

Roger Payne

THE
SONG OF
THE WHALE



Sunlight dancing on the ceaseless waves . . . myriad schools of fish darting just beneath like showers of silver. Such is our usual vision of the ocean. But this encompasses only the thinnest, uppermost layer. We give little thought to the underlying abyss, far greater in bulk, perpetually dark and very cold.

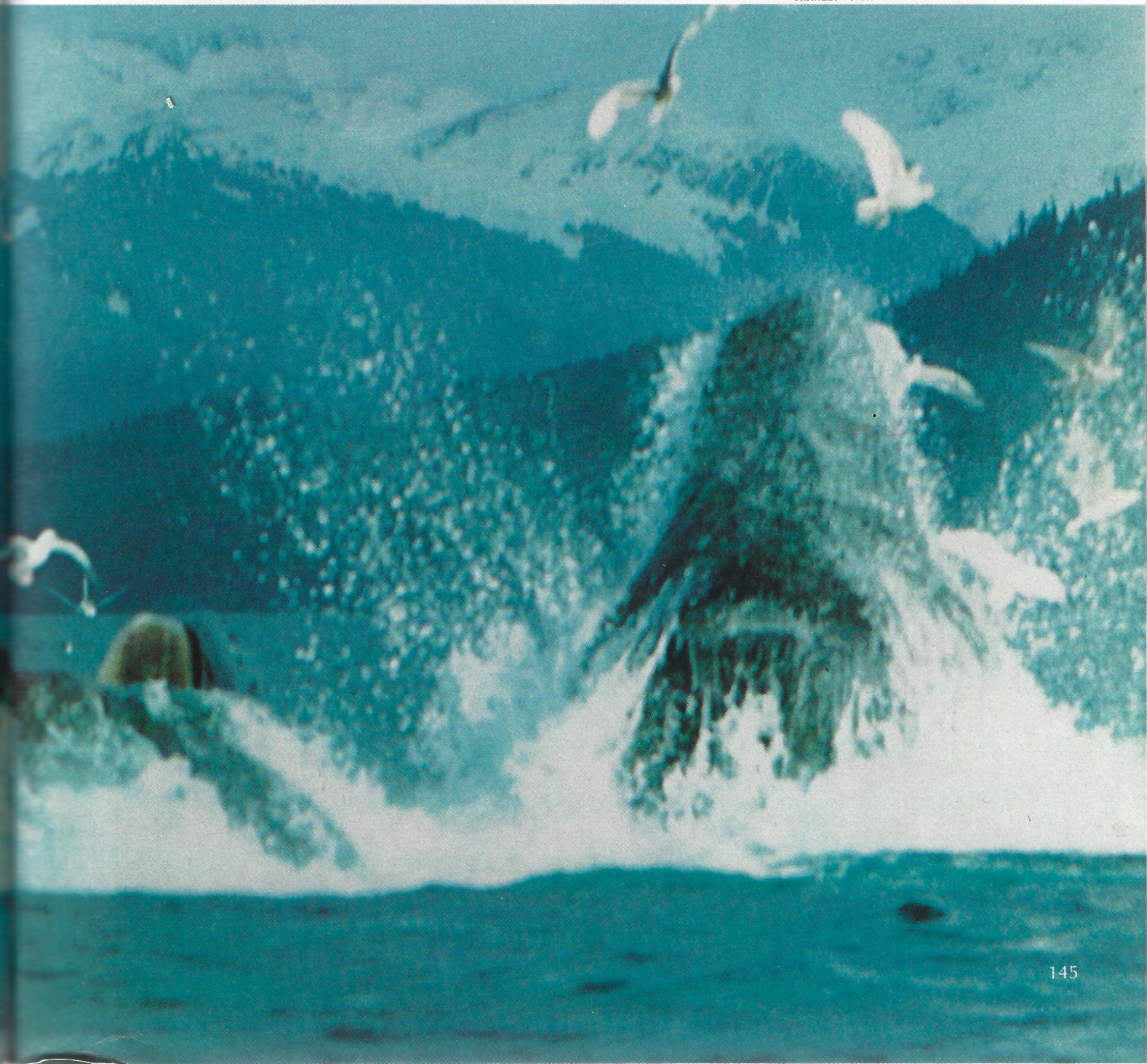
In the depths beneath the surface film, life consists mainly of tiny fishes adapted to the cold and the immense pressure. Because they live in darkness they must have trouble finding each other. The twinkling spots of luminescence sprinkled along their sides and bellies may improve their chances; as they move in shoals they look like slowly wheeling galaxies of stars.

Good visibility in seawater is seldom as much as a hundred yards; animals that rely on sight to find others of their kind are probably

Living archipelago of humpback whales erupts off Alaska during a herring feast. Breaching may stun many fish, making for easier pickings. Gulls fishing in the troubled waters can flap too close to an open maw—some have been found in whales' baleen, the hornlike slats in the upper jaw that filter out food.

Lauded by Herman Melville as "the most gamesome . . . of all the whales, making more gay foam and white water," the humpback today stirs new wonder with its wild, mystifying songs.

CHARLES JURASZ





able to meet only when they chance upon each other at close range. Those that depend on sound are far better off; sound travels much farther in the sea than light does.

If you lower a hydrophone into deep ocean, you may hear amid the abyssal murmuring the eerie mingled calls of some distant animal. At first scientists were baffled by these sounds, especially when they realized the faintest noises were remnants of extremely loud calls that had traveled a long way, weaving between the bright, undulating ocean ceiling and the oozy floor. In recent years we have found that many of the loudest sounds are the calls of whales. Some are very beautiful to human ears, surprisingly so since they have had a completely independent evolution—in a world as different from ours as a separate planet. Now, after millions of years of isolation, we and whales in a sense have come together; with underwater microphones we can listen in on their world.

I have spent many a day listening to whales through hydrophones and countless hours playing tapes of whale sounds. Of all I have heard, the most remarkable are those of the playful humpback. In both the Northern and Southern Hemispheres groups of humpbacks make long migrations, at times near continental shores, summering around the 60-degree latitudes. There these baleen whales sieve from the ocean unbelievably rich summer blooms of plankton.

In the south almost no land interrupts the plankton belt. Once it attracted earth's greatest concentration of whales. It also attracted



whale hunters, and in this century they have all but destroyed the humpback there. Today the four small northern humpback populations probably outnumber their southern kin.

Humpbacks from one or more of the northern groups breed around Bermuda and the Antilles, and each spring for five years my wife Katy and I have gone to Bermuda to study their hauntingly beautiful sounds. With Scott McVay of Princeton, a dedicated whale conservationist, I analyzed the tapes and discovered that the whales were singing! The songs lasted from 6 to 30 minutes—far longer than the usual few seconds' duration of a bird's song.

