

HAWAII

THE AMERICAN WILDERNESS/TIME-LIFE BOOKS/ALEXANDRIA, VIRGINIA

BY ROBERT WALLACE
AND THE EDITORS OF TIME-LIFE BOOKS

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The Cover: A branch of the Kalalau Stream courses through the valley of the same name, on the island of Kauai. The eerie spires through which it winds were once part of the lava cliffs behind them, and have been separated and sculptured into their present shapes by millions of years of water erosion.

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A fragment of volcanic rock, 910 feet high at its peak, is all that remains of Nihoa Island.

The Final Ravages of Time and Water

Once-active volcanoes, the 12 Leeward Islands, which extend the Hawaiian archipelago more than 1,200 miles to the northwest of the main islands, are the oldest links in the island chain and the most battered by time and erosion. Each successive Leeward island is older than the one to its southeast and hence displays greater ravages by wind, rain and sea. On Nihoa, the second youngest of the Leewards and some 2.3 million years older than the island of Hawaii, land-building lava flows that countered the forces of erosion ceased so long ago that the island, once 20 miles across, has shrunk to a rock one quarter of a square mile in area (*left*). Ages of rainfall and wave action have even more thoroughly worn down Kure (*right*), the oldest and outermost of the Leewards, at one point lowering it to sea level. But the shell of its volcano provided a foundation on which tiny sea creatures slowly built up a spacious, gleaming white coral atoll.



The low-lying atoll of Kure, oldest point in the island chain, outlines the site where a great volcano once towered above the sea.

4/ Refuge on a Reef

Against the illimitable blue of the sky, over the unfathomable blue of the ocean the sea birds of the Pacific wing the cycle of their lives. For them the ocean is a larder: the islands and atolls their mating ground and nurseries. GEORGE C. MUNRO/ BIRDS OF HAWAII

Before dawn the sky over the Pacific was like a sheet of dark blue glass. From below the eastern horizon, light and heat began to play on it. The stars squeezed shut and the sky expanded, growing pale and taut. Suddenly the sky shattered, falling in countless tinkling fragments, while overhead, replacing the stars, white birds soared.

The island is small, a sand-covered coral platform only about half a mile long and a few hundred yards wide. There are no trees on it, only broad patches of tough narrow-leaved grass and mats of yellow-flowered puncture vine. Along one side of the island runs a beach of coral sand; on the other there are limestone reefs and shelves. During the night a half-dozen green sea turtles, big as overturned wheelbarrows, have hauled themselves up on the beach to sleep. Not far away two brown-gray seals, each with her single black-velvet pup, are dozing on the sand. In the shallow water near them the silhouette of a little wave, less than a foot high, suddenly turns solid and moves against the grain of the other waves—a shark's fin.

The island is very low. The highest point on it is only 12 feet above the level of the sea. From there one can see about seven miles to the horizon where in all directions there is no smoke, no sail, no ship, nothing. The island is far from any traveled sea lanes; almost no one ever goes there intentionally. The discoverers of it surely went there by mistake.

In 1822 two English whaleships, the *Pearl* and the *Hermes*, cruising in consort, ran into the coral reef and broke up. The survivors built a 30-ton craft out of the wreckage, the *Deliverance*, and navigated it 1,100 miles southeast to Honolulu. Today the charts show this coral bank as Pearl and Hermes Reef.

Pearl and Hermes is in fact an atoll, a half-submerged coral ring about 15 miles wide enclosing a very pale green lagoon in the dark blue sea. There are a few tiny islands along the rim of the lagoon but this one, Southeast Island, is the largest and of greatest consequence. The rest are big sand bars. The atoll marks the place where once there existed a high volcanic island, perhaps as large as Oahu. Now it is worn down by rain, wind and waves so that no trace of it is visible, although if a drill bit were sunk through the sand and coral it would strike black lava roots a few hundred feet down.

