do, the pup watches us, then has a rollicking good sneeze.

A mother monk *baahs* to her black pup, which *baahs* back. For 40 days she will tend her pup without eating. During that time the pup will gain from 125 to 175 pounds, but the

mother may lose 300 pounds. At last, scrawny and famished, she'll go out on a feeding binge, then find a mate, and begin the cycle again. Next she'll spend seven to ten days molting, during which time she'll fast once more. We discover several slender nursing mothers on Whale-Skate, and a few fat new pups to tag.

Afternoon begins rouging toward sunset as we pack up and start back. Reflecting the shallow water, green-bottomed clouds float above us. But all the horizons are thick with clouds, wrapping around us and straggling high to where gauzier clouds stretch. It's like sailing through a planetarium. Soon Tern Island appears, and we put the whaler away for the night.

OUTSIDE MY bedroom window, four monk seals laze in the shade of bushes clotted with brown noddies. One seal twiddles its rear flippers. Another lifts its head and splutters a baritone phrase that sounds like *Bogs on Bogs on Bogs*. A third rolls over, stretches its cream belly longer and longer. The fourth, vexed by a bird, nips at it, then crawls under a tree heliotrope. A male booby whistles, as if through badly fitting dentures. All of a sudden the wedge-tailed shearwaters, or "wedgies," begin moaning—just a few at first—then urgent throngs of them as night pours its India ink into the shoals.

As the days pass, we rise in darkness, dress by moonlight, and set sail as the sun begins bluing up the atoll. Few things are sweeter than the cool damp morning of a scorching day on the ocean. We return often to East Island and Whale-Skate, two prime pupping islands, and always find new pups to tag, new adults to inspect at Gin Island, Trig Island, Shark Island, Round Island. It's only with the greatest reluctance that we pack our gear and leave French Frigate Shoals.

A healthy young monk seal makes a stand in the outer Hawaiian Islands. Just as the numbers at French Frigate Shoals were stabilizing, disaster struck: Long-liners in search of swordfish have injured and possibly killed seals with their hooks. Pupping rates have also fallen. Says Gilmartin, "The Hawaiian monk seal needs our constant attention."

Islands bloom on the horizon as we fly in a small plane straight toward the heart of the Hawaiian archipelago. We pass over Niihau, a large privately owned cattle ranch. Monk seals haul out on the island's beaches, but its owners won't allow researchers to step ashore to monitor the seals; no one knows how many use the island, what sex they are, or if they're healthy. A little later we land in Honolulu.

Bidding farewell to Gil, Bill Curtsinger and I fly to Kauai and rent a boat to take us out to Niihau. Even if we can't land on its beaches, we might be able to glimpse monk seals from offshore.

ACROSS THE CHANNEL from Niihau, the towering crescent of Lehua looms smooth and brown, with white specklings of guano. Long ropy fingers of frozen lava stretch down its sides to the sea. Only one cloud haunts the Wedgwood-blue sky—a large oval hanging directly over the island looks like a scar left by a knife wound. We head for the crescent's shallow reefs, to snorkel in one of several spots favored by divers. Seabirds work the thermals, and the ocean pours metallic blue and green as we drop anchor on the south side about a hundred yards from shore. Here we find an oystershell-shaped cave, partly above water, with a small lagoon in front of it. Sunlight dances like flame across the roof of the cave. Putting on a mask and fins, I slide over the side into 20 feet of water.

Heading for the lagoon, I enter into a small commotion of water and light. The surf frets the entrance. Ahead of me, through a curtain of bubbles, a long gray shape maneuvers, just out of range.

Suddenly it turns, comes closer, and stops six feet in front of me. Staring me straight in the face is a large monk seal with black eyes and thick whiskers. Eyeing me carefully, it pauses, then dives under me, rolling over as it does, comes up in back, eyes me again, and swings to my right. It doesn't seem to be using its flippers at all, and barely moves its body, and yet it darts around effortlessly.

Two more seals appear from the bubbles, rolling tightly together. Then another monk seal swims underneath me, looking up at me the whole time by turning its neck around like a ball turret, swimming forward but looking backward. Then it turns slowly and swims toward the cave. Now the tussling couple reappears, biting and chasing each other. If I could rub my astonished eyes, I would, as five adult monk seals swim around the lagoon, in front of me, in back of me, at the surface, below me.