Many biologists define a song as a complex, repeated pattern of sounds; in contrast the very short, repeated sounds of insects and frogs are more properly termed "calls." The definition does not imply a pattern pleasing to us, though in the humpback's case it is. Others have heard in these songs the sounds of lowing, moaning, wild shrieking, and wailing, but I have never found words adequate to describe them. Though we may find eventually that other whales also sing, the only singers definitely known in the mammal world

Setting a trap for whale sounds, Roger Payne anchors a sonobuoy off a remote Argentine coast—a winter haven for right whales. The floating rig picks up and broadcasts underwater sounds.

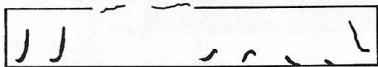
Right whales are rarely seen, much less heard. Slow swimmers that float when harpooned, they all but disappeared under pressure of 19th-century whaling. Here, in reef-fringed shallows, a remnant of the species comes to mate, calve, and play.

Eavesdropping on the hidden world of Leviathan is a chancy game; animals that may measure 55 feet and weigh as many tons easily break the sonobuoy lines and smash the gear.

WILLIAM R. CURTSINGER



To the sea's ageless symphony the voices of whales bring a beguiling chorus. Scientists have picked up sounds from every whale species studied extensively—though none yet heard can match the eerie music of humpbacks. Poring over spectrograph charts—on which the humpback's rising whoops, whistles, bellows, grunts, and descending roars look like this—



Dr. Payne and Scott McVay found complex sequences that comprise the fabric of song. And each humpback sang its own variations on the species' themes.

The songs were widely heard on a recording, "Songs of the Humpback Whale." The strange, haunting cries turned men's minds to the plight of whales and inspired a musical piece for orchestra and whale soloists.

The whales do most of their singing while submerged. Lacking vocal cords, they probably make sounds with the larynx and by internally shunting air.

are man, the whitelined bat, the bearded seal, and the humpback.

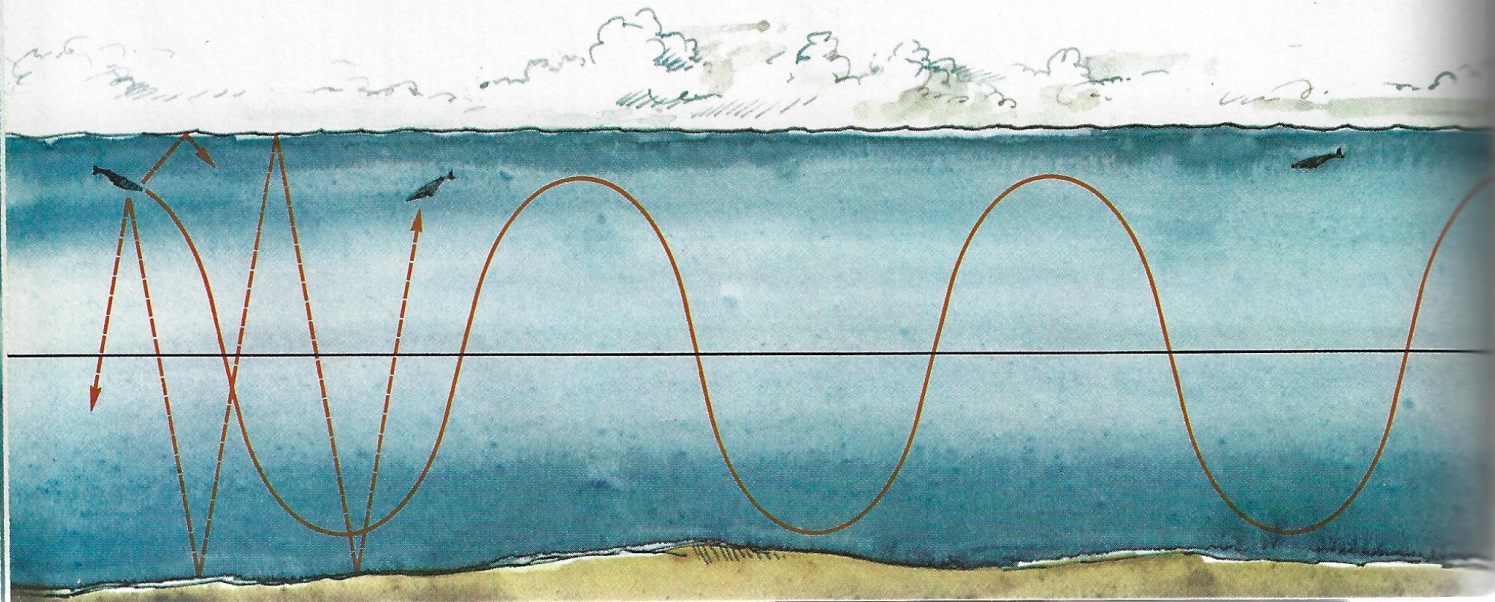
Why do humpbacks sing? We have no idea. They sing more at night and, it seems, on the wintering ground. But we do not know the singers' age or sex, whether they sing alone, in pairs, or in groups. One fact intrigues us. The high-pitched, high-frequency sounds are soft and varied, the low sounds loud and less varied. Why?

Given equal loudness, low frequencies go much farther through the ocean than high ones. Thus we would expect the highest humpback sounds to travel at most a few hundred yards before being lost in the background noise of waves; the lowest will go many miles. Unless we assume the whales are wasting a lot of time and energy on low sounds, the songs apparently contain information for two audiences—one nearby, the other at a distance. Or a song could be serving as a beacon that gives the listener some sense of distance, depending on how much is heard.

If the humpback is voicing its high-frequency repertoire for listeners close by, then this variety of sounds may be carrying a large amount of information. And our wonder grows at what it all means. The low frequencies would be expected to convey a simple message to a distant whale—perhaps no more than "There is a humpback here." The distortions of distance would smear out any subtle information; far away one would anticipate no more than a monotonous and repetitive signal, like the droning of a foghorn.

We need to know more about the loudness of humpback song to estimate range. But the sounds of another cosmopolitan baleen whale, the finback, are simpler and have been much studied. We can calculate roughly how far they carry. The result is surprising.

Let us lower a hydrophone into the abyss in the Pacific, hundreds of miles from the nearest shipping lane. The phone picks up a faint deep tone, its frequency around 20 hertz (cycles per second). It comes on and off like clockwork—in one typical pattern a one-second tone, then alternately 12 or 15 seconds of silence. This is



a call of the finback. We do not know whether finbacks are the only source of the sound—only that they are one of the producers of some of the sounds heard around this frequency.

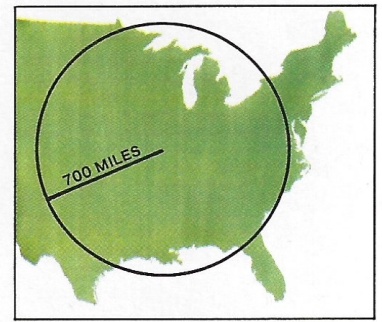
At times 20-hertz sounds are very loud. When acoustics experts engaged in naval research first heard it, they did not believe an animal could generate so loud a sound. Scientists finally were able to identify one of the “20-cycles-per-second monsters” as a finback and to pick up some of these calls 100 miles away! But is this the greatest distance at which these sounds might be heard?