In the early-morning light two structures appear on the island. One is a flimsy tower of metal posts and angle irons with something white lashed to its top: a five-gallon metal water can completely covered with sea-bird droppings. It might serve to alert a navigator approaching the low island. The other is a redwood sign. Carved on it in large half-inch-deep letters is "Hawaiian Islands National Wildlife Refuge/Pearl and Hermes Reef/Southeast Island." Below that there is "No Trespassing" in English and Japanese. Aside from the tower and the sign there are not many evidences of human life except for a temporary camp in which a few men are living.

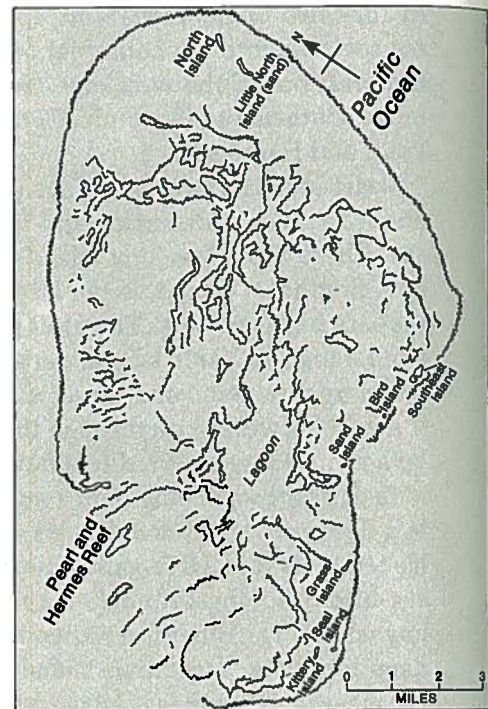
The birds that had replaced the stars were white albatrosses and red-tailed tropic birds. At lower levels shearwaters, petrels, boobies and frigate birds dipped and soared. On the sand, in the grass and on the bare limestone rock there were white eggs and speckled eggs, oval eggs and conical eggs, eggs that weighed less than an ounce and others that weighed three quarters of a pound. Chicks were everywhere. The newly hatched sooty terns were little gray fluffballs spotted with brown. The infant frigate birds were ugly enough to rouse religious thoughts in the mind of a heathen. Surely nothing could be that homely without being part of some grand design: stark naked, without even a visible hair or pinfeather; bright gray skin, the color of a bookmaker's felt hat; covered with permanent large goose-pimples; potbellied, scrawny; mad-eyed and squirming with lust for food.

The young albatrosses, although they were already about six months old, two feet tall and had six-foot wingspreads, were still only chicks and not nearly as ferocious as they tried to appear. Some were just

learning to fly and would make 20- or 30-foot hops that often ended in ridiculous crashes that seemed to embarrass them a good deal. When a man approached them they would snap their beaks rapidly with a sound like castanets but then they would trip over their own feet and fall down. Sometimes they made little peeping sounds. There were about 6,000 of them on the island, so that it was impossible to walk very far without running into one. Perhaps 80 per cent of them were Laysan albatrosses, with white heads, breasts and underparts; the upper surfaces of their wings and their tails are brownish black. The remaining birds were black-footed albatrosses, first cousins of the Laysans, with black bills and sooty brown heads and bodies. When they are standing on the ground both birds, at least at first glance, suggest enormous sea gulls. In the air, with their long, narrow wings outstretched in gliding flight, they look like sailplanes. Their common name is gooney, or gooney bird, a sailor's term that may derive from the old word "gawney," meaning a clownish fool. Still, although they have comical habits and often get into ludicrous scrapes, they are—as birds go—fairly intelligent.

The air over the island was not, as might be expected in a rookery, full of uproar and stench. The trade winds blew steadily from the northeast at about 10 miles an hour and the birds were fairly quiet except when a man intruded directly among their eggs and chicks. At such times they set up an incessant screaming, as they were doing now. Walking in a blizzard of sooty terns so thick he could reach out and catch them in midair in one hand was the man who has charge of the refuge, looking after the interests of the birds and the people of the United States. Although he had arrived on the previous afternoon, a good deal of time had been consumed in setting up camp; and now he was taking his first careful look around. "Please," he said to the terns in a reasonable tone, "stop dropping guano on the administrator."