By now I am able to identify the couple as male and female. Occasionally they surface and *baah* loudly at one another; then the female slips away and the male joins her in a swirling subterranean dance. Bubbles trail from them like comet tails as they glide and spin, occasionally swiveling their necks to nip and bite. Before I have time to think, a new drama unfolds. The female dives to a jagged corridor of rock at the bottom, which is just wide enough to hold a seal. The male follows her at speed, bites her flank, her tail, then tries to reach over the sharp rock. Huddled tight as a letter in a slot, the female pulls in her head and tail. At last, the male sees an opening, grabs her back below the neck and drags her out, forcing her belly-down on the sandy bottom as he mounts her. She goes suddenly passive. It lasts only a minute, but to me it seems ages, as I float above them, frozen in amazement.

I am watching monk seals mate, I tell myself twice, as a complete sentence, because it is an astoundingly rare event to behold. Most likely the pups I saw wrestling in the surf at French Frigate Shoals, tumbling and nipping like this adult couple, were practicing courtship. When the male releases his grip, the female bolts, and he chases her. They surface and one of them barks a short gargling protest to which the other answers with a loud foggy bleat.

After watching them for a good long spell, I fin back to the boat. Darkness is falling. When we hoist anchor and set sail for Kauai, we salute the sea cave. Two monks are still swimming somewhere inside it. One large adult, hauled up onto the rocks rimming the lagoon, dozes peacefully near a pup. The courting couple continues swiveling tightly together among the coral heads. Over and over they roll, spiraling gracefully through the water. Standing at the stern as the boat gathers speed, I watch until the crescent island grows shorter, the shining monk seals become indistinguishable from smooth wet stones, and all that's left are the indecipherable gestures of the sea. □

WILDLIFE AS CANON SEES IT

White Uakari
Genus: *Cacajao*
Species: *calvus*
Subspecies: *calvus*
Adult size: Length, 36-57 cm; tail, 13.7-18.5 cm
Adult weight: 2.6-4.0 kg
Habitat: Flooded forests between the Amazon and Japurá rivers, Brazil
Surviving number: 10,000–15,000
Photographed by X. Ferrer & A. de Sostoa

With its shaggy fur and masklike face, the white uakari is an unforgettable sight. The uakari's specialized feeding habits make it especially vulnerable to habitat change from logging. But a recently created 3,200 square mile reserve in western Amazonia, which includes the white uakari's entire range, will help ensure the survival of this unique primate. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Photography, both as a scientific research tool and as a means of communication, can help promote a greater awareness and understanding of the white uakari and our entire wildlife heritage.

EOS 1
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Forum

America's Illegal Wildlife Trade

I am a convicted poacher. Only recently, after watching National Geographic EXPLORER's four-part series *Wildlife Wars U.S.A.* and reading the September 1991 article did I feel remorse and fully understand the impact of poaching.

My family has hunted everything from elk and deer to geese and ducks. Hunting seemed the only time I spent with my father in mutual enjoyment—trudging through goose fields, standing under turning tamaracks.

As a 22-year-old first-time offender, I received 12 days in jail, and I was fined $2,500 and part of the value of the deer I and others had killed. My grandfather's present to me, a Remington 742 Woodsmaster .243 Winchester, was nearly lost to the state smelter. Neither my hunting privileges nor my weapon was taken, just my self-respect and freedom.

As I write from a jail cell, I issue a plea. Poachers beware: You can't predict the far-reaching consequences of your actions; you don't want to cause your family embarrassment and loss. To law-abiding hunters (which I now consider myself): If we can't or won't police ourselves, the sport will vanish. Refuse to ignore the poaching that goes on around us every day.

PATRICK MCCLURE
Seattle, Washington

You could have mentioned the good that the great majority of hunters do to support wildlife and those who manage it. My license fee goes directly to the Fish and Wildlife Department to pay the salaries of the very people who are out there catching the poachers. The bottom line is no hunting, no fee, no manager, no wildlife.

PHILIP N. CALVERT
Redlands, California

Constance J. Poten's article on illegal hunting was informative and well written. Being a hunter, however, I hate to see hunters categorized with poachers. Hunters contribute license fees and taxes on equipment toward habitat and conservation measures to increase animal populations. Poachers take that away from everybody.

LAUREN BAYLISS
Broomfield, Colorado

As long as consumers will buy something, someone will gladly supply it. This applies to domestic wildlife, African elephant ivory, or drugs. Let's place the blame where it ultimately belongs: on the ones who create the market.

