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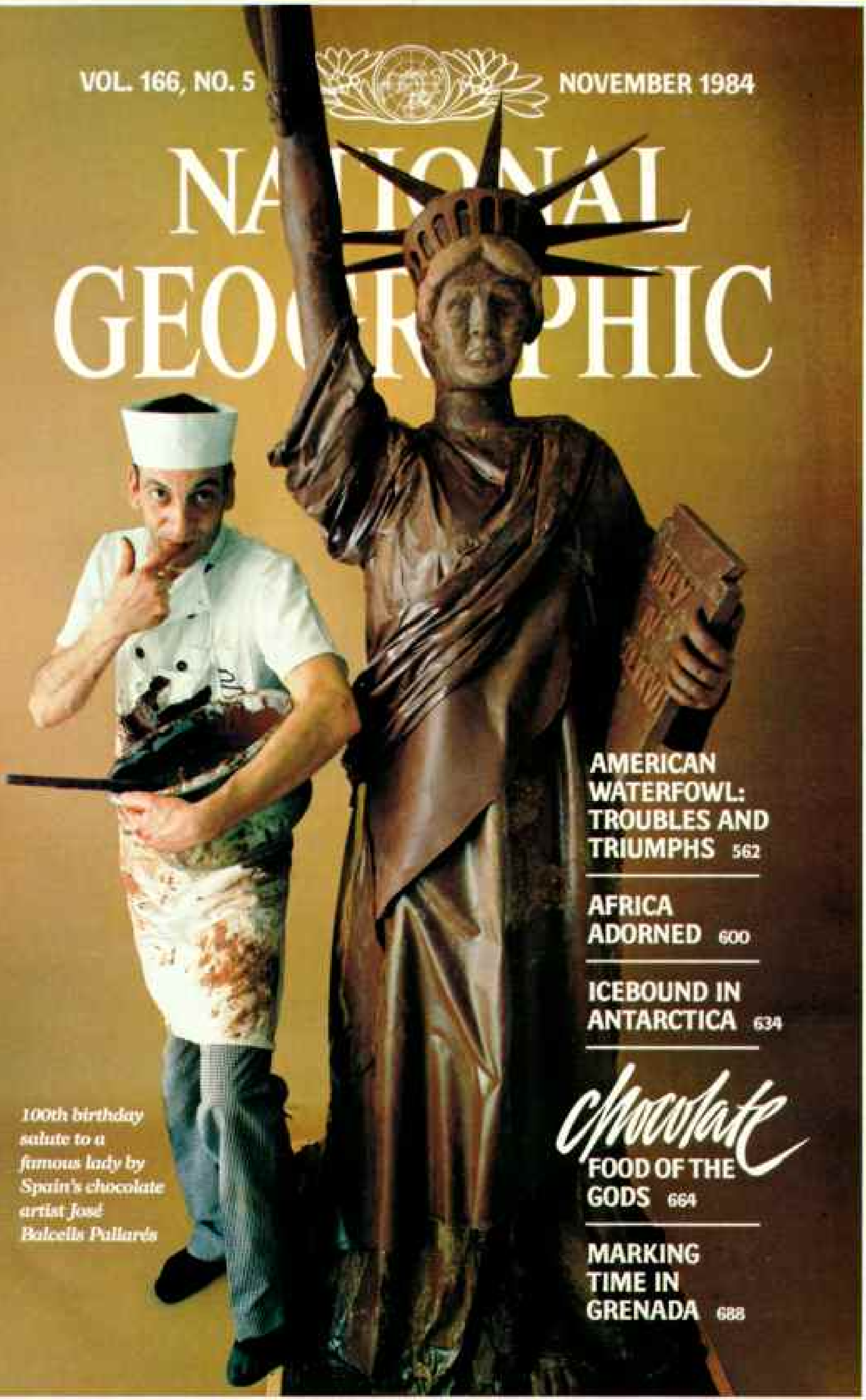
NATIONAL GEOGRAPHIC



100th birthday salute to a famous lady by Spain's chocolate artist José Balcells Pallarés

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READERS OFTEN ASK how we select the mix of articles in the GEOGRAPHIC. It's a little like asking how you chose the person you married. The easy answer is that we look for intelligence, beauty, excitement, and integrity in a mix that promises long-lasting fulfillment. Obviously, these are only guidelines. In both cases the final decision is based on emotion and instinct.

It's best we drop this dangerous analogy, because the editing instinct should be based on a lot of experience. Further, we're always looking for something new, for variety, discovery, the unexpected.

The word "magazine"—derived from *makhzan*, the Arabic word for storehouse—defines our editorial policy, to be a storehouse of knowledge with enough variety to satisfy any member's taste. For example, this issue offers nature, science, adventure, current events, and people and places from Africa to Antarctica.

Nature: Whether you hunt, bird, or do neither, you'll probably be distressed to learn that those formations of geese and ducks honking overhead this fall are finding fewer places each year to land and rest—essential to their long migrations.

Culture: Fashionable ladies worldwide emulate tribal adornment, which in Africa has both beauty and cultural significance, Angela Fisher shows us.

Adventure and science: Dr. David Lewis deliberately freezes his ship and crew into the ice for 11 months and studies both human behavior under stress and an environment where nature survives the long dark.

Food and fun: Find how and why chocolate has such an addictive hold on most of us.

Geography and politics: A year ago this October, world attention focused on the U. S.-led invasion of Grenada. Journalists, deliberately left out of the operation, used imagination and persistence to reach the island. Though our forces are still there, and that nation's basic problems seem no closer to solution than a year ago, this August the only U. S. journalists present for Grenada's first Carnival since the invasion were from the GEOGRAPHIC. But the story is still news.

To return to our opening analogy, we hope the mix this and every month is sufficiently fulfilling to assure a long, happy marriage with the GEOGRAPHIC.

Wilbur E. Garrett

EDITOR

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November 1984

COVER: *Chocolate Statue of Liberty towers beside Barcelona confectioner José Balcells Pallarés. Photograph by James L. Stanfield.*

THE NATIONAL GEOGRAPHIC MAGAZINE
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A LOT OF TROUBLE AND A FEW TRIUMPHS FOR

North American Waterfowl

By JOHN MADSON

A TRUMPETER SWAN ROUSES BEFORE SUNRISE AT MALHEUR NATIONAL WILDLIFE REFUGE, OREGON. STEVEN C. WILSON, ENTHEOS

Once an imperiled species, the majestic-winged trumpeter now numbers about 10,000 birds in North America. Though intelligent management and a web of protective laws have restored trumpeters as well as other populations of waterfowl, a diminishing habitat raises a flag of warning for the future.

Countless thousands of lesser snow geese and Ross' geese swarm over flooded rice fields near Colusa National Wildlife

JIM BRANDENBURG

Refuge in California's Central Valley. Here climate and grain missed by harvesters combine to provide a prime wintering area.

THOSE LITTLE SCRAPS of Iowa marsh hadn't died easily. They had been havens for waterfowl since the last ice age, and since the coming of the white man, they had lived through more than a century of change as the prairie around them was broken and tamed and put to cash grain.

They were tiny marshes, too small to lease for hunting, and for a long time they hadn't been worth the trouble and expense of draining. But they cost the owners scores of bushels of corn every year, and with land values soaring, one farmer after another extended a line of drain tiles into these last pockets of prairie marsh. Ancient waters trickled away, and the bond to winged creatures was broken. The marshes would never again shelter broods of teal ducklings or beckon to migrant swans.

My friend Don Carper, also an Iowa farmer, takes a different view of wetlands. He keeps a boggy patch of creek bottom just because he likes to see the snipes, dowitchers, and other shorebirds that come there. When I told Don about the many little marshes being drained, he said wistfully, "It's all in how a man looks at things, I guess. I'd have traded an acre of my best corn ground for a half acre of native marsh."

In the several major waterfowl migration routes, or flyways, that funnel down out of Alaska and Canada through the 48 states, there is a rich variety of wetlands: bogs, swamps, sloughs, tiny ponds and great marshes, river oxbows, saltwater bays and sounds and estuaries. They are essential to our ducks, geese, swans, and shorebirds—and many are living on borrowed time.

By current estimates, 33,000 acres of prime prairie wetlands vanish each year. In the 48 states about 458,000 acres of wetlands are lost annually to farming and other development—and as native wetlands have declined, so have certain species of ducks.

FEW ORIGINAL WETLANDS have been harder hit than the great hardwood swamps and timbered bottomlands of the South. Of the Mississippi River's alluvial plain, from the "boot heel" of southeastern Missouri to the Gulf of Mexico, nearly seven million acres of hardwood forests and their associated wetlands have been drained in the past 50 years.

Almost nine-tenths of Arkansas' original hardwood swamps have met the same fate, but a few surviving fragments can still be found along the lower Cache River and its tributary Bayou DeView, a main wintering area of North American mallards. Although the upper reaches of these rivers underwent extensive channel work during the 1920s, their lower portions remained pristine, with meandering streams flowing through hardwood swamps. In 1972 channelization of the Cache resumed, this time by the U. S. Army Corps of Engineers at the mandate of Congress. The new project, working upriver from the mouth, was authorized in an effort to control flooding of the Cache's bottomlands and was strongly supported by some riverside landowners and key politicians.

It was just as strongly opposed by conservationists, who charged that it created new cropland, destroying the finest waterfowl habitat in eastern Arkansas. They sued to halt the project, and the Citizens' Committee to Save the Cache River Basin was born with Rex Hancock, a Stuttgart, Arkansas, dentist and hunter, at its head. Through financial pinch and political delay, from one setback to the next with occasional flashes of success that bought time for the beleaguered Cache, the citizens' committee fought the project. In 1978 a government task force concluded that the channelization of the Cache River and Bayou DeView was the "single most damaging project to waterfowl resources in the nation today."

Out of this report came a U. S. Fish and Wildlife Service plan to "protect and preserve" 92,000 acres of floodplain in the middle and lower Cache River basin. Local support of the "big ditch" drained away. The ducks had won—for now.

Not only ducks win in such cases. Within a native wetland plants and animals exist in wilderness harmony—wild orchids and callas, irises and lotuses alongside muskrats and minks, otters, deer, bears, herons, egrets, bitterns, and marsh hawks. Such a wetland may not conform to the romantic image of wilderness. It may lack shining

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Author and naturalist **John Madson** has reported to GEOGRAPHIC readers on Nebraska's Sand Hills (October 1978) and the Badlands of South Dakota (April 1981).

mountains or towering trees. Yet the marsh can qualify as genuine wilderness on at least two counts: It is part of the original and it is essentially unpeopled, the cherished haunt of a few naturalists, hunters, and trappers.

But whatever else may live there, a wetland is fulfilled by waterfowl. Skeins of ducks, geese, and swans sew each unique marsh and swamp into the vast fabric of their flyways. Jerry Serie, a U. S. Fish and Wildlife Service biologist, told me this about whistling swans: "Their ancient migratory routes are what tie the continent together."

Swans nesting in Alaska may stop to feed on sago pondweed in certain saline potholes in North Dakota—a way-stop that refuels them for the next relatively barren leg, 1,500 miles long, to Chesapeake Bay. If the Alaska nesting grounds are disrupted, if the North Dakota potholes are drained, if oil spills foul the Chesapeake, perhaps those swans can work out a new strategy—but perhaps they cannot.

NATIONAL GEOGRAPHIC PHOTOGRAPHER BATES LITTLEHALES

"Bullheaded determination" *brought victory for Dr. Rex Hancock after a seven-year fight to stop a federal flood-control project that would have severely affected prime waterfowl habitat in the 2,018-square-mile Cache River basin of northeastern Arkansas. Says Hancock: "It would just have been a 232-mile ditch all the way to Missouri.*

"I have enjoyed this heritage," says the duck-hunting dentist, "and I wanted to see it pass to the next generation," such as sons Jim, far left, and Bryan.

SOME OF THE RICHEST wetlands, and surely among the most threatened, lie in a vast arc of open country curving through the southern parts of Canada's Prairie Provinces into the Dakotas and Minnesota east and north of the Missouri River. This is the prairie-pothole region, the fabled "duck factory of North America"—300,000 square miles of the richest waterfowl-producing range on the continent.

About a hundred miles west of Winnipeg in southwestern Manitoba is the Minnedosa pothole country, mile after mile of rolling farmscape strewn with thousands of jewel-like wetlands, an average of 50 ponds per square mile. The Minnedosa potholes are little wetlands of the sort called sloughs by local farmers, kettles by geologists, and potholes by wildfowl biologists. In a crazy assortment of shapes, they vary from hundreds of acres to only a few square yards. They constitute an enormously productive natural system that is on a collision course with modern agriculture.

Considering what several thousand hungry ducks can do to a ripening grainfield, a western Canadian farmer can't be blamed for wanting wetlands drained and plowed under and the millions of prairie-bred waterfowl gone somewhere else. In the Prairie Provinces in the heart of Canada's duck country, small grains are usually cut in late August and early September and left to dry on the ground in long windrows. Such "swathing" hastens the drying process of wheat, barley, oats, and rapeseed—grains that might otherwise remain green on the stem.

In a normal year grain is harvested before the northern ducks arrive and before local

Disappearing wetlands

***Potholes** gouged by glaciers dot farmlands in central North Dakota (**right**). Millions of the miniature marshes and ponds of the U. S. and Canadian prairies serve as nurseries for 50 percent of all the ducklings bred in North America.*

*Potholes also serve as an irritant to many farmers, who drain and fill them to increase cropland. Last year North Dakota lost 20,000 acres of potholes. Elsewhere farmers dig watering holes like this one (**bottom right**) near Simpson, Saskatchewan, good for cows but not for nesting waterfowl, conservationists observe.*

Prairie potholes, together with coastal and inland marshes, swamps, and small ponds, compose a disappearing natural resource known as wetlands. Replaced by farms and urban sprawl, they vanish at the rate of 458,000 acres a year in the 48 states. Approximately half of our precolonial 215 million acres of wetlands no longer exist.

*Prairie grass in its pristine state near Saskatoon, Saskatchewan (**bottom left**), provides excellent cover for nesting birds. Here researchers from the Canadian Wildlife Service try to determine the best habitat for nesting ducks.*

JIM BRANDENBURG (ABOVE); STEPHEN J. KRASEMANN

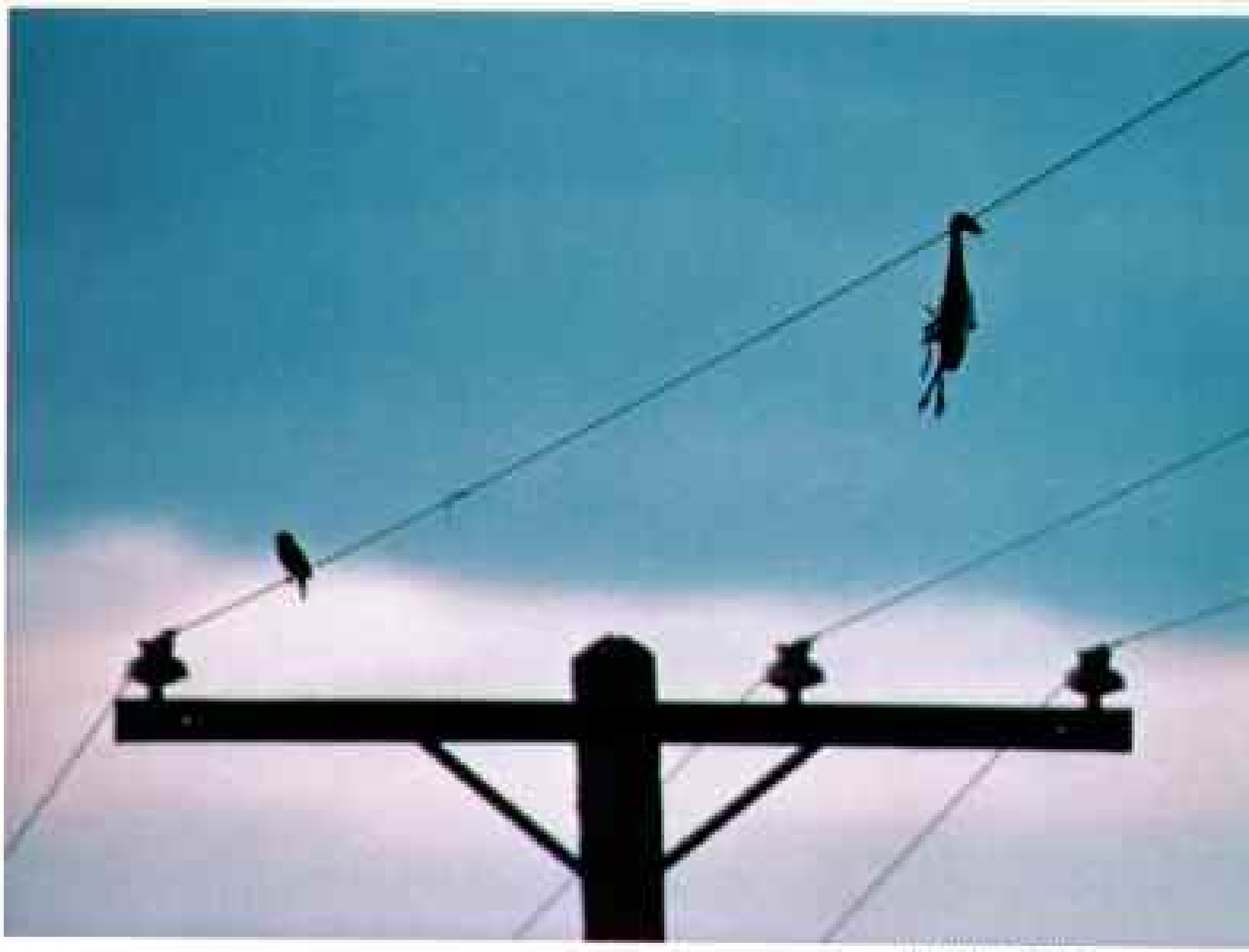
How do birds find their way?

When the mood to migrate strikes, brant take off from the Alaska Peninsula and fly nonstop over the ocean to Baja California, a journey of 3,000 miles. Sensing spring, a pintail leaves its winter quarters on the Texas Gulf coast and returns to the meadow in Manitoba where it was born. And a Canada goose alights near the nest on a muskrat house in the Arctic that it left the previous fall.

How the birds find their way remains a mystery that scientists can only partially explain. Mallards and some other species have been observed to steer by the sun and the stars or by physical landmarks, such as rivers, coastlines, and mountains.

Yet some waterfowl navigate over hundreds of miles of featureless landscape and even fly between layers of clouds that obscure both landmarks and stars.

Scientists feel that waterfowl, like homing pigeons, may use the earth's magnetic field for orientation and navigation.



JIM BRANDENBURG

There's hazard aplenty *as up to 100 million waterfowl wing southward each fall. Tons of lead from the guns of 2.2 million hunters claim more than 20 million birds. Perhaps 30 million succumb to various diseases. Winging across California, a coot* ***(right)*** *comes to grief on a utility line.*

In 1962 an airliner encountered a flock of swans near Ellicott City, Maryland. Two birds struck the aircraft, damaging a control surface. The airplane crashed, killing 17 people.

birds—young ducks trying their wings and old ones hungry after the summer molt—have begun to gather in the large flocks of autumn. But in a cool, wet fall, when harvests may be delayed until late October, local ducks are joined by migrants, and the resulting hordes of waterfowl glut themselves in the swathed fields. Their big appetites are bad enough; their big feet are worse. More grain is trampled out of the heads than is eaten and falls to the ground beneath the straw, lost to duck and farmer alike.

Gordon Grettum and his son Roger farm near Camrose, Alberta. Barley is their big crop, but they help raise a lot of ducks too. Early on an autumn morning we walked out into a field half a mile from the Grettum farmhouse. A recent rain had left several shallow temporary ponds in the field of freshly swathed barley. It looked like a good crop—from a distance. Closer inspection revealed that ducks had harvested the field before the Grettums could do so. The swaths around one of the wet basins were little more than grainless straw.

"The 12 acres around this pond are a total loss," Gordon said. "This land would have made about 80 bushels to the acre, meaning we lost about $2,000 worth of barley here. This isn't the only place; we have others about as bad. How can damage like this be relieved? Well, they might just as well buy this field and give it to the ducks!"

Gordon was awarded damage payments derived from government funds, supported by a special three-dollar fee paid by duck hunters in addition to the charge for their hunting licenses. Total payment to a landowner may amount to $65 an acre—far less than Gordon's actual loss of $240 to the acre, but better than nothing.

MOST OF THE DUCKS doing mischief in Canadian grainfields are mallards and pintails that after the feast continue southward through the American heartland or swing west toward the Pacific coast. But other prairie ducks may fly an 1,800-mile diagonal to the Atlantic coastal marshes.

Each spring and fall a narrow strip of broken Atlantic coastline from Maine to South Carolina has been the historic flyway of some of North America's greatest concentrations of ducks, geese, swans, and shorebirds. Famous among hunters, the coastal bays, estuaries, and tidewater marshes include such celebrated gunning waters as Merrymeeting Bay in Maine, Barnegat Bay in New Jersey, the Susquehanna flats and other parts of Chesapeake Bay, Back Bay in Virginia, and Currituck Sound in North Carolina. All report fading numbers of waterfowl, and some hold only shadows of their former sky-blackening glory.

The greatest of these traditional

The great migrating clouds *of waterfowl that delight the eye can bring devastation to a farmer's crops. It's a matter of timing. Geese and ducks (**above**) alight to feed on a farm at Isherwood Slough, Saskatchewan, after the wheat has been harvested. But mallards (**right**) gorge on corn piled on a farm in Gregory County, South Dakota.*

In Canada, waterfowl feeding on cereal grains cause 20 million dollars in damage a year. In Minnesota, North Dakota, and Montana the toll is nearly $600,000.

STEPHEN J. KRASEMANN (ABOVE); GARY R. ZAHM

The loon comes back

The wild song of the loon is being heard more often on New Hampshire lakes like Squam (**above**), where a common loon and its chick navigate. Harassed by too many people, too many boats, too many raccoons, and fluctuating lake levels, the birds had been producing fewer chicks.

In 1976 the North American Loon Fund began a public-education program to persuade people not to bother the birds. Floating nests (**below**) made of logs and marsh vegetation proved successful. Last year 25 percent of the state's loon chicks were hatched on them.

JOHN PATRIQUIN

wintering grounds is Chesapeake Bay, and even here a decline in numbers is apparent. Local problems include the encroachment of Baltimore upon Back River and Reed Bird Island. There is an ever present threat of pollution, particularly from oil spills, for the bay is not only the terminus of wildfowl migrations but also the destination of fleets of tankers. In 1976 a 250,000-gallon spill off Smith Point at the mouth of the Potomac River killed at least 10,000 waterfowl, and perhaps as many as 50,000.

There is no doubt that Currituck Sound in northeastern North Carolina has declined sadly as a waterfowling area since its halcyon days of 60 years ago. Some of its palatial old clubs are silent now, and the remaining guides sadly mark the passing of an era.

There are, of course, fewer ducks everywhere. But some old watermen around Currituck Sound believe that changes in water quality may be responsible for the fading duck flights. They point out that many fine duck foods prosper in brackish water and that Currituck Sound, fed by streams and cut off from the Atlantic by the barrier of the Outer Banks, no longer receives charges of seawater. Out on Knotts Island at the upper end of the sound, the Wade brothers, Tilford and Mike, told how summer-home development on the Outer Banks may have helped degrade Currituck as waterfowl habitat.

"Years ago flood tides in fall and early winter would wash over low places in the Outer Banks and bring surges of ocean water into the sound," Tilford recalled. "Then came the sand fences. First ones I remember out on the banks were built in the 1930s as a Civilian Conservation Corps project. These caused the sand to build up in the low places and ended frequent overwashing of storm tides into the sound. Now the water is so fresh that—well, it just tastes rotten!" You hear that often around Coinjock, Waterlily, and Knotts Island—that when the salt water left the sound, so did the good duck foods that used to bring in the big flights.

Just before the gunning season I joined several veteran guides at the little settlement of Waterlily on the west shore of the sound. Among racks of vintage waterfowl decoys

Mallards and men

Pop goes a mallard, *netted over a pond near Saskatoon (**right**) by a Canadian Wildlife Service biologist who uses a special gun to fire the net. Retrieved and banded, the hen became another participant in a U. S.–Canadian study that aims to sort out the major variables influencing duck populations, such as the relationship between hunting and nonhunting mortality.*

*Do ducks return to their hatching areas? The best way to find out is to mark them before hatching. A researcher pierces a mallard egg (**below**), extricates the foot, and affixes a tag (**bottom**). Then the foot is pushed back in, the egg taped, and the duckling hatches normally a day later. Distinctive nasal tags, as on a blue-winged teal (**below right**), enable researchers to study seasonal movements of individual females.*

JIM BRANDENBURG (TOP AND ABOVE); STEPHEN J. KRASEMANN

and fishnets, in an atmosphere blue with pipe smoke and expletives, we wondered where the ducks had gone. We knew many Canada geese no longer came to Currituck because they were short-stopped by refuges and the siren song of cornfields up in Maryland, Delaware, and Virginia. Would that also account for missing ducks? Guide Roland Twiford had other ideas.

"There are different reasons for it, in my opinion," he reflected. "There's somethin' wrong with this water now. Don't know what, but if we could get some salt water back in here again, it might help. There don't seem to be no feed for the ducks. . . ."

"Yeah, and what there is, the durn stuff rots before it takes holt," chimed in another.

"You take this ol' grass and pondweed like we used to have," added a third man. "It'll come up every spring same as always—but along aboot the last of June or first of July it'll just die."

"Well, too much salt will sure kill some forage," said Twiford. "But if we could get a little more salt water into the sound, we'd have more of the old saltwater grasses. As it is, there just ain't nothin' for ducks to eat."

On the other hand, some field biologists in the area believe there is more good waterfowl food in Currituck Sound than there are ducks to eat it, and that the big problem isn't water quality there but declining duck production up the flyways. But even the experts disagree, and more study is needed.

FROM THE NORTHERN ENDS of the flyways to the southern limits of wintering grounds, the birds wing their way from one set of problems to the next. For some *(Continued on page 582)*

Cacophony of high-pitched yelps *announces the arrival of lesser snow geese, most vocal of all waterfowl, at Tule Lake National Wildlife Refuge on the*

FRANS LANTING

California-Oregon border. The Department of the Interior's Fish and Wildlife Service manages 422 refuges encompassing 140,492 square miles of choice habitat.

BATES LITTLEHALES (COPPER LEFT); EDWARD R. DEGGINGER (ABOVE); TIM FITZHARRIS

Brilliance afloat, *the wood duck* ***(top right)*** *was thought to be near extinction until federal law and effective management brought it back. Last year 1.5 million woodies were shot, making the bird number two in the hunter's bag after the ubiquitous mallard.*

Distinctive sawbill of a red-breasted merganser ***(left)*** *enables this diving duck to catch small fish, its primary food. A blood-red eye and tufts of head feathers used in courtship displays identify an eared grebe* ***(above)****, another diving bird.*

Fighter pilots of duckdom, cinnamon teal ***(top left)*** *fly at around 50 miles an hour, dipping and changing course frequently, thus presenting hunters with difficult targets but tasty meals when the shots connect.*

species the future seems gloomy—canvasbacks, redheads, black ducks—but the sun shines brightly for others once feared lost.

Consider the wood duck, thought to be imperiled at the turn of the century. The wood duck is a very beautiful bird that also happens to be very good eating. Moreover, it had the bad luck to concentrate its breeding and wintering in well-populated, heavily hunted areas of the eastern United States.

Wood ducks were especially hard hit by spring shooting, for while other ducks might be hunted on their way north but then nest in relative security, the little "summer duck" lived among its hunters, and was under fire in fall, winter, and throughout its breeding season.

Apart from the actual kills, spring hunting affected the pairing and normal breeding patterns of wood ducks. Timbering along rivers and streams destroyed hollow trees and snags in which they nested. In 1901 ornithologist George Bird Grinnell warned, "They are becoming very scarce and are likely to be exterminated before long."

The gorgeous little woodies were woefully few in 1918, when a remarkable new law was enacted. The Migratory Bird Treaty between the United States and Canada resulted in the first wildlife legislation with the force of international law. It ended market hunting and spring shooting, banned the hunting of swans, cranes, curlews, and other rare birds for ten years—and gave special protection to wood ducks. Within a dozen years the woodies were out of danger and gaining strongly.

Some of the wood duck's comeback is owed to the direct, personal involvement of human beings. In the absence of hollow

JIM BRANDENBURG

Like an Irish Sweepstakes *for artists, the Department of the Interior's annual duck stamp competition can make the winner rich. Though the artist, like two-time winner David A. Maass* ***(left)*** *of Waterville, Minnesota, gets only a sheet of stamps from the federal government, he reaps fame and profit from the sale of prints. Dropout from an art correspondence course, Maass honed his skills, and now his paintings sell for around $16,000 each.*

This winning portrait of American wigeons ***(above)*** *by William C. Morris appears on the 1984-85 federal duck stamp, which hunters must buy for $7.50 before they can shoot waterfowl. Since 1934 the stamps have brought in 285 million dollars, used to purchase 3.5 million acres of land for national wildlife refuges.*

trees and other natural nesting places, woodies aren't above accepting man-made nesting boxes. This led to the sort of hands-on conservation that people want to be a part of—and countless sportsmen, bird lovers, and landowners began making nest boxes and placing them along woodland creeks, pond edges, and marshes. Around some of the city lakes in Minneapolis, wood duck nesting boxes seem almost as common as television antennas in a subdivision.

Today the wood duck, drawn back from the brink, is one of our most numerous ducks, with more than six million in the eastern half of the United States. But we nearly lost one of our national treasures.

THE MOST MAJESTIC of North American wildfowl—the trumpeter swan—had raised even greater concern. Until the 19th century trumpeters ranged through much of Canada and the northern United States. Then, hunted commercially for their skins, the swans suffered a swift decline. By 1912 ornithologist Edward Howe Forbush was predicting their extinction within "a matter of years."

As it turned out, the ornithologist was wrong. The immense breeding range of the great swans had shrunk from millions of square miles to a few little corners of wilderness. By 1932 there were just 31 trumpeters left in Yellowstone National Park, 26 more in the Red Rock Lakes of Montana's Centennial Valley, west of Yellowstone, and about a dozen others elsewhere in the United States. The trumpeter swan population then known totaled just 69 birds.

In that dark hour the trumpeters were given sanctuary with the creation of the Red Rock Lakes National Wildlife Refuge in 1935. Rescue was at hand. The trumpeters began to increase, slowly at first, and during the next 30 years the flock at Red Rock Lakes increased to a peak of 423 birds. Since then it has declined somewhat, adjusting to the available breeding habitat and natural food supply. The Red Rocks population is now about a hundred adult swans, with several hundred more in nearby Wyoming and Idaho.

These colonies and transplant populations in other western states are doing well—and previously unknown breeding grounds have been discovered in southern Alaska. All in all, nearly 10,000 trumpeters are alive today in North America. The great white birds are no longer considered in danger.

UNLIKE WOOD DUCKS and trumpeter swans, wild geese were never in peril of their existence, but they suffered their share of travail and were once far less numerous than they are today. My boyhood friend Jimmy shot the first Canada goose I ever saw close up. It was a far bigger creature than we had imagined, colored like a prairie-storm sky and with the look of a far traveler that had seen worlds beyond the dreaming of Iowa boys. In that long-ago autumn of 1937, it was a rarity. A picture of Jimmy and his goose made the front page of the local newspaper. Today the item would be so commonplace that it wouldn't rate two lines on the back page.

If someone had told us that we'd see the time when it was no more unusual to shoot a Canada goose than to bag a limit of cottontail rabbits, he'd have been pegged as a dreamer. Yet when Jimmy shot that Canada goose there were about 74,000 of them in our Mississippi flyway. Today there may be twice as many Canada geese in that flyway alone as there were in all North America when Jimmy and I were boys.

Dr. John P. Rogers, chief of the office of migratory bird management, U. S. Fish and Wildlife Service, told me, "Today there may be as many as seven million geese of all kinds in the fall flight. There are probably more geese now than there have ever been."

Even back in the 1930s, the dawn of modern wildlife management, it was believed that lack of nesting habitat wasn't the main problem of wild geese. Most geese tend to nest north of the marsh drainage and intensive land use that plague their cousins, the ducks. More serious problems for geese were the lack of secure way-stops and good wintering grounds along the flyways. These were problems with ready solutions. With new funding in the late 1930s, state and federal refuge systems were greatly expanded. In one of conservation's most heartening success stories, wild geese flourished again, proving to be more resilient and responsive to management than anyone had dreamed.

Ducks and geese still run a gantlet of

If ducks were engineers, *they probably could not improve on refurbished Cranberry Marsh near Valemount, British Columbia, a project of Ducks Unlimited. The islands and dredged interconnecting waterways substantially*

GEORG GERSTER

increase the marsh's breeding and nesting areas. Since 1937 Chicago-based Ducks Unlimited has rejuvenated more than two million acres of wetlands across Canada with funds contributed mainly by U. S. hunters.

gunfire along the entire course of the southward journey between breeding grounds and wintering areas. Hunting in Canada and the United States accounts for a loss of some 20 million game ducks each year. Many biologists say that much of this is "compensatory mortality" for birds that would be lost to other causes. An additional 20 million ducks die each year from disease, predation, and accidents. This year, then, something like half of North America's fall population of about 80 million game ducks will not survive to the next breeding season.