The name of the administrator is Eugene Kridler, pronounced with a long "i," as in rider. He is a rugged man in his early fifties who works for the Fish and Wildlife Service of the U.S. Department of the Interior. Two or three times a year he leaves his office on Oahu and journeys out to the refuge to see what has been going on there. The refuge extends for more than 800 miles northwestward from the main Hawaiian islands and comprises a chain of reefs, islets and atolls—Nihoa Island, Necker Island, French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan Island, Lisianski Island and Pearl and Hermes Reef—that are collectively one of the world's most important sea-bird nesting areas.



The classic semicircular shape of a coral atoll appears on this map of Pearl and Hermes Reef. Only 15 miles wide, Pearl and Hermes covers more than 100,000 acres of reefs, islands and lagoon within the barrier reef (outermost line) separating it from the ocean. The shorter lines mark coral formations that are usually below water; only the islands, which are labeled, stand above the tide level.

The refuge also contains most of the Hawaiian monk seals still surviving on the planet, and is the last remaining nesting ground in the United States of the green sea turtle.

To reach the island, Kridler relies on the cooperation of the Coast Guard and the Navy, which sometimes have ships or helicopters operating in the neighborhood and will take him along. In this instance a big Navy helicopter flying out of Midway Island had set him down on Pearl and Hermes with all his equipment, including aluminum bands for the birds, metal tags for the seal pups and turtles and an enormous slide caliper of the sort used by foresters to determine the diameter of trees. Kridler measures turtles with it.

The Navy had also provided him with a couple of burly assistants to help wrestle the turtles and the seals, which weigh as much as 300 and 700 pounds respectively. One of the assistants, a Chief Hospitalman named Marvin Cunningham, was an amateur naturalist who had accompanied Kridler on previous visits to the island. This time Cunningham hoped to find a seal, dead of natural causes, intact and not too fragrant, so that a skeleton could be secured for a museum. Museums are glad to have the skeletons of rare creatures so long as they are collected by people who know what they are about. Cunningham, whose main medical interest is in bacteriology, spent considerable time in Vietnam and sent back scores of carefully prepared rodent skins and skeletons to the Smithsonian Institution.

On this trip Cunningham was looking for Hawaiian monk seals, so called because the silhouette of their head and neck is thought to resemble that of a monk in a cowl; monk seals belong to an interesting branch of the pinnipeds, or fin-footed mammals. There are (or perhaps were) only three species, unusual among their kind in that they live in warm or subtropical waters. Several hundred of them still inhabit the Mediterranean, principally along the North African coast. At one time monk seals were numerous in the Caribbean, in the Bahamas and off the Florida coast, but they have probably all been slaughtered. The last sure sightings of them were made in 1949. Hawaiian monk seals were nearly wiped out as well, for their oil and skins, but have made a comeback since Theodore Roosevelt established the refuge in 1909. Kridler estimates their number today at about 1,000.

As Kridler made his morning reconnaissance he looked for signs that anyone had landed on the island since his last visit. "Do you know what could happen if there were a shipwreck out here?" he said.

It struck me that this would be a poor place for a man to be stranded.

"I wasn't thinking about people," he said. "What I worry about is rats. If a ship plows into one of these islands and the rats get ashore, they can wipe out a whole species before you know it. Ground-nesting birds are very vulnerable to rats." A few years ago a scientist from the Smithsonian, working in the outer islands, watched a rat attack an albatross on its nest. The albatross was so intent on brooding its egg that it defended itself only feebly and was killed.

Although it would be grim news if rats got ashore anywhere in the refuge, it would be disastrous on a couple of the islands because of the extreme rarity of the species living there. On Nihoa, and nowhere else on earth, live some grayish-brown millerbirds, so called because of their fondness for eating miller moths. When Kridler last estimated their number he put it at about 600. The island also is the only home of the Nihoa finch, a member of the Hawaiian honeycreeper family. In size and color the birds resemble large canaries, with yellow heads and bodies, but they have powerful crushing beaks like those of miniature parrots. About 4,000 of them still survive. On Laysan in the highly saline interior lagoon there are some handsome little ducks, unique to that island, that have been fighting nip-and-tuck with extinction since 1923. In that year only seven of them existed; today there are probably about 175. The ducks, the finches and the millerbirds would vanish quickly if rats became established on their islands. In 1969 a Japanese fishing trawler ran aground at a speed of eight knots on Laysan. After the men were rescued they swore a great nine-jointed oath that rats had never set foot on their vessel, but when he inspected the wreck Kridler found several boxes of rat poison. "I had nightmares about it for some time," he said, "but either there really weren't any rats aboard or they failed to get ashore. That time, anyway."