The range of finback calls today is limited by background noise of similar frequencies—mainly the roar of ships’ propellers. But finbacks have been evolving from other baleen whales for some 15 million years; their powerful calls must have been adapted to some purpose long before propeller-driven ships arrived.

Douglas Webb of the Woods Hole Oceanographic Institution and I have attempted to make a rough estimate of the range of the finback’s call in the quieter oceans that no longer exist. By one set of calculations the sound under favorable conditions could carry 500 miles. This means that a finback could have heard a companion from anywhere within 785,000 square miles of ocean.

Any of our assumptions may be wrong. On the other hand, 500 miles may be far too low a figure. For instance, we assumed that sound energy from the finback spread out in the shape of a swelling sphere—a realistic assumption for short ranges. But different principles govern sound transmission in deep ocean; they may have interesting consequences for the lives of whales.

In deep ocean the speed of sound increases with temperature and with pressure; thus sound travels fastest near the surface and at the bottom. If we were broadcasting from the slowest, middle layer, sound rays directed almost straight up and down would reflect from surface and bottom and lose much energy. But oblique

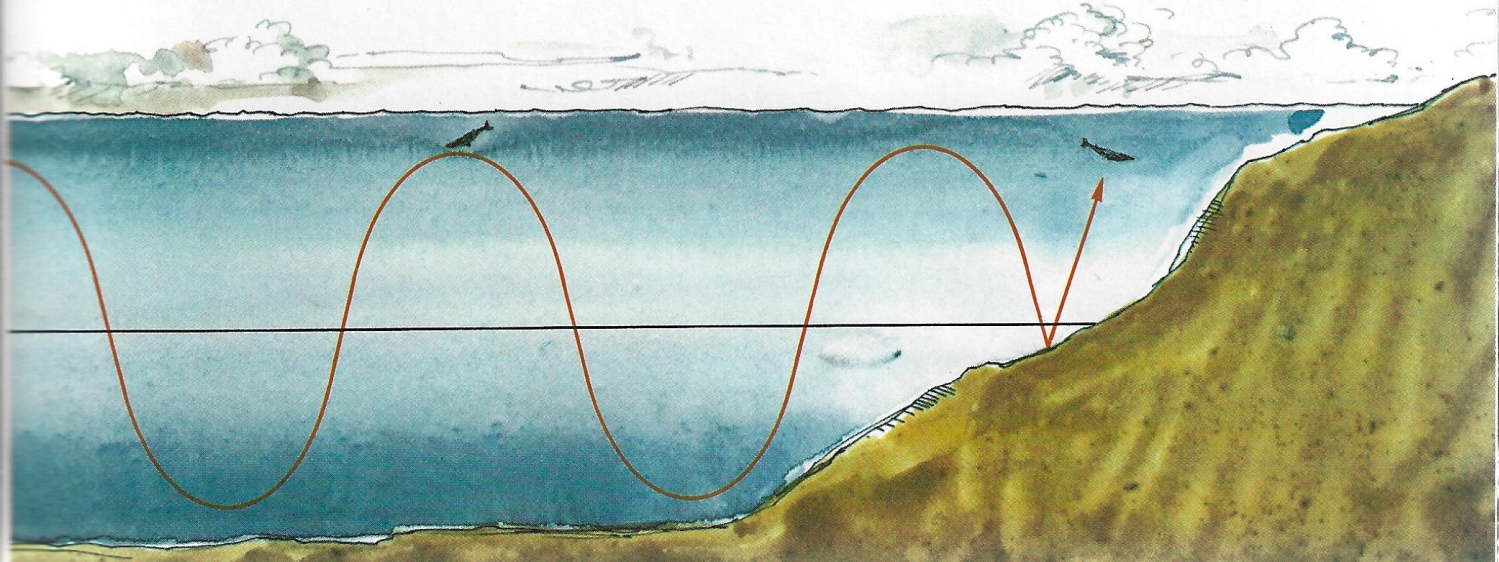


The ocean gives a whale's voice enormous potential range.

Diagram below shows how the finback whale's loud, low-pitched call travels in deep ocean. Nearly vertical sound rays, hitting sea bed and surface, soon dissipate but may reach nearby finbacks. Other rays avoid energy loss from reflection, traveling up and down over vast distances. They near the surface every 35 miles. Whales at intermediate points may hear a signal that bounces off sloping terrain—or they may miss many sounds. But if a call served only to signal the sender's presence, occasional contact would suffice.

Along such sinuous paths the finback's voice might have had a range of thousands of miles when no ships' noises interfered. More likely, says Dr. Payne, the finback would regularly have achieved 700 miles—sweeping an area equal to more than half that of the contiguous 48 states (above). Even in today's noisy seas finbacks have been heard at distances of 100 miles.

DIAGRAMS BY RICHARD SCHLECHT





rays under these conditions are always bent back toward the layer of slowest speed and do not lose energy from striking the ocean floor or ceiling. These bending rays would trace a sinuous pattern that weaves up and down across the middle. The sound would spread in the shape of an expanding cylinder, not as an expanding sphere. Channeled this way, sound travels much farther.

According to our calculations, if a finback were at optimum depth, prior to the intrusion of ships' noises, the maximum range of its call would be between 4,000 and 13,000 miles. A circle with a 4,000-mile radius covers about 50,000,000 square miles—some 17,000,000 more than the area of the Atlantic Ocean!

Though finbacks are not thought to dwell at depths required for maximum potential range, even a signal sent very near the surface can gain some benefit from cylindrical spreading. There is, however, no satisfactory way to estimate the farthest range of such a signal. We can only calculate the optimum case and then assume that the performance of finbacks lies somewhere between this value (4,000 to 13,000 miles) and the lower 500-mile maximum.

If the sounds of the finbacks do constitute a long-range signaling system, what possible advantage did these whales gain by developing a call that could carry across an ocean? The answer may lie in the finback's annual cycle. We know most about the Southern Hemisphere finbacks and will focus on them.

Although many people assume that all finbacks swim north to breed, there is good evidence that many never leave the Antarctic. Presumably some of the finbacks—juveniles, elders, new mothers—do not participate in breeding every year and need not make the full migration. At any rate the finback does not fit the familiar picture of a migratory species moving regularly between fixed locations. Everything seems to point to a sort of "emancipated migration" where destinations and participants may change dramatically. Plankton pastures, for example, may be frozen over one year, ice-free the next. Despite such fluctuations in migratory destination the herds concentrate each summer wherever food is abundant. For this, some sort of long-range communication seems necessary.

The finback's strange mating patterns also seem to demand such a system. Unlike animals that rendezvous during the breeding season at a fixed place, fin whales reach a breeding peak at the time of year when they are *least* concentrated. How can scattered animals pair up without some means of signaling to each other?