Hunting, though it is responsible for many losses, also accounts for certain gains for waterfowl. Before the U. S. duck or goose hunter ever pulls a trigger, he will pay an 11 percent federal excise tax on his shotgun and ammunition, buy a federal duck stamp (as well as a similar state stamp in more than half the states), and purchase a resident state hunting license and a nonresident license if he hunts out of state.

The "Pittman-Robertson" Federal Aid in Wildlife Restoration program—financed by that excise tax on guns and ammunition, with matching state funds from hunting-license sales—raises some 30 million dollars annually for wetlands acquisition, development, and research. The federal duck stamp brings in another 15 million dollars. The dedicated waterfowler may also contribute to Ducks Unlimited, a vigorous private effort that raised over 38 million dollars in 1983 for wetlands preservation. Beyond this the hunter may be a member of a private duck club that is saving its own marshland.

AS WATERFOWL NUMBERS are compressed into shrinking wetlands surrounded by high-technology agriculture with its arsenal of insecticides and herbicides, disease and poisoning can do deadly work among concentrations of ducks and geese. Botulism, long known as western duck sickness, may appear almost anywhere but is commonest in the western states. In the winter and spring of 1952 as many as five million ducks died of botulism in the western United States. Of two million ducks at California's Tulare Lake, as many as a quarter of a million died in 1941.

In Nebraska's Rainwater basin, losses of

Disease's grim toll

***Mass die-off** of mallards from duck plague, totaling more than 40,000 birds, occurred at Lake Andes National*

STEPHEN J. KRASEMANN

MILTON FRIEND, U. S. FISH AND WILDLIFE SERVICE

Wildlife Refuge, South Dakota, in 1973 ***(above)****. The unprecedented outbreak, caused by a herpes virus, may have originated in captive waterfowl. Today's major killers are botulism, often carried by toxic maggots—such as these on a duck at Last Mountain Lake, Saskatchewan* ***(lower left)****—and avian cholera. A worker incinerates two cholera-stricken lesser snow geese at the Sacramento refuge* ***(below)****.*

JIM BRANDENBURG

Troubled waters at Kesterson

Deadly plaques *mark an evaporation pond at Kesterson National Wildlife Refuge* ***(above)****, near Gustine, California, that contains selenium, pinpointed as the cause of deformities in refuge-bird embryos. An eared-grebe embryo has a deformed beak* ***(right)****, a fatal abnormality. A coot embryo with truncated feet* ***(right, lower)*** *also has no eyes or lower beak.*

The Kesterson ponds receive water from a canal that transports contaminated drainage containing salts, selenium, and other materials leached from irrigated San Joaquin Valley farms. Federal and state agencies study ways to solve the problem, but meanwhile the birds die.

DAVID CUPP (ABOVE); S. W. WOO, UNIVERSITY OF CALIFORNIA, DAVIS, COURTESY USFWS

waterfowl to avian cholera during spring migration have been put at some 80,000 birds in a single year. Duck plague, or duck virus enteritis, was first reported in the United States in 1967 and has likewise taken its greatest toll in the West. In midwinter 1973, at Lake Andes National Wildlife Refuge in southeastern South Dakota, this disease killed more than 40,000 ducks and several hundred Canada geese.

A new kind of western duck sickness has struck California's San Joaquin Valley. In the summer of 1983 U. S. Fish and Wildlife Service biologists found an alarming number of deformed embryos and newly hatched young of several kinds of waterfowl and shorebirds nesting at the Bureau of Reclamation's Kesterson Reservoir in the western San Joaquin Valley. The 5,900-acre tract, which includes 1,200 acres of ponds, is managed by the Fish and Wildlife Service as a wildlife refuge.

Of 347 nests of stilts, coots, grebes, mallards, gadwalls, and cinnamon teal, 20 percent were found to contain deformed young. The stricken birds were characterized by missing or malformed features—misshapen beaks, bulging skulls, clubfeet, stubby wings; some lacked eyes. In tests of eggs, 15 percent contained dead embryos.

The cause of this havoc is believed to be a silvery gray, nonmetallic, naturally occurring element called selenium. Although as a trace element it is necessary to health, selenium is known to be poisonous when highly concentrated—and in some places, California agricultural practice seems to have developed such concentrations.

The San Joaquin Valley has an arid climate. With less than eight inches of annual rainfall, much of it was semidesert until massive irrigation systems began bringing water down from northern California in 1951. Today more than 70 percent of the valley is irrigated, and like some other regions of the world that have depended heavily

on irrigation, it has run into problems.

Underlying some of the most productive parts of the valley is a soil layer that is virtually impervious to water. Even though the natural water table below this layer is being depleted by pumping, a perched water table has developed above it as irrigation water seeps down. This perched water table slowly rises, threatening to waterlog the farmland until it cannot be worked.

Farmers bury drain tiles as deep as eight feet in such fields, with tile lines converging on a central field from which water is pumped away into a canal. All this might provide a neat recycling of irrigation water if the water hadn't leached many salts as it percolated down through the mineralized soil. Indeed, more water is pumped onto the land than is required for crops for just this reason—to rid the soil of some of its saline content. As much as three times saltier than the sea, the drain water is discarded into special evaporating basins such as those at the 1,200-acre Kesterson Reservoir.

There is little doubt that this wastewater is highly charged with the agent that is poisoning waterfowl. Bird embryos are sensitive to selenium poisoning—and selenium levels in some drain waters run as high as 4,200 parts per billion.

The worry has begun to reach beyond the Kesterson ponds. There are 17,000 acres of similar drain-water ponds in use or under construction in the southern end of the San Joaquin Valley, and concern is growing that the threat may someday extend to the striped bass, Dungeness crabs, shrimp, and shellfish of San Francisco Bay, into which the selenium-polluted waters of the San Joaquin Valley may ultimately drain.

LEAD POISONING is perhaps the longest known and most controversial of the waterfowl sicknesses brought about by man. It is caused by spent shot pellets that waterfowl pick up from marsh bottoms as they feed. The lead pellets are abraded in the birds' gizzards and deadly lead salts enter the bloodstream. At least 2 to 3 percent of our waterfowl die annually of lead poisoning. The magnitude of this loss and what to do about it provoke bitter controversy. Soft steel shot is now required as a nontoxic substitute for lead in some hunting areas. And while some hunters contend that this lighter steel shot is less efficient and results in greater numbers of cripples, others believe that its advantages greatly outweigh any shortcomings (pages 593-4).

If the full extent of lead poisoning is hard to pin down, the impact of pesticides on waterfowl is even more difficult to measure. Pesticide residues in soil, water, and vegetation may affect not only waterfowl, but also anyone who eats wild duck. In the spring of

FRANS LANTING

1981 the pesticide endrin was used to control cutworms on more than 100,000 acres of wheat in Montana. When waterfowl carcasses were analyzed later that year, levels of endrin in some birds were as much as 1.35 parts per million, four and a half times above federal health action levels for poultry.

Montana fish and game officials issued warnings against frequent consumption of waterfowl, especially by pregnant women and nursing mothers. Although the U. S. Environmental Protection Agency suggested that no danger was posed by human consumption of affected game birds and that "danger to humans has been overstated," the agency nevertheless urged that such birds be skinned and all fat removed before they were eaten.

Dr. Frank Bellrose of the Illinois Natural History Survey is among the most experienced waterfowl biologists in North America, and among the most respected. At the survey's field laboratory beside Lake Chautauqua on the Illinois River, I asked him about pesticide poisoning in waterfowl.

"It can be serious, all right," Dr. Bellrose replied. "And a big part of the problem is that no one really knows *how* serious. I've always felt, though, that such poisoning tends to be an acute temporary problem. The bigger problem, the old chronic problem, continues to be loss of prime waterfowl habitats up and down the flyways."

When I mentioned that I'd soon be visiting some central California marshes, Frank came on point. Even after some 40 years of uphill struggle in behalf of wildfowl, he still has the crusader's ardor. "There you go—that's exactly what I mean! California's Central Valley—talk about places that have been lost! And if you want to see a little piece of what used to be, don't miss Butte Sink."

In all North America there is no more vivid illustration of the whole catalog of waterfowl problems than the Central Valley of California. A vast trough 400 miles long between the Coast Ranges and Sierra Nevada, the valley once held an estimated four million acres of wetlands teeming with wildlife. But with the favorable climate and irrigation, it became one of the world's most valuable agricultural regions. Predictably, wetlands shrank as land values soared.

Since early settlement 94 percent of the Central Valley's marshes have vanished; only about 270,000 acres of wetlands remain, in state and national refuges and private clublands. Yet this valley of the sun is regarded by the U. S. Fish and Wildlife Service as one of the most important wintering areas for waterfowl in the nation: Fully 60 percent of the Pacific flyway's waterfowl winter there—18 percent of North America's wintering waterfowl. About nine million ducks and geese visit the Central Valley during fall, winter, and spring. It is

JIM BRANDENBURG

Megagoose, *a fiberglass-and-foam decoy eight feet long, really brings 'em in, according to its maker, Charlie Long (**left**), who deploys a dozen of the giants near Klamath Falls, Oregon. "I've watched a flock of Canadas three miles away turn and just glide right in," he says.*

*Duck fever comes to a head (**right**) in November at the Waterfowl Festival in Easton, Maryland. At Blades & Co., a men's store, a mannequin wears the head of a mallard. As manager Bruce Berrier puts it, "This area is real ducky."*

the heart of the West's waterfowl habitat, and its showplace is the Butte Sink.

With Pat O'Halloran, biologist of the nearby Sacramento National Wildlife Refuge, I stood at the edge of the fabled Bean Field, a 440-acre block of waterfowl heaven that has recently been bought by the Fish and Wildlife Service. Several miles away the rugged massif of the Sutter Buttes reared a thousand feet and more above the flat valley. Drawn across this vivid landscape was a veil of white-fronted and Canada geese, thousands of mallards, and pintails beyond counting. In the nearer distance, weaving back and forth over the Bean Field, small flights of sandhill cranes, a resilient species millions of years old, called to each other in their strange deep trilling—a sound right out of the Pliocene.

HERE PRIMEVAL California still lived. Birds rested and fed in great rafts in the Bean Field itself, lifting briefly off the water or rising to join other loose flocks in the middle altitudes. Far above, nearly out of sight, tight formations of travelers came out of the north into the golden air of the Sutter basin.

"I'm glad it's here for you to see," Pat said. "Some naturalist—I can't remember who—has remarked that when the last bird flies in California, it will fly in the Butte Sink." Pat raised his binoculars and studied a flock of cranes feeding not far away. "The question, of course," he mused, "is how much longer there'll be a Butte Sink. . . ."

That question bothers Ed Collins, manager of the Sacramento National Wildlife Refuge and an old pro in waterfowl affairs. "Butte Sink is surrounded by rice farms," he observed, "and agriculture is constantly gnawing at its edges. If marsh owners are offered $4,000 or $5,000 an acre for rice farming—well, they'll have to be dedicated duck hunters or mighty rich, or both, to turn down many such offers."

"But ducks and geese use rice fields, don't they?" I asked.

"Sure. But no rice field can offer a duck the kind of diversity it can find in wild places like Butte Sink and on the state and federal areas near here. There's just nothing like these little pieces of the original."

All Butte Sink's 11,000 acres of native

Five white dots *in an X ray of a dead duck* ***(below)*** *are shotgun pellets. Despite the wounds, the bird survived and was later trapped during a U. S. Fish and Wildlife Service lead-poisoning survey in Arkansas. A wildlife biologist killed it humanely for study.*

In places where the gunning is heavy, such as a shell-littered blind on a lake near Mazatlán, Mexico ***(facing page)****, up to 30 percent of the waterfowl surviving a season carry shot. Wounded birds that later die without being retrieved are estimated to number about four million, 20 percent of the total annual kill.*

JIM BRANDENBURG (FACING PAGE); JIM BURRINGER, NATIONAL WILDLIFE HEALTH LAB, USFWS

ALL BY JIM BRANDENBURG

Deadly dose *of lead shot, ingested while feeding on corn, proves fatal for a Canada goose* (**above**). *A South Dakota conservation officer surveys other lead-poisoned geese collected along the Missouri River near Pierre* (**below**). *Even one pellet, picked up by waterfowl as grit for the gizzard, may kill a bird.*

Canvasbacks at a National Fishery Research Laboratory tank in LaCrosse, Wisconsin (**facing page**), *dive for food. In the wild, such birds risk picking up spent pellets from lake or river bottoms. With a toll of perhaps two million lead-poisoned waterfowl a year, 26 states now require the use of steel shot in certain areas.*

marshlands are owned by private hunting clubs. Most are young clubs by Currituck Sound standards but are no less expensive; memberships cost $50,000 or more. Gunning at such places is superb, and it is kept that way by careful management and by the typical practice of shooting only three or four days a week, even though all-week hunting is lawful.

AT THE SUTTER BUTTE Outing Club, Ed Collins and I were guests of a gentleman sportsman cast in the old mold. Russel Gallaway, 72, was up from Sacramento for a day's gunning with his big Labrador retriever, Poacher.

"Butte Sink was originally about 50,000 acres," he told us after lunch. "Now the kernel of the nut is all that's left—most of what used to be is gone. There was a period, back between the last stages of the frontier and the beginning of modern times, when there were certain sportsmen who said: 'This we save!' But as they pass, so do the last vestiges of the native marshes. All too often their heirs care little for such places—just too many other diversions, I suppose; too many other priorities. Members may not buy into one of these clubs as an investment, but if they suffer business reverses or have a financial emergency—well, this marshland commands high prices for rice or orchards. Of course, there's never been any agriculture here at the Sutter Butte club, and I'll fight the incursion of agriculture to the finish."

To encourage preservation of private marshlands, the U. S. Fish and Wildlife Service pays marsh owners who enter into a perpetual conservation easement contract a fee, based on an appraised value of the land, and the owners agree to preserve the marshes. Owners continue to enjoy all rights such as hunting, leasing, or even selling their property, but the easement is permanent, assuring the future of the marsh.

More than 700 acres of Butte Sink marshes are now protected by perpetual conservation easements. But the program holds out little hope for the rest, according to Russel Gallaway. "I believe the larger clubs in this immediate area will absolutely not enter into fee easement with the federal government," he declared. Why? Because the big Butte Sink clubs don't really need the

government fees, and because they don't relish government mixing into something as personal as their beloved duck marshes.

THE CENTRAL VALLEY can be broadly divided into three parts: the north with the Sacramento River as the main drainage, the delta region east of San Francisco, and south of that, the San Joaquin Valley drained by the San Joaquin River. Within these general regions, surviving natural wetlands are complexes of public and private holdings.

Butte Sink and the Sacramento, Delevan, Colusa, and Sutter National Wildlife Refuges, together with Gray Lodge State Wildlife Area, are key wetlands of the Sacramento Valley; farther south in the heart of the San Joaquin Valley are such public lands as the Kesterson, San Luis, and Merced National Wildlife Refuges, and the Volta and Los Banos State Wildlife Areas. Surrounding these are extensive private wetlands, for a total of 90,000 acres collectively known as the Grasslands. Unlike those farther north in the Butte Sink, many private marshes in the Grasslands are under perpetual conservation easements.

As biologist for the U. S. Fish and Wildlife Service at Los Banos, Gary Kramer was responsible for selling this program to Grasslands owners and helping them improve the marshes. "In the past five or six years nearly five times as much marsh has gone into easement as has been lost to agriculture," Gary told me. "There are about 25,000 acres under easement now. They keep pecking away at the edges, though. During the past decade more than 5,000 acres of bona fide duck clublands have been converted to agriculture."

A lot of marsh has been saved for wildfowl—so long as the marshes continue to receive water. Water is a valuable commodity in the Central Valley and especially in the San Joaquin Valley. A complex canal system brings water down from the mountains. This is meant for agriculture and other human needs. Until 30 years ago none was earmarked for waterfowl marshes.

Now it is, and much of the credit for the change in priorities belongs to a Fresno duck hunter named J. Martin Winton—leader, political gadfly, irritant to bureaucracy, and

BATES LITTLEHALES (ABOVE); J. SHERWOOD CHALMERS

Fury on the wing, *a male Canada goose* ***(above)*** *flies menacingly at an ornithologist who ventures too near a nest at La Pérouse Bay, Manitoba. Naturalist John James Audubon was twice attacked by a gander in a similar situation, receiving blows on his right arm, "which for an instant I thought was broken."*

In a rain-swollen pond at Middleburg, Virginia ***(left)****, a Canada goose crouches protectively over eggs in a nest that earlier had been covered by a foot of frigid water. Six days later all the eggs produced strutting goslings* ***(right)****, testimony to the survivability of a tough species.*

Though it's 15° below zero on a January morning at Silver Lake in Rochester, Minnesota, giant Canada geese and interloping mallards don't seem to mind. A power plant keeps the lake water warm, and grain is available in fields a short flight away. Thus some 12,000 of the adaptable Canadas choose to winter here; about 200 stay year-round.

champion in the long fight to guarantee water for marshes in the San Joaquin Valley. "If every state had one man like Martin Winton," Ed Collins told me, "most of our waterfowl problems would be over." After years of hard work and political goading by wildlifers led by Winton, it was agreed that the waterfowl wintering habitat of the Grasslands would receive 50,000 acre-feet of cut-rate federal water annually.

DANIEL J. COX

"We'll have these good wetlands as long as people want waterfowl, and as long as the Department of the Interior makes water available to these refuges and clublands," Martin Winton told me. "If the government reneges, the wetlands will go—and the great flights of waterfowl will go with them."

Like Russel Gallaway, Winton worries about the next generation. "There doesn't seem to be the driving interest in these young people that there was in us old-timers. For us the flights of ducks and these old marshes and the hunting we do there are all part of a way of life. It's all such a delicate balance. Shifts in federal water policy, with curtailed bag limits and fading interest in hunting, declines in duck-stamp sales and license revenues—any of these could turn marshes into farmland. Is it all passing? Are we going to lose it? Sometimes I'm afraid. . . ." □

A continent speaks through its decorative art

Africa Adorned

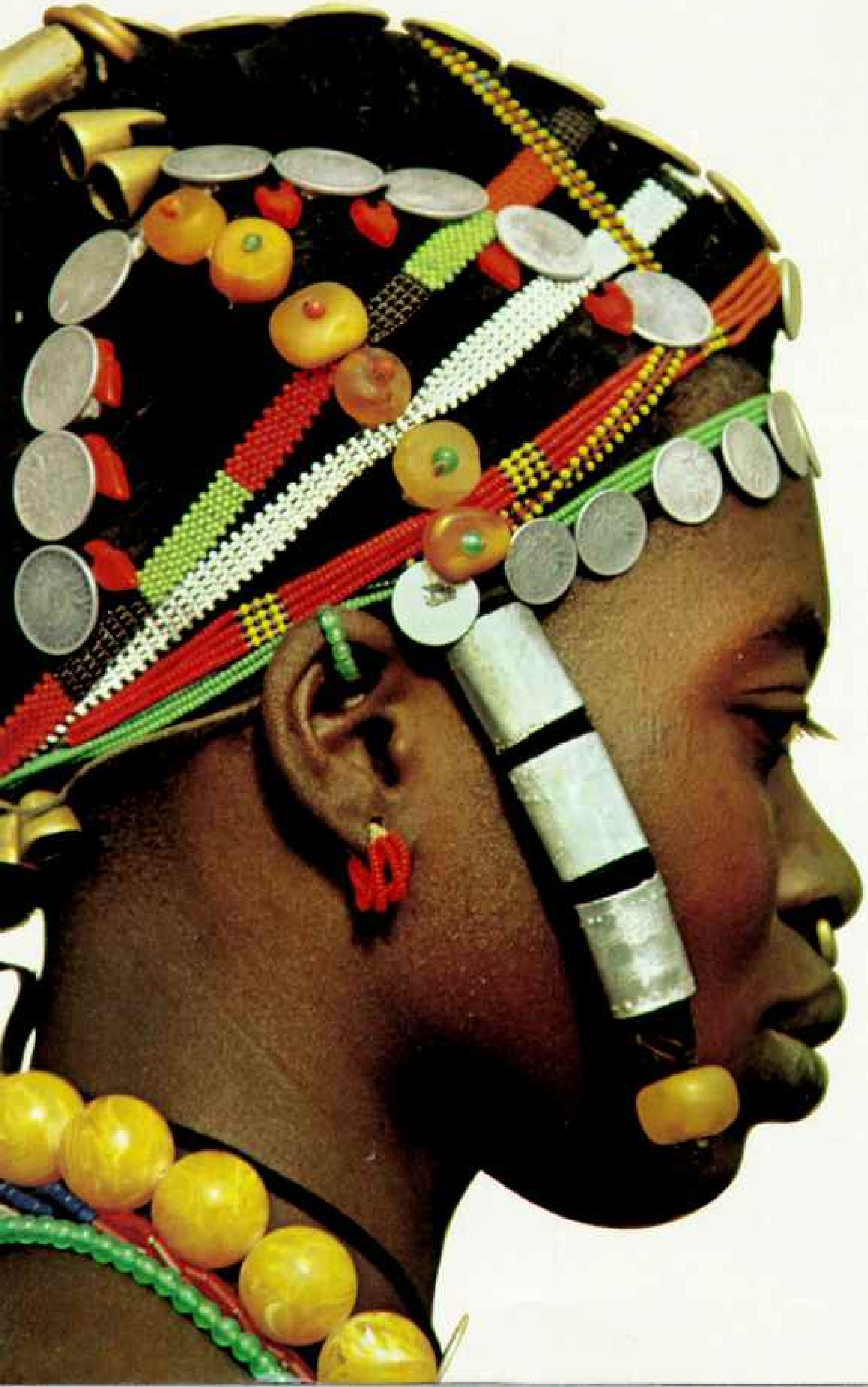
TEXT AND PHOTOGRAPHS BY ANGELA FISHER

THE LANGUAGE of body decoration is almost as old as man himself. The first smear of clay on arm or face, the first fragment of bone twisted into hair conveyed a message from the wearer, perhaps simply, "Look at me." Over millennia that language has evolved into an elaborate form of communication—nowhere more varied and expressive than in Africa, where a single ornament may identify the wearer's social status, age group, or exploits in love, battle, or daily life.

During the past seven years my study of that language has led me to remote and inhospitable parts of Africa. Often traveling as a solitary woman, I was sometimes viewed with suspicion. But once accepted, I discovered advantages in my sex since I posed no threat to anyone. In order to win the trust of a group, I had to adopt their pace and learn to be patient. Only then could I witness rituals usually closed to the outside world.

Governments of the emerging nations were often more hindrance than help, regarding traditional cultures as "primitive" in a derogatory sense. Partly as a consequence of that attitude, many of the old ways are disappearing. The photographs on these pages are a record of some of the best of what remains—a portrait of the creative spirit of an extraordinary continent.

***Everyday** coiffure of a young woman of Mali's Songhai people combines silver, copper, brass, European coins, lumps of amber, and glass beadwork.*



Treasures of a continent

Superb craftsmanship is exceeded only by immense variety in Africa's decorative art. As I traveled the length and breadth of the continent, I found that jewelry and other adornments vary dramatically, not only through cultural influence, but also through available materials. Thus, gold jewelry is favored by several peoples of West Africa, where the precious metal is mined, while Kenya's Samburu and Pokot have developed jewelry from leather and plant fibers, sometimes enhanced with telegraph wire and spent cartridge cases.

Among the most colorful and universal materials are glass beads, many from 16th-century Venice. Highly prized beads were often traded for slaves; one unusual specimen brought seven able-bodied men in exchange. Thousands of tiny beads make up the magnificent crown, left, worn by kings of Nigeria's Yoruba people. The six-foot-long veil of beads kept commoners from gazing directly at their all-powerful monarch.

1 YORUBA CROWN, NIGERIA; 72 IN

2 PAIR OF AMBER NECKLACES OF MOROCCO'S BERBERS; 22 IN

3 GOLD MASK PENDANT OF THE BAOULÉ, IVORY COAST; 3 IN

4 BRONZE BRACELET OF THE DOGON OF MALI; 4.5 IN

5 BRASS CHAMELEON PENDANT, THE TIKAR PEOPLE, CAMEROON; 2.5 IN

6 BRASS ANKLET OF THE IBO, NIGERIA; 14 IN

7 ENAMELED CLOAK CLASP OF ALGERIA'S KABYLE PEOPLE; 3-5 IN

BILLION CROWET COLLECTION (1, 3); JERNANDER COLLECTION (4, 5); PRIVATE COLLECTION (6); EMSELS COLLECTION (7); AND MESTACH COLLECTION (10); ALL BY BRUNO PIAZZA. ANSCHEL/FISHER COLLECTION (2, 8) AND ANSCHEL COLLECTION (11, 12); ALL BY HEINI SCHNEEBELI. FISHER COLLECTION (9) BY FABBY K. J. NIELSEN

8 VENETIAN-STYLE GLASS BEADS, WEST AFRICAN COAST; CENTER BEAD 2 IN

9 CHRISTIAN NECK CROSS, LALIBELA, ETHIOPIA; 3 5 IN

10 IVORY TALISMAN OF THE PENDE OF ZAIRE; APPROXIMATELY 2 IN

11 SWAHILI SILVER ARMLET AND HINGED ANKLETS, EAST AFRICAN COAST; ARMLET 6 IN

12 ZULU GLASS-BEAD NECKLACES, SOUTH AFRICA; THICKNESS 1 IN

TUNISIA
LIBYA
EGYPT
NIGER
CHAD
SUDAN
NIGERIA
CAMEROON
CENTRAL AFRICAN REPUBLIC
EQUATORIAL GUINEA
GABON
CONGO
ZAIRE
UGANDA
KENYA
RWANDA
BURUNDI
TANZANIA
ETHIOPIA
SOMALIA
MALAWI
ZAMBIA
ANGOLA
MOZAMBIQUE
ZIMBABWE
BOTSWANA
NAMIBIA
SWAZILAND
LESOTHO
SOUTH AFRICA
MADAGASCAR

Portfolio of classic beauties

Five women from widely scattered cultures of Africa display highly varied dress and jewelry. In some regions I found it difficult or even impossible to make such portraits. Many Africans still believe that to capture their image is to ensnare their soul and steal its power. They are suspicious, or even terrified, of cameras. Other Africans have learned that cameras mean money, and more than once I was asked for a sizable fee. But after these women accepted me, they accepted my work.

*A brass wire pierces the lower lip of a Toposa woman of Sudan (**right**), proclaiming that she is a wife, as does her coiffure of miniature pigtails glistening with fat. Scarified cheeks and a coiled iron collar affixed at marriage complete her ensemble.*

*Demonstrating her husband's wealth, a Haratin of southern Morocco (**right, lower**) wears her entire stock of jewelry. Of Berber and Negroid descent, the Haratin consider it improper for a woman to go unadorned, even when performing such strenuous tasks as plowing a field.*

*A richly embroidered veil, or burqa, studded with buttons and pendants, cloaks the face of a young girl of Sudan's Rashaida (**center**), whose interpretation of Islamic law dictates that females wear the veil from the age of five. The covering must be worn even at mealtimes and can be removed only in strictest privacy.*

*Heavy brass earrings and facial tattoos beautify a Wodaabe woman of Niger (**far right, upper**). The triangular tattoos on either side of her mouth are regarded both as a defense against the evil eye and as decoration.*

*Cherished items adorn the wife of a Podokwo chief in Cameroon (**far right, lower**): a beaded skullcap crowned with a pom-pom of mongoose fur and a necklace of leopard's teeth.*

A book by the author, *Africa Adorned*, has recently been released by Collins Publishers of London and Abrams, Inc., of New York.

Sudan: The Dinka speak the language of beads

Making their living primarily from herding cattle, the Dinka number approximately a million and inhabit one of the world's largest swamps, the southern portion of Sudan. Like many nomads, they concentrate their artistry on their bodies rather than on their simple homes and possessions.

*For some groups of Dinka, beaded clothing is the principal form of decoration: loose-fitting smocks for the women (**above left**) and skintight corsets for the men (**right**). These two women have passed the age of 17 and are eligible for marriage. The patterns of color in their smocks bespeak wealthy families. Cowrie shells are attached to promote*

FABBI K. J. NIELSEN (ABOVE)

fertility. Scarification on the women's foreheads symbolizes the horns of cattle, which the Dinka consider beautiful as well as vital to their existence.

The colors of Dinka men's corsets vary according to the owner's age group: red and black for 15- to 25-year-olds; pink and purple between the ages of 25 and 30; predominantly yellow for those over 30. The corsets are so tight-fitting that they must be removed by cutting when their owners change age groups. Used and mended corsets are normally sold to younger brothers for the price of one bull each—the equivalent of more than a hundred dollars.

The Dinka call themselves Monyjang, meaning "the men of men." Their unusual height—many are over six feet—and powerful physiques, coupled with the practice of coating their bodies with ash, earned them the nickname "ghostly giants" from 19th-century European travelers.