There were no signs that strangers had been prowling on Pearl and Hermes in the immediate past, so Kridler turned his eye to legitimate visitors, the turtles on the beach. A full-grown green sea turtle is surprisingly powerful and when it is alarmed it moves like a bulldozer across the sand, heading straight for the water. To capture the turtles, which were asleep, Kridler and Cunningham sneaked up on them from the side and turned them over with sudden strong charges reminiscent of interior line play in football. They were careful to avoid the turtles' flippers, which are hard and bony on the front edges and can break a man's wrist with a solid blow. They also took heed of the turtles' mouths—green sea turtles do not snap aggressively, but may bite off a hand if it is carelessly offered to them. The two men turned over four big tur-



Scrawny and bare, a newborn frigate bird (above) hugs its nest in a clump of solanum shrub on Pearl and Hermes Reef, waiting to be fed small pieces of fish and squid that its parents steal from boobies. The adult female at right, gliding to the nest on its seven-foot wingspan, prepares to disgorge tidbits to its young as its mate looks on. Adults also eat tern chicks and turtle hatchlings when such delicacies are in season—mostly in summer.



tles with little trouble. A fifth one awakened, however, and began making for the water. Cunningham jumped in front of it and put his foot on its head, shoving it down hard into the sand. The turtle halted and in a moment Kridler hurried over and flipped it.

When green sea turtles are overturned they cannot right themselves again as can various other members of their kind, including snapping turtles. Upside down they can survive for weeks or months and were often carried in that manner for fresh food on long sailing voyages, to be butchered when needed. Kridler's turtles, as though they had some dim racial recollection of this, lay on their backs without struggling, occasionally uttering long, loud sighs. Two of them already had numbered metal tags attached to the trailing edges of their right front flippers, close to the body, where Kridler or his fellow workers had placed them in previous years. He took note of the numbers and then tagged the others, using pronged tags that are pinched shut with pliers. The turtles seemed not to notice, apparently being fairly insensitive to pain. One of them had been attacked by a shark that had bitten a semicircular piece out of the side of its shell about the size of half a dinner plate. The wound had healed in the manner of bark covering a gash on a tree.

Kridler took the dimensions of the turtle shells with his caliper, measuring length, width and thickness of body, which in a fair-sized creature came to 38.1, 29.2 and 13.7 inches. In weighing the turtles he and Cunningham slid them one at a time onto a piece of heavy canvas that had a slack loop of rope threaded through metal grommets around its edge. When the rope was pulled taut the canvas enclosed the turtle as in a hammock. The rope was then hooked onto a spring scale fastened to the middle of a stout eight-foot pole. They strained to lift the pole on their shoulders and when the hammock was clear of the ground I read the scale. The fair-sized creature weighed 295 pounds. Released, right side up, it rapidly heaved itself over the sand into the water and swam off at what seemed great speed, although it was probably only about 10 miles an hour.

"We're building up a file of information on the migration and growth rates of these turtles," Kridler said. "They're not an endangered species yet, but they soon may be. They're a great delicacy and bring high prices on the market. Right now we're cooperating with a scientist at the University of Hawaii who's trying to figure out if they can be raised commercially." Thus far Kridler has recaptured a number of turtles that have traveled from island to island within the refuge, and to some of the main inhabited Hawaiian islands—as much as 600 miles at times.