DONALD BRADLEY
Plainfield, New Hampshire

One thing that could help is firm judicial resolve to permit no more community service and probation for convicted poachers. Maximum prison time and maximum fines should be the rule. If our state and federal judges would do this in all cases, the professional repeat offenders would be checked and the erosion of our natural legacy retarded.

LOUIS C. WYMAN, *Retired Justice*
New Hampshire Superior Court
Manchester

Many states, including Iowa, have TIP (Turn in Poachers) programs that are very effective. The illegal taking of game and the selling of animal parts are very real problems and should be fought at every turn by both the hunting and nonhunting public. The actions of a few have put a dark cloud over millions of ethical hunters.

DAN WATKINS
Des Moines, Iowa

Maya Artistry

It crossed my mind that the eccentric flint artifacts (pages 102-103) could be mounted on wooden poles and used with the sun behind them to cast shadows of deities to foster belief in those gods by spectators.

JOHN BOYLAN
Bradford, Yorkshire

Germany

After reading about the problems of rapid reunification, I was inspired to write your magazine. The coup in the Soviet Union had begun, but by the time I was ready to mail my letter, the coup was over. To me the two German states were correct to pursue reunification at such a hell-bent pace in spite of growing pains. It is not beyond the realm of possibility that someone might have tried to close the Iron Curtain once more, had the Wall not been torn down. Today, more than ever, he who hesitates is lost.

LOREN L. HANKS
Columbia, Maryland

I was fortunate enough to be exposed to NATIONAL GEOGRAPHIC magazine as a boy in Vietnam. From the pages I got to see glimpses of the world.

In the photograph on page 27 I noticed some scribbling at the upper right. *Con tao lam viec o day* in Vietnamese means "I worked here." Workers were brought from Vietnam to work in various factories in East Germany, which explains how the phrase got there.

HAI ON
Houston, Texas

My father (a U. S. citizen but a German resident) and my stepmother (a German native) have told me of the huge tax increases on everything, of the absolutely impossible housing shortage, and of the general feeling of hopelessness in dealing with the influx of East Germans into an already overtaxed, underhoused, employment-scarce, and overcrowded West Germany. In addition, the arrival of top-flight athletes from East Germany is having an impact on athletes like my 13-year-old brother, who is training to be an Olympic ice skater. What has been accomplished by unification may be undone by the harsh realities of the vast differences of the two Germanys.

LESLIE COPPEDGE
San Antonio, Texas

That life in the old GDR was of lesser quality when compared with West Germany is clear. But it was comfortable, and when seen on the level of a family unit even wholesome. The lack of political or intellectual freedom was balanced by social conditions that for the average North American are a never-never land.

GARY F. SCHOLZ
Lone Butte, British Columbia

While many thousands of Germans fled East Germany after World War II, millions more could not leave. What commenced throughout Russian-occupied central and eastern Europe was a new holocaust for countless thousands who were imprisoned without cause, save for the crime of surviving the war, having an education or leadership potential, or not meeting production quotas. Many of the infamous Nazi prison camps emptied by the Allies in the spring of 1945 were filled with this unfortunate group. My father died before Christmas of 1945 in Buchenwald. It is no surprise that not only the land but also the psyche of the former East German populace must be rebuilt.

INGRID RUSSELL
Muncie, Indiana

Medical Donors

Your article arrived on the day of the memorial service for our 15-year-old daughter, Sarah, who died in a traffic accident. It reassured us that the decision we made to offer her body for tissue donation was the correct one. Her corneas have helped two young men to see; her bone tissue will benefit some 40 to 50 people. Thank you for bringing to the forefront a subject we all should consider carefully.

STEVEN and CONNIE WHITE
Lexington, Kentucky

Many of the patients mentioned in your story are alive as much because of blood donors as organ donors. Last year more than four million Americans required transfusions. Yet only a fraction of the American population provided the millions of units of blood used. Shortages are so frequent in some metropolitan areas that centers must import blood from Europe. Considering that a donor can give blood as often as every 56 days, one person can literally save hundreds of needy patients over a lifetime.

TERRI GLUECK
Central Blood Bank
Pittsburgh, Pennsylvania

Another way individuals in many cities can help save lives is pheresis. This involves hooking a donor to a machine that separates blood into component parts, extracts the desired product, and returns the rest to the donor. The process is often essential for recovery from certain cancers and blood diseases. A leukemia patient, for example, might need only white cells. One pheresis donor is able to give as much of the needed product as ten people who donate blood in the usual manner.