Kenya: Lion manes crown victors of the hunt

*Killing a lion wins a Masai warrior the animal's mane to be fashioned into a ceremonial headdress such as the one worn by this 14-year-old (**right**), who has already demonstrated his prowess.*

*Once every seven years, older Masai warriors become tribal elders in a ceremony known as Eunoto. Candidates (**left**) don their lion-mane headdresses for the last time and smear themselves with chalk from a sacred cliff. Stylized patterns proclaim bravery in killing lions or enemy warriors.*

FISHER COLLECTION; BY HEINI SCHNEEBELI (BELOW LEFT); PRIVATE COLLECTION; BY BRUNO PIAZZA (BELOW RIGHT)

*An elder of Kenya's Turkana people uses a wooden headrest (**above**) while asleep to protect the elaborate coiffure that marks his status.*

*A warrior's ornaments may also double as weaponry. This Toposa bracelet (**near right**) from Sudan instantly converts to a lethal wrist knife by removal of the outer leather guard; a Turkana thumb knife bound with copper wire is bare.*

Making much of what's on hand

*Bridal gifts among Kenya's Rendille people come in the form of huge collars of woven palm fibers bound with red-ochered cloth (**far right**). The larger the collar, the higher the woman's status—and that of her husband. In the past, when elephants were plentiful in Rendille country, the collars were made of elephant hair.*

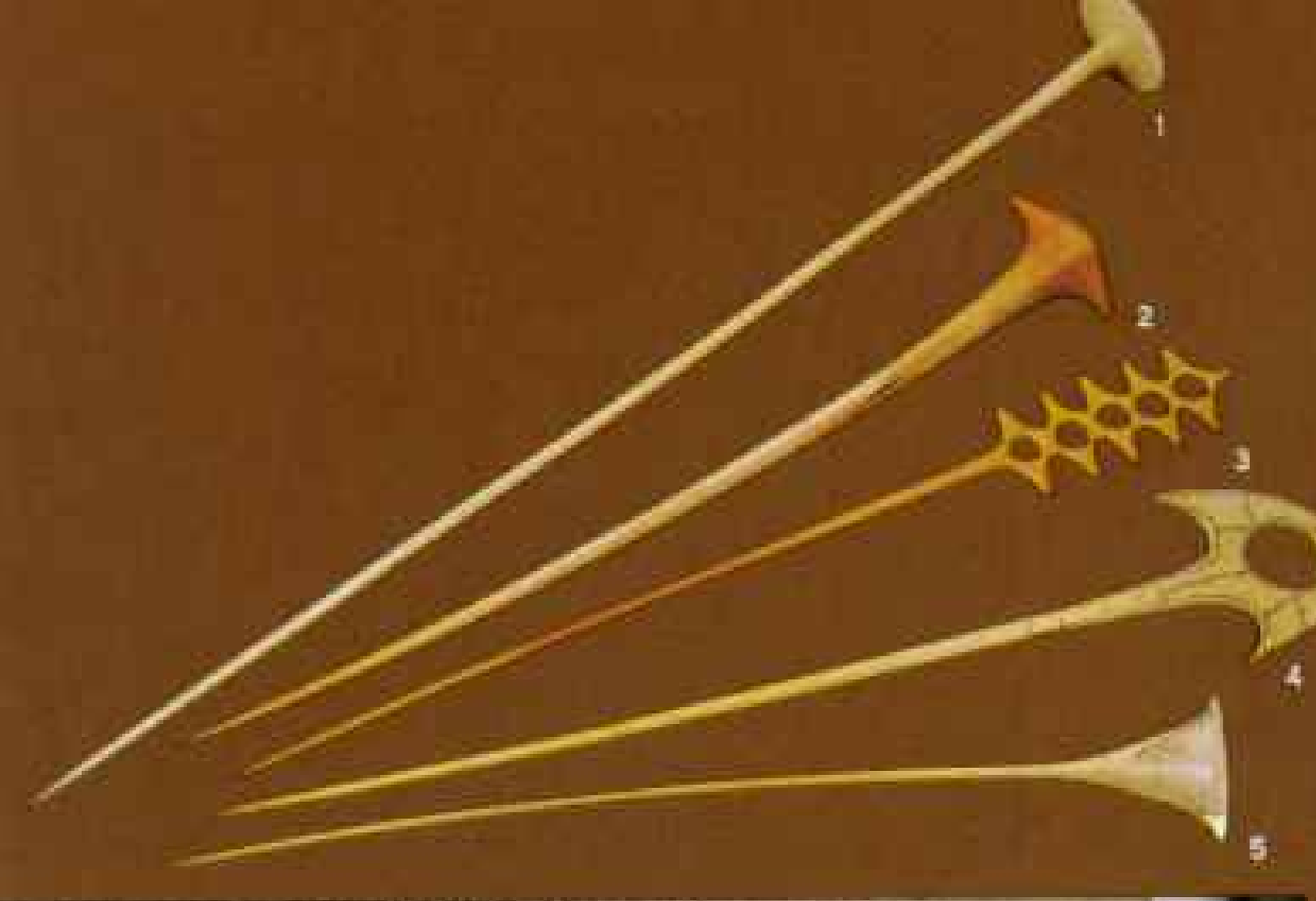
*At the birth of her first son the Rendille woman adopts a cockscomb hairstyle fashioned of mud, animal fat, and ocher (**left, at right**). The cockscomb remains intact until the son is circumcised or a close male relative dies; in either instance the woman's head is shaved, as with the woman at left. Even for a visit to a water hole in the sere Kenyan countryside, these matrons wear their finery; bracelets and armbands are of brass and iron wire, a European introduction.*

*A visorlike coiffure created from sisal, cloth, ocher, and fat adorns a Samburu warrior (**above, near right**).*

*Sudanese necklaces utilize mostly natural materials (**right**). The Dinka fashioned the top strand of rounded ostrich-egg chips and the middle one of snake vertebrae and cowrie shells. A Nuer craftsman made the bottom string of wooden beads with a forked pendant representing the horns of a cow.*

JOHN HAWKINS

FISHER COLLECTION; BY HEINI SCHNEEBELI

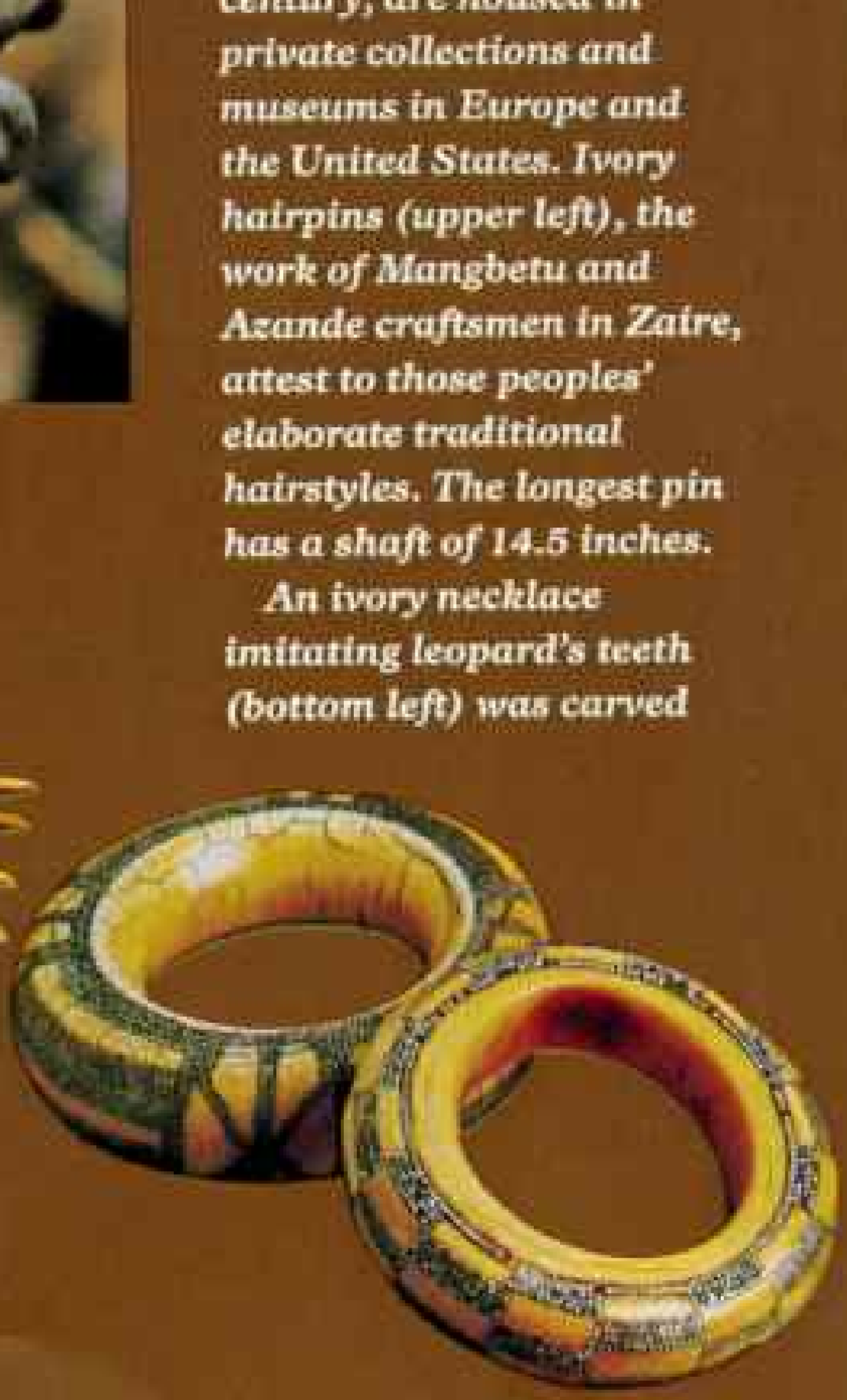


Warmth and wonder of ivory

For millennia, African artisans have fashioned ornaments of ivory, valued not only for its texture and beauty but also for its legendary powers to heal, to protect, and to honor gods and ancestral spirits. Ivory earrings on a Dinka girl of Sudan (left) are incised with a dot-in-circle design. Here purely decorative, the symbol is used widely to represent the "good eye," a defense against the evil eye.

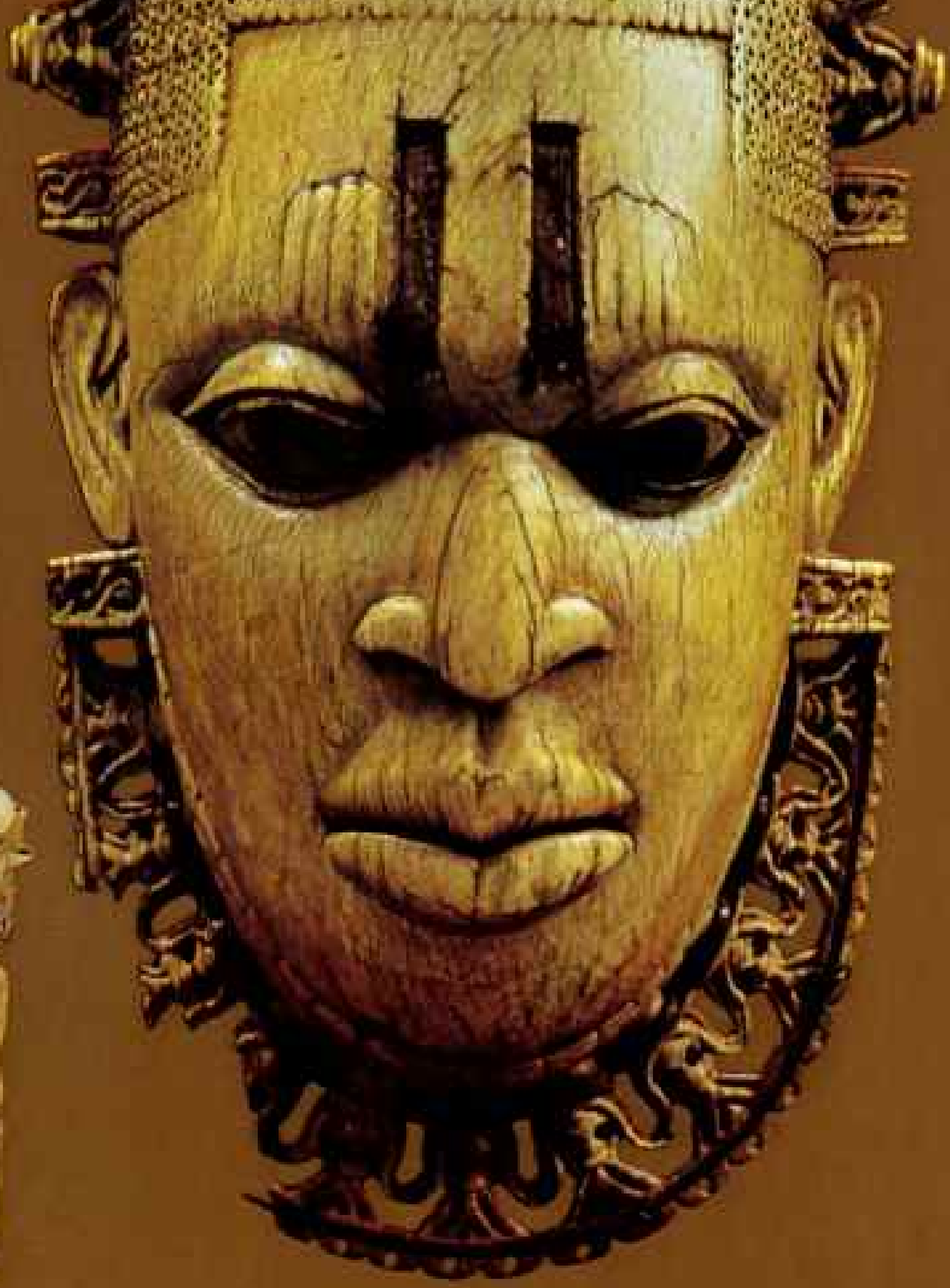
Other examples of ivory workmanship shown here, mostly from the 19th century, are housed in private collections and museums in Europe and the United States. Ivory hairpins (upper left), the work of Mangbetu and Azande craftsmen in Zaire, attest to those peoples' elaborate traditional hairstyles. The longest pin has a shaft of 14.5 inches.

An ivory necklace imitating leopard's teeth (bottom left) was carved



by a Songye craftsman of what is now Zaire. A human face on the center tooth may represent an ancestor of the owner. Songye bracelets of ivory are studded with hundreds of lead beads (opposite, bottom right).

A priceless masterpiece, this ivory ornament in the shape of a human face (right) belonged to the oba, or king, of ancient Benin in West Africa. Slots on the forehead once held iron strips representing scarification, and human



figures around the head depict Portuguese traders.

An intricate 19th-century bracelet (left) from Owo, Nigeria, echoes an older design of interlocking cylinders carved from a single block of ivory.

PRIVATE COLLECTION (HAIRPINS 1, 4); MUSÉE ROYALE D'AFRIQUE CENTRALE (HAIRPINS 2, 3 AND IVORY NECKLACE); JERNANDER COLLECTION (HAIRPIN 3); AND BRITISH MUSEUM (INTERLOCKING BRACELETS); ALL BY BRUNO PIAZZA. ANSCHEL COLLECTION (STUDDED BRACELETS); BY HEINI SCHNEEBELI. METROPOLITAN MUSEUM, MICHAEL C. ROCKEFELLER MEMORIAL COLLECTION, GIFT OF NELSON A. ROCKEFELLER (IVORY MASK); BY JERRY L. THOMPSON

Cameroon: A monument to the carver's skill

*The Bamileke of western Cameroon specialize in decorative architecture in addition to bodily adornment. The king's house at Bandjoun (**above**) features massive wooden columns, whose stylized carvings represent past royalty and servant figures. The siding of woven bamboo strips bears geometric designs. The dwelling's most recent occupant, Kamga II, had several dozen wives and more than 250 children.*

The man beside the right-hand column is a member of the elite elephant-mask society of high-ranking Bamileke. His

FABRY N. J. NIELSEN (ABOVE)

ceremonial costume consists of a broad-brimmed parrot-feather hat and a mask with an elongated beadwork panel that resembles an elephant trunk.

*A decorative apron of forged iron pendants (**right**) adorns a young woman of Cameroon's north. Such aprons are seen today only in remote regions of the country; in the name of modesty, the government now discourages their use.*

West Africa: The power of ancestors

Like many other African peoples, the Lobi, Kassena, and Sénoufo believe that ancestral spirits wield enormous power. Together with bush spirits, they represent a main link between gods in the beyond and man on earth. And among the most powerful talismans for enlisting their protection are ornaments bearing their likenesses, such as this bronze anklet adorned with four ancestral heads.

*A chameleon and a cricket (**right, below**) decorate a bracelet worn by a chief of the Kassena people, who attribute protective powers to certain animals as well as to ancestors.*

BRUNO PIAZZA

FABBY K. J. NIELSEN (ABOVE AND BELOW)

Ghostly panel of ancestors ***(above)*** *presides over the family altar in a Lobi household. Only after long association with the family were Fabby Nielsen and I permitted to see and finally to photograph the altar. The Lobi believe that valuables offend the gods, and we were obliged to remove keys, coins, and jewelry before approaching the altar. For some reason, however, our cameras were exempt.*

Tools of the diviner's trade ***(right)*** *assist a Sénoufo fortune-teller of the Ivory Coast in curing a client's problem or ailment.*

A celebration of bronze

Among the highest art forms of Africa was the casting of bronze by the smiths of ancient Benin, in what is today Nigeria. The casting process known as lost wax reached West Africa from the north via trade routes across the Sahara as early as the ninth century. In the process the artist first makes a wax model of his creation, then packs wet clay around the model. Heat is applied, and the melted wax runs off, leaving a hardened clay mold of the original design. Molten bronze, an alloy of copper and tin, is poured into the mold and allowed to cool. In the final stage the clay mold is broken and the bronze casting removed. Since both the wax model and the clay mold are destroyed in the process, a lost-wax casting can never be precisely duplicated. Thus each work of art is unique.

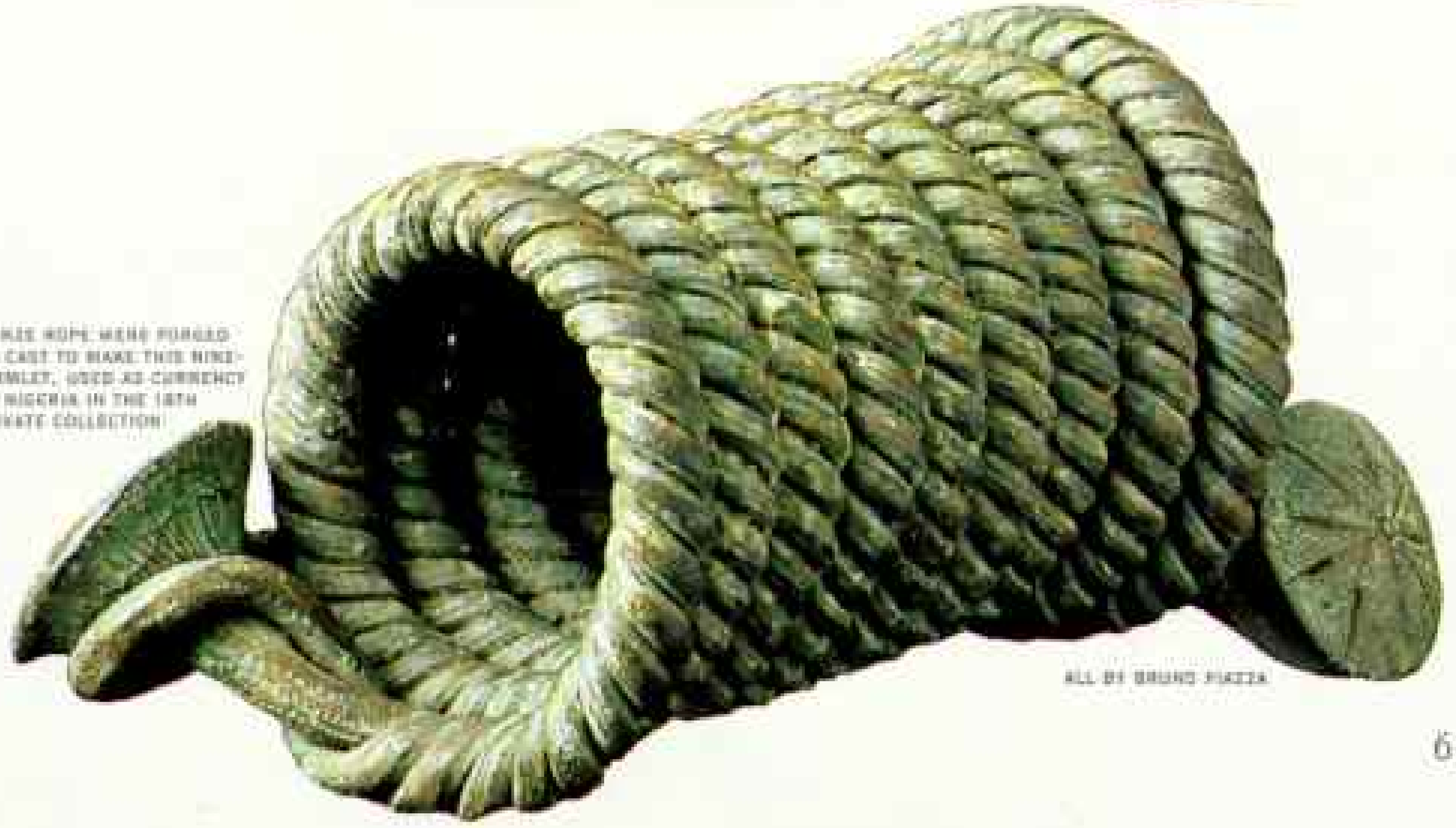
The process eventually spread across West Africa, especially after the Europeans arrived in the 15th century with brass and copper to trade. This beautifully stylized figurine of a pregnant woman (**left**) *was cast by an artist of the Koulango of the Ivory Coast, probably in the 19th century. Worn as a pendant, the ornament was a charm to induce fertility. A human face adorns the armlet* (**upper right**) *cast by an artisan of Nigeria for a member of the Yoruba people's Ogboni cult, which includes chiefs, priests, and nobles. Another bracelet* (**right**), *probably cast by a Sénoufo or Bobo, features a large spider as its motif. The folklore of some West African peoples holds that spiders can talk, act like humans, and tell a man how to become rich.*

Such superb castings have all but disappeared from West Africa. Most artists I talked to maintained that they could no longer afford such painstaking work. They were all too busy mass-producing items for the more lucrative tourist trade.

ANSCHEL COLLECTION; 5 IN

GILLION CROWET COLLECTION; 5 IN. WESTACH COLLECTION; 4 IN (LEFT)

ARMORED WARRIORS WERE CAST AS AN ORNAMENT FOR A KING OF BENIN. THE PIECE MEASURES SIX INCHES LONG. PRIVATE COLLECTION



COILS OF BRONZE WIRE WERE FORGED RATHER THAN CAST TO MAKE THIS NINE-INCH-LONG ARMLET, USED AS CURRENCY IN SOUTHERN NIGERIA IN THE 18TH CENTURY. PRIVATE COLLECTION

ALL BY BRUNO PIAZZA

FABBY K. J. NIELSEN

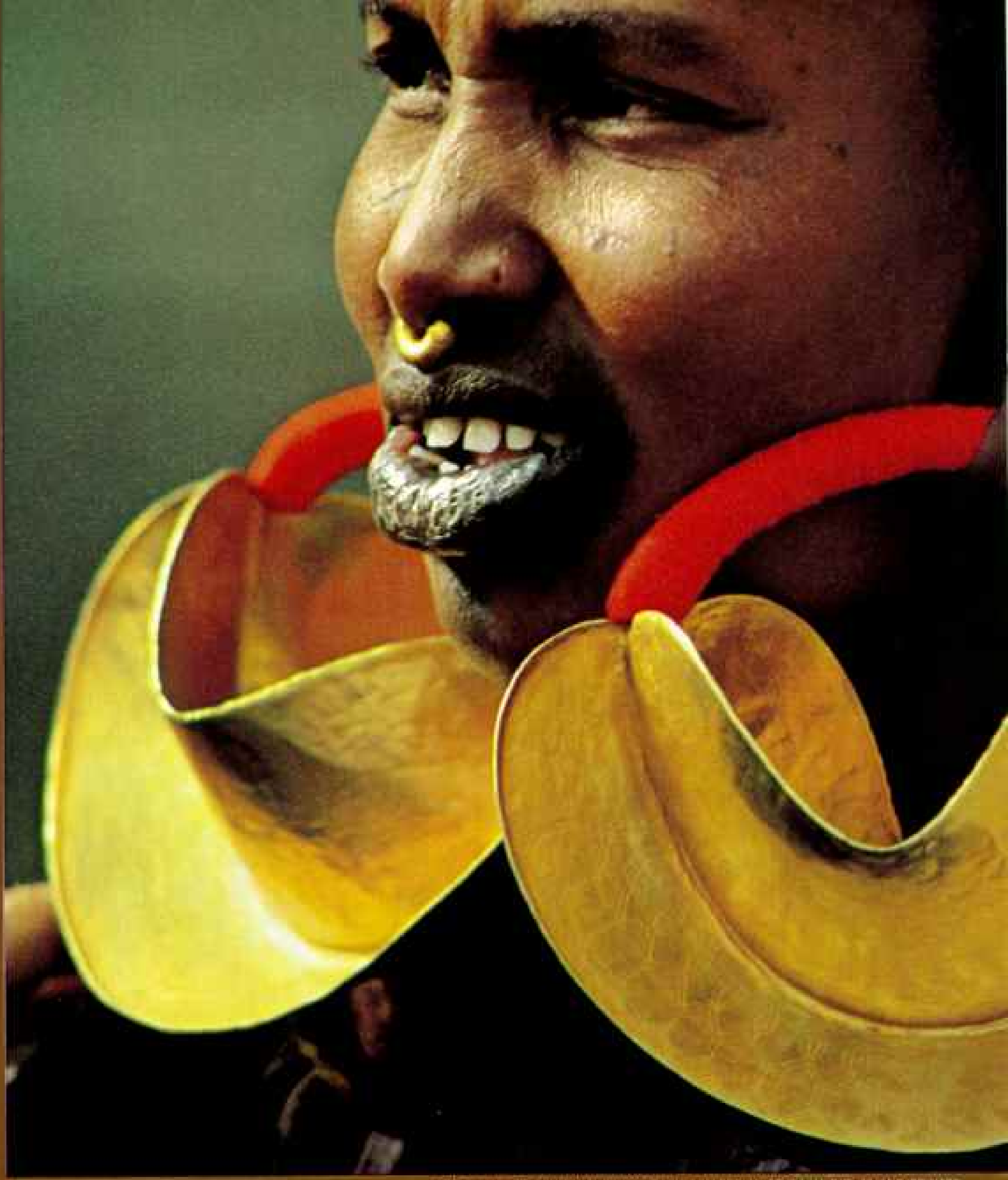
Ghana and Tunisia: Golden finery of life and death

In former times when a king of the Ashanti people of Ghana lay on his deathbed, he chose companions to die with him, sometimes including several of his wives. At the funeral the women, dressed in white and wearing gold jewelry, drank themselves into oblivion. They were then strangled and buried in ritual style.

Modern funerals for high-ranking Ashanti are less grim but still major events, complete with a dancer clad in gold (facing page). The ritual dressing of the dancer (above) requires at least a day, with gold breast pieces added last.

Like the Ashanti gold jewelry, a gold necklace from Tunisia (right) is both highly valued and symbolic. The heart-shaped beads are made of ambergris, rose petals, and saffron, giving off a scent reputed to last a lifetime.

GHYSELS COLLECTION; 19 IN; BY BRUNO PIAZZA



FABBY K. J. NIELSEN (ABOVE); MESTACH COLLECTION (BOTTOM RIGHT) AND PRIVATE

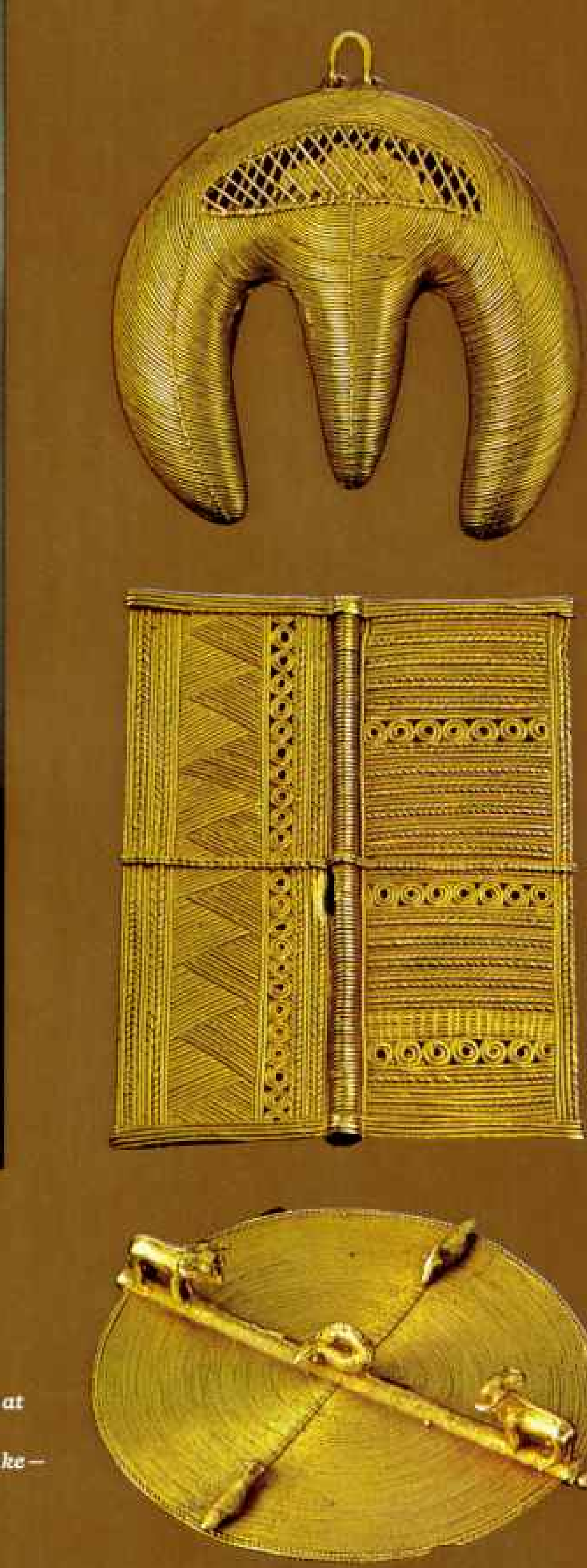
Mali and the Ivory Coast: A Flowering of the Goldsmith's Art

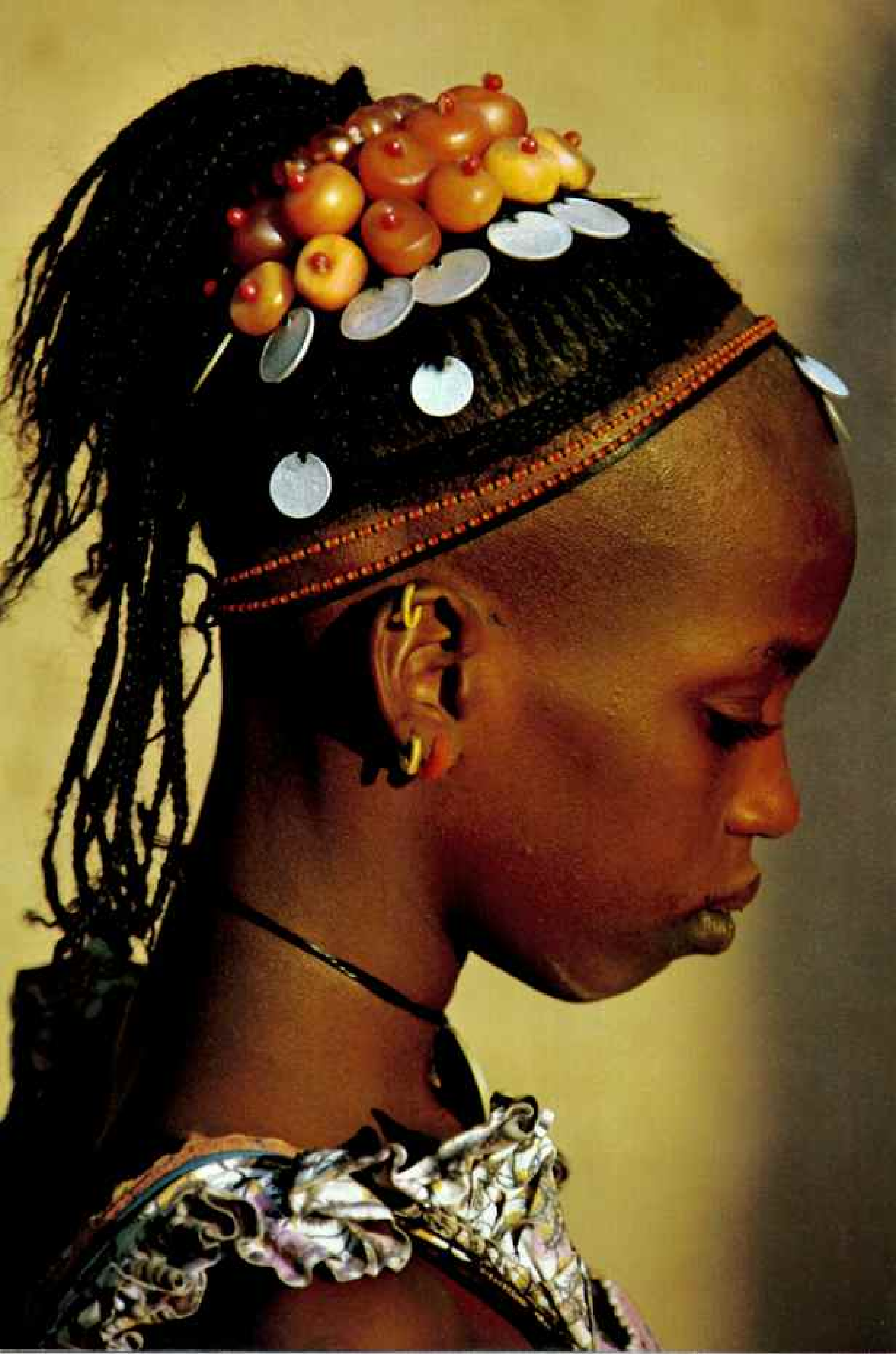
Giant handwrought gold earrings, suspended from the earlobes of a Fulani woman of Mali, are valued less for their workmanship than for their metal, worth some 20 head of cattle, or $3,000 U. S. She wears them as a continuous display of wealth and status.

A stylized gold ram's-head

COLLECTION; EACH 2.5 IN; BY BRUNO FIABEA

pendant (upper right) and the ornament of geometric design below it were cast in the lost-wax method by Baoulé craftsmen of the Ivory Coast. Another Baoulé masterpiece, the exquisite circular pendant at right, is adorned with two buffaloes, two birds, and a snake—all animals rich in symbolism.





Ethiopia and Mali: The elegance of amber

Though unknown to Africa in its natural state, amber—the fossilized resin of pine trees and other conifers—was imported for centuries from Europe across the Mediterranean to West Africa and down the Red Sea to Ethiopia. In medieval times Europeans valued amber highly, not only for its beauty but for its legendary healing properties as well. Amber was also considered protection against witchcraft, sorcery, and the evil eye. Many believed that when worn as a tight beaded necklace, amber guarded against chills by absorbing body heat by day and retaining it at night.