It was midsummer noon. Pearl and Hermes is not far from the intersection of the international date line and the Tropic of Cancer, and the sun there is like a sledge hammer. The water and the white, coarse coral sand reflected light and heat. The young albatrosses, facing into the wind, stood with wings outstretched, occasionally waving them to exercise and strengthen them. To cool off, the birds rocked back on their heels, lifting the soles of their triangular webbed feet so that the air could circulate under them. Networks of fine blood vessels enable their feet to serve as radiators, dissipating body heat. It is an effective mechanism except in one regard: unlike land birds, sea birds have no strong rear toes to support them when they rock back, and albatross chicks take some humiliating pratfalls before they get the hang of it.

Not all of the albatross eggs on the island had hatched. Some had been infertile and now, several months old, they were baking in the sun, full of green slime and gas. *Pow!* If a man picked up one of them, juggling it, there was a fair chance that it might explode in his hand. Sometimes an egg would burst spontaneously when no one was near. The sound was like a small light bulb breaking but the smell was thunderous, fortunately soon swept away by the breeze.

Scattered along the beach were scores of corked or capped glass bottles, seemingly a strange litter to be found in the far wilderness of the sea. Almost all of them were liquor or Japanese sake bottles tossed overboard from trawlers, merchantmen and passenger ships in many latitudes and carried to Pearl and Hermes by the wind and the ocean currents—the Kuroshio, the California and the Equatorial—that create a slow-moving clockwise flow of water in the North Pacific. A well-stoppered bottle will float for years or decades in the currents, and since there are literally millions of them adrift, even the most remote islands become strewn with them. In fact the remote islands, rarely reached by beachcombers and souvenir hunters, have many more bottles than the accessible ones. Among perhaps 200 bottles on Pearl and Hermes, two had messages or, at any rate, communications in them. One contained a tract from a West Coast Bible society announcing good news for sinners: the word of the Lord will reach them even at the ends of the earth. The other contained somewhat more earthly comfort: a photograph of a pretty Japanese girl, some Japanese cigarettes and matches.

Among the beached bottles were Japanese fishing floats, beautiful hand-blown glass globes of pale green, light blue and lavender that are used to hold nets upright in the water or to support lines of baited

hooks. Many of them were the size of small grapefruit, others as large as basketballs and one, measured with Kridler's caliper, was nearly 16 inches in diameter. In use the floats are secured by light rope netting that sometimes breaks and sets them adrift. Occasionally in a storm a fishing boat may lose part or all of a tuna line, perhaps a mile long, with dozens of the big glass balls attached. They are eagerly sought by beachcombers in Hawaii, British Columbia, Washington and Oregon, who sell them to collectors and curio shops for as much as \$50 apiece. There were at least 100 of various sizes on Pearl and Hermes, waiting for someone to pick them up.

In the heat of the afternoon Kridler took a census of some small birds commonly called Laysan finches. Canary-like, with heavy bills, they very much resemble Nihoa finches, and they too belong to the honeycreeper family. They are the only land birds on Pearl and Hermes and arrived as recently as 1967, when 50 pairs of them were transferred from their ancestral home on Laysan Island. They were in no immediate danger on Laysan, but it seemed a good idea to establish a colony of them on another island as insurance. To make an approximate count of the little birds, Kridler followed the wildlife biologist's standard procedure of sampling by transects, or swaths. At random in all parts of the island he selected 100 pieces of ground, each 100 feet long and 16½ feet wide, and walked down the center of each one, counting finches as he went. The population could be calculated by a ratio: the number of birds counted is to the total number of birds as the area of the 100 transects is to the total area of the island.

I set out to walk a few transects with Kridler. He began in the middle of the island, which was covered with wiry bunch grass in which the finches had built nests. On the ground between the bunches, terns were nesting too. Below the ground, in burrows they had dug in the soft earth, wedge-tailed shearwaters were nesting. Shearwaters are about 18 inches from bill to tail tip, gray brown above and whitish below, and can dig at a remarkable rate. It is very unsettling to walk across their nesting ground. Inevitably one steps on a concealed burrow, sinks to his knees in the earth and stands there horrified, not knowing if he has crushed an adult bird, a chick or an egg. Twice when I caved in their tunnels, adult shearwaters, hopping mad, dug their way out and scuttled and bounced away unhurt.