H. BRUCE CARR
Farmington Hills, Michigan

Because of the article, my wife and I have become donors.

JAMES F. DALEY
Colchester, Vermont

Jumping Spiders

Mark Moffett has helped the fascinating jumping spiders leap into our minds with his spectacular photography. His sequential images remind me of studies by D. A. Parry and R.H.J. Brown, which revealed the major function of the trailing silk line. More than a safety line, as the author suggested, the dragline prevents the spider from pitching forward into a somersault, enabling it to land properly.

JEROME S. ROVNER
Zoological Sciences, Ohio University
Athens

The spider's rapt look on pages 42-3 impresses me as arising from curiosity and a willingness to communicate. My brother and I as preteens deduced that jumping spiders must be communicating with foreleg and palpus gestures. We bugged out our eyes to make them more round and jumper-like, held our hands below our noses with the first two fingers imitating palpi, and mimed their gestures. We found that indoors we were able to "call" them from 30 feet away and dismiss them with an upstretched V sign, which we took as a threat gesture. I have been "talking" with jumping spider passersby for 40 years. They will often climb right up onto my nose and sit peering into one of my eyes for several minutes. Try it!

R. O. HESSLER
Somerville, Alabama

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Geographica

JAMES L. STANFIELD

Independent Cat Opens the Vatican's Portals

"Nothing's more determined than a cat on a hot tin roof, is there?" asked playwright Tennessee Williams.

How about a cat trying to get into a Vatican kitchen?

NATIONAL GEOGRAPHIC's James L. Stanfield spotted this dogged feline named Rambo serving as his own doorman. Stanfield was photographing the Swiss Guards' barracks for *Inside the Vatican*, published last October by the Society's Book Division.

"The cat had been living in the barracks for more than a year," Stanfield recalls. "I was working in the private dining area where five nuns work as cooks for the Swiss Guards. One of the cooks, Sister Anna-Lina, went through the door into the kitchen, closing it behind her." As Stanfield watched, Rambo leaped up to the door handle, forced it downward to unlatch and open the door, and sashayed through to join bemused Sister Anna-Lina (above, right).

"He opens all the doors in the Swiss Guards' area," Stanfield reports. "Wherever there's a door with a handle, he goes through."

Bronze Age Way of Life Emerges in the Fens

Archaeologist Francis Pryor stumbled—literally—upon the English Bronze Age site of Flag Fen in 1983 when he tripped on a piece of wood lying in the bottom of a drainage ditch.

ADAM WOOLFITT, SUSAN GRIGGS AGENCY (BOTH)

Nine years later Pryor (bottom, at left) and his co-workers have found thousands of such timbers, part of a $3\frac{1}{2}$-acre wooden platform. They also have an array of metal artifacts and some clues as to how people lived 3,000 years ago, near what is now Peterborough.

The Fens of East Anglia made up England's largest wetlands before they were drained to create farmland, and Flag Fen—named for a native wild iris—sits where wet and dry land once met. Bronze Age settlers had "the best of both worlds," Pryor says. They could catch fish in the marshes and grow wheat and barley on land.

Pryor calls the site a major ceremonial center for the earliest British Celts. The 300 metal objects he and his team have found were weapons and ornaments, from swords (left, top) and spears to tiny pins, almost always broken on purpose, then put into the water. Sometimes this was a funerary sacrifice, but Pryor thinks the settlers often vied for social status by showing they could afford to discard valuable possessions.

"I don't think people lived here all year," Pryor says. "We're looking at ceremonial occupation when hundreds may have been here."

Geographica

CRISTINA TACCONE

Clothing Styles Adapt as Two Cultures Meet

What happens when two cultures collide? Some things will change, but others will persist for a long, long time. Take clothing fashions.

With support from the National Geographic Society, Patricia Rieff Anawalt of UCLA is studying four Indian groups in mountainous regions of the Mexican state of Puebla. She has found that some garment styles worn before the Spanish arrived in the 16th century still are worn today, while other traditional items have been replaced by styles introduced by Spaniards.

Men in several villages, for example, wear a fringed sleeveless jacket called a *cotorina;* Anawalt says Aztec statues dating from 1500 show men performing religious rites while wearing a similar garment, the *xicolli.* In the same way, she recognized a present-day woman's shawl, a *quechquemitl,* in depictions of other Aztec rituals.