*Yet the sheer beauty of amber has always been its greatest attraction for African women, who wear it in various styles according to their status and background. These Fulani girls (**left** and **above, near right**) display coiffures decked with coins and small amber beads, identifying them as unmarried and belonging to nomadic families. A woman (**above, far right**) wears gold earrings and a hairstyle with larger amber pieces, both signifying that she is married.*

*Necklaces (**right**) include a long string of prayer beads and two wedding strands, all of genuine amber, some man-made beads on the left, and a necklace of dark red imitation amber at right.*

FISHER COLLECTION; BY HEINI SUNNEBELI

Morocco, Ethiopia, and Niger: Coins, everyone's source of silver

*Loving silver but lacking sufficient supplies of their own, Africans turned early to imported coins as an inexhaustible source of the coveted metal. Many used the coins themselves for ornaments, as with the headdresses of two Berber women of Morocco (**upper right**). Other artisans melted the coins down for a variety of pieces such as the long hinged bracelets (**above**) of a young Oromo woman of Ethiopia's central highlands.*

*Most popular of all coins is Austria's Maria Theresa taler (**near right**), whose beauty and unvarying silver content—83 percent—make it ideal as an ornament alone or as a cutout such as the Ethiopian Christian cross beside it. Melted and recast, a coin might become a distinctive Tuareg cross (**right, third from left**) in Niger or a "hand of Fatima" (**far right**), a protective charm from Morocco.*

FISHER COLLECTION. TALER AND CUTOUT CROSS 2 IN; HAND OF FATIMA 4 IN; BY HUNI SCHNEIBOLI. TUAREG CROSS 2.5 IN; BY BRUNO PIAZZA

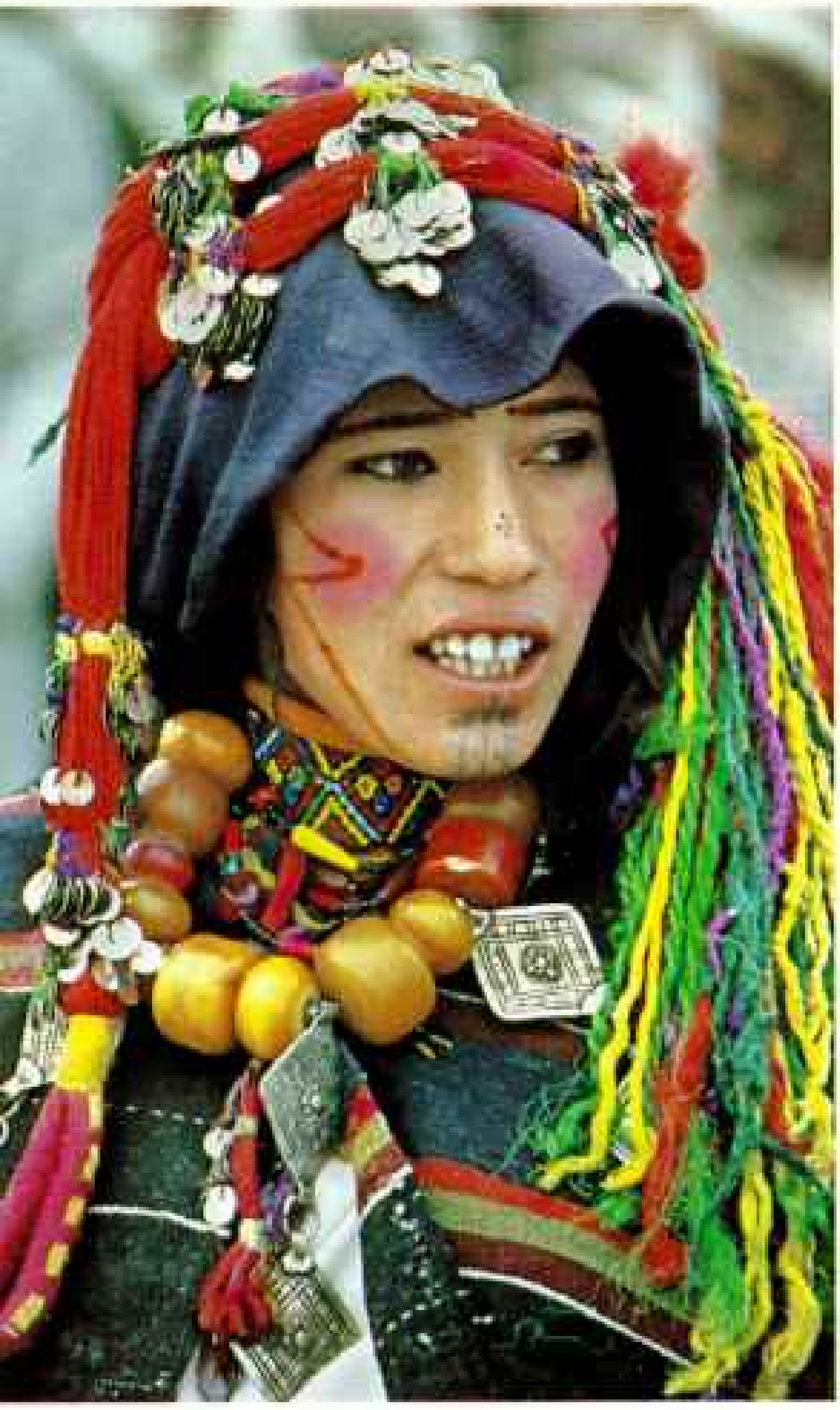
The Sahara: Lively contrast in desert design

*Desert dwellers of North Africa, the Tuareg and the Moors both descend from the Berbers, an ancient white-skinned race originally inhabiting Africa's Mediterranean coast and now mostly scattered across the Sahara. Going separate ways, the Tuareg clung fiercely to their Berber heritage of simplicity in dress and life-style, while the Moors intermarried with their neighbors, the Negroid peoples of Africa, and eventually with the Arabs. The resulting Moorish culture is one of color and flamboyance, as reflected in the style of dress, jewelry, and body decoration favored by the women of Mauritania. One is dressed here (**top right**) to perform the guedra, a ritual dance of love conducted by women before a male audience. Every plait of hair is garlanded with beads of red and green glass, carnelian, tiny golden balls, bits of amber, carved shell disks, and colored talismans shaped like arrowheads. Heavy silver bangles and intricate designs made with henna focus attention on the dancer's hands and feet (**right center** and **below**), which tell much of the story of the guedra.*

The diamond-shaped silver pendant above, created by a Mauritanian artist, embodies a simple, old-style Berber design but adds Moorish embellishments of silver beading and inlays of colored glass.

*Surrounded by inhospitable desert, the Tuareg seem to reflect their austere environment in their few simple ornaments. A Tuareg chief, Hamadaba Muhammad of Mali (**facing page**) displays three handsome but plain brass headband ornaments called* tcherot *on his* tagelmoust, *or desert veil. Arabic inscriptions on the ornaments quote passages from the Koran. Because of a chronic scarcity of water, some Tuareg veils—traditionally dyed blue with indigo—must have the dye pounded rather than soaked into the cloth. With either method, much of the dye rubs off on the wearer. The effect earned the Tuareg the title "blue men of the desert," a term that endures.*

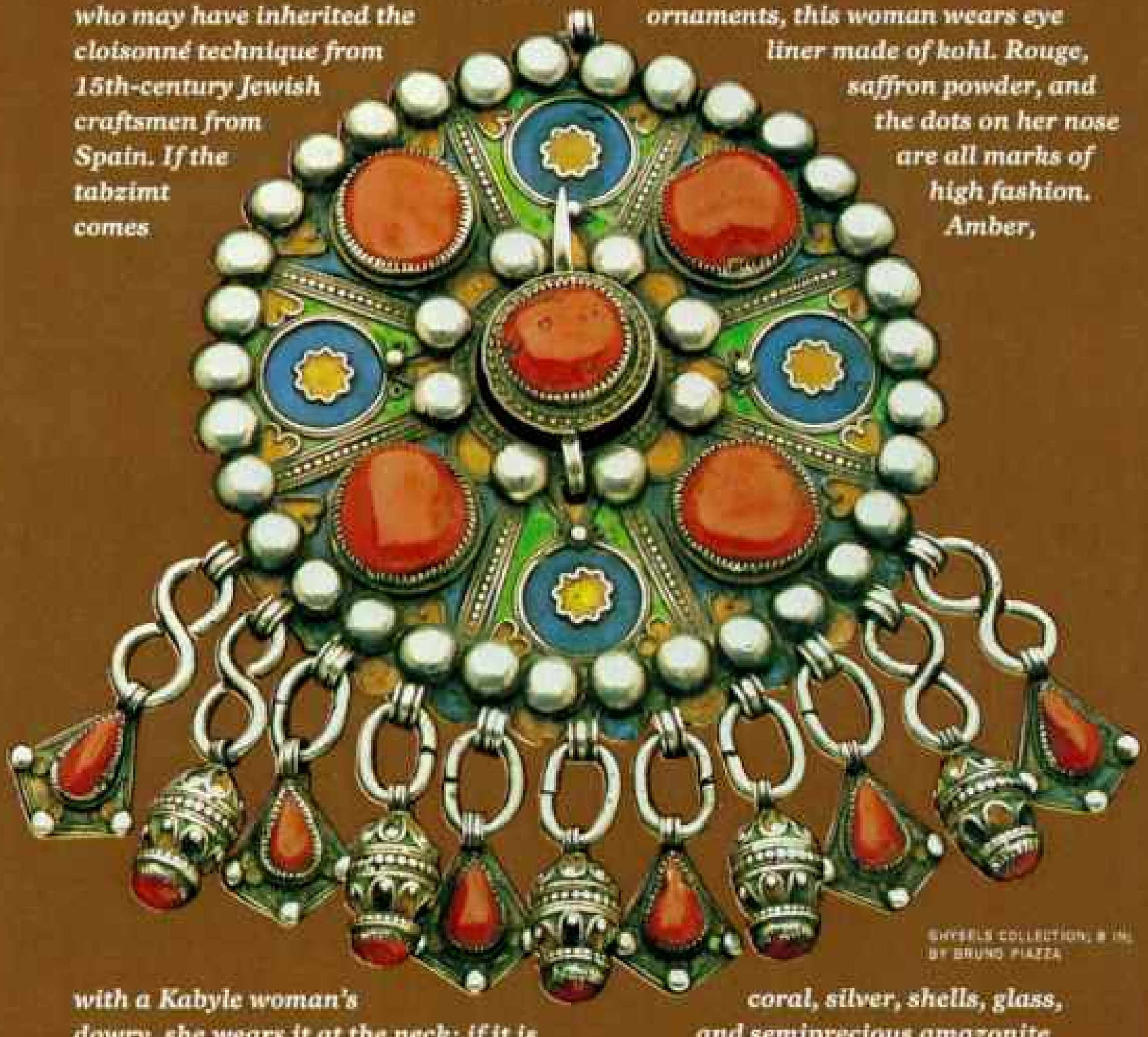
FISHER COLLECTION; REINI SCHNEEBELI (LEFT); FABBRI & J. NIELSEN (RIGHT)



FISHER COLLECTION; BY HEINI SCHNEEBELI (ABOVE AND LOWER LEFT)

Algeria and Morocco: A festival of colors

Like a radiant solar system, a cloisonné pendant (below) combines inlays of coral, silver, and enamels. Called a tabzimt, the piece is a specialty of Kabyle artisans of northern Algeria, who may have inherited the cloisonné technique from 15th-century Jewish craftsmen from Spain. If the tabzimt comes with a Kabyle woman's dowry, she wears it at the neck; if it is a gift from her husband on the birth of their first son, it hangs on the forehead. A young Ait Hadiddou woman of Morocco's High Atlas Mountains (opposite, upper left) wears a rounded hood to a festival where eligible men seek wives. The rounded hood warns that she is presently available only for betrothal. By contrast, a peaked hood identifies a widow or divorcée open to a proposal of instant marriage, without the formalities of parental negotiation and a long engagement. In addition to heavy imitation amber beads and silver ornaments, this woman wears eye liner made of kohl. Rouge, saffron powder, and the dots on her nose are all marks of high fashion. Amber, coral, silver, shells, glass, and semiprecious amazonite gleam in a necklace (opposite, upper right) made in southern Morocco's Draa Valley. A young girl in the valley (opposite, lower right) fingers her necklace, shown in greater detail at far left. Silver coins alternate on the strand with coral, amazonite, shells, and glass, along with pendants of stylized hands to ward off the evil eye.



SHYBELS COLLECTION, 8" (H), BY BRUNO PIAZZA

Kenya and Niger: Beauty from saucepans and wire

*Irresistible source of adornment to the herdsman of northern Kenya, telephone and telegraph wire often comes unstrung to feed their desire. Other ingenious craftsmen fashion jewelry from castoffs such as aluminum cooking pots. A Pokot woman (**left**) wears both types of ornaments—brass wire earrings and an aluminum lip plug—along with beaded necklaces. She might also be wearing a coiled wire bracelet and earrings (**lower left**) of Pokot design. In belts (**top left**), a new-style aluminum one contrasts with a traditional model of antelope toe bones.*

FISHER COLLECTION; BY HEINI SCHNEEBELI (LEFT, TOP AND BOTTOM)

*Among the Wodaabe men of Niger a sense of humor combines with an artistic flair to produce such inspired items as a suitcase-lock pendant (**above**). The very latest in fashion, a pair of modern sunglasses, combines with brass-and-shell ornaments of a time-honored Wodaabe headdress (**right**).*

Of such is the beauty—and the genius—of Africa adorned. □

Greeting from a native emperor penguin welcomes Jannik Schou of our multinational, privately funded Frozen Sea Expedition. Four men

By DAVID LEWIS

Photographs by
MIMI GEORGE

Icebound

and two women, we were to become natives ourselves for a year, exploring out from our base—a boat frozen in a safe anchorage on the coast.

in Antarctica

SAILING WEST, then south across the roaring forties, we arrived at our wintering site in the Rauer Islands three months after our November 1982 departure from Sydney. With the boat locked in ice from March 1983 until January 1984, four of us logged 850 miles apiece on the ice by foot and by snowmobile, camping and recording wildlife and environmental data.

FROM AUSTRALIA TO ANTARCTICA AND BACK BY SHIP
LATE MARCH-APRIL: FIRST SLEDGE RECONNAISSANCE
MAY-JUNE: ICE RECONNAISSANCE
EARLY JULY: TO DAVIS FOR FUEL
JULY-AUGUST: ESTABLISHING ADVANCE DEPOTS
SEPT.-OCT.: SCIENTIFIC RESEARCH
NOV.-JAN.: LICHEN STUDY AND PLATEAU RECONNAISSANCE TRIPS

Dashed routes indicate one-day trips.

■ *Research station*
□ *Camp*

Prydz Bay

Open water during most of antarctic winter

Vestfold Hills
Davis
AUSTRALIA
Sørsdal Glacier
Sea-ice breakout line (July-Jan.)
Filla Island
ADÉLIE PENGUIN ROOKERY
Winterover Bay
RAUER ISLANDS
ENLARGED BELOW
Seeking a safe bay for the winter, we sailed the coast on waters that later froze.
Sea-ice breakout line (Sept.-Oct.)
WEDDELL SEAL PUPPING AREA
Cape Drakon depot
FEBRUARY
SEPTEMBER-OCTOBER
JULY-AUGUST
JUNE
Svenner Islands
Rough ice and icebergs
Chaos Glacier
Ranvik Bay
Author suffered hypothermia.
Gelato berg depot
ADÉLIE PENGUIN ROOKERY
Steday Island
EMPEROR PENGUIN ROUTE TO OPEN SEA
Ranvik Glacier
WEDDELL SEAL PUPPING AREA
Brattstrand Bluffs
Fast sea ice
Amanda Bay
Hovde Glacier
INGRID CHRISTENSEN COAST
EMPEROR PENGUIN ROOKERY
Vitroy Island
WEDDELL SEAL PUPPING AREA
Larsemann Hills
Dålk Glacier

0 10 km
0 10 mi

NGS CARTOGRAPHIC DIVISION
RESEARCH: LINDA ARIETE
PRODUCTION: RAMSEY MURRAY
ART: ISKANDAR BADAY

I LOOKED BACK and saw that David, jouncing along atop a runner of our snowmobile-towed sledge, was in trouble, his knees on the verge of buckling. I came to a halt, but he insisted that he would be all right. "Don't stop now," he muttered. "This place is too dangerous—keep going."

As usual, he was right. He seemed OK. Everything he said made sense, so rational. It was dangerous there. The temperature—minus 22°F—and the slashing antarctic wind were just parts of our concern. All four of us hurrying across this frighteningly unstable stretch of frozen sea were fearful that the ice beneath us might suddenly break away from its winter-anchored mass and send us into oblivion.

But then David began mumbling incoherently and staggering about, unable to stand without support. I touched his cheek—I touched ice. "It must be hypothermia," I told Gill and Jannik. I pointed far ahead: "Let's get to the shelter of that iceberg; we'll make camp there and get him into his sleeping bag."

We seemed an interminable time passing the landward ice cliffs, but finally, an hour later, we reached the berg. Gill and Jannik had the tent up in a trice, and I quickly bundled David into the sleeping bag. I climbed in too, snuggling close in a feverish attempt to arrest the decline in his body temperature, which, if it dropped too far, could ultimately be fatal. Without David's leadership, the expedition might not survive. Some time later, as I tried again to force hot, sweet coffee between his chilled lips, David opened his eyes halfway.

"Rum!" he requested.

I knew then that the worst was past.

THAT'S HOW MIMI recalls that scary day in July 1983, in the very heart of the antarctic winter. I certainly can't argue.

My own memory of those events is completely void of eight hours and captures only wavering shadows of another twenty—a sobering indication of the severity of brain chill I experienced.

Mimi George—31-year-old anthropologist, photographer, athlete, world-class sailor, second in command of our expedition, and my boon companion—seemed sometimes oversolicitous about my well-being. I can't deny that she might have had cause. In all truth, at age 64 I did show some wear from more than a quarter of a century of mountaineering, skiing, solo sailing, circumnavigation, and polar exploration. I have experienced frostbite on several occasions, rely on a "tin-and-Tupperware" left hip—a stainless-steel ball joint and socket that replaced the original hip (victim of a downhill skiing mishap)—and live with a surgically reattached retina, which still can sometimes affect my balance.

On that bitter July day I owed my survival to Mimi's *(Continued on page 642)*

Welcome blaze *from searchlights of the U. S. Coast Guard icebreaker* Polar Star *illuminates the snowy deck of the expedition's 65-foot steel-hulled schooner* Dick Smith Explorer. *The icebreaker approaches us through floes that trapped our boat on our route to the coast. We were glad for* Polar Star's *help, for we knew the ocean would freeze solid in a month's time. We carried enough provisions for a 28-month stay but had no intention of overwintering at sea.*

Getting there *is the first trick to exploring Antarctica. Here brash ice—fragments ground by colliding floes—fills open leads in the pack ice,*

but it didn't halt our progress. Our collected information on pack ice could be useful to future expeditions.

Last light *of the antarctic autumn shines on me* **(top)** *as I test the thickness of new ice forming a curious pressure ridge where it joins older pack ice. This day, May 29, was the last day we would see the sun until July. From now until then we would live and work under dark or twilit skies often brightened by moon, stars, or aurora australis—the southern lights.*

BILL CRACKNELL

I had voyaged four times to antarctic waters, once before on Dick Smith Explorer, *but overwintering was new for both me and the boat. I chose a bay that sheltered it from storm-driven floes and icebergs but anchored too near shore, where expanding ice pushed* Explorer *into a winter-long list (**bottom, left**). To stop further tilting, we dug a trench on one side, here kept ice-free by Mimi George (**above**).*

prompt actions. Three days and 20 hazardous miles from our ship—solidly locked in ice for four months already—and with a faulty field radio that prevented communication with the two members of our party who remained aboard, we were totally dependent on our own resources. The incident underlined how fragile are the life-support systems in Antarctica (as in space) and how survival demands unremitting vigilance and meticulous care.

Death, of course, is an ever present part of the backdrop for any expedition that pits fragile humans against exceedingly powerful (I refuse to call them hostile) forces of nature. That unseen presence is a primary reason that so much care is exercised in the selection of personnel for an expeditionary team. But it was precisely that aspect of our preparation—picking crew members—in which I made errors of judgment that ultimately tainted the flavor, though not the success, of perhaps my most ambitious scientific endeavor.

OUR BOAT, *Dick Smith Explorer*, a 65-foot three-masted steel-hulled schooner, had already proved its worthiness in ice and storm during a three-month voyage to the Antarctic* that ended in March of 1982, only eight months before this latest expedition was to depart. This new project, however, involved greater distances, longer periods of isolation, and a smaller crew devoted to carrying out considerably more scientific tasks than had the earlier one. The primary goal of the expedition, sponsored by the Oceanic Research Foundation, which I founded in 1977, was to allow a small ship to become locked in the ice of an antarctic bay for a full nine-to-eleven-month winter so it could be used as a research base, harmless to the environment, for various projects. During that time we wanted to use the fast sea ice—the solid ice sheet, some six feet thick, that in winter fringes Antarctica, extending miles out from the continental landmass to which it is anchored—as a frozen highway to different sites.

The specific goals of what we dubbed the Frozen Sea Expedition were to assess a number of potential moorings and formulate guidelines for future winter-research expeditions; to determine the problems and potential of sea-ice travel; to observe (for Mimi's University of Virginia doctoral dissertation) the human dynamics of a small, mixed-sex group of people sharing much time and little space in a remote, harsh environment; to film the expedition for Sydney's Channel 7 TV, a principal sponsor; and, for a variety of other antarctic research organizations and investigators, to make hydrophone recordings of seal songs, observe seals pupping and instructing their young to swim, tag seals, monitor emperor and Adélie penguins and collect their stomach contents, count numbers and types of other birds, collect lichens and mosses, capture fish specimens, gather plankton, and record polar weather data.

Because Mimi and I considered this to be a people's expedition—one supported by schoolchildren, pensioners, businessmen, scientists, manufacturers, and former expeditionaries in addition to the National Geographic Society and Dick Smith, the Australian helicopter adventurer and electronics magnate for whom our research vessel is named—we felt especially obliged to put together just the right team.

All we needed were four other people, but the conditions of the trip precluded many scientists. Not only did we expect to be gone for 16 months (or possibly 28, if whichever winter anchorage we chose failed to thaw after the first winter), but we also required that each participant contribute $3,000 toward expenses. We believed that the very stringency of these terms would ensure the enthusiastic participation of anyone willing to meet them. That belief, alas, would be proved quite wrong.

In all, more than a hundred people volunteered to take part. Few of them (including the valorous American who advanced an elaborate plan on how to protect us from pirates—in the Antarctic!) were really what we were looking for.

Two that we signed on, though lacking the experience and credentials that I had originally hoped for, turned out to be fine teammates. Gill Cracknell, a 24-year-old Briton, came to us as a geographer; by dint of her tenacity and dedication to the project's goals

*See the author's "Voyage to the Antarctic" in the April 1983 NATIONAL GEOGRAPHIC.

she also became, during the expedition, the biological-projects coordinator and third in command. Jannik Schou, a 29-year-old Danish gamekeeper of remarkable strength and endurance, was completely enthralled by the magic of the southland and its array of curious creatures. Eventually—perhaps inevitably—the two became a couple, and their fondness for each other helped cement the positive side of the expedition.

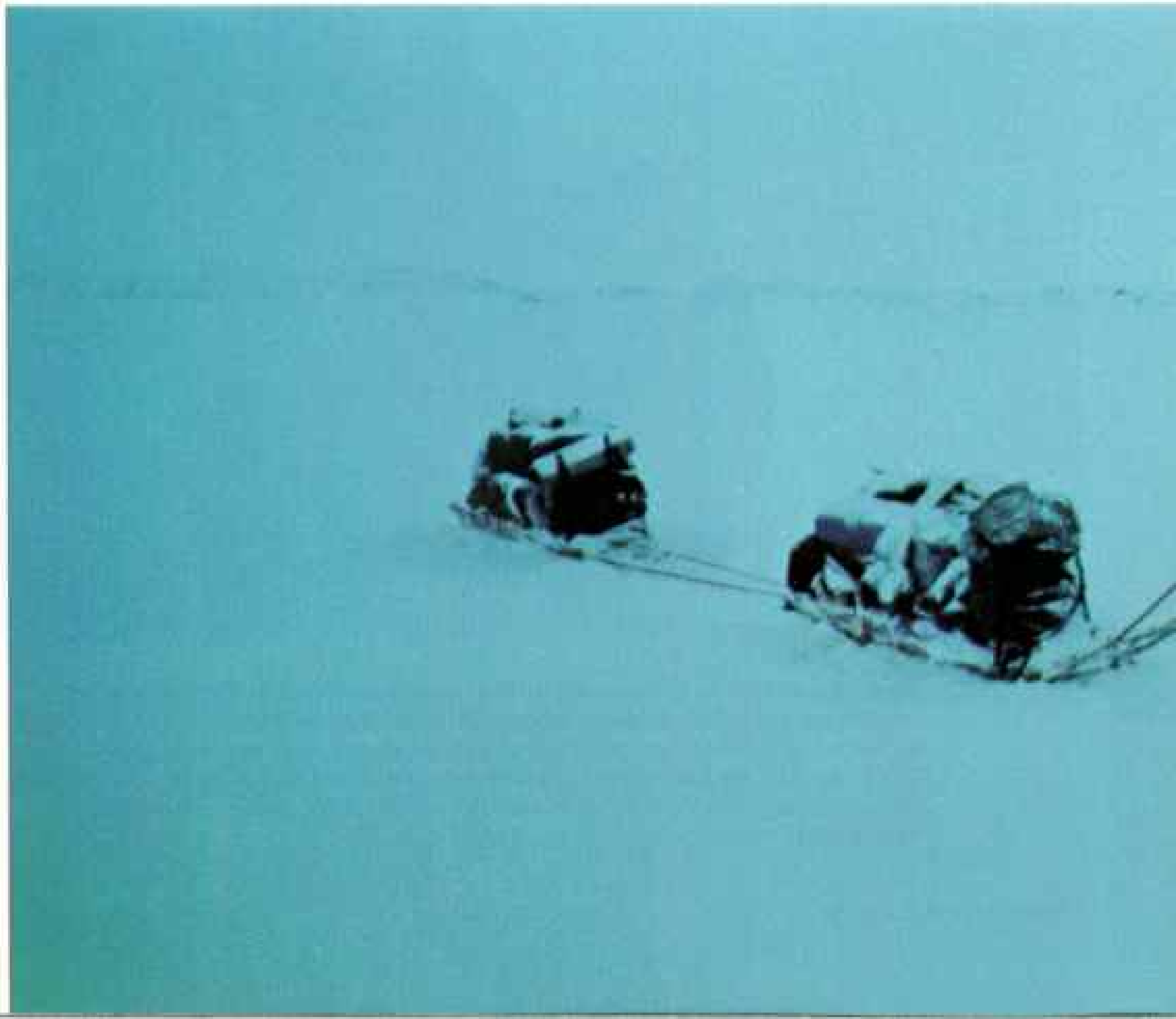
I insisted, and later regretted my adamancy, that one of the remaining two team members have credentials as an engineer and the other as a zoologist, over any other considerations. James "Jamie" Miller, a 25-year-old Australian with a degree in zoology, though no postgraduate experience, filled one of the slots. Another Australian, Norman Linton-Smith, 57, was signed on as engineer/radio operator at the last minute, after the first person chosen was found unsuitable.

We set sail from Sydney on November 14, 1982, but it wasn't until late January 1983—some 5,750 nautical miles later (map, page 636), much of it slogging against head winds—that we entered the polar ice pack. Because of warnings about dangerous shoals on the west of Prydz Bay, our overwinter goal, I kept to the east—too far east, as it turned out—and sailed in among the clutter of ice almost 200 miles north of Australia's Davis Station, an antarctic research base. Four days later, having followed meandering open leads between the drifting floes, we were roughly halfway to Davis.

Then, without warning, the half-mile-wide leads began to close in round *Explorer*. We barely had time to lay her alongside a

All of us *gathered on Christmas Day before a meal of luxuries: fruitcake, wine, and canned ham. But unfortunately a rift divided the expedition. Anthropologist Mimi George, at left, myself beside her, and, standing, geographer Gill Cracknell and gamekeeper Jannik Schou all worked well together. But engineer Norman Linton-Smith, right, and zoologist Jamie Miller, center, responded differently to the practical realities of expedition life.*

Heavy going *across sea ice yoked Jannik* ***(below,*** *left) and Jamie to sledges carrying provisions that we cached on early trips for later journeys. At first we were leery of camping on sea ice, but it soon became routine since we traveled during every month that it remained frozen. Yet we never forgot how thin was our margin of survival: In 70-mile-an-hour wind Jannik checks insecurely placed tent pegs* ***(above)****. We lived in tents on the ice four months in all.*



concave floe before its fellow bore down on us. The propeller screeched as we were thrust upon submerged ice, and I quickly shut down the engine. We didn't have control now; we were securely locked in, wholly at the mercy of the wind, ice, and current. Swept along in the grip of the lumbering floes, we barely skirted a huge grounded iceberg, but then managed to slip away into a relatively open pool of water behind it.

By midnight, to the thumping and grinding noises of floes devouring themselves against the berg in a driving gale, we were hard put to remain in shelter. "Huge floes break up, overturn, and sweep past," I recorded in the ship's log. "We have to weave to and fro under power without a break to maintain contact with the sheltering berg."

The pale dawn found the racing clouds slowing down and the gyrations of the pack slackening. By midday the immediate danger was past, and we began zigzagging southward through reopening leads.

Three days later, however, we were firmly beset in pack ice under the patronizing, or so it seemed, gaze of a group of emperor penguins. I had to make a choice: Should I trust that the very heavy pack would open up once again before the final winter freeze-up, no more than a month away, or should I seek outside aid?

We had heard by radio that the U. S. Coast Guard icebreaker *Polar Star* was about due to pass our position. Prudence dictated my decision: I immediately radioed for help.

THE HUGE VESSEL arrived at midnight, her powerful searchlights probing through the falling snow (page 637). She came steaming through the pack ice at ten knots, tossing aside 20-foot-thick floes as if they were Ping-Pong balls. As she circled our boat, the floes began to grind and heave, lifting our stern completely out of the water and bending the auxiliary rudder.

As magnificent as her arrival was her departure. Following *Polar Star's* track was rather like dog-paddling in the wake of a romping giant. Although the most powerful

BILL CRACKNELL

Camping with penguins *at an Adélie rookery (**above**) a few miles from the boat, we were accepted as fixtures in the community. Adélies collect pebbles for their nests, so we piled pebbles in front of our tent. As soon as the flap was closed, they would rush over to steal them, just as the little thieves do with one another's when they can.*

*We surveyed and monitored hatching and survival rates at several Adélie rookeries as part of a spectrum of data collection performed for scientists of the Antarctic Division in Kingston, Tasmania. Jannik gets a workout capturing an Adélie (**left**) in order to collect the material in its stomach. This is not as hard on the birds as it sounds: Warmed salt water poured down the throat induced vomiting. Healthy birds were found to be stuffed with krill, their main food. Intensive study of the antarctic food web is crucial if large-scale krill harvesting gets under way.*

conventional icebreaker in the world, *Polar Star* was using but a fraction of her 60,000-horsepower capability; still the mighty wash of her 16-foot propeller repeatedly swept *Dick Smith Explorer*'s bow around to thud awkwardly against the buffeted floes. Hastily backing off a distance, *Explorer*, her 120-horsepower Mercedes diesel chugging bravely, scampered after the icebreaker down the rapidly closing lane. We reached relatively open water in time to accept Capt. Joe Smith's invitation to breakfast aboard the *Polar Star*.

Skirting the margin of the pack, we made better progress as we continued toward Davis Station. Then, suddenly, our engine-lubricating oil drained away. At the time, it seemed a rather easily solved problem. On my antarctic voyage of the previous year the same thing had occurred, but the engineer quickly located the fractured oil pipe responsible, and it was rapidly repaired. I was confident the same pipe was the culprit now and directed Norman to investigate.

After several hours in the engine room, however, he assured me, "No, that oil pipe is intact; it's not the cause of the leak."

I accepted the judgment, and we proceeded. It was a major error on my part. Before long the last of our reserve engine oil had poured into the bilge.

Again I had to call on outside help; again luck was with us. The Soviet *Kapitan Markov*, an ice-strengthened cargo ship, was due near our position the following day, and she had already planned to send a helicopter on a social visit to the Davis base. A three-way radio conversation determined that she would stop near our ship and her helicopter would pick up and bring back from Davis an Australian mechanic and engine oil.

By the time the helicopter returned from Davis, Mimi and I were bobbing about in our little inflatable boat—nicknamed the Rubber Duck—alongside the *Kapitan Markov*, carrying on an animated conversation in a minimal common vocabulary with the crew of the Soviet vessel. The fur-hatted women crew members, eight of them, were especially interested in Mimi; somehow both nationalities managed to communicate, though perhaps not as directly as the Soviet physicist aboard the ship.

"It is a pleasure," the English-speaking scientist shouted, "to meet an Australian woman!"

"I'm afraid I'm an American," Mimi called back.

"Ah, well . . . maybe it is better!" responded the Russian, obviously a born diplomat.

We transferred the Davis mechanic and the drum of oil to the *Dick Smith Explorer* in the Rubber Duck. It took him no more than five minutes to find the leak—in the very pipeline I had suspected.

Before we lost contact with the *Kapitan Markov*, I asked if she carried any satellite ice reports. Though it divulged nothing, I will always admire the answer. "We are an icebreaking vessel," an officer said patiently. "We do not *need* ice reports in summer!"

AT LAST, the *Kapitan Markov* and a visit at Davis behind us, we began searching for the right winter mooring. We examined a number of potential sites recommended to us before we left Australia—around the Larsemann Hills on the Ingrid Christensen Coast—but we found none that were really suitable until we explored the offshore Rauer Islands.

Suitable, in the case of antarctic winter anchorages, generally means an actual bay or narrow sheltered strait between islands, which protects against the crushing sandwich effect of pack ice. At the same time the anchorage should not be so protected from the elements that the ice fails to thaw and break up each year (some areas are ice-free only about once every three years).