After 25 transects I left Kridler, found a patch of shade in the lee of a tent and sat watching him. Back and forth he went under the ham-

mering sun, changing direction, counting his steps, counting birds, sinking into the earth and getting up, plodding across the hot sand and coral rock. Kridler believes in the old-fashioned virtues and regards himself as employed not by the bureaucracy in Washington but by his fellow citizens. On that small island, although it was 6,000 miles beyond eyeshot of civil-service headquarters on the Potomac, he seemed to have no thought of dogging the job by walking only 72 transects or even 99. He walked 100. He was dripping with sweat and limping when he came over to the tent and sat down to work out his ratio. The 50 pairs of finches had multiplied in five years and now, he figured, there were about 350 birds.

In the afternoon, isolated clouds drifted over the green lagoon, and the reflection of the sunlight from the water tinted the bottoms of the clouds. It was a good strong tint that must have been visible for many miles, if anyone beyond the horizon had been looking for it. Polynesian sailors, who were among the best the world has known, used to find atolls by searching the sky for green-tinted clouds. At sea they also studied the flight of birds heading from their fishing grounds to their colonies to feed their young, and the men turned the prows of their seagoing canoes to follow. Now the birds were beginning to straggle back to Pearl and Hermes, carrying in their gullets and stomachs small fish and squid that they would regurgitate for their chicks.

Albatrosses feed largely on squid, and their digestive systems contain reservoirs of oily squid chowder. When a chick inserts its beak crosswise into its parent's beak the adult expels a jet of liquid that the chick catches so deftly that not a drop is spilled. Albatrosses continue to feed their young until they are five to six months old and almost ready to fly, and then abandon them. Thereafter the chicks, which drink salt water, may go without food for as long as two or three weeks, living on their body reserves. If they have not learned to fly and fend for themselves by then, they die. Many of those on Pearl and Hermes had already been abandoned and a man could tell almost at a glance which of them were going to live, and which not. The weaker birds would stand in one place day after day, scarcely moving, while the stronger would continue to exercise their wings preparing for their long flight out to sea.

Some of their short practice flights, however, ended in quick death. The chicks would land 20 or 30 yards offshore and while they drifted with outstretched wings sharks would drag them under. The annual feast of albatrosses had attracted to the island a large number of sharks,



Member of a species once found only on Laysan Island, a Laysan finch, shown nibbling seeds of setaria grass, is one of a growing colony introduced to Southeast Island on Pearl and Hermes Reef in 1967. The bird's right leg has been banded for identification. The island's only land birds, Laysan finches feed on insects and grass seeds. In choosing nesting grounds, they favor the dense matting of eragrostis grass on the island's sheltered side.

among them reef whitetips and tigers, which sometimes swam so close to the beach that their bellies appeared to rub the sand. A few years ago on Midway, sailors from the naval station caught a 16-foot tiger shark and strung it up on a pole to take its picture. After a couple of bushels of wet feathers had oozed out of the shark's mouth the sailors cut it open and found 13 young albatrosses inside.

Among the birds coming home to feed their young there were a number of boobies, so called because of their apparent stupidity, although that may not be quite the word to apply to them. The three species on Pearl and Hermes have a persecuted, frantic look that fits well with their names—the blue-faced booby and the red-footed booby, which are white, and the brown booby. The adults are about 18 inches tall and appear to be hard-working conscientious birds. By day they toil in their watery vineyard, dipping into it for squid and skimming over it to catch flying fish, and when they have a full basket for their chicks they try to get it home without being hijacked. They fly low, as though trying to escape the notice of the piratical frigate birds, but this is not much use. The frigates plunder them anyway.