Generally we do not think of scattered individuals as members of a herd. Yet a lone whale may be in acoustic contact with others, may be part of a group that stretches

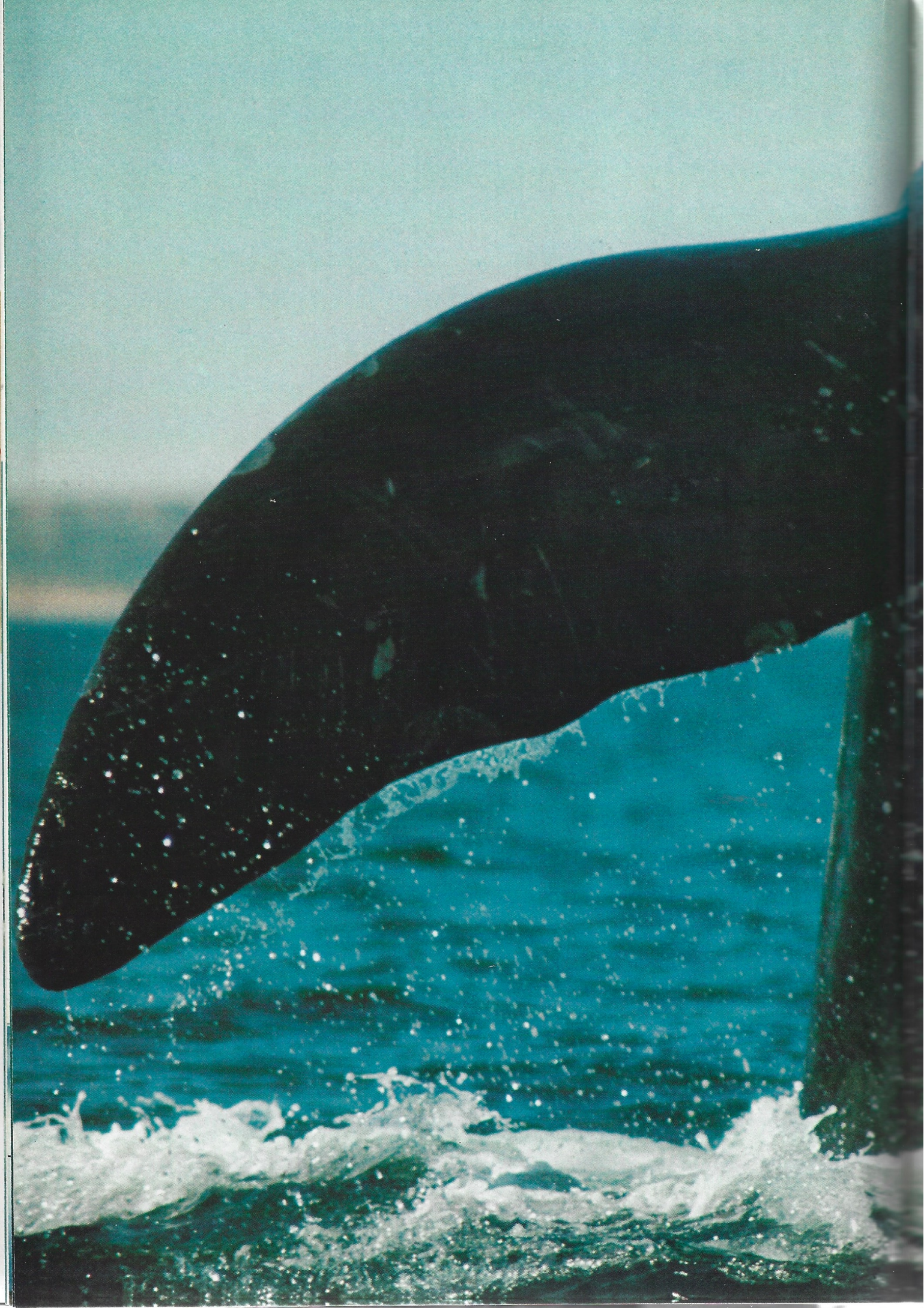
(Continued on page 158)

In silhouetted grace dusky dolphins rally round a visitor to their emerald realm off Patagonia. Guided by converging seabirds, divers dropped in to find more than a hundred feeding dolphins. Sleeker and swifter than their ponderous right whale relatives, the dolphins cooperated to corral a school of fish. Observers could hear clicking noises like those reported from dolphins in echolocation studies. During such tests the animals could detect fish and avoid obstacles even when blindfolded.

Many people confuse dolphins with game fishes of the same name and also with the tubbier, blunt-nosed porpoises of the whale tribe. Some biologists favor the terminology of sailors; they call any small whale species a porpoise.

A specimen of the dusky was collected in these Patagonian waters during the epic voyage of the Beagle. Darwin called the species Fitzroy's dolphin in honor of the ship's captain.

WILLIAM R. CURTSINGER





A gallery of whales

Whales began to evolve from earthbound ancestors into sea mammals at least 60 million years ago. Today the order of whales, or Cetacea, numbers some 80 species; its members are warm-blooded, breathe only at the surface, and suckle their young. They range from 4-foot porpoises to the blue whale (1), as long as 90 feet, weighing 135 tons—the largest creature that has ever lived. Its heart circulates 2,000 gallons of blood; a child could crawl in its aorta. A newborn blue whale weighs two tons and may gain up to 500 pounds a day in its first week.

To swim, whales swing their flukes up and down—in contrast to the side-to-side motion of fishes. Slow in cruising, big whales may spurt briefly at 20 miles an hour. In speed tests a porpoise once reached 24.6 mph. The deepest diver, the sperm whale (2), plunges perhaps 4,000 feet, can stay under an hour or more.

The cetaceans divide into toothed whales that seize fish or squid, and baleen whales that strain food. Toothed whales have one blowhole, the others two. Furrows on the undersides of some baleen whales let the throat expand as water is scooped. In winter and in migration some species may live off their blubber for months.