Finally we settled on a cove of Filla Island, a site we named Winterover Bay.

There, 150 feet offshore in 10 to 15 feet of water, we prepared for the lengthy winter: We made the boat fast with heavy lines anchored to boulders ashore on each side of the bay, cut and fit insulating foam sheets to the wheelhouse windows and the skylight, and installed and serviced kerosene heaters.

Just in time. On March 4, 1983, the sea froze. In the Antarctic it is not a subtle intrusion, this freezing up. You can actually watch it happen, in a matter of hours, sometimes minutes. And then it's just you and the elements . . . spring is a long time coming.

By the end of the month, the ice in our bay had grown thick enough to travel across,

and Mimi and I ventured forth for a first taste of what the winter would hold. Harnessing ourselves to a supply-loaded sledge—total weight about 300 pounds—we leaned into the traces and slowly, painfully, hauled it across the sticky, new, runner-clinging snow between the islands of the Rauer group. Our aim was to ascertain whether the sea ice outside the shelter of the islands was strong enough yet to traverse.

The second day took us to a camp on an islet off Varyag Island in the southern part of the Rauers. No sooner was the tent pitched than a 115-mile-an-hour blizzard began battering its walls. Next morning we were shocked to find that the ice path we had traveled the day before had become a raging waste of white-capped water—an awesome lesson in how quickly and catastrophically an ice road can disintegrate.

Eight days later, after struggling against formidable head winds, we were back at the ship. Our education had begun.

Time crept; April, 3°F . . . May, minus 17°F. My New Zealand heritage rebelled. "It's all right for you," I told Mimi. "You've lived in New York and in Chicago, but we Kiwis are semitropical!"

IN FACT, there was much to keep us occupied. It was necessary to trench along one side of the hull of the boat daily to keep the fast-forming ice from pushing it over, and every third day we would clear the exhaust port so we could rev up the ship's engine. Jannik had his fish traps and fishing holes to monitor. Gill was going from strength to strength, throwing herself into every aspect of the expedition. And we all had nearby bird cliffs and the emptying Adélie penguin rookeries to visit and study.

The challenge of the environment did not equally excite all members of the expedition, however. The group was becoming more polarized daily. The need for reliable performance, given isolation and close quarters, struck different people in different ways. Whereas Gill and Jannik (not to mention Mimi and me) were almost electrically charged by the opportunities that presented themselves, Norman and Jamie seemed to be withdrawing into a cocoon of apathy, clearly resigning from active participation in the adventure. One of them rarely arose

Flash-frozen *on exposure to minus 13°F air, specimens of* Pagothenia borchgrevinki *(**above**) were hooked by Jannik for later analysis of their stomach contents. Below the ice they were protected from 29°F water by glycopeptides in their blood.*

*For studies of the region's hardy plant life, Mimi collects lichens and mosses (**below**) on one of several trips that she, Gill, and I made to the edge of the polar ice cap onshore.*

DAVID LEWIS

***Well met** by a bevy of emperor penguins, we were rewarded for our longest over-ice journey by being the first ever to visit the Amanda Bay rookery (**right**) while chicks were still so young. Eggs hatch in winter at rookeries on the sea ice. We counted those unhatched (**above**) as part of our study of infant mortality among the only known creatures that breed in the antarctic night.*

from bed before 1 p.m. each day, and then spent most of his waking hours reading—mainly about antarctic adventures!

Months later Mimi's human-dynamics study—which used questionnaires, individual journals, official logs, and taped interviews—examined this polarization of the crew. Personality differences, it concluded, played little part; four of the members were bonded exclusively in their determination to make the expedition a success. Two, on the other hand, seemed drawn together "largely by mutually held resentments, loneliness, and disinterest in achieving the goals of the expedition."

Not surprisingly, Jamie and Norman today vigorously dispute these conclusions and challenge the data upon which they are based.

"Mid-April," the report observes, "was the lowest point of expedition morale." Mimi and I decided that a reorganization of responsibilities was essential. She took charge of maintaining stoves, heaters, field equipment, and our snowmobile. She also trained Gill, now coordinator of biological fieldwork, as her deputy. Jannik was Gill's deputy. Norm and Jamie were given simple tasks and chores (such as collecting berg ice to be thawed for drinking water) that required them to spend some time off the boat. But in terms of our plans to venture beyond the

GILL CRACKNELL

Rauers from our icebound ship, only four of our six-person team were really functional.

We four conducted all the fieldwork south of the Rauers—the main thrust of our research. We each sledged a total of 850 miles over the frozen sea, working along 60 miles of coastline in the course of a dozen field trips. Half was by man-hauling and half with the snowmobile. We were in the field with our sledges and tents every month of the year that the sea was frozen—a total of some four months of overnights—including the dead of the polar winter.

Most antarctic exploration has been conducted on land ice or ice shelves. Few expeditions have performed such all-season activity over sea ice. And no women in the history of antarctic exploration have matched the achievements of Mimi George and Gill Cracknell.

THE DAYS DREW IN rapidly. On May 29, as Mimi and I trudged across the sea ice six miles south of the Rauers en route to a camp on the bluffs of Chaos Glacier— our first serious reconnaissance outside the Rauers—we saw the sun top the horizon for the last time that winter. We now broke camp in polar darkness, and after a day's sledging by the light of the aurora and about three hours of feeble daylight at midday, we pitched tents in the dark again.

Herded by fear, *Adélies mill about on the ice wary of leopard seals seen in the area earlier. We saw one seal, lurking under the edge of the sea ice, take three penguins in a couple of hours. A few of the birds—braver, more foolish, or perhaps just more hungry—follow the leader into the water in search of krill and*

JANNIS SCHOU

fish for their chicks at the rookery. Other Adélies line the ice in the background.

Skuas are the chief enemy of Adélie young at their onshore rookeries, taking both eggs and chicks. But when the Adélies and their young move out to the loose pack ice to spend the winter, leopard seals move out with them.

One that got away *races out of a leopard seal's reach (**above**), while an Adélie that didn't (**right**) is literally jerked out of its skin by a violent snap of the seal's head. We saw this technique used time and again by the ten-foot-long predators. Sometimes they would eat only the breast meat of the birds.*

Jannik, experienced with wildlife in his native Denmark, never tired of observing and photographing leopard seals. He very nearly paid for his fascination with his life on one occasion when, as he approached the water's edge, a leopard seal hurtled up at him from below, jaws wide. Only Jannik's quick reactions saved him from becoming a meal as he instinctively leapt backward and then ran across the ice with the seal behind him, following for a good 30 feet.

Camping on the ice was an agony of frozen fingers, being wind-chilled through and through and snow-coated in the howling darkness. Tugging off each other's frozen boots and parkas, we would crawl gratefully into chilly sleeping bags and light the hurricane lamp (flashlight batteries were frozen) and kerosene pump cooker to melt snow for water. It was wonderful how quickly a hot drink of tea, or cocoa with condensed milk, along with dehydrated stew, revived our spirits and stilled our shivering.

Perhaps this is the place to answer a question often asked about such antarctic expeditions. Yes, antarctic wildlife can be eaten. For various reasons—including the spoilage of hundreds of pounds of ill-cured salami during our summer approach voyage—we had a taste of truly southern fare. We sampled a gamy old bull Weddell seal, pungent Adélie penguin breast, tasty skuas, and a few nibbles of fish on one occasion when Jannik hooked many more than our quota for stomach-content research (page 649). The flavor was quite good and verified that the glycopeptides in the blood, which keep fish from freezing in the 29°F water, impart no particular taste.

BOTH BY JANNIK SCHIØLER

We made meals of these creatures partly to find out what was good eating and partly to meet our own protein needs. While sledging, we were burning at least 5,500 calories a day. The finest reward for one perilous over-ice journey that Mimi and I made, to Australia's Davis Station to get fuel for our snowmobile, was not just the hospitality during our two-night visit, but also the luxury stores that the Aussies pressed upon us to take back to the ship: such delicacies as steak, chicken, lamb, and a side of bacon! Thereafter our dead seal, frozen in a drift, could be—and was—used only for fish bait.

That trip to Davis, in early July, was the first time we know of that this particular over-ice passage had been made. To get to Davis, we had negotiated the notoriously unstable ice off the snout of the Sørsdal Glacier. Nine days after our return the Sørsdal ice broke up and never re-formed. Had our timing been bad, we would have been forced to attempt an arduous 125-mile trek over the polar plateau. Had our timing been worse, we might have drifted away entirely.

After five weeks below the horizon, the sun returned early in July, and the days began *(Continued on page 660)*

Songs of Weddell seals *echo beneath the ice as Mimi records them with a hydrophone lowered down a breathing hole in a tidal crack* ***(right)****. Recording equipment is kept warm by hot-water bottles in the cooler on the sledge. Behind her Jannik and Gill work to tag a seal.*

Our recordings were the first such made in the Larsemann Hills area, our farthest penetration south along the coast. Analysis of the tapes by the Hubbs Sea World Research Institute shows that Weddell seals here communicate in sound patterns distinct from those of two other groups previously identified elsewhere in Antarctica.

We arrived in the October calving season. The second pup of 1983, here ten minutes old ***(above)****, arrived on the eighth. Mortality rates appear to be low. One female whose pup died* ***(left)*** *remained beside it for four days after its death.*

JANNIK SCHOU (LOWER LEFT); DAVID LEWIS (BELOW)

Icebound in Antarctica

In an awesome display *of antarctic majesty, an iceberg is born as we stand witness less than a mile away* (**above**). *We were camped at the time on sea ice off the Ranvik Glacier, trying to find a snowmobile route through the jumbled ice in front of the glacier's tongue. The tongue itself spawned the berg. When the berg broke from the mass, it rolled partway over, exposing its wave-smoothed underside while clouds of snow streamed off its top like smoke. The violence shattered the sea ice nearby* (**right**). *On returning to the area weeks later, we found that the berg had capsized fully, throwing huge parts of itself a quarter of a mile and smashing the ice where we walk in the photo above.*

While travel on sea ice is relatively common in Antarctica, none so extensive had been done by women. Mimi and Gill blazed a trail of competence and courage.

JANNIE SCHOU

lengthening rapidly. Soon an unbelievable profusion of wildlife would be returning to the empty land. Unfortunately, it was also the coldest period of the year.

It was time to continue probing a route southward. We set out, toward the end of the month, to place a depot of food and supplies partway along the route of a planned long-term trip a little later on in the year.

IT WAS ON THIS TREK that I developed hypothermia. It was a bad three weeks for Jannik too. One of his big toes froze badly, and time and again the two of us developed telltale white frost patches on our noses and cheeks.

"This is certainly one advantage of traveling with women," I quipped to Jannik as the frost nip was "kissed better" by our partners. Mimi and Gill apparently were made of better stuff; their faces never froze. "In all truth," I was to remark to a questioner some time afterward, "by far the best men in the expedition were the women."

With great difficulty we bulled our way over extremely rough ice in a berg field that barred our way to the Brattstrand Bluffs, Amanda Bay, and the Larsemann Hills. We stashed food and fuel at a berg we named Gelato, and then we forged a path on foot to the bluffs through the indescribable jumble of bergs, ice blocks, ridges, and six-foot-wide shear-line tide cracks that extended for miles over the ice. We were rewarded upon returning to the Gelato depot by witnessing the birth of an iceberg (preceding pages), calved with great sound and fury from the Ranvik Glacier, which was less than a mile away.

In September, once again leaving Norm and Jamie to look after the ship, the rest of us set out in high spirits for our major trip to the

Close quarters, *here seen at mealtime in a galley where only four could sit comfortably, exacerbated tensions that grew when Jamie and Norman challenged decisions made by myself and Mimi, the expedition's leaders. Jamie was finally sent back by helicopter, three weeks before our return voyage to Australia. No environment on earth imposes such isolation as the antarctic winter, and Mimi's anthropological study of our group has won interest from NASA officials and other scientists.*

south. Not only did we plan to visit colonies of Adélie and emperor penguins and presumed Weddell seal nurseries, but also we wanted to collect samples of the tiny, brilliantly colored lichens among the Larsemann rocks hard by the great ice sheet itself.

As on our reconnaissance trip, the rough-ice barrier nearly stymied us. We now tried a seaward route—and survived a hundred-mile-an-hour blizzard—before returning toward the ice cliffs after ten fruitless days. We encountered ice so rough that we had to chop a path with our ice axes, working in near-whiteout conditions as Mimi piloted the snowmobile and its trailing sledge blindly over crests and ridges. A measure of the difficulty: It took us five arduous days to cover no more than five miles of sea ice! Finally, though, we won through and began racing southward at 15 miles an hour. A day later we were at Amanda Bay.

"There they are," someone shouted, and indeed they were; long lines of little tuxedoed figures—emperors—half of them stolidly plodding out toward open water (23 miles distant, we later ascertained) at a speed of about 1.5 miles an hour, and the other half returning. Columns going in opposite directions seemed to be bearing to the left as they passed one another.

"Proper little Australians, aren't they?" I remarked. "I wonder if the ones at McMurdo [the American base] keep to the right?"

At the rookery, on a snow-covered moraine, fluffy spectacled chicks swaggered importantly among the adults. We camped for several nights on a mound opposite, and we went to sleep lulled by the surprisingly musical chorus of what our census eventually showed was 2,450 adults and 2,340 chicks (the rest of the adults were on their way to or from the fishing grounds).

Our next stop, and southernmost campsite, was in the rugged Larsemann Hills. From here we surveyed the winter mooring inlets that had been recommended—and were grateful that we had not anchored at any of them—and scoured the land, Gill in the lead, for lichens. It was the Weddell seals that delighted us most, however.

The first pup of the year was born October 7, on the fast ice by a tide crack between two monstrous grounded bergs. Thereafter dozens were born each day. We could have spent all our time watching the antics of the newborn pups, each as individual as a human infant and endlessly curious. But Gill and Jannik had tagging to tend to—much resented by the 720 individuals targeted—and Mimi and I concentrated on photographing the seals, as they taught their young to swim, and also on making underwater hydrophone recordings of their sounds (we were to learn later that we had captured a variation distinct from two others already identified).

In a last fling, Mimi and I snowmobiled from a camp outside Amanda Bay six miles to Stedoy Island. Here we discovered an apparently unknown Adélie rookery, just being occupied. We counted a thousand birds, and we assumed, from the spacing and the amount of territory remaining, that perhaps as many more were still to arrive.

Much as we hated to leave this fascinating region, we were forced to head homeward before our icy path started breaking up.

NEITHER SHIP nor caretakers had come to harm in our 50-day absence. Though the schooner seemed luxurious to us now, we sorely missed the magic beauty of the vast open spaces. Not that there wasn't plenty to do as we awaited breakout.

Fish were collected, nearby Adélie penguins monitored and their stomach contents examined by forcing them to regurgitate, not by killing them, the interaction between the penguins and the egg-robbing skuas observed, and leopard seals photographed. A masterful predator, the leopard seal makes short work of any penguin he catches, grasping it with massive jaws and wrenching it, quite literally, right out of its skin (pages 654-5). Unfortunately, the most dramatic leopard seal encounter was not captured on film. One day Jannik, walking to the edge of the fast ice to investigate a leopard seal he had seen, was suddenly confronted by a sleek, ten-foot-long natural torpedo. Jaws agape, the leopard seal hurtled out of the water and onto the ice, pursuing his new prey for some 30 feet before giving up the chase.

Although the days became warm and sunny and the sea ice outside the Rauer group began to break up, the fjords between the

With antarctic aplomb emperors appraise the bleak and beautiful

islands remained obstinately frozen over. But in mid-December the first supply ship reached Davis, and shortly thereafter a helicopter brought us our first mail in nearly a year. From then on contact with the outside world was frequent as various biologists were ferried out to the islands.

A distressing effect of this contact, added with the shrinking of our accessible world as the sea ice grew dangerously soft and thin, was renewed flareups of resentment by Norman and Jamie against the expedition leadership. Finally, after Jamie challenged my directive to accept Gill's judgment about the safety of sea ice they were hoping to cross, he became especially abusive. I was forced to take strong measures.

That evening the disconsolate Jamie and his belongings were flown out to the Davis base aboard a specially dispatched helicopter, and from there shipped to Australia.

At last, on January 26, 1984, we nosed cautiously out of Winterover Bay, our home for 11 months. After a stop at Davis and a weather-thwarted attempted visit to the Soviet base of Mirnyy, 700 miles eastward, we shaped course for Sydney, 3,250 miles northeast, speeding across the southern ocean on the wings of a succession of storms.

March 11, 1984—16 months and nearly

JANNIK SCHIØLL

world that we shared with them for so long—and hope to share again.

10,000 nautical miles older—we arrived in Sydney to a tumultuous welcome.

> "IN SPITE of difficulties," Mimi's small-group study later concluded, "the expedition met all its goals."

Not surprisingly, "the periods of lowest morale and greatest stress . . . were the times when expeditioners were unable or unwilling to leave the boat because of the weather or other reasons and usefully engage the environment."

In that rigorous engagement we had sledged and camped throughout an antarctic winter, and we had managed to make its harshest aspects serve our own purposes.

And most of all, as I see it, we had established beyond doubt the validity—in terms of flexibility and low costs—of private, nongovernmental research efforts. After all, the future of the Antarctic probably lies in joint administration by governments in alliance with big business. It seems vitally important that people who are not employees of either should gain the experience to be able to speak authoritatively and independently on behalf of this wilderness continent (which, larger than the United States, stands alone in awesome beauty) and all its living creatures. □

Chocolate

FOOD OF THE GODS

Cornucopia of delight: Chocolate confections tumble from a chocolate sack. Derived from the cacao tree, chocolate holds the power to gladden mortal hearts. Sighs one manufacturer in this multibillion-dollar industry, "I'm dealing in pure joy."

By GORDON YOUNG
NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by JAMES L. STANFIELD
NATIONAL GEOGRAPHIC PHOTOGRAPHER

and SISSE BRIMBERG

***Ritual beverage** of Mesoamerican royalty, a mug of frothy chocolate seals a 12th-century Mixtec marriage. Aztecs shared this bitter, watery drink called xocoatl with Hernán Cortés, who helped spread the valuable cacao bean crop to the Caribbean and Africa and introduced drinking chocolate to Spain in 1528. Mexicans still toast happiness with the now sweetened concoction (**right**).*

NUTTALL CODEX, GEORGE E. STUART, NATIONAL GEOGRAPHIC STAFF; DISK BRIMMING (RIGHT)

LINNAEUS—you who brought order out of botanical chaos—a million chocolate lovers salute you. You spent much of your 18th-century life methodically renaming the world's plants, but when you faced the cacao tree, the source of chocolate, detachment suddenly gave way to a burst of lyricism.

You gave cacao the gorgeous name of *Theobroma*—"food of the gods."

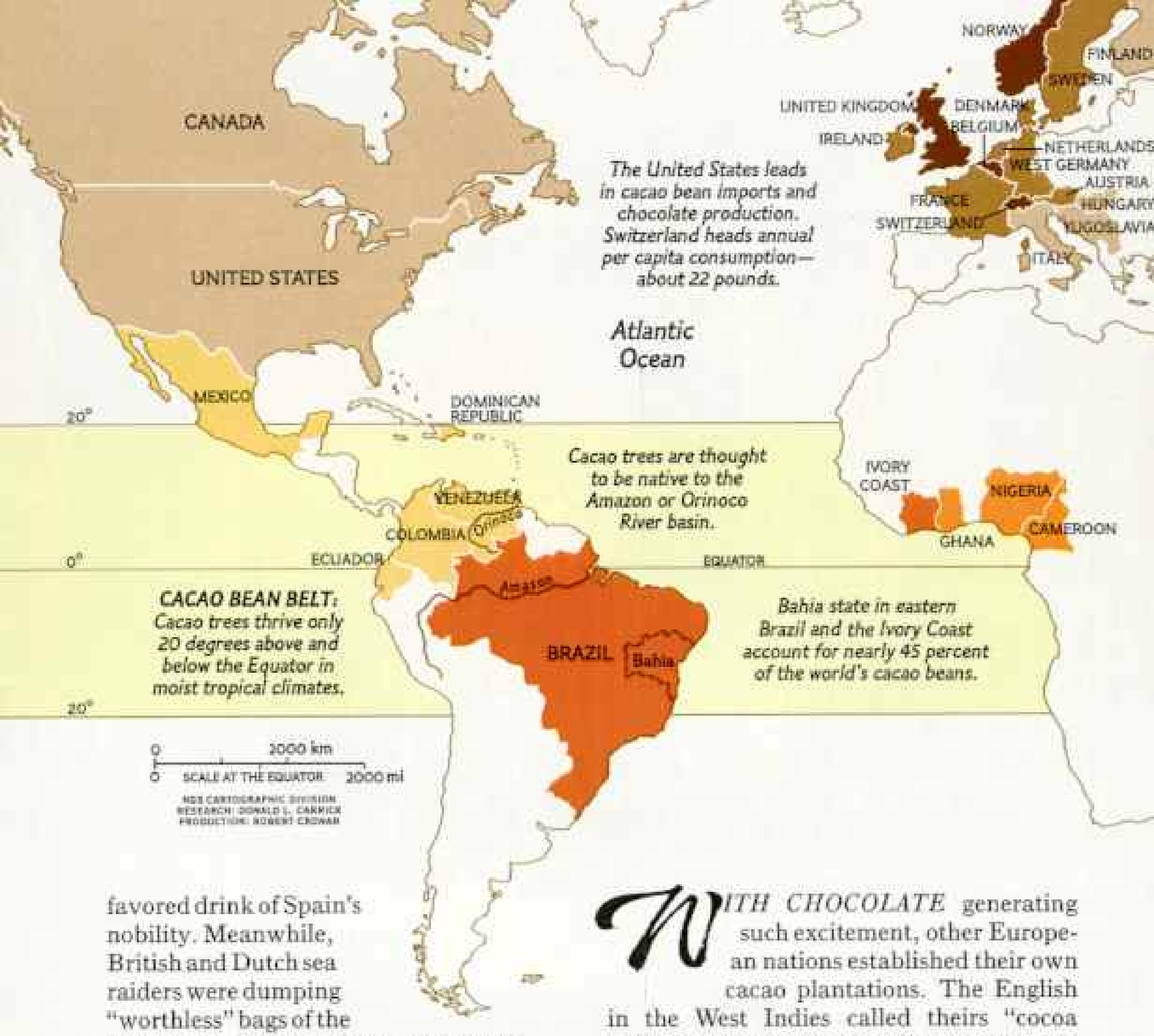
And why not? Long before your time the beans of that equatorial tree nourished imagination and body. Today they nourish a multibillion-dollar industry as well. I recently followed the chocolate trail from the jungles of Africa and Brazil to sophisticated chocolate factories in Europe and the United States. I tested torrents of sweet brown delights that flow from those aromatic production lines, and my last doubts melted. Linnaeus, indeed you chose the perfect—the only—name for that miracle bean.

Cacao, as rich in history as in flavor, is said to have originated in the Amazon or Orinoco basin at least 4,000 years ago. Christopher Columbus, in 1502, was the first European to run across the beans, on his fourth voyage to the New World, but he virtually ignored them.

Two decades later Hernán Cortés found Moctezuma, the Aztec emperor, drinking cup after cup of *xocoatl*—a liquid so prestigious that it was served in golden gobiets that were thrown away after one use. Cortés sipped the bitter, spicy beverage, and when he returned to Spain in 1528, he took some of the wondrous beans back to his king, Charles V.

He was a man with his eye on a golden doubloon, this Cortés, much impressed by the fact that cacao beans were used as Aztec currency (about a hundred beans would buy a slave). So when the Spaniards left the Aztec Empire, they took cacao beans with them, seeding "money plantations" on Trinidad, Haiti, and the West African island of Fernando Po, now Bioko. Later one pod was brought from that island to the mainland; from it grew the huge cacao trade now dominated by four West African nations.

The Spanish then added water and cane sugar (another New World import) and heated the brew. Soon chocolate was a



favored drink of Spain's nobility. Meanwhile, British and Dutch sea raiders were dumping "worthless" bags of the cacao beans off captured Spanish ships.

The money plantations of Cortés gave imperial Spain a virtual monopoly of the cacao bean market for almost a century. Still, the sweet reputation of the drink began to drift throughout Europe.

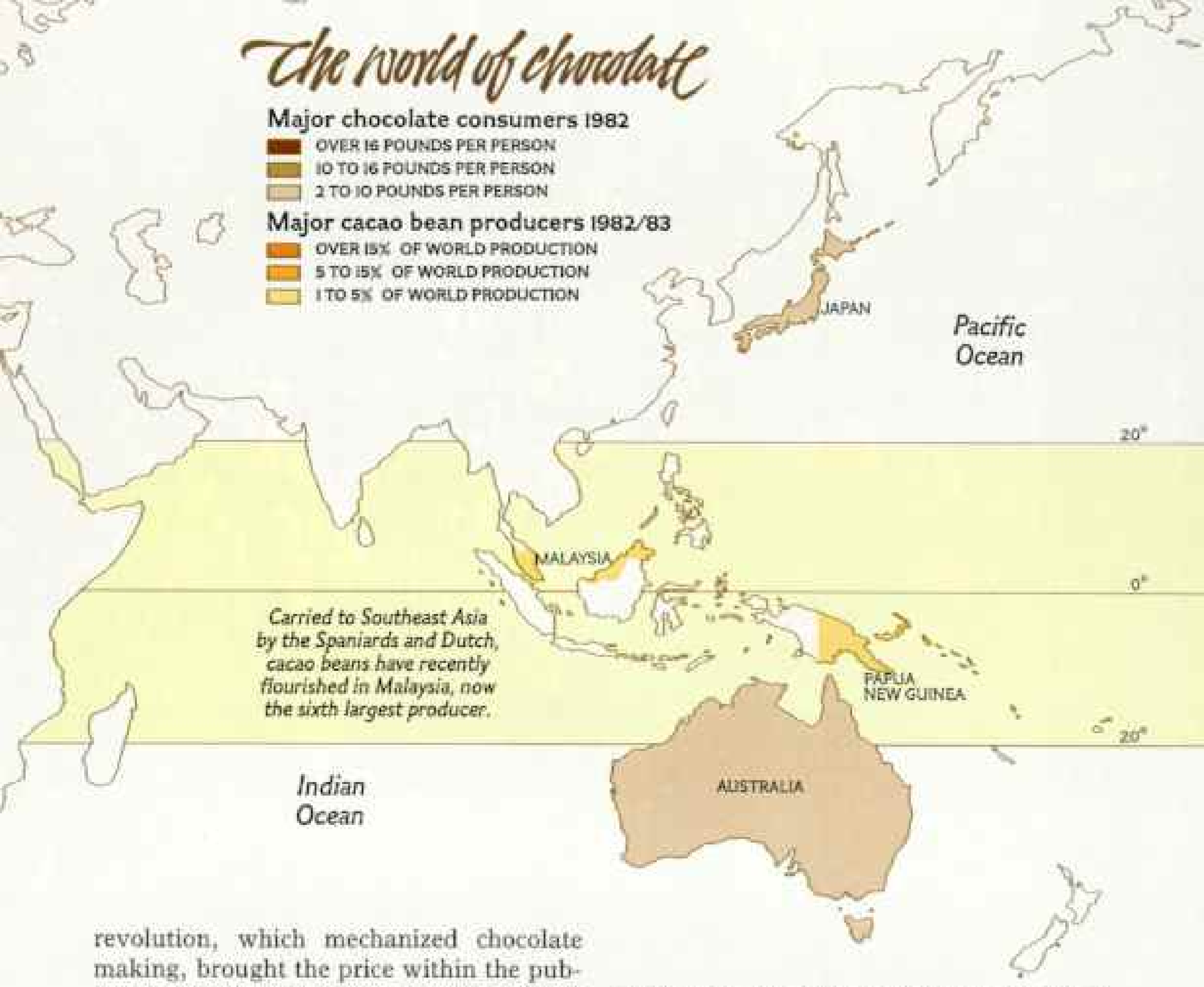
Dr. Stephani Blancardi of Amsterdam declared about 1705 that tasty chocolate "is also a veritable balm of the mouth, for the maintaining of all glands and humors in a good state of health. Thus it is, that all who do drink it possess a sweet breath."

One of his countrymen backed that claim with the report of a man who had died at the age of 100: "He subsisted for 30 years on nothing other than chocolate and some biscuits. Occasionally he would take a little soup to eat. Yet he was so fit that, at the age of 85 years, he could still mount his horse without stirrups."

WITH CHOCOLATE generating such excitement, other European nations established their own cacao plantations. The English in the West Indies called theirs "cocoa walks" and soon were satisfying well-to-do countrymen with a blander chocolate drink mixed with milk. "To a coffee-house to drink jocolatte," Samuel Pepys's diary chronicled in 1664. "Very good."

It was not yet the drink of the European masses. Charles Dickens's *Tale of Two Cities* dwells on one nobleman's conspicuous consumption: "It took four men, all four ablaze with gorgeous decoration . . . to conduct the happy chocolate to Monseigneur's lips. . . . Deep would have been the blot upon his escutcheon if his chocolate had been ignobly waited on by only three men; he must have died of two."

In the early 1700s chocolate houses sprang up in London to compete with coffeehouses. English Quakers sang the praises of the drink as a healthful substitute for gin. And then increased production and the industrial



revolution, which mechanized chocolate making, brought the price within the public's reach. Though it was often thickened with alien substances (such as brick dust), its popularity soared.

Theobroma came full circle back to the New World in 1765 when a chocolate factory was established in the Massachusetts Bay Colony. Thomas Jefferson expressed the hope that "the superiority of chocolate, both for health and nourishment, will soon give it the same preference over tea and coffee in America which it has in Spain."

In 1828 Conrad van Houten, a Dutch chemist, learned to press out some of chocolate's fat—a pale substance called cocoa butter—and make cocoa powder. Two decades later, when cocoa butter and sugar were added to a paste of ground beans, "eating chocolate" came on the scene. In 1875 the Swiss developed a way to make solid milk chocolate. New machines were developed to stir, or conche, the liquid chocolate in the process, vastly improving its smoothness.

Today chocolate lovers range from the affluent seekers of the good life to the kid at the candy counter. The food that chocoholics crave ranges from extravagantly lush (and extravagantly priced) assortments down to simple "chocolate bars"—which may actually contain no chocolate at all.

BUT back to the source. There is a long way between cacao beans and chocolate candy; I found that out when I tasted my first raw bean. It was in Africa's Ivory Coast (cacao thrives only within 20 degrees of the Equator) at a settlement too small to have a name. The main flavor was an uncandy-like bitterness.

I asked the cacao farmer whether this was a profitable crop. He nodded. Yes, he would get 350 West African francs (78 cents) per kilo for his cacao beans. But to him it was simply a cash crop. He had no idea what happened to it after it was trucked away. He had never tasted chocolate.

His tiny cacao grove seemed just another

JAMES L. STANFIELD (FACING PAGE AND ABOVE); SISSE BRIMBERG

Harvested nearly year-round, *cacao bean pods mature in about six months on the trunk and lower branches of cacao trees. Pods of the three most widely grown varieties ripen to yellow, red, or variegated green. Like harvesters worldwide, men on an Ivory Coast farm* ***(left)*** *reap the fruit with long, bladed poles and machetes.*

The crack of a machete reveals 20 to 40 beans, or seeds ***(top right)****, nourished by a central placenta and coated with mucilage. To extract a pick-me-up nectar, plantation workers in Brazil cradle freshly picked beans in angled banana leaves* ***(above)****. The taste? "Like drinking flowers," says photographer Brimberg. Sucking beans, a Mexican harvester's child enjoys the same treat* ***(right)****.*

Separated by hand, covered beans ferment for several days, developing a brown color and a chocolate taste. Drying then preserves them for shipping and storage.

Pod-splitting party *in the Ivory Coast starts before dawn and ends after dark as workers husk as many as 25 pods a minute. Neighboring Ghana, top cacao grower a decade ago, dropped to third following economic and political turmoil. The smuggling of Ghanaian beans into the more stable Ivory Coast market hinders Ghana's recovery.*

piece of jungle; cacao, banana, and other trees were mixed haphazardly, and the underbrush was waist-high. But the distinctive cacao trees were easy to spot: Their elongated, melon-like pods sprouted from the branches and from the trunks themselves.

He swung his machete, lopping off a golden pod, then split it open to reveal dozens of white beans enmeshed in thready pulp.

JAMES L. STANFIELD

While fermenting in the equatorial heat, the beans begin changing to chocolate brown, and the pulp withers away. Then the cacao beans start their journey to Abidjan, port city and capital of the Ivory Coast.*

More cacao sets sail from Abidjan than from any other West African port. Ghana, Nigeria, and Cameroon are producers, too, but the Ivory Coast has better roads and a more dependable currency.

The price of cacao beans—presently about $2,200 a metric ton—is far from constant. Drought or disease can decimate a crop, and prices shoot up. Then enthusiastic planting brings overproduction a few years later when the trees begin to bear, and the prices drop. Political turmoil can also

*See "The Ivory Coast—African Success Story" by Michael and Aubine Kirtley, in the July 1982 NATIONAL GEOGRAPHIC.

have a drastic effect on the price of beans.