On the other hand, the Spanish brought tailoring techniques that were adopted by the indigenous peoples, enabling them to make *calzones,* white cotton pants tied at the ankle, and white cotton shirts. Shirt and calzones replaced the unfitted cape and loincloth.

The themes of change and persistence continue as the Indians meet another "invading" culture. Anawalt saw these two Nahuatl men—one in calzones, one in blue jeans—in the village of Naupan.

Did Trumpets or a Quake Tumble Jericho's Walls?

It is a familiar biblical tale: Joshua commands his priests to blow their trumpets, the children of Israel issue "a great shout," and the walls of Jericho fall, allowing the Israelites to enter.

Maybe, says Amos Nur. But more likely an earthquake caused those walls to come a-tumbling down.

Nur, a Stanford University geophysicist who has been studying the 10,000-year-long historical record of earthquakes in the Holy Land, says that quakes have repeatedly destroyed Jericho, the last time in 1927. And no wonder: The town "sits practically on the Jordan Fault that divides the Arabian plate from the Sinai plate," he says.

Archaeologists have learned that Jericho's walls often collapsed in a single direction, as they would in a quake, not in all directions as if an army had destroyed them. They also have found grain and dried meat in the ruins; residents fleeing an invasion wouldn't have left food, the Israeli-born Nur argues.

NGS CARTOGRAPHIC DIVISION

Finally, he turns to the Bible. The Book of Joshua says the Jordan River stopped flowing, allowing the Israelites to cross. This typically happens in quakes in the Dead Sea Fault Zone, says Nur: The Jordan's banks collapse and briefly dam it.

To a Sandperch, It's All in a Night's Work

Talk about maintaining a complicated social life! Every evening just before sunset in the northern Red Sea, a male spotted sandperch makes the rounds of his territory and drops in on the females. The first visit is what Eugenie Clark of the University of Maryland calls "a checkout circuit. He is saying, 'Hi, how are you? Get ready, I'll be back in a while.'"

The checkout circuit complete, he starts a new round, this time to mate. Now it's up to the female: "She takes the lead, and if she's not receptive, there's nothing he can do about it." After a brief courtship they spawn, and she releases the eggs he fertilizes. Then he either goes to the next female or leaves, and all retire for the night—separately—under a handy piece of coral.

RUTH PETZOLD

Clark and two colleagues, who reported their findings in National Geographic's RESEARCH & EXPLORATION, have been studying the sandperch for four years in Egypt's Ras Mohammed National Park off the Sinai peninsula. Because sandperch communities are stable, the scientists were able to recognize the same fish from year to year.

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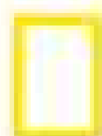

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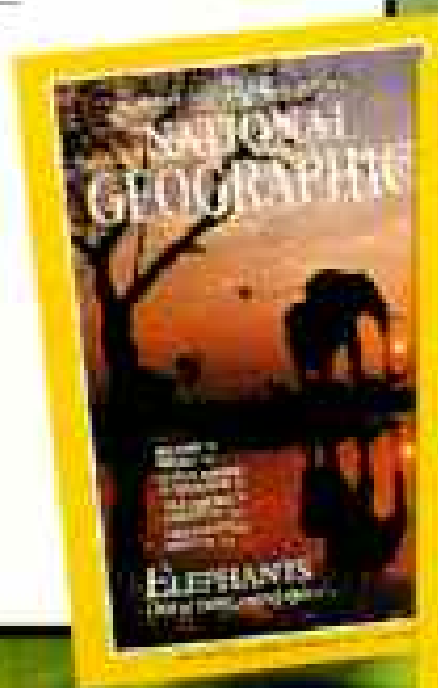