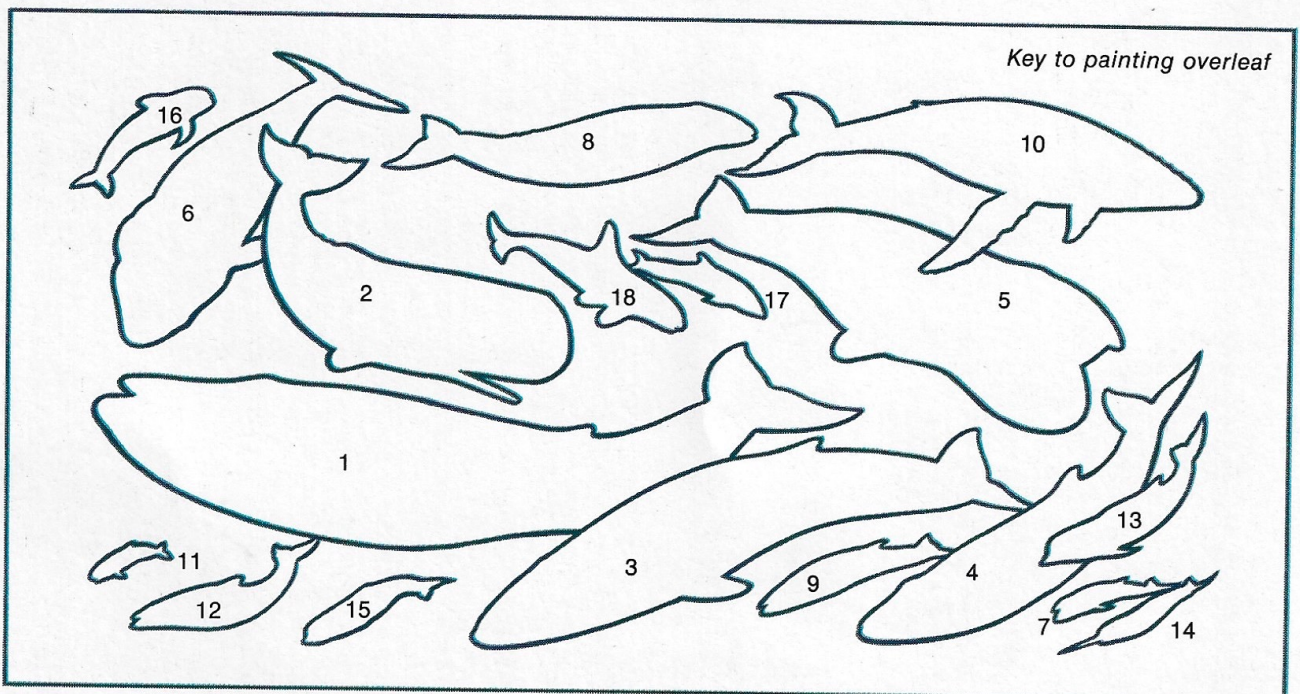
The baleen group includes the giants. The cosmopolitan blue, fin (3), and sei (4) whales migrate to low latitudes in autumn, to higher ones in spring—the sei avoiding icy waters. The bowhead (5), or Greenland right whale, lives in Arctic seas; its enormous baleen grows up to 15

feet long. Three forms of the right whale (6), sometimes classified as distinct species, frequent cold Atlantic and Pacific waters. The scarce pygmy right whale (7) roams southern seas. The gray whale (8) is seen off California each winter as it migrates from the Arctic to breeding grounds in Mexican lagoons.

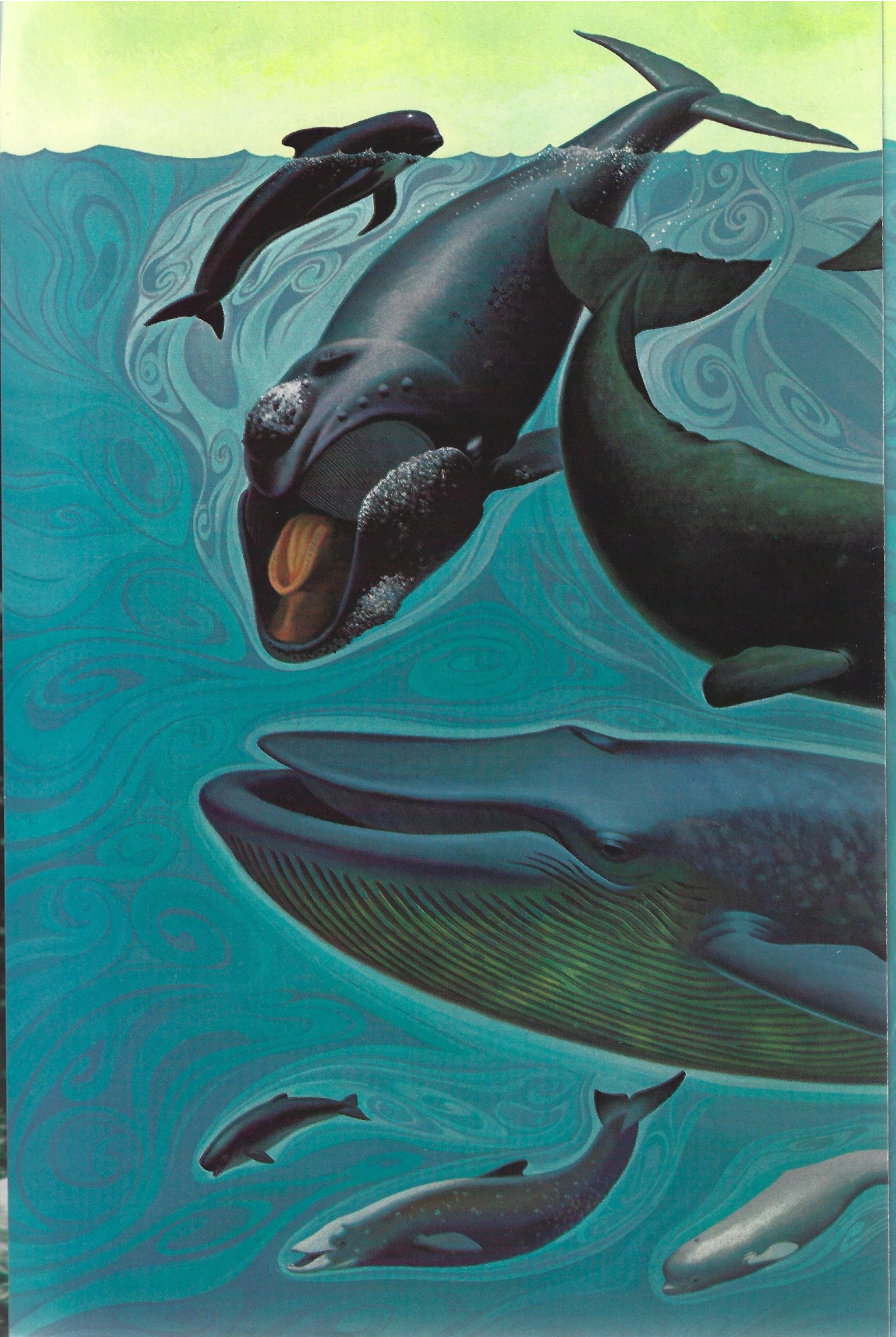
The little piked whale (9), flashing its white flipper patch, dwells in moderate and polar latitudes of both hemispheres. The humpback (10) grows the longest flippers—up to 14 feet.

Largest of the toothed whales, celebrated in *Moby Dick*, the sperm whale lives in all oceans. Bachelors may wander to frigid waters; harem herds remain in warmer climes. The great head yields spermaceti, long used in candles and ointments. The pygmy sperm whale (11), also widespread, has a more porpoiselike size.