Those wildly fluctuating prices are the despair of both buyer and seller. West Africa's cacao producers have tried to band together to keep the price high, though most are too poor to hold the crop until prices rise. Chocolate-manufacturing countries try to present a united front; not surprisingly, they support a lower price than do the sellers.

Officially, an international cocoa agreement *does* exist now. It, too, lacks effectiveness, since the largest buyer (the United States) and the largest seller (the Ivory Coast) have refused to sign it: Neither country feels the pricing formula is fair.

I FOUND an ocean of difference between *Theobroma* cultivation in West Africa and in Brazil. Brazilian cacao groves have the look of orchards. The trees are planted in neat rows on cleared land. Brazilian growers carefully prune them to allow easier access for spraying and harvesting. Not surprisingly, production per tree is considerably higher than in Africa.

But in addition to diseases that afflict African cacao trees, the Brazilian crop faces another major threat: witches'-broom.

"It is a fungus that attacks all parts of the tree, deforming it in bizarre ways," said Ronald Alvim, plant physiologist with CEPLAC, Brazil's cacao research center. "The disease is endemic in the Amazon region of Brazil, but fortunately it has not yet spread to the state of Bahia—and almost 95 percent of Brazilian cacao comes from this state. We try to keep it out with rigid checks at roads and airports. Meanwhile, we try to develop a 'hyperparasite' to kill witches'-broom spores."

Dried and bagged, the cacao beans begin shipborne journeys to foreign chocolate plants. There they are cleaned and roasted, then shelled—and at last the fragrance of chocolate fills the air.

Shattered first into nibs (large fragments), they move between heavy disks where heat and grinding pressure produce a thick, dark paste called chocolate liquor, though it has no alcoholic content. It is the base for all chocolate and cocoa.

The hardened chocolate liquor becomes baking chocolate. If the chocolate liquor is subjected to high pressure, however, an amber liquid, cocoa butter, is extracted, and a residual cakelike mass, chocolate press cake, is then ground and becomes cocoa powder—source of that cheery cold-weather drink. If additional fatty cocoa butter is blended with chocolate liquor, the mixture is on its way to becoming candy. If cocoa butter but no chocolate liquor is used in the process, white chocolate will result.

At times candymakers may substitute other ingredients (usually vegetable oils) for cocoa butter. That mixture cannot legally be called chocolate: The term is "confectionery coating." For decades I have enjoyed Baby Ruth candy bars, for example, unaware that technically they are not covered with chocolate at all. No matter—I still like them.

Add *these* curious facts to your store of chocolate knowledge: The Baby Ruth bar was named not in honor of a baseball player but for the youngest daughter of President Grover Cleveland. Cocoa butter, because of its oily smoothness and low melting point, is frequently used in cosmetics and suntan lotion.

No matter what chocolate bar you buy, read the label—especially if you are on a low-salt or low-cholesterol diet. Chocolate itself is virtually free of salt and cholesterol; other listed ingredients may not be.

If you are allergic to chocolate, consider candy made from carob (the mashed fruit of a Mediterranean pine tree), since its flavor approximates chocolate.

But back to that tasty mixture—the blend of chocolate liquor laced with great gobs of rich cocoa butter that spells CHOCOLATE to candymakers and to chocoholics.

Hot on the chocolate trail, I toured a dozen candy factories in the U. S. and in Europe. No two were alike; each contained its own distinctive array of efficient machinery. If there was a common denominator, it was automation; control panels were everywhere, bedecked with diagrams and switches and colored lights.

In Hershey, Pennsylvania, I drove slowly down Chocolate Avenue, past streetlights resembling foil-wrapped Hershey's Kisses, inhaling the aroma of chocolate that fills the town. Accompanied by Susan Graham, manager of public information, I toured the mammoth Hershey plant.

We walked past endless rows of conching machines. In each, a lake of liquid chocolate was being stirred in slow-motion waves by rollers moving ponderously back and forth. "We conche for up to 72 hours," Susan said. "It's the secret of Hershey's smoothness. For the majority of our products, machines do most of the work. A few specialty products, such as five-pound souvenir bars, are wrapped manually. The rest is untouched by human hands."

The machines spew out enough Hershey bars, I thought, to pave the planet. Multiple nozzles rained precise amounts of chocolate and almonds into passing molds. The molds shook for a moment to work out bubbles, then disappeared into a cooling tunnel.

Emerging again, the molds upended, flipping their contents onto another conveyor that sped them to wrapping machines. Something happened there too fast to see, and the wrapped bars were on their way to the shipping room.

Meanwhile, across the huge room, other nozzles were blowing Hershey's Kisses by the millions—20 to 25 million a day. Enraptured, I watched machines far smarter and more agile than I; they wrapped each Kiss, tucking in a label tab in the process.

At one time tourists could see the plant, but when their numbers grew to more than a million a year, the tours had to stop. Instead, visitors get a free trip through Chocolate World, riding an automated (of course) carriage past exhibits that explain the whole chocolate-making process.

AT NEW YORK CITY'S Coffee, Sugar and Cocoa Exchange in the World Trade Center, I watched dozens of shirt-sleeved businessmen standing around the cocoa ring shouting and gesturing at one another. The tumultuous scene reminded me of the action at a gaming table in Las Vegas.

But that was a deceptive thought. Most of those men were doing the very opposite of gambling. They were "hedging"—making futures-market transactions that would protect their clients against price fluctuations on the cocoa market.

More than one expert exhausted his patience leading me through the arcane world of the futures market. But contemplate this: If you want to buy something to be delivered at a specified date in the future, protect yourself against price changes by hedging. That means buying and selling contracts for future delivery of commodities for real money, and it is a noisy business. As one broker explained over the din, "all futures trading is conducted at open outcry."

Contracts worth millions of dollars flow back and forth across that cocoa ring each day, trading in future delivery periods that might involve cacao yet to be harvested—beans from unspecified plantations in unknown nations.

JAMES L. STANFIELD

Hands full of cacao beans *from West Africa hold about the amount needed to make a pound of chocolate candy. But how a company blends different varieties from various nations is a guarded trade secret.*

Who were those traders around the cocoa ring? Some were cocoa brokers. Some represented chocolate manufacturers. Most were connected with the cocoa business, but some were simply private investors speculating on the volatile cocoa market.

My head was spinning when I left that world of high finance. Who would have thought that famous candy plants are owned by a macaroni company and a soup company? Fortunately for chocoholics, the parent firms contribute only money and merchandising advice; leaving the chocolate making to the *chocolatiers*.

ALL BY JAMES L. STANFIELD

Gourmets' sweetheart, *Joseph Draps* ***(right)*** *founded Godiva Chocolatier in Brussels after World War II and launched its reputation for luxury chocolates—now nearly $20 a pound—and for handcrafted boxes that have become collector's items. New creations and old favorites each week face the scrutiny of executives in Godiva's Brussels headquarters* ***(above)****. Nearly 70 percent of the candies are decorated by hand. Reattached with drops of chocolate, stems grow from fondant-covered cherries* ***(left)****. Dipped in chocolate, the fondant soon liquefies. Because these cherries contain alcohol, they cannot be imported into the United States. Most Godiva chocolates sold in the U. S. are made in the U. S.*

When chocolate swept 17th-century Europe, it met both praise and scorn. Those who touted it as an aphrodisiac may not have been far off, however. Modern analysis of chocolate reveals small amounts of phenylethylamine, a chemical naturally produced in the brain that, some speculate, increases when people fall in love.

I went behind the scenes at the Fannie May kitchen in Chicago with Kenly Day, vice president in charge of production.

We stopped to watch neatly aligned rows of coconut cream centers march by on a conveyor. They traveled through a shallow pool of chocolate that coated their undersides, then under a "waterfall" of dark chocolate that covered tops and sides.

"It's called 'enrobing,'" Mr. Day told me. "It's much faster and more efficient than the old hand-dipping process."

As he talked, quivering nozzles squirted squiggly, final-touch designs on the top of each piece.

My eyes lit up. "Is there some universal key?" I asked. "Designs that would let a candy lover know what he's getting when he reaches into a box?"

The answer, unfortunately, was no. Each candymaker has his own system, though a few do include identifying diagrams in their boxed assortments.

Chocolate factories, I found, come in all sizes and locations. One of the most curious was on the 13th floor of a Park Avenue high rise in downtown Manhattan. Tom Krön, a Hungarian émigré, then operated a sweet little kingdom up there, based on absolute quality. When I asked him about his clientele, Mr. Krön handed me a note from actress Katharine Hepburn, raving about her chocolate-covered strawberries. Next he pointed to a framed letter on White House stationery, thanking him for the chocolate-covered jelly beans.

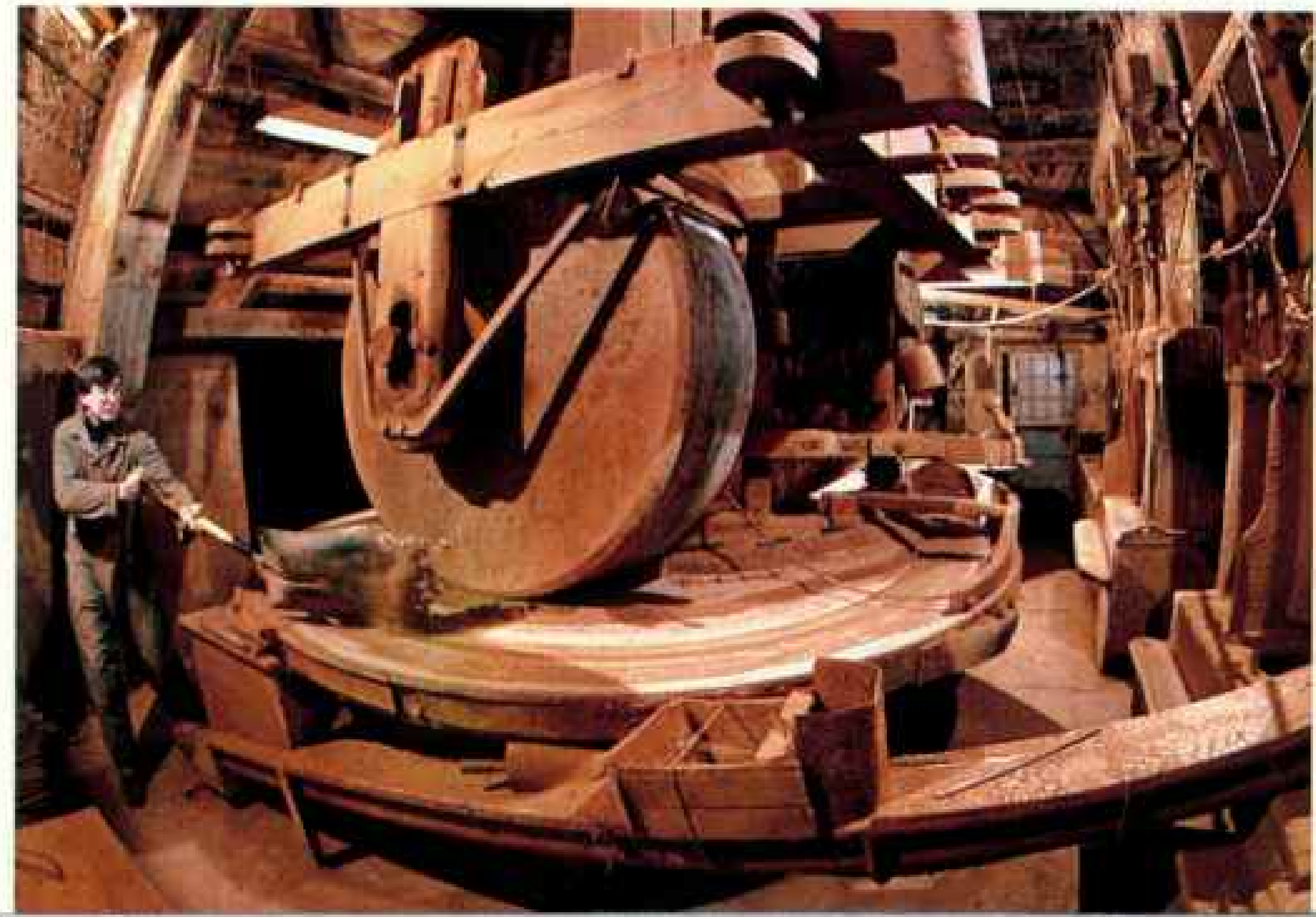
Also from Manhattan comes the chocoholics' very own magazine, *Chocolate News*, printed with chocolate-colored and chocolate-scented ink. Its growing legion of readers learns about such things as "starch casting" (using cornstarch to mold liquid centers for chocolate candies), the results of taste tests, and new products in the field.

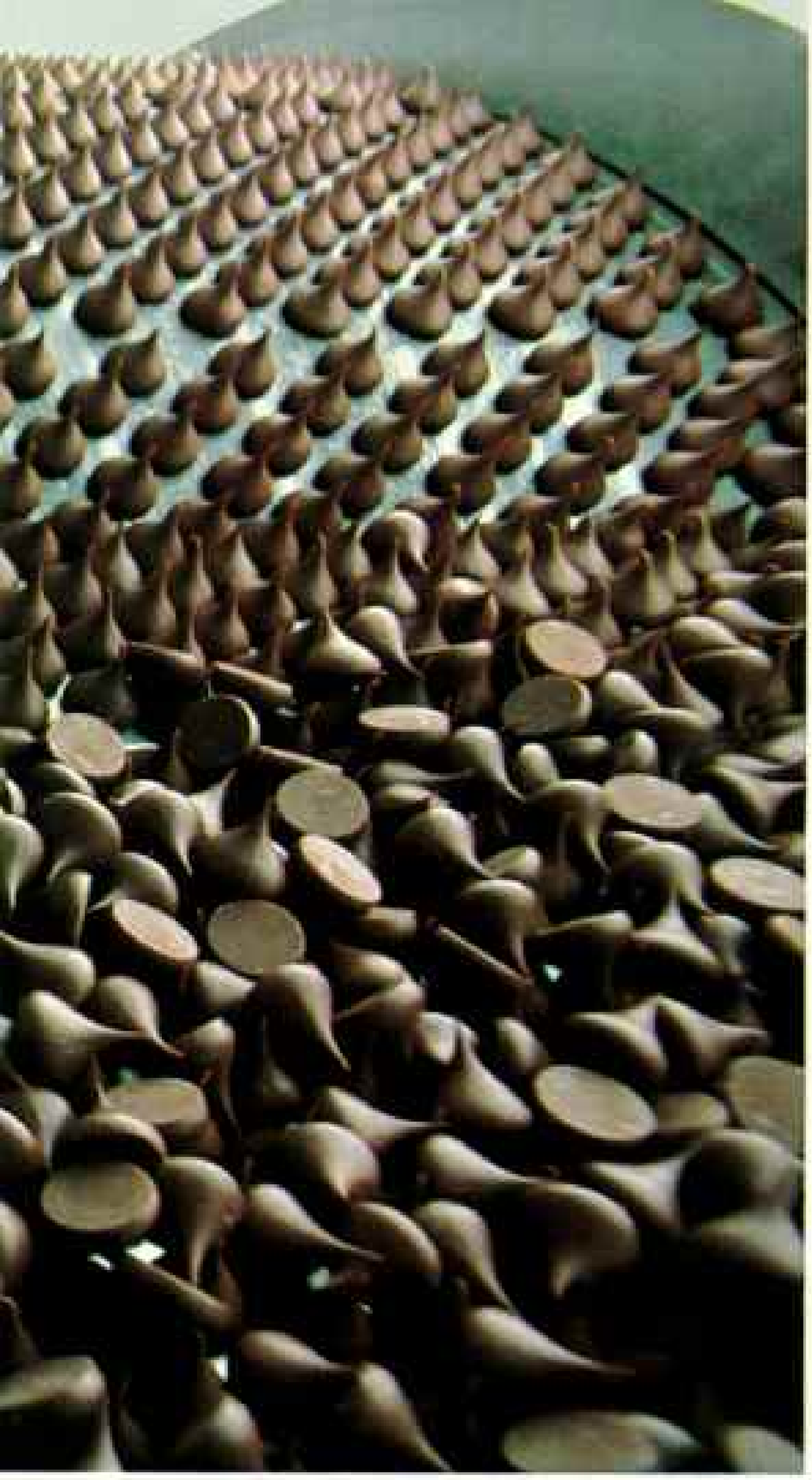
THOUGH THEOBROMA began in the New World, Europeans eat more pounds of chocolate per person than do Americans. European chocolates containing alcohol other than the small amounts in flavor extracts cannot be imported into the United States. At Godiva Chocolatier in Brussels, Belgium, I nibbled at candies filled with good Scotch and

Dutch treat for livestock, *cacao bean shells ground by Albert Gruys (**right**) in Ooievaar Mill in Zaandam (**above**) are added to pig and cattle feed. Nearly 15 percent of the world's cacao beans are shipped through Amsterdam, and the country keeps about half for domestic production.*

In 1828 a Dutch chemist simplified chocolate drinking when he invented powdered cocoa by separating out the fatty cocoa butter from the ground-up cacao beans. Chocolate wasn't eaten as candy until 1847, when J. S. Fry and Sons, an English firm now merged with Cadbury, combined the ground cacao beans with extra cocoa butter and sugar. Cocoa butter now also finds use in cosmetics, soap, and suntan lotion.

BOTH BY JAMES L. STANFIELD





A love affair *with milk chocolate dates to 1875 when Swiss candymaker Daniel Peter, collaborating with chemist Henri Nestlé, blended chocolate with condensed milk. In the U. S., Milton Hershey later devised his own process using fresh whole milk. The Henry Ford of chocolate makers, Hershey made chocolate affordable through mass production. In 1903 he broke ground for the Hershey Chocolate Company in a Pennsylvania town soon renamed Hershey. There milk chocolate is conched, or stirred* ***(left)****, for 72 hours—the time given fine European chocolates. One end product, some 25 million Hershey's Kisses are made each day. With white-glove treatment, misshapen Kisses return to the melting pot* ***(above)****.*

Following her mother's recipe, Sarah King ***(top right)*** *now passes the Amish Christmas tradition of milk-chocolate-covered pretzels to daughter Marian.*

A Godiva decorator adds dark chocolate accents to candy whose feather design ***(below)*** *was inspired by a hat worn by Scarlett O'Hara in* Gone with the Wind.

ALL BY JAMES L. STANFIELD

munched on cherries that had marinated for a month in fine brandy.

It is class all the way at Godiva. In one room resembling a tailor shop, women were cutting bolts of fine fabric with electric scissors; Godiva makes its own boxes and covers them with satin or velvet.

Godiva's windows display understated elegance: silken, flower-bedecked boxes surrounded by fine crystal and porcelain figurines. Godiva's president at that time, Peter Gaffinel, explained: "It is no simple matter to open a new shop in a European town; people there already have their favorite *confiseries*. We must lure them in with better chocolates, top-quality displays, and very personalized service."

When I mentioned the fact that his firm is now owned by the Campbell Soup Company, he nodded acknowledgment but stressed that it has continued supporting local management's traditional methods—such as making 30 percent of the chocolates entirely by hand.

The soup company also owns the Godiva affiliate in the U. S., but merchandising methods differ. For a time Americans could have a box of Godiva chocolates delivered by a woman clad in a flesh-colored body stocking, riding a white horse and surrounded by minstrels (delivery charge: close to $3,000).

"We Europeans are more conservative," Mr. Gaffinel said gently.

Godiva airfreights chocolates from Belgium to hot countries, such as Zaire, in insulated boxes to preserve them. And to Japan too—where they sell for almost $40 a pound.

"Let them eat cake," Marie Antoinette, according to legend, once suggested for starving peasants. Fair enough; this peasant headed for Vienna, Austria, to do just that.

It was the famous Sacher torte, first concocted in 1832 by Franz Sacher, a 16-year-old apprentice chef in the court of Prince Clemens von Metternich. It has been famous ever since; famous enough, in fact, to generate almost a decade of litigation over who had the right to call theirs the *original* Sacher torte. From the little bakery notched into the side of the Hotel Sacher, I bore my prize—and it bore a chocolate seal on its top, proclaiming that originality.

I can tell you this about the torte: Much of its unique flavor comes from apricot jam spread between layers and just under the dark chocolate icing. The rest of the recipe remains a secret, securely locked in the safe of the hotel's owner.

OFF TO SWITZERLAND, then. Was there ever a day when that nation was not famed for its fine chocolate? Yes: less than two centuries ago. Consider the German literary giant Johann Wolfgang von Goethe, who journeyed to Switzerland in 1797. He was so suspicious of the Swiss that he brought his own supply of German chocolate and a pot to warm it in.

But today Switzerland *means* chocolate to much of the world, and several of its great chocolate factories stand, like scenes on their own candy wrappers, along the shores of sparkling Swiss lakes.

By law Swiss chocolate makers must use Switzerland's raw materials, some price-controlled and expensive; outsiders are not bound by such restrictions. A Swiss candy executive told me of an invasion from Mars.

"In the 1960s," he said, "the Mars company came into our market with less expensive candy bars made outside Switzerland and backed by a heavy advertising campaign. Before we realized it, they had captured a sizable share of the children's market. Since their prices were lower, it was a battle we could fight only with very small spears. But prices have been adjusted now."

Even so, the sales record for Swiss chocolate is bittersweet: "Consumption is still on the rise in France, Germany, and the United States," said Dr. Hans Rudolf Reeb, president of Lindt & Sprüngli, "but leveling off in Switzerland, so the Swiss have turned to new markets, such as Saudi Arabia, where chocolate is growing rapidly more popular."

Lindt & Sprüngli perches beside the Lake of Zürich. Inside I saw the original conche, invented by Rodolphe Lindt in the late 1800s. It is used even today to stir up batches of chocolate against which the modern product is compared.

The company's board chairman, Dr. Rudolph Sprüngli, is a chocolate historian. He has his own "museum"—a collection of almost 100 antique chocolate pots displayed in his home. "For nearly a century the Spanish

kept chocolate making to themselves," Dr. Sprüngli said. "But in the early 1600s the secret began to spread throughout western Europe. Like the Aztecs, many Europeans considered it an aphrodisiac. Others believed that chocolate calmed fevers, cured chronic dyspepsia, and prolonged life. But not everyone agreed. A British doctor believed it to be a poison. Why? Because it tasted much too good to be medicine!"

IN TODAY'S COMPETITIVE candy world, chocolate recipes are closely guarded secrets. The world press carried stories in 1980 of chocolate espionage in Switzerland—an employee of a Swiss candy producer managed to photocopy some recipes and tried to sell them to various embassies.

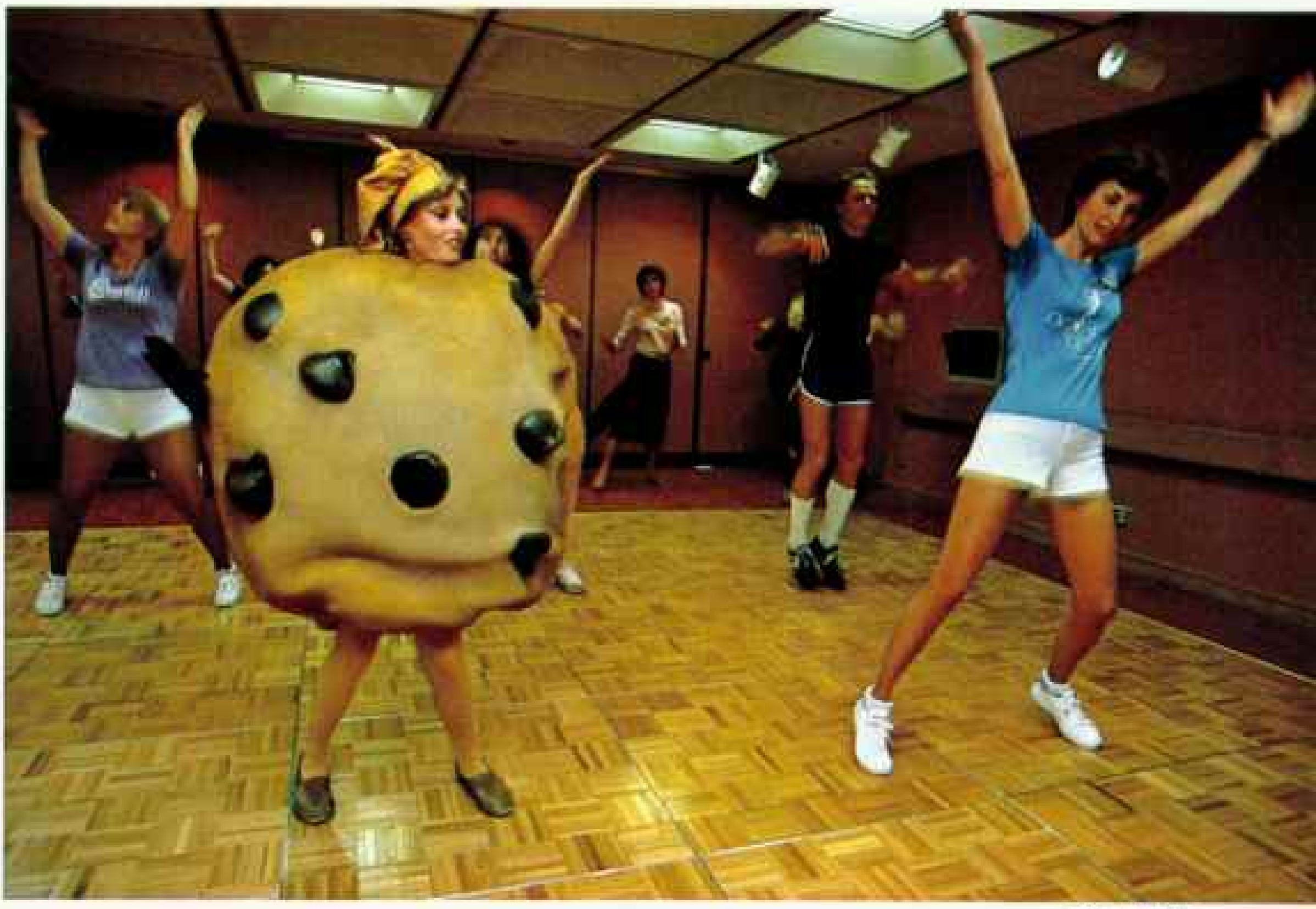
The company is Suchard-Tobler, on the shores of the Lake of Neuchâtel. Mr. Henry E. Parel, then the general director, chuckled when I asked for the details.

"A young apprentice had money problems; I believe he wanted to buy an automobile. So he offered the recipes to the Russians, Chinese, Saudi Arabians, and a few others. Maybe he had seen too many spy movies, because he kept his recipes hidden in a baggage locker in the train station. But he was caught.

"Really, newspapers made too much of it. You may steal a recipe, but you can't steal the vast amount of experience needed to make the candy itself."

Suchard declined to institute legal proceedings against him, so he received a 12-month suspended sentence for larceny and industrial espionage.

In a comfortable lakeside restaurant, Suchard's director of marketing enlightened me on chocolate preferences. "Even in



SUSIE BRANDT

Just desserts? *Chocolate buffs work off indulgences of an annual weekend festival near Chicago. "I love chocolate," says Nestlé Toll House Cookie fan Kim Chamberlain, "but I never realized how people crave it." Many of the 1,200 participants joined a Chocoholics Anonymous meeting, chanting, "I'm a chocoholic, and I'm proud."*

Vienna takes the cake, *to many minds, for its treasury of chocolate baked goods. Mouth-watering decisions face patrons at Demel's, whose clients include the Austrian*

JAMES L. STANFIELD

government and King Hussein of Jordan. Triangles distinguish its version of the famed Sacher torte, above, created in 1832 for Prince Clemens von Metternich.

Europe, tastes differ," he said. "Central Europeans go for the Swiss taste, made from a mixture of beans from many lands and carefully conched. The Spanish use mostly Brazilian beans, which have a different taste, and they prefer their chocolate in large slabs. The French use beans from their former colonies in West Africa; the Netherlands gets its beans from Asia. And you Americans prefer a sweeter-tasting chocolate blend, which is one reason why so many European companies have affiliated plants in North America."

Switzerland's largest chocolate company has a plant located in a small village that—appropriately—nestles in the foothills of the Alps. The village is Broc; the company, of course, is Nestlé.

Henri Nestlé didn't start out in the chocolate business; he made baby food. It was his work with condensed milk that helped Swiss chocolatier Daniel Peter invent a method of combining chocolate and milk in solid form—the first milk chocolate—in 1875. Today the Nestlé firm is a giant, with chocolate plants in 13 countries, and it has diversified into many other products.

But unlike Hershey, which casts its benevolent brown shadow over the Pennsylvania town that bears its name, this area is as noted for cheese as for chocolate. Nearby is the famous old village of Gruyères.

ONE MAJOR QUESTION nagged at me during my travels: Who *does* make the best chocolate on earth?

Is it Godiva, in Brussels? Lindt & Sprüngli, in Zürich? Or is it some perfectionist hidden away in a part of the world I have yet to visit? Perhaps it is the restaurant Taillevent, in Paris, which makes its own chocolate fresh daily: "Chocolates more than three days old are dead; they've lost all their flavor," says chef Claude Deligne.

Or perhaps it is the small London chain called Charbonnel et Walker, with their firm but quiet claim—"Probably the Best Chocolates in the World." As supporting evidence, they told me of a New York hostess who, discovering that her supply of dinner mints was running low, sent her chauffeur flying off to London to replenish the supply at Charbonnel et Walker.

Without a doubt their chocolates are very, very good. But the best? The ultimate answer, I think, lies in the taste buds of each chocolate lover. Still, that episode of the New York hostess points at another fact—chocolate, food of the gods, has an almost magical power to engender emotional extravagance. What else, except fine wine, can do that?

But chocolate can generate another emotion too: guilt. Doesn't it cause cavities? Make your face break out? Make you fat?

Chocolate associations on both sides of the Atlantic deny the first two points. Acne, they say, is not primarily linked to diet; nutritional tests tend to back that assertion. As far as tooth decay is concerned, more than one research group has found that cocoa powder contains a substance that may actually inhibit cavities.

Will chocolate make you fat? Most certainly it will, if you lead a sedentary life and gorge yourself on it. But it is an excellent high-energy food. Sir Edmund Hillary and his teammates devoured pounds of it struggling up Mount Everest. All American and Soviet spaceflights have carried it aboard. Armies have often used it for quick energy.

Well, chocolate associations are in the business of selling chocolate. Consider instead this humble evidence: In all my chocolate travels—and I was not resistant to the free samples that came my way—I gained no cavities, no pimples, and no poundage.

Moderation: That's the key. Nibble if you will, you chocoholics, but take to heart the advice that appeared in a *Spectator* article in England more than two centuries ago:

"I shall also advise my fair readers to be in a particular manner careful how they meddle with romances, Chocolates, novels, and the like inflamers. . . ." □

The sweet taste of Liberty *towers eight and a half feet tall in a 229-pound sculpture crowned by Barcelona confectioner José Balcells Pallarés. He and assistant Xavier Salvat created the semisweet chocolate novelty in three days of intense craftsmanship. Their secret for devouring chocolate and staying slim? "Working hard."* JAMES L. STANFIELD

Marking Time in Grenada

By CHARLES E. COBB, JR.

Photographs by DAVID ALAN HARVEY

NATIONAL GEOGRAPHIC PHOTOGRAPHER

Bullet-pocked wall at Fort George, site of the Bloody Wednesday massacre of October 19, 1983, here echoes with sounds of play. Prime Minister Maurice Bishop was among some 40 people gunned down by radicals within his own party, triggering an invasion led by the United States. Now, a year later, Grenadians await new elections for another chance at an elusive goal—stable leadership.

IN NOISY REVELRY at 6 a.m. on Jouvert, the first day of Grenada's mid-August Carnival, dancers swirled through the streets of St. George's to the tumult of steel bands and hundreds of voices raised in calypso song.

Everyone I knew in Grenada seemed to be dancing and singing all around me, faces and bodies streaked with grease. They were heaven bound—pantomime escapees from an antic hell. A young girl named Charmaine pulled me into the throng and smeared me with thick dark grease. "You black up real nice!" laughed another "devil," as we danced away together.

"Carnival is the one welding force here," as 75-year-old Willie Redhead had told me. "Everybody jump up and hug up!"

Next day Grenada would dress up in colorful costumes and celebrate Pretty Mas, the bright side of Carnival. But today was devoted to "jab-jab," a Creole word derived from the French *diable*, as Grenada mocked its devils and drove them out.

The previous October the devils had been real enough on this lustrous pearl of an island lying in the Caribbean 90 miles north of Trinidad. Remembering October 19, 1983, Bloody Wednesday in Grenada, eyewitness Roy Chasteau told me: "I thought I was dreaming. The people were like a moving rainbow, it was a beautiful sight. Suddenly it blazed up with gunfire. You could see the children dropping down."