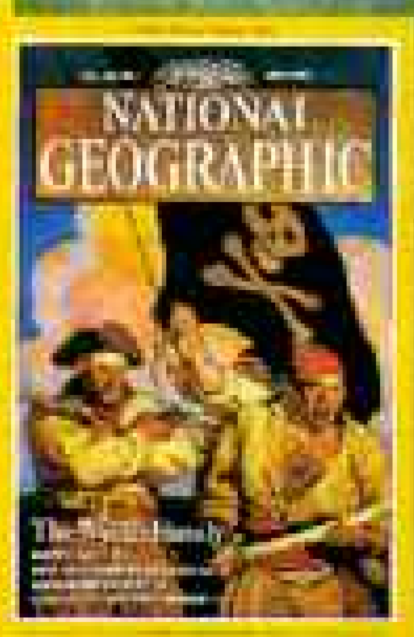

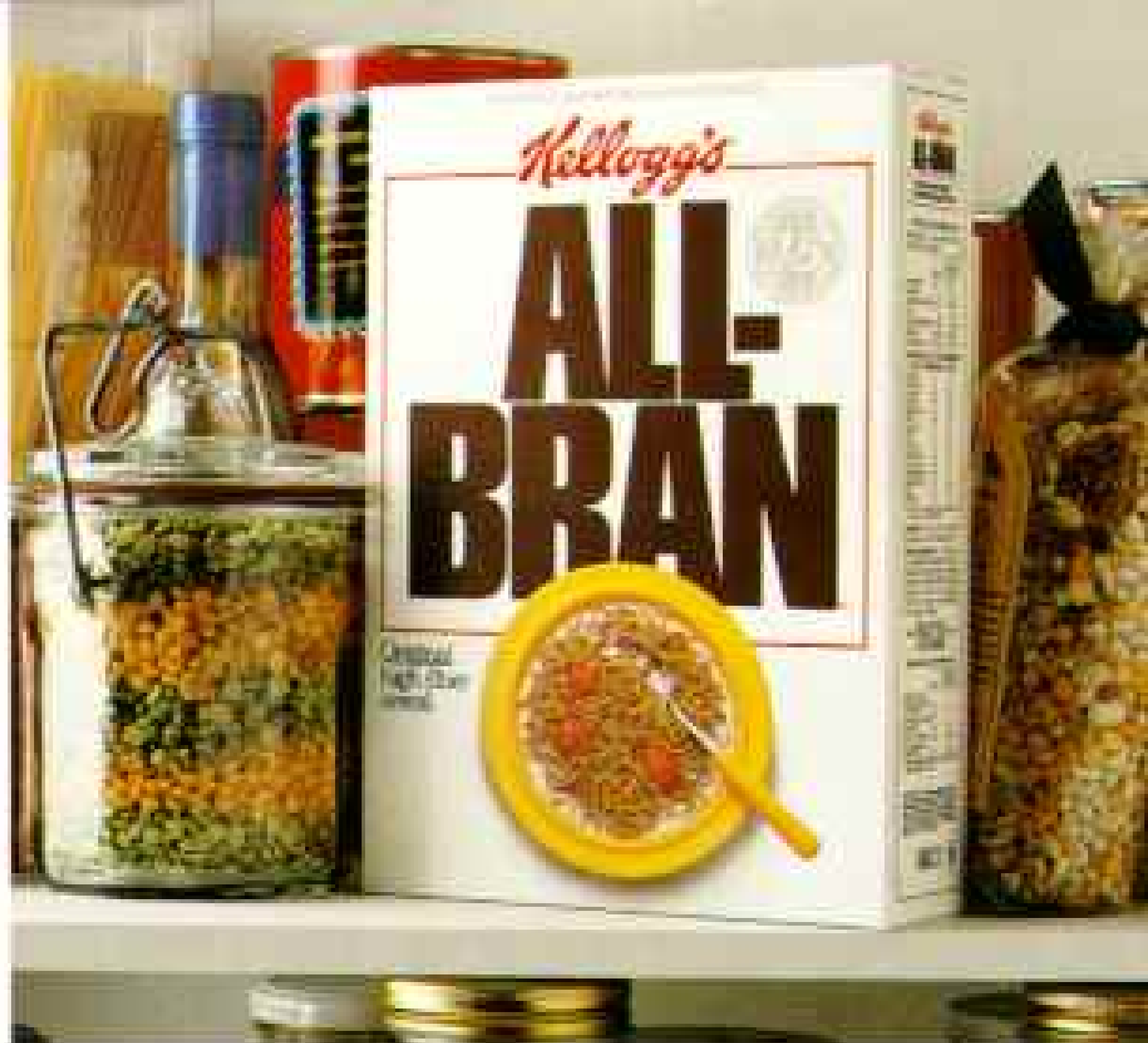

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On Television

BOTH BY BEVERLY JOUBERT

Pride versus Clan in Botswana

It is night on the Savuti plain of Botswana, Africa. A clan of spotted hyenas gorges on a dead elephant. Suddenly a pride of lions appears. They attack. The hyenas fend them off, their eerie laughs echoing in the night, their glowing eyes reflecting the photographer's lights. The lions, outnumbered, eventually give way to their tenacious rivals.