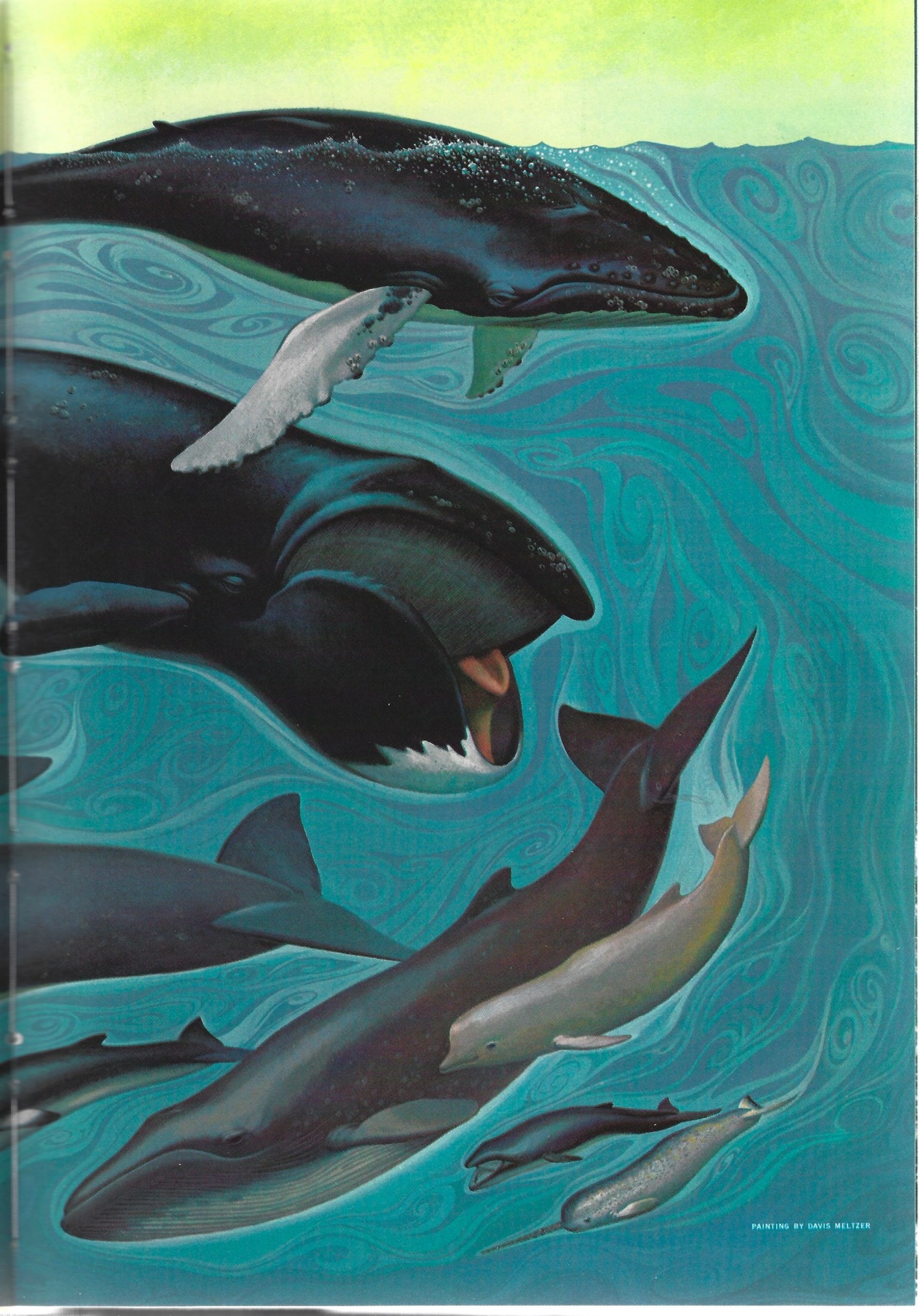
The goose-beaked, or Cuvier's, whale (12), at home in temperate regions, and the bottle-nosed whale (13), with distinct northern and southern forms, have but a single pair of teeth. The male narwhal (14) of the Arctic usually displays only one tooth, an eight-foot tusk, its purpose a mystery; men once related it to the fabled unicorn. The beluga (15), or white whale, another northerner, resembles a tuskless narwhal. The pilot whale (16) is often seen off Scotland. Wide-ranging in deep water, the false killer (17) is akin, though not in repute, to the killer whale (18). Unjustly feared by man, the killer preys on fish, seals, penguins, and other whales.



Flying flukes of a right whale slap the sea in a cetacean pastime called lobtailing.







PAINTING BY DAVIS MELTZER

"Surely this Patagonian shore is the Serengeti Plain of the marine world," writes Dr. Payne. "There can be no other place left on earth in which marine mammals and marine birds occur in such numbers and—even more unusual—such tameness."

The ways of wildlife on a littoral unmarred by man spiced the whale watchers' sojourn. A huge, maned bull stands out in a sea lion rookery (below) filled with females and pups. Beyond rise fossil-studded cliffs, ancient beaches now high and dry.

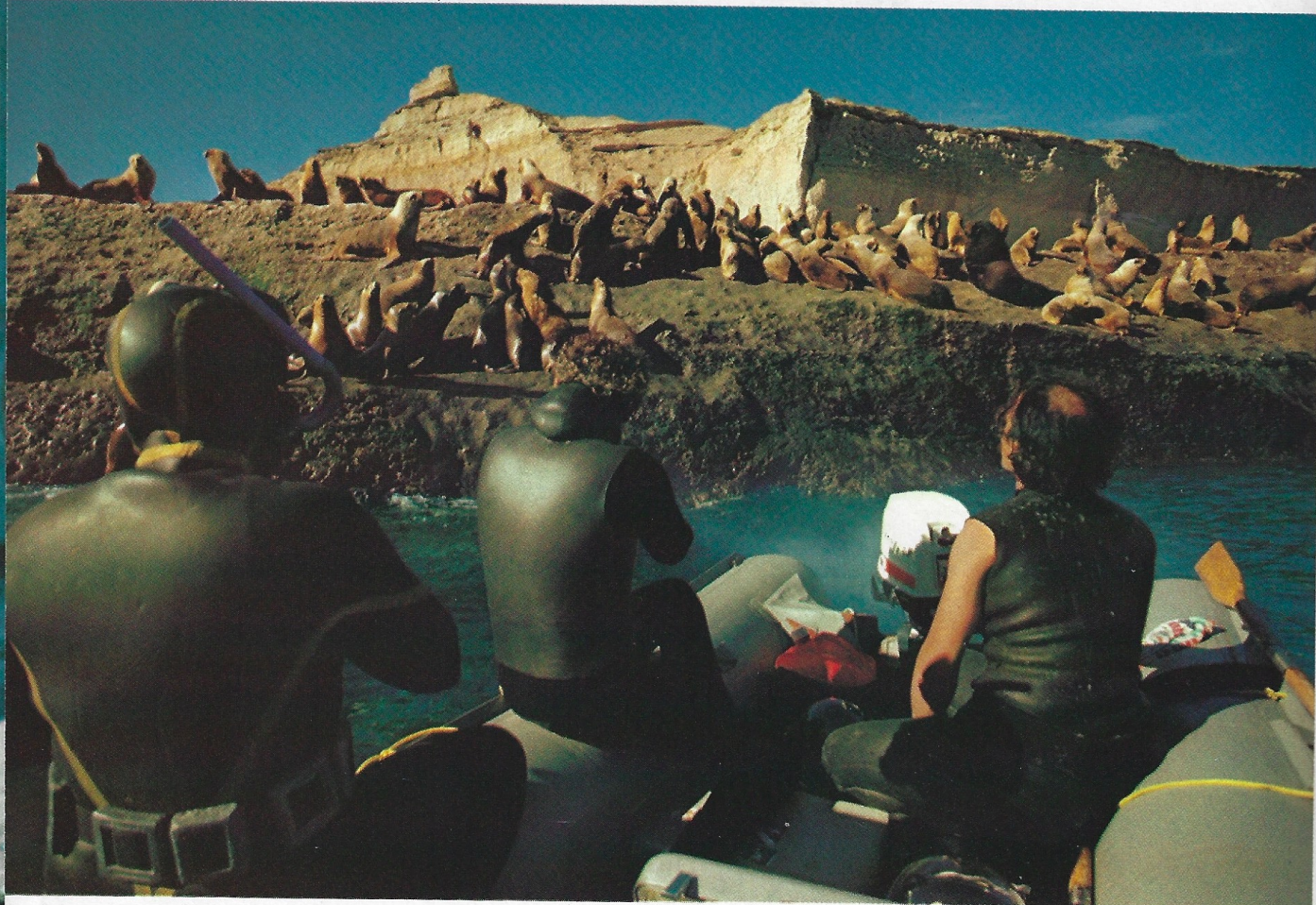
Where sand meets sea, surf plays a lullaby for nursery and playground (opposite). Like tiny shadows, three baby elephant seals lie close to females; a fourth adult may be expecting. Gulls nearby clean up the afterbirth. Beyond the breakers a right whale mother blows peacefully while her calf cavorts.