Only days before, leftist Prime Minister Maurice Bishop had been stripped of his powers and placed under house arrest by ultraleftist rivals within his own New Jewel Movement, who accused him of not being Marxist enough. Crowds of Grenadians, many of them schoolchildren released from the classroom by Bishop loyalists, climbed the hills above the harbor at St. George's, the island's capital, and freed their charismatic leader. With Bishop in their midst, they marched on the army administrative headquarters at Fort George.

Trevor Thomas, one of those in the crowd at the fort, recalled that "Bishop say, 'We don't want no blood.' Then army people come down and don't ask no questions; just start shooting."

It is believed that as many as 40 persons perished in the gunfire of troops the victims

Giving the devil his due *with greased bodies and dead snakes, Carnival*

revelers play "jab-jab," patois for Satan. The Evil One must be appeased before one can gain entry to heaven, says the street-theater script—bizarre, but all in fun.

Carnival finale, *the day called Pretty Mas inspires costumes such as Cheryl Joseph's mobile Ferris wheel* (**facing page**) *in St. George's, the capital and focus of island life* (**left**).

St. George's waterfront (**below**), *where a cruise ship docks to turn loose 800 passengers, is known by the French name Carenage. During the 18th century France and Britain squabbled over the island, while both imported African slaves to work indigo and sugar plantations.*

Cruise visitors were scarce

during the upheavals of the past few years. Their return has been eagerly awaited, since tourism contributes a good share of the nation's income.

Carnival, originally held before Lent, was moved by former Prime Minister Eric Gairy to avoid a conflict with the celebration of independence from Britain, which came, under his leadership, on February 7, 1974, amid the turmoil of a general strike. Carnival is now held in August, the timing designed partly to boost a slow tourism month.

had known as relatives and neighbors. Bishop was executed by soldiers. So were three of his ministers and two trade union leaders. That night, islanders say, trucks rumbled through the countryside, loaded with corpses to be burned or buried in the Camp Calivigny area on the southern end of the island or to be dumped at sea.

FOR A TIME Grenada as its people had known it—effervescent, colorful, and cousinly—seemed to disappear. A 16-member Revolutionary Military Council controlled by Deputy Prime Minister Bernard Coard took power. It banned demonstrations, closed schools, and shuttered most businesses. The council imposed a 24-hour curfew and warned that violators would be shot on sight.

On October 21, representatives of seven of the eight island nations belonging to the Organization of Eastern Caribbean States —Grenada did not attend—met in Bridgetown, Barbados, and unanimously requested assistance from Barbados, Jamaica, and the United States in dealing with the "unprecedented threat to the peace and security of the region created by the vacuum of authority in Grenada." Four days later a small force of Caribbean soldiers, spearheaded by 1,900 U. S. troops, invaded Grenada in Operation Urgent Fury. As dawn broke, Rangers parachuted onto the island, Marines poured from helicopters, and rockets strafed suspected military sites.

Many civilians found themselves in the thick of the battle. Almost every Grenadian I talked to used the same word to describe the invasion: terrifying. "I think we're dead," Mrs. Alston Johnson told me.

Overmatched and outgunned, the Grenadian army quickly collapsed, shedding uniforms and—according to some reports—hiding weapons. Some 800 well-trained Cubans, brought to the island under Bishop to

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Charles E. Cobb, Jr., contributed "After Rhodesia, a Nation Named Zimbabwe" to the November 1981 NATIONAL GEOGRAPHIC.

construct a new airport, fiercely resisted the invaders. By October 28, however, the combined U. S.-Caribbean forces had secured the island. Coard and other leaders of the coup against Bishop were taken into custody to await trial in the Grenadian courts.

One objective of the U. S. soldiers was to protect the approximately 1,000 Americans on the island, including some 600 students at the St. George's University School of Medicine. Many students told their rescuers that they believed they were in peril from the revolutionaries. Yet Dr. Geoffrey Bourne, vice-chancellor of the school of medicine, who was in Grenada during the invasion, told me, "At the time they were rescued, the students were not in immediate danger." He added, however, that "the council would have done anything to survive, including using the students as bargaining chips."

Was the invasion welcomed? Yes. Many a Grenadian corrected me when I used the word invasion to describe the storming of the island. "Rescue mission" is the term they prefer. A waiter named Frank, whom I encountered masquerading as a devil at Carnival (pages 690-91), put it this way: "Nobody going to fight for them [the Revolutionary Military Council]. After you shoot your own people, who else you going to shoot?"

Grenada was shaken to its soul by Bloody Wednesday and its aftermath. Warfare and political turbulence had come like strangers into an island where the good-humored tolerance of a close-knit family was the rule.

Gazing at the bullet-chewed wall where Bishop took leave of life on Bloody Wednesday, I felt at a loss to understand how mass murder could have happened on an island where everyone seems to be family, friend, or neighbor. Grenadian assessments echoed my own puzzlement: "They just after some power." "Bish, he get in too deep and can't get out." "Dunno, I just hope better come."

History offers some clues. There has been violence aplenty in Grenada's past. *Kaori homan!*—to arms!—was the battle cry of the Carib Indians. *(Continued on page 701)*

Close call: *Holding fragments of the helicopter he flew—a UH-60 Black Hawk like the one overhead—Dan Kuchenberg (**right**) of the U. S. Army's 82nd Aviation Battalion returns to Petit Calivigny Point. On October 27, 1983, during Operation Urgent Fury, he was flying in Army Rangers to attack barracks housing Cubans. Upon landing, he was wounded in the leg by ground fire, then narrowly escaped when another helicopter crashed into his. Three men were killed and five wounded in the action.*

The crisis that led to the invasion stems from the 1970s, when charges of corruption and violent repression against Prime Minister Gairy sparked the opposition New Jewel Movement of Maurice Bishop. The Bishop forces overthrew Gairy in a 1979 coup. Intervention came after Bloody Wednesday showed the world how far amok the revolution had run.

What Castro started *with Cuban workers, at Bishop's invitation, the U. S. finishes: a new airport at Point Salines* ***(above)****. A 21-million-dollar grant created much-needed jobs for Grenadians, here completing the 9,000-foot runway* ***(left)****. Used at first only by military aircraft, such as a C-141 boarded by U. S. troops heading home after a tour of duty* ***(right)****, the facility was scheduled to begin limited commercial service in October. Grenadians hope for more tourists, yet the expected jumbo jets would severely tax present hotel accommodations.*

Through a political minefield *tread the walking wounded still willing to lead. Bishop's agriculture minister, George Louison (**right**) represents the remnants of the badly tarnished New Jewel Movement. In a poll taken shortly after the invasion, more than half supported barring from elections both the New Jewel and the Grenada United Labour Party of Sir Eric Gairy (**below right**). George Brizan (**below left**) and Herbert Blaize (**bottom**) aim for the middle ground by hoping to form, with a third party, a moderate coalition. Blaize, an old antagonist of Gairy, carries strength as a former premier.*

Judgment awaits *the alleged leaders of Bloody Wednesday—Bernard Coard, Hudson Austin, and 17 others on trial for murder at Richmond Hill prison* ***(below)****. There, Bishop's legal affairs minister, Kenrick Radix, at center, argues for permission to attend a hearing as members of the Caribbean Peacekeeping Force maintain strict security. The force, now numbering about 400, has drawn soldiers and police from Jamaica, Barbados, Antigua, Dominica, St. Vincent, St. Kitts, and St. Lucia.*

Although a nine-member advisory council serving as an interim government urged early elections, most Grenadians do not seem eager for another ordeal at the polls, and the voting has been delayed. Some candidates chafe at such reluctance. George Brizan asks, "If the pilot of your plane has a heart attack, do you try to land it yourself, or do you let the plane nose-dive into the ground?"

Early elections would have most benefited Sir Eric Gairy. Despite an avowed belief in UFOs and a suspected interest in witchcraft, as well as charges of having used political thugs known as the Mongoose Gang, Gairy seemed to regain strength rapidly after returning last January from exile in the United States.

"**The longest night of my life**" *came on the invasion's second day, according to Dr. Robert Jordan (***above,** *center), professor of anatomy at St. George's University School of Medicine. The safety of its some 600 U. S. students was first a rationale, then the focus of the invasion. Dr. Jordan awaited evacuation with students as flying steel raked their Grand Anse campus (***below***). Nearby, Cuban and Grenadian troops had set up an antiaircraft gun and had dug in on the beach. He heard a "terrific explosion" when two cottages used by Cubans were destroyed just across the street, foreground. Stranded after fighting interrupted the rescue, Dr. Jordan, his dog, and an aide crawled into a strong shelter—the cadaver storage room—until picked up the next day.*

early inhabitants of the island. In 1651, after trading most of their land to a French entrepreneur, they changed their minds and engaged in a losing battle with the new colonists. Rather than surrender, 40 Carib warriors leapt to their death from a precipice in what is now the northern town of Sauteurs.

Columbus named the island Concepción when he sailed by in 1498 on his third voyage to the New World. The island's hills reminded later Spaniards of Granada. It was La Grenade under the French, Grenada (pronounced Gre-NAY-da) under the British. The two nations handed it back and forth until 1783, when Britain gained permanent control. The island was prized for the sugar and imported slave labor that generated huge profits. In a bloody revolt against the British led by Julien Fédon in the 1790s, a quarter of the island's slave population died or disappeared.

GRENADA is a place of stunning beauty: tropical flowers, forested volcanic mountains, crystal freshwater pools, and over all, a deep, dark, green stillness. In the hills around St. George's, neat houses, many on stilts, overlook plots of vegetables and fruit above the Carenage, or inner harbor—actually the crater of a dead volcano. Narrow streets bustle with commerce and buzz with merry gossip.

All over this isle of spice the scent of nutmeg and clove and cinnamon hangs in the air. The cultivation of spices and cacao in post-slavery Grenada produced a kind of spontaneous land reform, dividing the island into small, privately owned parcels. Seventy percent of Grenadian families own land—and the soil is fertile enough to make a job optional for many. Alphonso Batson, farmer and sometime taxi driver, expresses the carefree spirit of the island: "I only drive when it's convenient."

On five fertile acres, Alphonso grows tomatoes, sweet potatoes, melons. He picks all sorts of tropical fruit from trees he planted himself, following instructions he found in books his brother sent from England, and makes a tasty wine from oranges. What he and his family cannot eat, he sells for ready money in the market at St. George's.

It's not an easy life Alphonso leads, but neither is it a life of want. There is poverty here, but not the grinding, oppressive desperation that haunts some other Caribbean islands. Eighty-five percent of Grenada's population can read and write. Per capita gross national product is $930, in the mid-range for the Caribbean.

For a decade two hostile forces have dominated politics in Grenada: the New Jewel Movement and the Grenada United Labour Party of the flamboyant father of Grenadian independence, Eric Gairy. In 1950 Gairy organized a general strike that established him as a political leader to be reckoned with. By 1951 he was the undisputed leader of Grenada's working class, dominating island politics. When independence came in 1974, he became Grenada's first prime minister and, in 1977, Sir Eric Gairy. He later changed the date of Grenada's Carnival to avoid any conflict with the island's independence day.

Charges of corruption surrounded his regime. The Mongoose Gang, a squad of ruffians acting as special police, bullied Gairy's critics and political opponents. Some Grenadians were jailed for political reasons.

Gairy called on the United Nations to investigate flying saucers. He claimed mystical powers (it is said that he once "walked on water" before an assembled throng at the Carenage) and was widely believed to practice *obeah*—witchcraft.

Since 1973 Bishop—a London-trained lawyer—and his followers in the New Jewel Movement had been mounting street protests and other political challenges in Grenada. On March 13, 1979, while Gairy was in New York, they overthrew his government. "The revo"—the revolution, the first to overthrow a government in the English-speaking Caribbean—was avowedly Marxist-Leninist in its beliefs. Bishop and his ideas were warmly embraced by Cuba and other Marxist countries and the island's militant youth. Most Grenadians, while not attracted to the revolution's ideology, probably welcomed Gairy's removal.

Eric Gairy is back in Grenada and still commands loyalty and unmeasured influence. As one woman told me, "Eric Gairy gave us the vote, and he'll have my vote until the day I die."

"I, not Maurice Bishop, liberated Grenada," Gairy, wily and wiry, insisted when we met in his home in St. George's. There were

Tide of children *freed from school laps into the Caribbean at Gouyave during Fishermen's Birthday. On June 29 island towns honor all those who tend the nets. Most festive is Gouyave, a spice-processing and fishing center on the west coast.*

All told, about a thousand fishermen struggle for a living, with ice unavailable and the catch averaging about $1 U. S. a pound. To help keep their heads above water, Grenadian government aid includes low-interest loans.

a number of things I asked him to explain; he responded in his own canny way.

The violence of the Mongoose Gang? "Some delinquent boys got a job killing mongooses. They continued to misbehave. My opponents said they were secret police."

Will he seek the office of prime minister in the elections projected for this fall? "No." Then he is out of politics? "I wouldn't want to speak about that. Talk to me afterward."

Meanwhile, erstwhile supporters of Bishop have formed the Maurice Bishop Patriotic Movement and plan to run candidates in the coming elections. At the time of Bishop's execution his New Jewel Movement, as a matter of choice and policy, had fewer than 100 members. In 1974, five years before it seized power, it had decided to become a "vanguard party," a revolutionary elite, abandoning its grass-roots membership in the name of ideological purity and expelling rank-and-file members. Obedience to authority instead of rational understanding was demanded of Grenadians.

While in power, Bishop's party launched a number of innovative programs: agricultural cooperatives, credit unions, medical services, adult-education classes. But other actions of the Bishop regime alienated the island's people. A new band of toughs disciplined opponents; preventive detention of dissidents was reinstated. The elections that had been promised in the first days of the revolution were never held.

Whoever helps, shares: *A modest pan of herring and scad (**facing page**) recalls a tradition that even a stranger who stops to lend a hand with the nets will earn such a reward.*

*Most watermen also till small plantings in the fertile soil that makes agriculture Grenada's largest revenue earner. Nutmegs, a major export along with cacao and bananas and at the core of the nation's nickname, the "isle of spice," are processed at a Grenville station (**above**). The red fibers coating the seeds are sold as mace. Together these two spices earned 4.5 million U. S. dollars last year, fighting a depressed world market.*

IN THE OFFICES of the Maurice Bishop and October 19th, 1983, Martyrs Foundation, overlooking St. George's busy Market Square, I talked with George Louison, a former minister in Bishop's government who appeared to be captured still by the very formulas that had led to Bishop's downfall and death.

"If we had gone to the public with our internal differences, it would have damaged our image, our credibility," Louison said. Then he paused: "Of course we were wrong on that. . . . [But] elections don't guarantee open government. You get out there and engage in bribery and slander. Elections breed political tribalism and violence."

Yet Louison still felt the wounds of a lost cause and a lost friend. "Our personal relationship was so close," he said of Bishop and

his followers. "All those years down the drain—it just blew up in our faces."

I pondered Grenada's past politics at the national museum in St. George's. There, in a case in one corner of the main room, lie the ceremonial robes of Eric Gairy. In another exhibit are the bloody clothes worn by Bishop when he was beaten during a 1973 protest demonstration, and the stone that is said to have struck his head during the demonstration. Where, I wondered, did Grenadians think politics would take them next?

ACROSS THE ROAD from my hotel, U. S. Army helicopters with their dark paint rested among wandering cows grazing on grass and hibiscus leaves. A short walk down the powdery seashore took me to the Grenada Beach Hotel, headquarters of the U. S. military, 300 strong. At the entrance, razor-edge barbed-wire coiled around sandbags. Grenadians, laughing and playing all up and down the beach, ignored these signs of military security.

Security is the main mission of the U. S. military contingent. Instructors from Britain and Barbados are training a new Grenadian police force, and sometimes American soldiers ride along on routine patrols.

"Actually, it gets kind of boring, driving around," Pfc. Lawrence Connolly of Putnam Valley, New York, told me. Nevertheless, he checked his pistol. Rolling along Grenadian roads in a jeep with Connolly and his partner, a policeman from the island of St. Kitts, I felt no whisper of danger. Children and many adults waved and smiled. One woman asked for a ride. Youths and young adults—the age group that found Maurice Bishop charismatic—can be another matter. "Sometimes I've looked back after somebody smiled," Connolly said, "and seen an angry gesture."

For now anyway, most Grenadians seem to view the intervention as a welcome respite from the island's tumultuous politics.

Workboats at play *race past an islet in a regatta at Carriacou, a 13-square-mile sister island. Working craft such as these sloops show off the skill of the renowned Carriacouan shipwrights.*

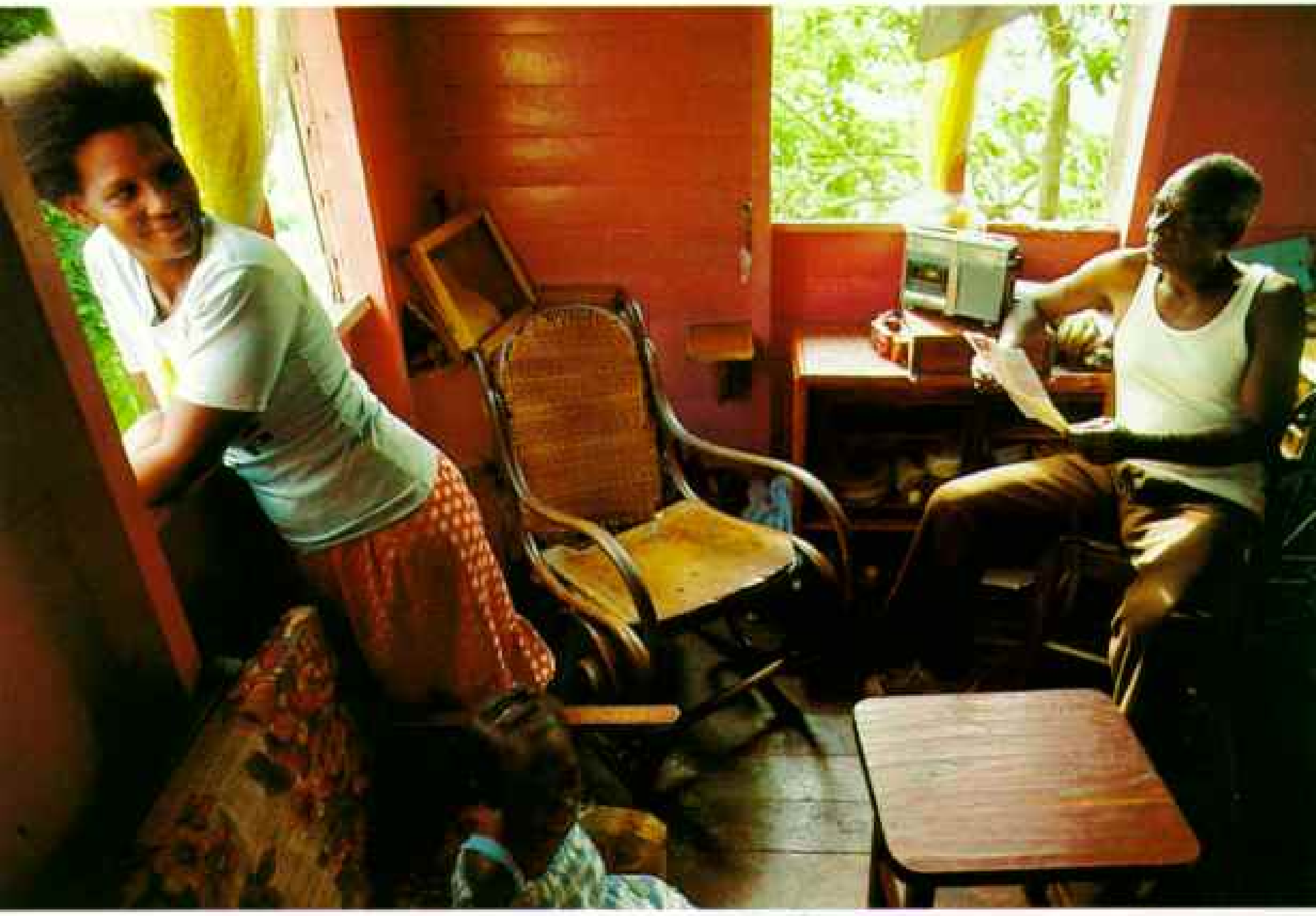
But some have expressed uneasiness. Journalist Alister Hughes, who was badly beaten up during Eric Gairy's regime and jailed as a critic of the leftists after Bishop's overthrow, wrote soon afterward: "We are quick to welcome those who come here, even quicker to suspect those who stay too long. . . . We are worried that the 'rescue mission' may turn into an occupying force."

But Leslie Pierre, editor of the weekly *Grenadian Voice*, who was imprisoned by the Bishop government in 1981 for starting a newspaper without government authorization, expresses another view on the issue. How long should the military stay? "The minimum would be another year," firmly replied Pierre. "The militant remnant of the New Jewel Movement will look for any opportunity to take over in Grenada again."

Caribbean and U. S. officials say that Grenada must have an adequate police force before the foreign troops can depart. So far, some 450 constables have been trained.

Good roads, communications, power, all leading to steady development, are clearly needed, and development specialists seem to be everywhere on the island. The U. S. government has authorized 57 million dollars in aid for the two-year period ending next September. That's $300 a year for each person, among the highest rates of U. S. aid in the world, but Grenadians see little in the way of visible improvement.

"We're under a lot of pressure to generate jobs immediately," a consultant for the U. S. Agency for International Develop-



With their own bit of land *to add peas and corn to the table, Adolphus Jacobs, Marlene Hosten, and daughter Danielle enjoy a view of the sea from Cemetery Hill. More than two-thirds of Grenada's families are landowners, most of plots two acres or smaller. Such intense subdivision of property began after the abolition of slavery in the 1830s, when sugar plantations were broken up. Perhaps partly as a result, Grenadians have traditionally tended to be independent and outspoken when addressing political causes—although land reform has never been among them.*

ment told me. "I guess if we wanted to do so, we could fling money from those helicopters. But would the island develop?"

TOURISM, agriculture, and light industry are the main objectives of American assistance. Though work is available on the farms, about one-third of Grenada's youth are unemployed. The average farmer is shorthanded but can't get young workers, Aubrey Arnold said, selecting a few mangoes for me from a pile of the yellow fruit. "Look around. Don't see any youths working this land."

As a jobless youth put it to me when I asked him about laboring on the land: "Too hot, too hard, too little money." The phenomenon of youthful disdain for farming and other manual labor and restless fascination with the bright lights of the cities is endemic in the Caribbean.

For the unemployed, the explanation of idleness can be more complicated. Plumber William Craig lost his job under the Bishop regime for refusing to join the militia and has since been idle. He hopes there may be work for him "when they start building again." But in his heart, he'd prefer to leave the island: "It's small here. London or New York is where I'd like to try."

Withal, there is no miracle fix for Grenada, although economic magic is what many Grenadians expected after the intervention. Many hopes are pinned on the new international airport, scheduled to open this fall.

In 1980 the Bishop government began building a new airport at Point Salines, with most of the funds coming from Cuba. The Bishop government denied that the airport had any military purpose. But President Reagan, displaying aerial photographs of the construction site during a televised address in 1983, said that it was part of the "Soviet-Cuban militarization of Grenada." Now Washington's aid package includes 21 million dollars for the airport's completion; the total funding from all sources is estimated at more than 70 million dollars.

Outside the office of John Lamb, the U. S. government's project manager at the airport, bulldozers and other heavy equipment roared. Engineers and foremen in hard hats rushed in and out with blueprints and problems. Lamb, ignoring the racket and solving the problems, expressed optimism that big jets would be landing at Point Salines on schedule. "We're going to bust our tails to make sure the runways, control tower, and navigational aids will be finished by the deadline," Lamb told me. Other amenities, such as a huge modernistic terminal, may not be finished until mid-1985.

It is widely believed in Grenada that if the new airport opens, visitors will reach 38,000 a year by 1985, generating about 1,100 new jobs. But Grenada now has fewer than 650 hotel rooms, not enough to accommodate the passengers on even three of the jumbo jets for which the airport's 9,000-foot runway is designed. According to André Cherman, president of the Grenada Hotel Association, only 25 percent of the island's

For all the world to see, *T-shirt sentiment is widespread and in large part spontaneous. How long will it last? Many Grenadians expect a U. S. pipeline of aid and expertise to solve all their problems. The question is, how long should* that *last?*

hotel rooms were occupied during the Bishop years.

An unwritten Grenadian law forbids the construction of new hotels taller than a palm tree. Two new hotels are planned on Grand Anse beach, and the interim government speaks of the need for 500 new rooms by the end of 1985. So far nothing is being built. Not surprisingly, Grenadian hotelkeepers, with their small inns, have doubts about developing a mass market. The island's hotels are 90 percent home-owned, and André Cherman and his fellow hoteliers believe the figure should not fall below 60 or 70 percent.

Grenada's fundamental problem remains: It lacks an elected government. International civil servant Nicholas Brathwaite is chairman of a nine-member interim administration appointed by Sir Paul Scoon, Grenada's governor-general—until the intervention a largely ceremonial office. Brathwaite told me that he carefully avoids "politically controversial policy." Increasing tourism is noncontroversial, for example, but legalizing gambling casinos would trigger political controversy: "That's for an elected government to deal with."

I remarked that many Grenadians seemed wary of politics. "My hope," Brathwaite replied, "is that when the process of elections gets going, there will be a gradual change in the mood of the people."

To understand that mood better, I visited the Parliamentary Elections Office and inquired about voter registration. "When people heard we were thinking of elections they said, 'Oh, not *that* again!' " Roy Chasteau, the supervisor of elections, told me.

Registrars go from door to door signing people up. Among Grenada's disillusioned electorate, that can sometimes produce disconcerting responses. "A chap went to enumerate a man, and when it got to the point where he had to sign, the man said, 'I know all about this' and tore up the card," Chasteau told me. Near Grenville one registrar had a knife thrown at him. But some responses reveal that islanders haven't lost their sense of humor. Entered under description on one form was "bandy legs." Under occupation on another was "sick in bed."

Herbert Blaize, head of the Grenada National Party, and Francis Alexis, leader of the Grenada Democratic Movement, don't think that any single party can form an effective government—in their view, only an alliance of several parties can win the support of skeptical Grenadians. "Politics can divide and it can unite," Alexis said. "Like religion, it's not all rationality."

I asked George Brizan, leader of the National Democratic Party, how his campaign was going. His reply revealed an interesting fact about post-Bishop politics in Grenada. "Because we're making inroads among young people and ex-Jewels," he said, "other parties are saying that I'm a Communist."

Rival political leaders denied making that accusation but agreed that most islanders, equating youth with militancy, are wary of young politicians. Another one of those younger politicians, Winston Whyte, wryly remarked: "If you're not old and you have a beard, around here you're a radical."

The political advantages or disadvantages of age remain to be proved. About 70,000 Grenadians are under 40. Some 25,000 are of voting age, outnumbering the above-40 age group by five to four.

IN THE END Grenada is best understood in terms of its families and friendships and the relationships bred by centuries of life on an island where tolerance is synonymous with survival. In ways that might seem puzzling and contradictory elsewhere, life goes on here though heroes may be toppled and ideals may be shattered.

Winston Whyte is one of the "prison fraternity," those on the island who were held in prison under Bishop without charge or trial. One day when I was with him, he stopped to chat with a man beside the road. Getting back in the car, he told me that the man with whom he had just been talking and laughing had been his warder: "One of the worst of our prison guards."

I expressed my astonishment at his apparently friendly conversation. Whyte shrugged. "Why not?" he asked. "We're still Grenadians."

This may well reflect the most telling truth about this tiny but surprisingly complex island—the people are rooted in one another for better or for worse.

An American GI said it best: "The people here are as firm as this coconut tree." □

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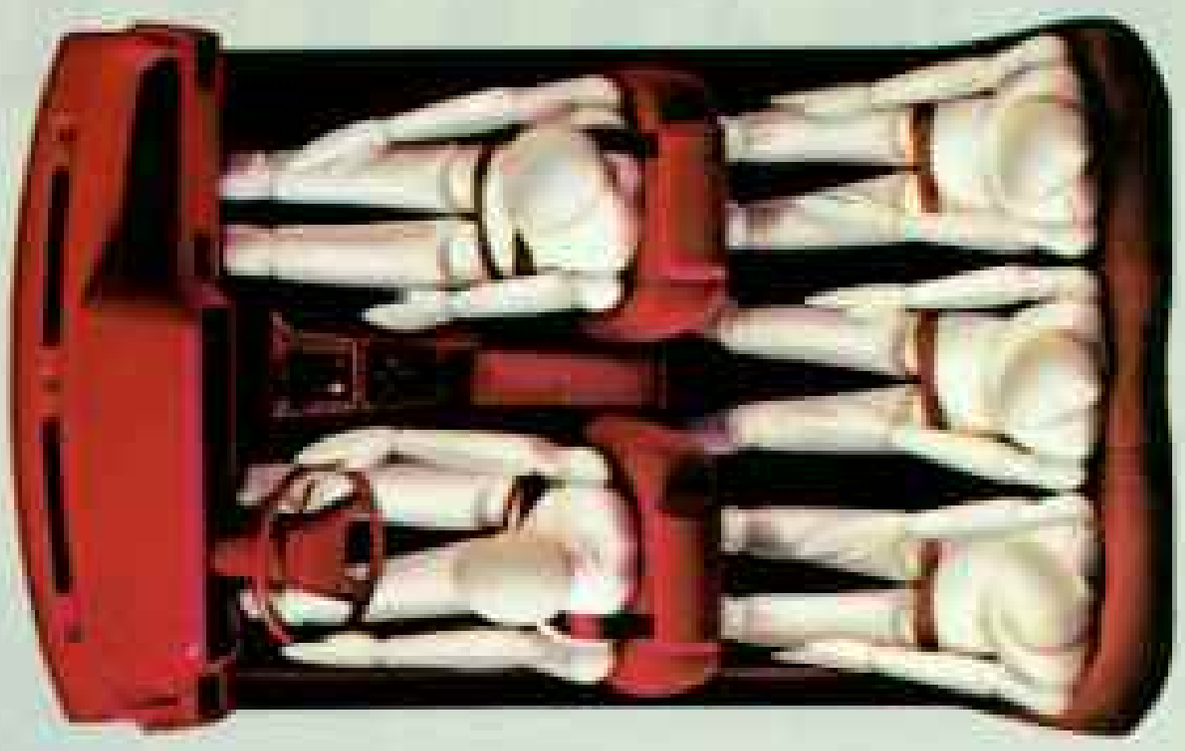

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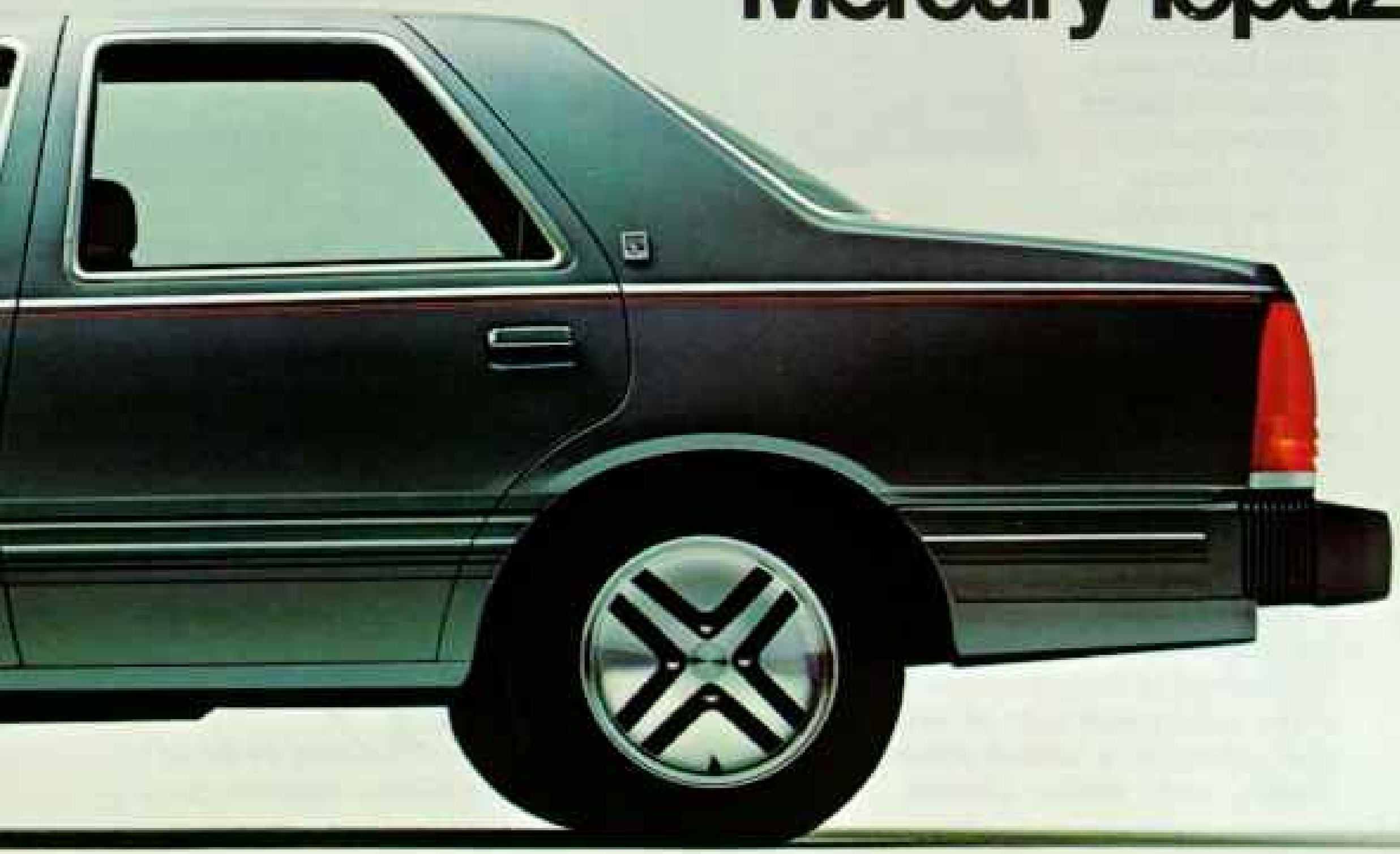
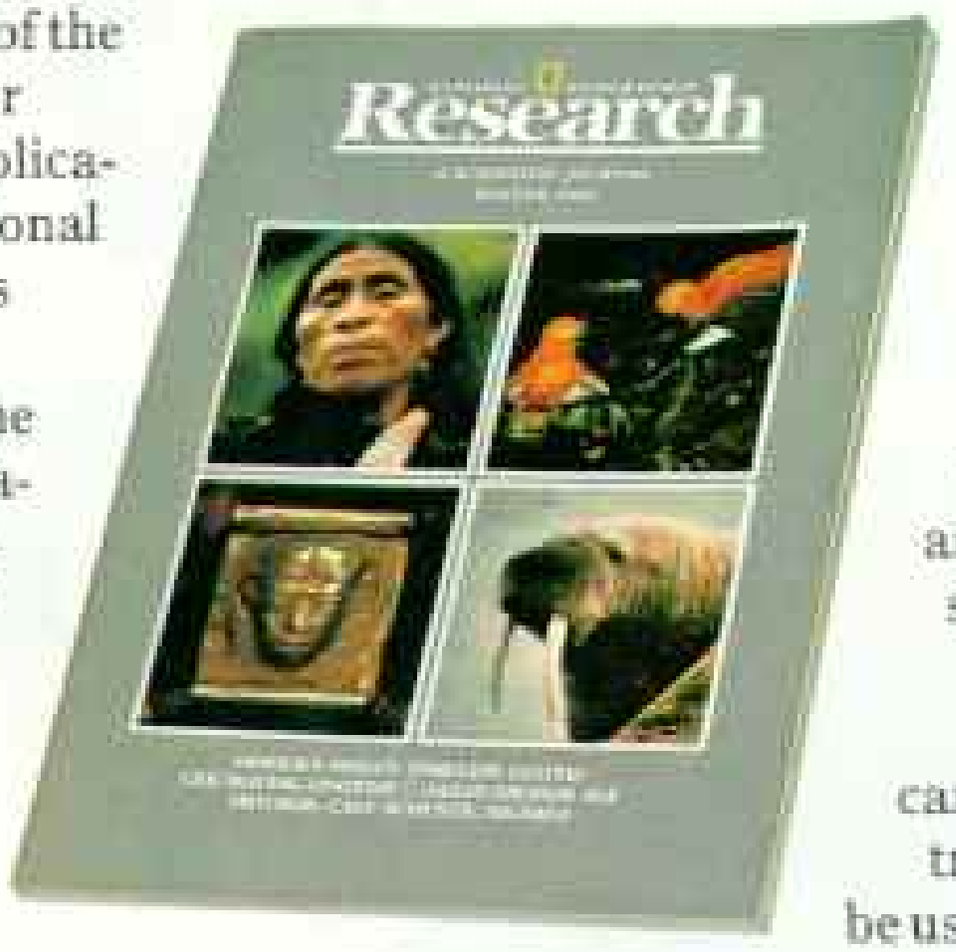
Mercury Topaz



The audience will be small, but the impact will be large

OUR OLDEST IDEA for a periodical is being reborn. The original was NATIONAL GEOGRAPHIC, in its early years devoted to scholarly articles that spanned geography, the "queen of sciences." The Society then as now had a dual mission, "the increase and diffusion of geographic knowledge." Early in this century the magazine was made a popular journal, diffusing such knowledge to a membership fast growing beyond professional geographers.