On this night the hyenas win; on another they themselves may be the victims. It's an endless struggle, one that has been going on for millennia between these eternal enemies.

A film of such fierce confrontations is the work of naturalists and filmmakers Dereck and Beverly Joubert, a husband-and-wife team who have recorded little-known animal behavior in northern Botswana for ten years. To track their subjects, they use a modified truck that is both their home and their camera platform. The Jouberts spend long hours in patient observation and, with subtle lighting, often film at night, a favorite hunting time for lion prides and hyena clans.

The dramas are compelling: A male lion, a vision of power, grace, and purpose, runs down the matriarch of a hyena clan. A lioness with cubs is bitten by a cobra. Weakened, disoriented, and enduring incredible thirst, she wanders for a week, trying to hold on until the venom washes out of her body.

"As observers it is not always easy to witness these struggles for survival," says Dereck.

Life in the Savuti region is unpredictable, often unpleasant, as seen through the Jouberts' lenses. Indeed, prides and clans are like street gangs fighting a bloody turf war for food and territory.

One unexpected encounter did not make it on film: "Right after female lions had made a kill, a male lion rushed in and took the carcass," Beverly recalls. "The females, left with nothing, heard the motor of Dereck's remote-control camera; one lioness snatched the tripod leg and started to run off. Dereck said, 'Grab the tripod!' I said, 'Forget it! I'm not going to argue with her!' So Dereck seized it, but the lioness wrestled it away. Eventually we got it back."

ETERNAL ENEMIES: LIONS AND HYENAS, NATIONAL GEOGRAPHIC SPECIAL, PBS, JANUARY 22, 8 P.M. ET

Earth Almanac

California Puts a Charge Into Electric Carmakers

Start your engines—cleanly and quietly, please.

The race is on to get the electric car off the drawing board and onto the street. California has fired the starting gun with tough new air-quality standards. By 1998, 2 percent of all new vehicles sold in the state—about 40,000—must emit zero pollutants, a mandate that only electric vehicles (EVs) can fulfill; in 2003 the minimum rises to 10 percent. "The idea is to jump-start the electric-vehicle industry in California," says John Schumann of the Los Angeles Department of Water and Power (LADWP). Twelve other states and the District of Columbia are considering similar laws.

Breakthroughs include improved batteries and recharge time. Last August, Nissan unveiled a prototype (above) with a new nickel-cadmium battery. The company says it can be fully recharged in only 15 minutes, providing a range of about 100 miles at 45 miles an hour. General Motors, however, like most carmakers, uses lead-acid batteries for its EV, which require two to eight hours to recharge. But GM is much closer to production than Nissan.

Closest of all is a Swedish-based enterprise, Clean Air Transport, whose model is scheduled to roll in early 1993. The company has signed a contract with LADWP to bring 10,000 EVs into southern California by 1995. This EV, a hybrid, has both an electric motor for short-distance commuting and a conventional four-cylinder engine for longer trips.

Nosy Detective to Monitor River Thames Pollution

A nearly blind African fish called the elephantnose mormyrid lives in murky water and navigates as if it had radar. Its keen sensory powers are being enlisted to detect pollution in England's River Thames. To aid feeding, the fish's mouth is located at the end of a long snout, but the mormyrid's real advantage is in an electric organ in its tail.

This creates an electrical field that lets the fish sense any change in the water—including pollutants—that causes its electrical output to vary. John Lewis, a University of London biologist, plans to submerge tanks of mormyrids to test the city's water supply by monitoring these watchdogs with fins.

NISSAN NORTH AMERICA (TOP); TOM MCHUGH, PHOTO RESEARCHERS, INC.

Mammoth Lode of Ivory From the Pleistocene

In Siberia the Russians are mining millions of woolly mammoths preserved in glacial ice between 10,000 and 40,000 years ago. The extinct behemoths live on—in ornaments carved from their tusks (below). Despite the recent ivory-trade ban, this source is still legal and not on any endangered species list.

JOSEPH C. LAVENBURG, NGS

Siberia's freezer may hold more than 600,000 tons of ivory, according to Ed Espinoza of the National Fish and Wildlife Forensic Laboratory. While a brownish grade brings about $150 a pound, the top grade, comparable to elephant tusk, fetches $400.