far beyond the horizon. If so, a functional social group may once have covered a whole ocean basin. Perhaps we should start thinking in terms of a "range herd" in which a species could live in tenuous contact throughout large portions of its whole range, spreading out to find and exploit resources as they bloom and wane in the seas. Yet an animal that announces its presence across thousands of miles of ocean might attract predators. This way of life could evolve only in an animal relatively free of predators, a very large animal—a finback whale, for example.

This line of reasoning makes us want to know much more about the social structure of whales. But these creatures roam all the world's oceans, as much an embodiment of wildness as has ever existed. Even when you find them you may see little, for they are constantly vanishing beneath the shroud of the sea. We require some point of access where whales are abundant and resident before we can capture more than fleeting glimpses of their lives.

We have found such a place in Argentina. Off Patagonia a band of southern right whales appears each fall and lingers through the winter. A rare spot and a rare species. Once, right whales abounded off all continents. Whalers prized them for their oil and baleen and, dubbing them "right," slaughtered them without restraint. The

WILLIAM R. CURTSINGER. OPPOSITE: CHARLES NICKLIN, JR.







species today is perhaps the rarest of all wide-ranging mammals.

I shall never forget the sublime shock of my first visit to the Patagonian right whales. I found a 30-mile stretch of shore dotted every hundred yards or so with male elephant seals guarding their harems and adding females to them. Offshore, at times within a hundred yards, right whales patrolled at slightly longer intervals. Penguins scrambled in the surf; albatrosses, shearwaters, and petrels wheeled in the updrafts that form as sea breezes meet the land. Skeins of cormorants, gulls, terns, and sheathbills swept by. Far up the beach a colony of sea lions lolled.

Nearby rose sheer cliffs with layer upon layer of fossils—a myriad of extinct shellfish. Whale bones, too, indicating that whales have frequented these waters for hundreds of thousands of years. No wonder William Conway, director of the New York Zoological Society, who studied birds here, called the area “the greatest coming together of sea, land, birds, and mammals on earth.”

In one bay, right whales swam so close to the cliffs that we could look down through the water and see them as if they were suspended in air. Around Bermuda I had lurched for days in a boat to



catch an occasional look at humpbacks. Now I could sit in comfort and gaze at whales completely undisturbed by my presence.

The site was right and the whales were right, in more than just the name. Bulbous, callous-like growths—known to old-time whalers as “the bonnet”—adorn the heads of these whales. The callosity patterns vary with each individual. Many right whales also have distinctive white belly patches. Once you sort out the patterns, every time a right whale raises its massive head or rolls belly up it tells you who it is. Nothing quite like this has ever before been available for the study of whales in the wild.

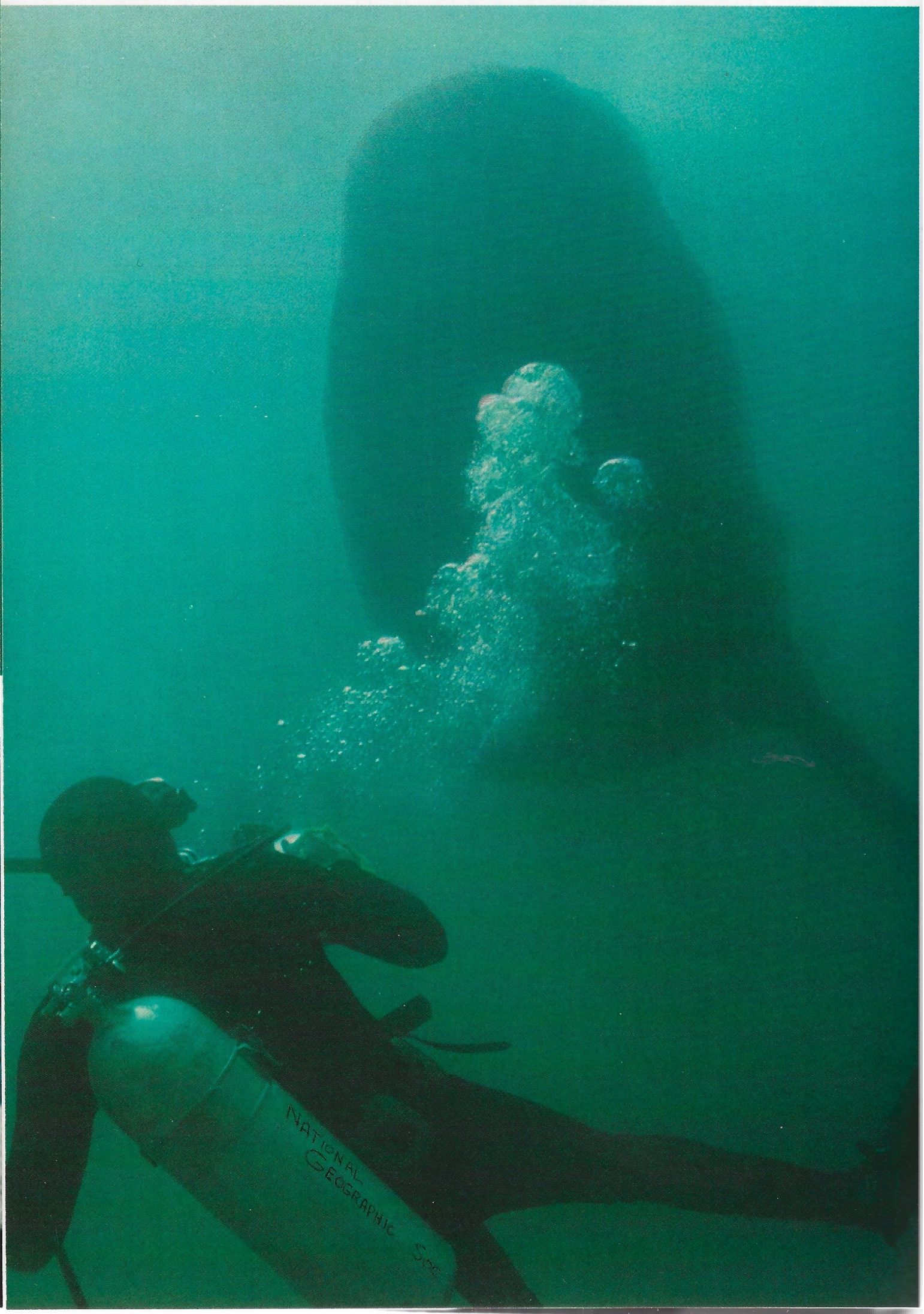
In 1971, I returned for three months of research sponsored by the New York Zoological Society and the National Geographic Society. Day after day my colleagues and I observed the whales, swam with them, boated near them. Some shied away from us, others kept a discreet distance, a few curious ones let us come within arm’s length. For the most part they were gentle. We recorded the head and belly markings of virtually every whale in the area.