Through the years the Society continued to increase geographic knowledge by supporting exploration and scientific inquiry. Some of the results appeared in our magazine or other publications and in the occasional scholarly monographs we published.



In recent decades the Society's support of basic research has greatly increased. We now make grants to some 200 scientists annually under a budget approaching four million dollars. On the one hand, much of this significant work is too specialized to be of general interest to most Society members. On the other, we have felt the need to improve communication of scientific results to scholars, scientists, researchers, and students.

In January 1985 we will begin quarterly publication of *National Geographic Research: A Scientific Journal*, under the editorship of Dr. Harm J. de Blij, a distinguished geographer and author. The central purpose of the new journal will be to convey the findings of Society-sponsored scientists to the wider community of their colleagues and perhaps to a limited number of other readers with serious scientific interests.

The world of scholarly periodicals is large in numbers—literally uncounted. Such journals as *Science* in the United States and *Nature* in the United Kingdom treat a broad scope of science. Thousands of others range from the general to the ultraspecialized. *National Geographic Research* will encompass topics from anthropology to zoology and suggest the rich connections among the many disciplines whose sum is geography.

The journal will be "refereed," meaning that an independent editorial advisory board of eminent scientists will assist the editor in determining which submissions are appropriate for publication as full articles. Shorter reports will be published separately in a section where researchers can present new finds. A "Noted Elsewhere" section will alert readers to scientific articles resulting from Society-sponsored research published in other journals.

Our extensive experience in cartography, typography, illustration, and color printing will be used to convey scientific results fully and precisely.

Articles will be technical, professional, and well documented. For example, "Late Permian and Triassic Tetrapods of Southern Brazil," scheduled for the first issue, will include 26 references to other works in the professional literature. Such articles are certainly not designed to be armchair reading for idle hours. The audience for *National Geographic Research* will be small, but the impact will be large. At least that is our hope for this new venture in support of our abiding mission.

Gilbert M. Grosvenor

PRESIDENT, NATIONAL GEOGRAPHIC SOCIETY

Photographed by Rajesh Bedi. ***Great Indian Bustard:*** *Genus: Ooriotis Species: nigriceps* ***Adult size:*** *Average length 122cm, male; 92cm, female; average 1m tall* ***Adult weight:*** *Average 11.25kg, male; 5.12kg, female* ***Habitat:*** *Grasslands interspersed with scrub or cultivated land in northwestern India, may occur sporadically throughout India and Pakistan* ***Surviving number:*** *Estimated at less than 1,000*

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

The great Indian bustard presents an impressive sight as it moves through the savannas, its long white neck glistening in the sun. Early in the morning and late in the afternoon, when temperatures are cooler, the bustard searches through the grass for locusts and other insects to feed on. Due to hunting and habitat loss, this large land bird today faces an uncertain future.

Nothing could bring the great Indian bustard back should it vanish completely. And while photography can record it for posterity, more importantly photography can help save it and the rest of wildlife.

An invaluable research tool, photography can assist in efforts to save the great Indian bustard. Continued protection and preservation of its habitat are required to ensure the bustard's survival. Photography can also help foster a greater awareness and understanding of this striking bird.

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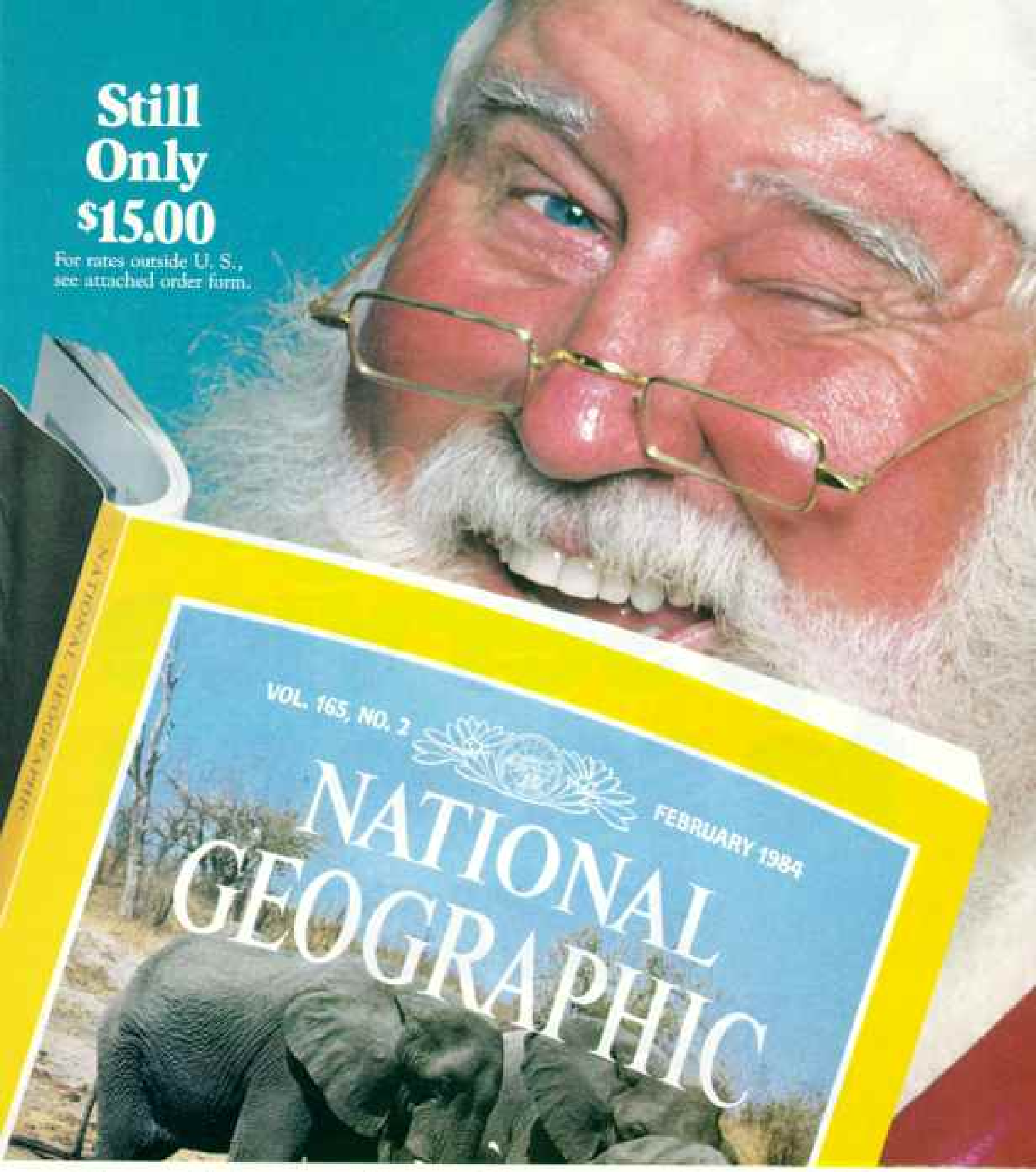

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Members Forum

Whales

I enjoyed "The Whales Called 'Killer' " (August 1984). Mr. A. Bolz, manager of the Sealand aquarium in Victoria, British Columbia, has much experience with these fascinating animals, both in that organization and with the University of Victoria. While confirming that this is no killer, he adds that neither is it a true whale, but rather the largest of the dolphin family.

Larry Huddart
Vancouver, British Columbia

Correct, which is why we said they are known to feed on "other dolphins."

I loved your article on "killer" whales. Having been born and raised just south of Nanaimo, British Columbia, as children we often encountered whale pods while rowing off the coast. It is quite thrilling to have one of these huge creatures dive beneath your boat and playfully break the surface, just short of tipping you over! But despite their reputation, we never felt fearful.

Jeanne Labelle
Regina, Saskatchewan

Underground Railroad

Charles Blockson's superb treatise (July 1984) turned my mind around. Instead of thinking schools should drop the poorly attended black-studies programs, I now believe students at all school levels should be given courses in black studies to help them understand the many black contributions to our country and the plight of blacks in our history.

W. J. Sinnott
Groveland, California

The Blockson/Psihoyos article on the Underground Railroad reminded me of how proud Michigan is to have taken part in helping the slaves escape from slavery. In a small cemetery near the town of Vandalia rest slaves who fled the South. Their descendants are still farming in that area. At the back of the cemetery my aunt and uncle are buried. My uncle was part of the group of Quakers that actively resisted the "Jacksonian Raiders," who came to capture and return the runaway slaves. Not too long before he died, he wrote to my father, "There is no black problem, only a white one."

Harriet A. Noble
St. Clair Shores, Michigan

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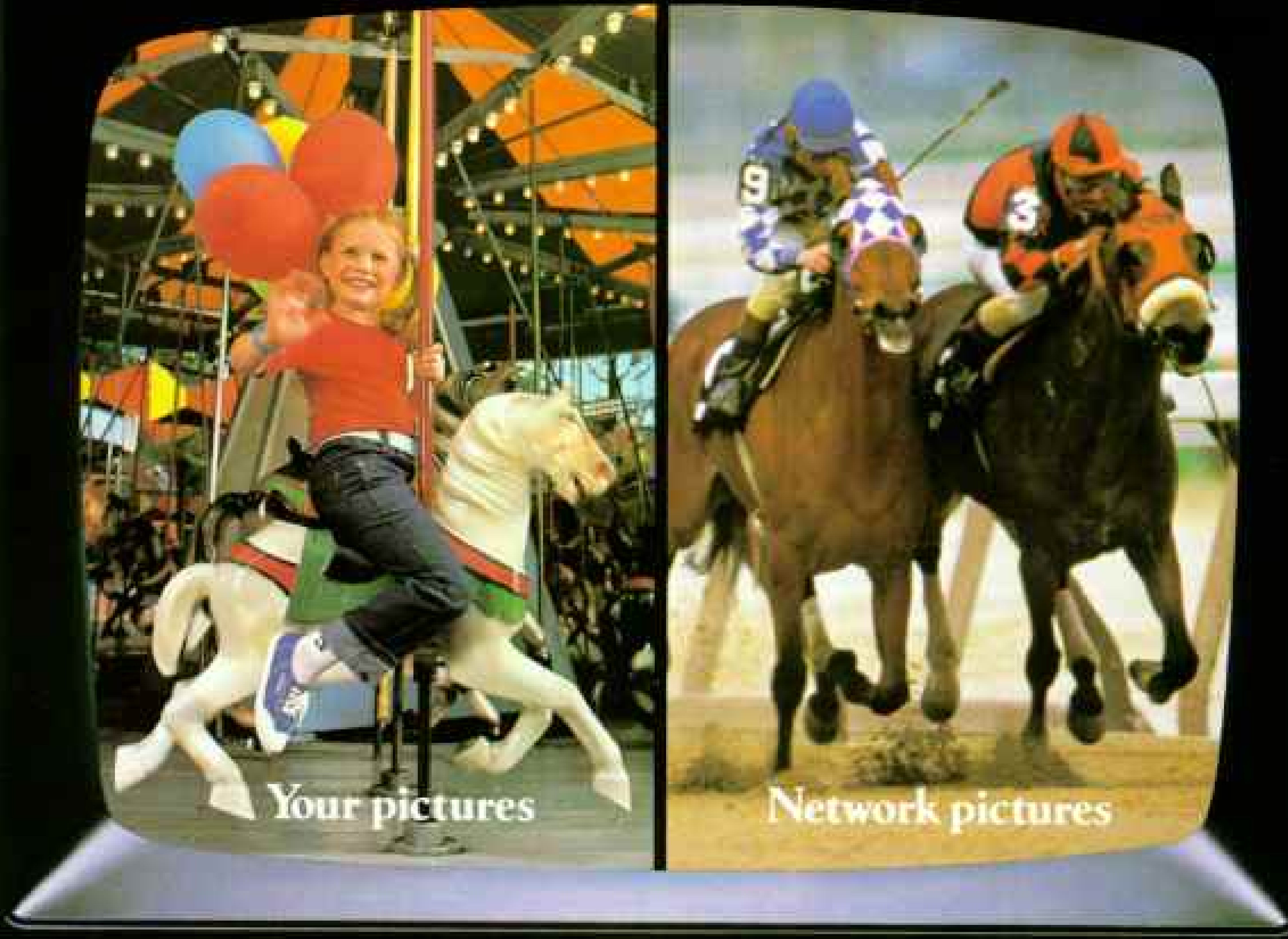

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For pictures that look broadcast quality.

The slave distribution map of 1860 fosters a popular myth that slavery was limited to the "slave states." Maps of 1820 and 1840 show that Pennsylvania, New York, New Jersey, Ohio, Indiana, Illinois, Connecticut, Rhode Island, and for a time New Hampshire all had small but significant slave populations. In northern New Jersey a population of slaves persisted in 1860.

Robert Boklund
La Porte, Indiana

The purpose of our 1860 map was to depict the major routes of the Underground Railroad. In the North, pockets of slavery did exist prior to 1860—mainly blacks born before the legal abolition of slavery by individual states—and the rights of free blacks were sometimes severely restricted.

Thank you for the excellent article on the Underground Railroad and the flight to freedom of hundreds of people. It also helps us to understand what is happening today—in 1984—with a new underground railroad designed to help people from Central America avoid murder and brutality at the hands of their own government. Again hundreds of people, and churches, are very much involved in preserving freedom, justice, and dignity for this group of people, hiding them, transporting them, giving them sanctuary—again in the face of "going against current laws of the land" because they must obey a "higher law" that proclaims love and justice for all people.

Richard K. Gibson, Pastor
Terrace View Presbyterian Church
Mountlake Terrace, Washington

In Charles L. Blockson's article, he writes—"Nestled in the woods on Hines Hill Road in Hudson, Ohio, is a house where John Brown once lived . . . and still existing somewhere under the barn floor is said to be a secret compartment where runaways hid." That house and farm were owned by my uncle and aunt for many years. According to my aunt's stories, there was a dugout behind the house where runaways hid until they could safely be moved on to the next station.

Rolland T. Whapham
Mentor, Ohio

We qualified our statement because this and many other stories about the Underground Railroad are undocumented. We will pass your account on to Dr. Blockson.

Charles Blockson's article reminded me of my grandmother's account of the funeral in the 1880s of her cousin Kosciusko McArthur, thought to be a Confederate sympathizer. As his coffin was being closed, his old friend the Reverend Shipman suddenly stood up and said it must now be told that he and "Kos" had been heavily involved with the Underground Railroad for many years, Kos hiding runaway slaves at his farm in Crawford County, Pennsylvania, and then passing them on to the Shipman home.

The dropping of this bombshell solved two childhood puzzles for Kos's daughter Mary. She remembered seeing her mother take food to a closet under the back stairs—the one place in their house the children were forbidden to go. Even more mystifying had been her trip for the cows one morning, when out of the fog appeared a group of black people thinly clad and barefoot. She'd run for the house and been calmed by her parents with the reminder that she'd "always had a remarkably vivid imagination."

Mary Jamison
Jamestown, Pennsylvania

Scotland

However much the landmass of Scotland may resemble it in outline, it is not "the rearing lion that guards its coat of arms" ("Scotland, Ghosts, and Glory," July 1984), but the unicorn. The lion rampant is the heraldic beast of England.

Thomas A. Reisner
Quebec, Canada

Unicorns do support either side of the Scottish coat of arms, but the central shield bears the lion that appears with the flag on our map on page 49.

I was horrified to see on page 61 that the caption described the Shetland pony as "gentle." They are lively, headstrong, brave, tough, and mischievous. They engender adoration in their tiny owners, although they have been known to push their luck with parents! Ours also objects to being called "stunted." He prefers the description "perfectly proportioned to cope with the climate." Shetlands are courageous, lovable rogues, and lots of fun, but never gentle.

Sarita Tilford
Moniaive, Scotland

Pony experts we consulted agree that generally Shetlands are gentle, but they also have a reputation for being mischievous.

Your article has reinforced my opinion that we Dutch and Scots share more than just a reputation for being closefisted penny-pinchers. I'm convinced that golf was another common bond, which thrived in Scotland because of its terrain and disappeared from the Low Countries for the same reason. Can you imagine a Scotsman going on with a game wherein he loses half his equipment in a canal or drainage ditch every time out?

Gerrit J. Rexwinkel
Long Beach, California

Golf as we know it originated in Scotland, but the old Dutch game of het kolven *was quite similar and contributed many terms to today's game.*

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You'll find them all waiting at the Post Office. But hurry. Dogs like these won't sit around.

U.S. Postal Service

Burma

From the beginning I sensed something different about Bryan Hodgson's article (July 1984). It wasn't his use of words—all GEOGRAPHIC writers are pros. It wasn't the pictures by Stanfield—I've come to expect excellence to accompany all articles. Finally on pages 115 and 121 I understood. It was Hodgson's attitude toward those he was featuring. Not an ethnocentric American almighty judgment, but an ability to see both good and bad, beauty and ugliness, successes and problems and present them all openly and without bias.

Mrs. Guy Hayden
Sand Lake, Michigan

In the article "Time and Again in Burma," author Bryan Hodgson states on page 121: "Its [Burma's] people had never starved." The infant mortality rate (IMR) of Burma is 99. Most experts on world hunger agree that a country having an IMR of more then 50 has a hunger problem. The author does mention a subtle green revolution in Burma and also focuses attention on some of the efforts being made to create a sustainable agricultural system. However, in a country where one out of every ten babies under the age of one year dies, it is important to recognize that a hunger problem exists therein.

Tom Rogers
Warsaw, New York

Burma has never experienced the extremes of hunger or malnutrition that have greatly affected other poor countries, and its per capita daily caloric intake is above the minimum set by the World Health Organization. Burma's infant mortality rate reflects inadequate medical facilities, nonfamine-related diseases—such as tuberculosis—and poor sanitation.

Eskimo Hunt

The Yupik Eskimos have created a whole new bingo game (page 828, June 1984). "B-14." Correct. "I-23." Correct. "N-47." Wrong. The numbers 46 through 60 are under "G" on all of the bingo cards I've seen.

Dick King
Topeka, Kansas

You win. Forty-seven falls under "G" in the 75-number game played in the U. S. In Europe there is a 90-number game with 47 under "N."

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

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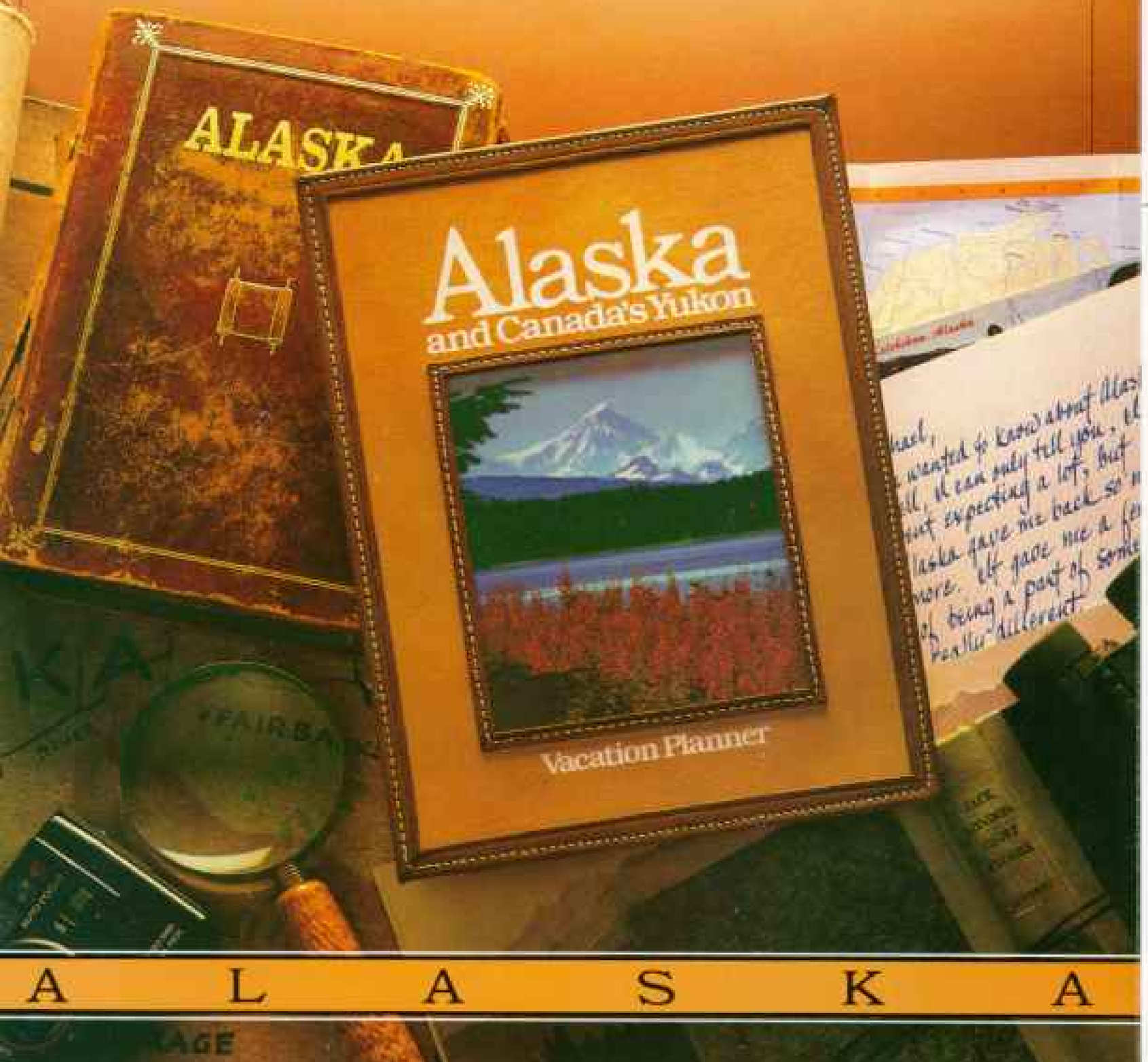

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4. When are you likely to visit Alaska?
   a. ☐ 1985 b. ☐ 1986 c. ☐ 1987 or later
5. What time of year are you likely to travel?
   a. ☐ Winter (Dec.-Mar.)
   b. ☐ Spring (April-May)
   c. ☐ Summer (June-Sept.)
   d. ☐ Fall (Oct.-Nov.)
6. Your Age: _____
7. Have you taken a foreign vacation in the past three years?
   a. ☐ Yes b. ☐ No
8. Have you been to Alaska before?
   a. ☐ Yes b. ☐ No

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(6/85)

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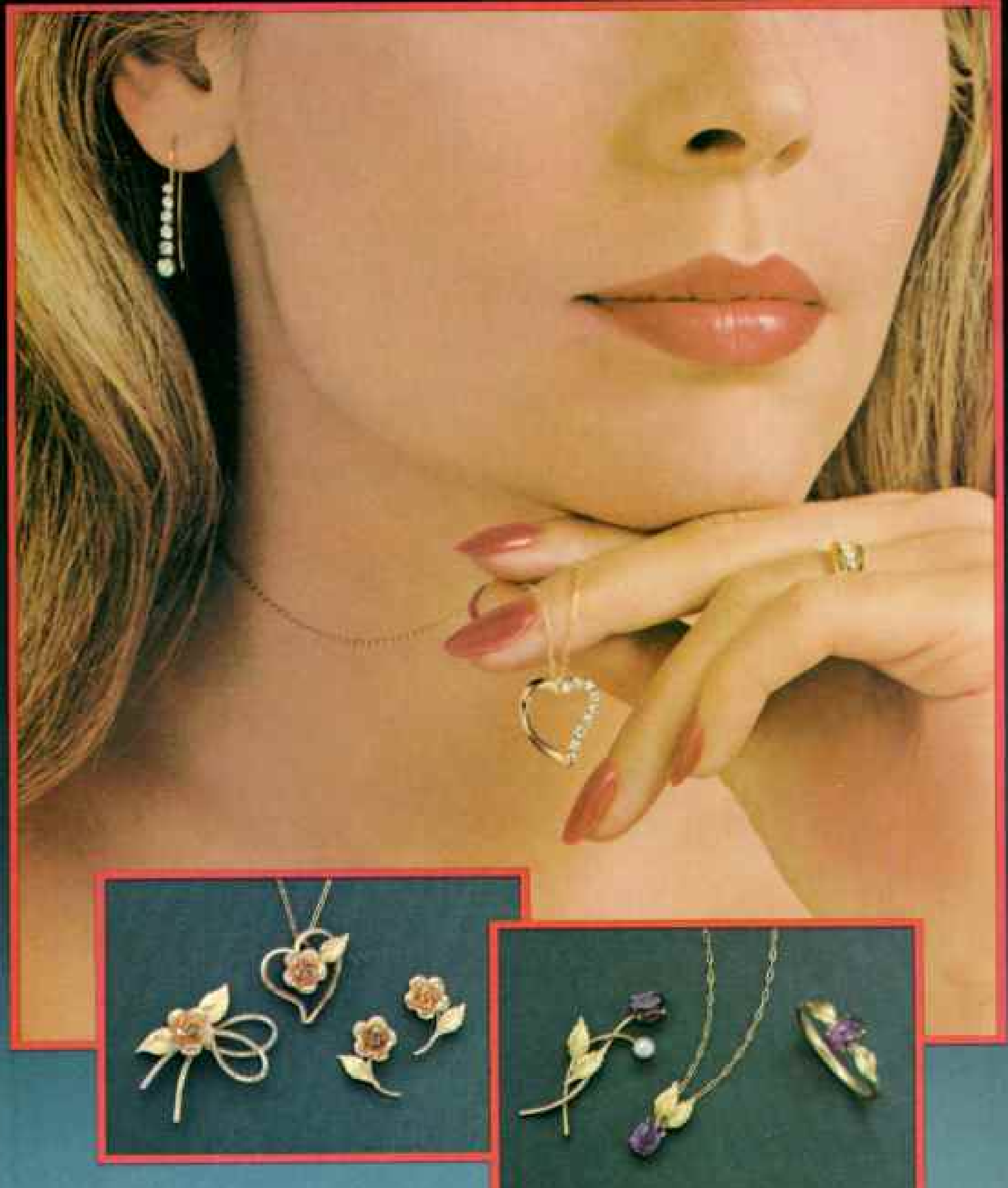

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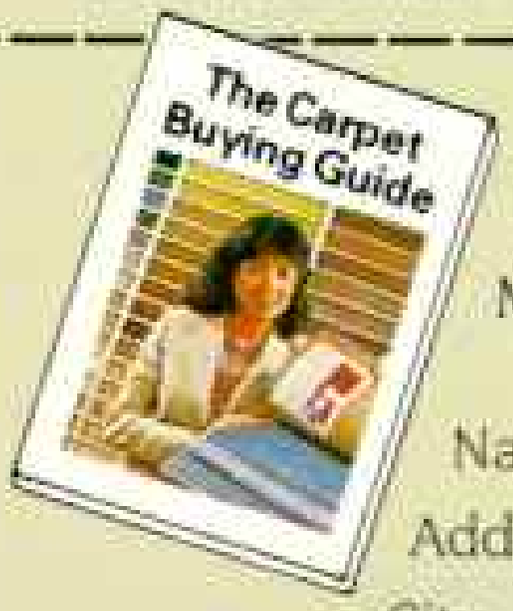

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On Assignment

A WOMAN ON HER OWN in Africa is sure to arouse suspicion, yet ***Angela Fisher,*** conversing with a Samburu warrior coiffed with sisal, cloth, ocher, and fat (***right***), has won the trust of scores of peoples. In 1970 the native Australian began to document and study the fabulously diverse adornments that identify an African's station in life, age, or marital status. In her wide-ranging travels Fisher was twice joined by Danish photographer Fabby Nielsen, some of whose pictures appear with hers.

African authorities occasionally hindered Fisher's work. At a tribal ceremony in West Africa police abruptly banished her, saying, "You have no right here—where is your husband?" Another time, while photographing 350 naked Masai warriors painting each other in a sacred ritual, she suddenly realized they were staring at her. "They yelled to me either to take my clothes off or to stop photographing." She made a strategic retreat into some nearby undergrowth and continued with a longer lens.

DAVID COULSON

PHOTOGRAPHS BY MIMI GEORGE (ABOVE) AND DAVID LEWIS (BELOW)

"WHEN YOU OVERWINTER in Antarctica, you expect isolation, but we also found exhilaration," says explorer ***David Lewis*** (***left***). The six-member team included anthropologist ***Mimi George*** (***bottom***) and four others. Physician, Polynesian-navigation expert, and lifelong sailor, Dr. Lewis competed in the first single-handed transatlantic sailboat race and skippered the first catamaran around the globe. The New Zealander's five previous articles for the GEOGRAPHIC include two on solo trips to Antarctica, the only such to that continent.

Mimi George spent a year living with the Barok-speaking people of Papua New Guinea, where she was adopted into a clan. A facial tattoo signifies her membership.

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