Frigate birds, also called man-o'-war birds, are nearly as large as albatrosses although lighter, blackish in color and with wingspreads that approach seven feet. They have long, deeply forked tails, which in flight they open and close like shears. They are absolute masters of the air, remaining aloft indefinitely by riding currents, although they can also perform acrobatics and can put on a handsome turn of speed. When the boobies and tropic birds come home loaded late in the day, the frigate birds dive down on them and sometimes even grab them, forcing them to cough up their catch. Before the falling fish or squid can hit the water the frigates swoop down and gobble it up. Luckily most boobies carry more than one fish. In *Birds of Hawaii* ornithologist George C. Munro quotes an observer who is "positive that [the booby] always gives up a flying fish to the frigate, retains a squid for its young and a flying fish for itself." Whatever the case, the look of the boobies is not so much one of stupidity as of extreme exasperation verging on lunacy.

Frigate birds have their own problems. I watched one commit a mid-air robbery and take the fish home to its own chick. The frigate glided in, braked, hovered over the nest and then collapsed on it like a broken umbrella. After countless generations of airborne existence the legs and feet of frigate birds are atrophied, weak and useless except for perching. The birds cannot walk. When they land they must come down on a spot with some elevation, however slight, so that they can take off

again without the aid of an upward push with their legs. Their great wings can make the most of the smallest updraft, but if they chance to land on a flat place on a calm day they must do a great deal of flapping and floundering before they can become airborne once more.

After dinner Marvin Cunningham, the Navy hospitalman, said that he had found a dead seal, and we walked over to have a look at it. The animal had been dead for a couple of months and there was no longer much odor. It was on the coral-reef side of the island, lying in a few inches of water in a tiny protected cove. Small waves, only a few inches high, had been lapping at the carcass and had neatly separated most of what remained of the flesh from the bones, so that Cunningham's task was mainly to gather them up and put them in a huge plastic bag. The action of the waves had detached some of the smaller bones and teeth from the skeleton. Cunningham searched carefully for them in the water, meanwhile talking about the unusual characteristics of seals.

Seals can dive to remarkable depths—a few have been caught by accident on fishhooks as far as 500 feet or more under water. One reason for their remarkable swimming ability is that most seals are so streamlined; they have no protuberances anywhere. The sex organ of the male is recessed and can be thrust out through a slit in the body when needed. To assist in this the seal has a baculum, or penis bone, that is also found in some other mammals, although not in the primates. It is not firmly attached by ligaments to other bones and thus it can readily become separated from the rest of the skeleton. In the case of Cunningham's seal this had already happened and he looked right and left for the bone in the shallows. "We can't send an incomplete skeleton to a museum," he said.

"God forbid," said a coworker, joining in the search.

At length Cunningham found the bone, which resembled a small ivory pencil, and put it in the plastic bag with the others. When he got the skeleton back to Midway Island he would put fresh water and detergent in the bag, and after some soaking, scrubbing and drying it would be ready to pack and ship.

Night, in contrast to the shattering dawn, seems to fall slowly in the mid-Pacific. It takes the stars a long time to drill holes in the sky. When it was dark Kridler made another patrol of the island. On the beach, barely visible against the sand, hundreds of little nocturnal ghost crabs glided back and forth. The flimsy tower with its guano-covered jerry can loomed like a scaffold. The sooty terns, which fly all night calling

out their other name, "wideawake, wideawake, wideawake," swooped low overhead. As we approached the grassy center of the island Kridler stopped, listening. At first I could hear only the noise of the terns but then beneath it emerged a hair-raising sound, exactly like the sound of men and women, barely conscious, in agony. There were long-drawn-out feminine moans answered by masculine groans; wordless noises of heartbreak and grief; mournings, wailings and low lamentations. Certainly no other birds, and probably no other living creatures except humans, make such sounds. It was a colony of tunnel-digging shearwaters. They were singing.

In the morning Kridler and Cunningham set out to tag some seal pups. Hawaiian monk seals come ashore on Pearl and Hermes and other refuge islands throughout the year. Like humans, they are fond of wriggling on the sand until they have made a comfortable pillow and bed, where they doze in the warm sun. They are trusting creatures who have no enemies but man on land, and in the sea only the shark. A man can approach within four or five feet of them before they show any alarm, and even then they merely grumble about being disturbed and do not become belligerent. Females with pups will roar and try to bite anyone who threatens their pups, but this is not very surprising. The faces of the seals seem wise and pensive, with drooping whiskers and sad eyes. They appear to be weeping, and in fact they are. Unlike most mammals, seals have no tear ducts to drain off internally the fluid that lubricates their eyes. Instead, the fluid overflows externally, rolling down their cheeks in streams of seeming sorrow.