We set up a triangular array of sonobuoys—floating transmitters with underwater microphones—to pinpoint the source of whale

Collision course—or prelude to mating? Though observers could not pin down the sequence here, the meeting resembled many that preceded the onset of courtship among right whales: a male nudging close (like the whale at right), an unwilling female turning away. By rolling on her back at the surface, a female can completely frustrate a male’s advances. If she decides to accept him, a change of position leads to an embrace with flippers, then mating.

Distinctive patterns of callous-like growths on the whales’ heads enabled scientists to identify individuals but not their sex. With rare exceptions, male and female could be distinguished only by their parental and breeding behavior.

WILLIAM R. CURTSINGER



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sounds. A four-channel tape recorder picked up the sonobuoy transmissions and simultaneously recorded descriptions of behavior from observers on a cliff or in a light plane overhead. By studying associations between sounds and behavior, James Gould, a Rockefeller University graduate student, and I hope to discover some clues to the communication system of right whales.

Unquestionably the whales' chief social activity here is courtship and mating. The whales seem to be promiscuous. One may mate with two partners within an hour—the female breathing quietly at the surface, the male beneath, on his back, holding his breath. When a female wants to avoid a male, all she has to do to put herself out of reach is roll over onto her back.

At such times several males seem to try to push her down by overriding her. Eventually, of course, she must right herself to breathe. Then all the males dive amid much pushing as they try for a proper alignment. One would expect some violence in these melees, but we never saw any—sudden turns and hard bumps, yes, but no determined attacks. And whenever a female accepts a partner it is quite tenderly done, each hugging the other with its flippers.

Similarly a mother seems to exhibit tenderness toward her calf, holding it across her chest, or hugging and patting it. She will tolerate a good deal of shenanigans—bumping and butting, or the calf's swimming all over her back and tail while she tries to relax.

Once I watched a calf alternately breaching and banging into its mother. For half an hour she took it like a rock. Then on one pass she flipped onto her back. As the calf swam over, she caught its tail with a flipper and clamped it against her chest while the

Tête-à-tête at sea, man and whale take a close look at one another. Barnacles bedeck the right whale's "bonnet" and wraparound lower lip; a trickle spills down the lip, which covers baleen plates measuring as long as eight feet.

Undersea murk, blurring detail, turns a curious whale into a frightening apparition. Perhaps attracted by the noisy gurgle of breathing gear, the whale approached to within 15 feet. Its head arches upward, presumably to enable the eyes, set far back, to see ahead.

Only a few encounters proved hazardous. Flailing flukes accidentally cracked one man's ribs and flung him into the air. And once a whale made the sea boil with frenzied head-thrashing within a yard of a photographer. "It was the only threat of raw violence I have ever seen in this species," the author declared.

WILLIAM R. CURTSINGER





Right whales rocket into the air; in moments they'll crash-land with the boom of distant thunder. Flipper reaching for the sky, the leaper at right arches its back as it turns on its side; the other displays its white belly patch. Both will land on back or side; right whales seem to disdain belly flopping.

Whales often breach; no one knows just why. They may jump to stun schooling fish, to shake off parasites, to scan surrounding waters, to show off to one another —or just for the fun of it.

CHARLES NICKLIN, JR.

youngster struggled with choking breaths. Finally all calmed down; she slowly released her hold and they swam placidly off.

When a storm set adrift tangles of kelp, the whales had a new plaything. It was a delight to watch. A whale would lie on its side patting the kelp strands between its flippers, then come up underneath the kelp, letting it drape over the head like some fantastic hat. As the whale swam forward, the strands slid backward, and as they were about to fall off a swish of the tail brought them around where the flippers could catch and hold them, or just bat them about. Again and again the whales played this game, and always at the magnificent slow, slow pace that governs their lives.

Toward the end of our stay we noticed more and more mothers and calves concentrating in one place, while in another grown males were vigorously pursuing females, with few calves in evidence. From this we tentatively conclude that one area served principally as a nursery, the other as a mating ground.

From our hydrophones we heard a large variety of sounds occurring in many contexts—sounds like grunting, mooing, moaning, and sighing. Clearly there is a good deal of vocalizing among the mating groups. Occasionally a whale seemed to produce a kind of soft swallowing sound just before breaching. But firmer conclusions await a more detailed laboratory study of film and tape.

plan to return for a much longer stay, in hopes of putting together a more complete picture of the life of this fascinating species. There is a bitter urgency about such plans; the whales are in danger. True, the voices of concern are rising, and factory ship whaling, with its deadly efficiency, is declining. But the killing goes on, and the industry pushes into new hunting grounds. Two companies operate in the South Atlantic—near our right whales—without heed to international restrictions. Both on occasion have killed whales of rare species for the production of dog food, automatic transmission fluid, cosmetics, and soap. Yet every ingredient taken from whales can be obtained from other sources.

It's all simply a matter of time, and then whales will be so rare that we will no longer be able to find them, even we who have received the grace of seeing them in their wild, free state. Maybe they will be unable to find each other. And the voices of whales will be lost in the relentless roar of ships' traffic.

Vapory geyser jets from blowholes of an exhaling right whale—a welcome sign of life from a species hunted to the edge of extinction. A century ago Melville wondered “whether Leviathan can long endure so wide a chase . . . whether he must not at last be exterminated . . . and the last whale, like the last man, smoke his last pipe, and then himself evaporate in the final puff.”

WILLIAM R. CURTSINGER