Many carvings analyzed at U. S. ports last year were legal mammoth ivory—good news for elephants. But now there is bad news for other species. "Ivory from hippopotamus teeth and warthog tusks is showing up," says Espinoza.

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Earth Almanac

Black Bear of a Different Color Needs Protection

Amid the mist and the rain of the once virgin forest along British Columbia's coast, the Tsimshian-speaking people have long known of a rare white bear, a spirit bear that they believe possesses great power. They call it *moksgm'ol.* Wayne McCrory and Erica Mallan are the only biologists in the world currently studying the bears. McCrory loves the mystic side of these animals, too, but he calls them *Ursus americanus kermodei*, or kermodes for short.

In this obscure subspecies of North American black bear most individuals are black, but about one in ten is white, like this cub romping with its sibling (right). Kermodes can also be orange, gold-and-white, or even "pinto," with black and white patches. Recessive genes are probably responsible for this natural circus. No one, including McCrory, has estimated the total population, since the kermodes range nearly 30,000 square miles. But Princess Royal Island is home to at least a hundred (perhaps ten of them white), and McCrory hopes to establish a 514-square-mile Spirit Bear Provincial Park there.

"The habitat of the kermode is being degraded by clear-cut logging," says McCrory. "This includes destruction of winter den sites—huge cedars with hollow interiors that make excellent chambers for the bears. And logging roads are making things easier for poachers."

SERGE HOUDE

Sprouted Deep in a Mine, Trees Restore the Surface

Created by decades of nickel mining, the infamous 25,000-acre "moonscape" of bare rock at Sudbury, Ontario, is becoming less lunar. In 1984 the mining company Inco Limited hit upon a plan to aid both its own reclamation project and one begun by the city of Sudbury. Inco's Creighton Mine, a 4,600-foot-deep horizontal tunnel called a drift, was played out. Why not grow trees in it?

"Free heat," says Inco's Ellen Heale, was the deciding factor; ambient geothermal heat at that depth keeps the nursery at 75.2° F. Also, pests are fewer. Active mine shafts nearby provide water, electricity, and elevator service. Powerful metal-halide lights simulate the sun, and plastic sheeting increases light reflection (below).

Last year 85,000 jack and red pine seedlings were grown from January to April, then transplanted to the surface. All told, about 530,000 mine-grown trees are helping to reclaim desolate Sudbury from moon back to earth.

INCO LIMITED

On Assignment

DIETER AND MARY PLAGE (ABOVE); DES AND JEN BARTLETT

Blowing sand and sizzling sun surround DES and JEN BARTLETT (above), themselves fixtures of Africa's Namib Desert. While time is the ally of all wildlife photographers, the Bartletts' quest to find and film desert animals over vast distances has turned into an incredible eight-year marathon.

"After three years, we started saying to each other that if we'd known the difficulties at the beginning, we'd have been fools to take this on," says Jen. "Yet we might still have taken it on, because this is a film that needs to be made."

Even with 40 years of recording wildlife between them, the Australian naturalists had never seen a desert roamed by elephants and lions, sustained by underground water. To cover the 19,000-square-mile sea of sand and rock, including Skeleton Coast Park, they used a pair of lightweight aircraft and two ground vehicles to haul gear from their base, a cabin on the coast.

Once they spent an entire day 70 yards downwind of 26 elephants at an oasis. "All we had were two oranges and an emergency water container," Jen recalls. "There was a calf, only days old, the first we'd seen. Late in the day they all left, stopping every few hundred yards to let the baby rest. We watched until they were just dark, distant specks."

They also focused on smaller

residents like the suricate, a relative of the mongoose, atop Jen's head (left). Suri, as they named their pet, here scans for birds of prey. On the beach, Des uses an endoscope lens for a wide-angle shot of ghost crabs feeding on a dead seal.

For the GEOGRAPHIC the Bartletts have migrated with snow geese, revealed life within a beaver lodge, dived with right whales. During six years of filming Namibia's Etosha National Park they heard tantalizing tales of the Skeleton Coast. Here they filmed lions on deserted beaches. Alas, all the park's lions have since disappeared, many shot by herdsmen beyond park boundaries. Now Des and Jen strongly support a proposed game reserve next to the park: "This tragedy must lead to something positive, both for local inhabitants and for wildlife."

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