When seal pups are born they weigh about 35 pounds and are covered with beautiful glossy black fur, for which they would be clubbed to death if hunters could get at them. They grow at an incredible rate, drinking huge quantities of milk, and may reach weights of 200 pounds within six to seven weeks, after which they are weaned. Once on their own, they shrink to perhaps 100 pounds and begin an orderly growth until they become eight feet long and weigh 650 to 700 pounds. They moult their black baby fur six to seven weeks after birth, eventually becoming soft grayish brown above and light gray on their stomachs.

Kridler and his coworkers have been tagging seal pups since 1966 and have become very adept at it. There were a half-dozen pups on the beach with their mothers and he tagged each one in a matter of three or four minutes. Cunningham would distract the mother, waving his arms, jumping and shouting, while Kridler slipped in behind and quickly fastened a tag in the webbing of the pup's hind flipper. During this

operation one of the pups became so far separated from its angry parent that it seemed safe enough to pick it up. I held the pup in my arms for a few moments, looking at its friendly unsuspecting face, and put it down when a big tear welled out of the corner of its eye. The pup hurried off to join its mother and the two immediately touched noses, which is apparently the seals' way of reassuring each other.

After the last of the pups had been tagged, we waited on the beach for the Navy helicopter from Midway to pick us up. An adult seal was swimming lazily about 50 feet offshore and Kridler was taking pictures of it. It was then that we saw the shark's fin cutting through the small waves, fast, in a straight line for the seal. Within seconds there was a thrashing in the shallow water where the two had met.

We wear, all of us, the old mammal school tie. Our blood is warm. We rarely think, until we see and become emotionally involved in a fight between a fellow mammal and a damned shark, just how strong our loyalty is. I glanced at Kridler, who was trying vainly to get pictures of the underwater struggle. He was yelling encouragement to the seal and so was I. We shouted until we were hoarse, both of us prejudiced, bloodthirsty mammalian chauvinists to the core.

What can a seal do against a shark? I had read that porpoises had been known to fight sharks. They form a ring around their enemy, and while a porpoise on one side of the ring makes a diversionary movement, another on the opposite side dashes in and rams the shark with the top of its head. In short order they batter the shark to death. But a lone seal? For an instant as I stared into the water I thought of *The Threepenny Opera* by that outstanding German mammal, Bertolt Brecht, and the translation, "When the shark bites with his teeth, dear/ Scarlet billows start to spread. . ."

But there were no scarlet billows. God knows what the seal did to the shark, but after a few wild flurries the shark turned tail and swam off, beaten. The seal continued to laze along in the water, parallel with the beach, and then hauled itself ashore about 50 yards away. There was not a mark on her, or him. It is too much to think that the seal understood our cheering, any more than it understood the gigantic bird that soon came rattling down, swallowed us, and flew away.

A Teeming Speck in the Ocean

PHOTOGRAPHS BY DAVID CAVAGNARO

Far off the course of the ships that ply the Pacific, a mere speck in the ocean when seen from a passing jet, Pearl and Hermes Reef ranks high on any list of the world's most isolated places. Since 1822, when the wreck of the whalers *Pearl* and *Hermes* gave it its name and put it on the map, relatively few people have set foot there. The nearest landfall is Midway, 100 miles to the northwest. And although the reef is officially one of the Hawaiian Islands, Honolulu lies over 1,000 miles southeast.

But if human beings find Pearl and Hermes off the beaten path, other creatures do not. From the surrounding sea—itsself incredibly rich in fish—seals and turtles lumber ashore; albatrosses, frigate birds and a dozen other winged species come wheeling in. All these visitors derive their sustenance from the ocean, but must touch down on dry land to fulfill critical parts of their life cycles. Pearl and Hermes Reef well serves their purpose, thanks to its very isolation and security—it has been part of the Hawaiian Islands National Wildlife Refuge since its creation in 1909.

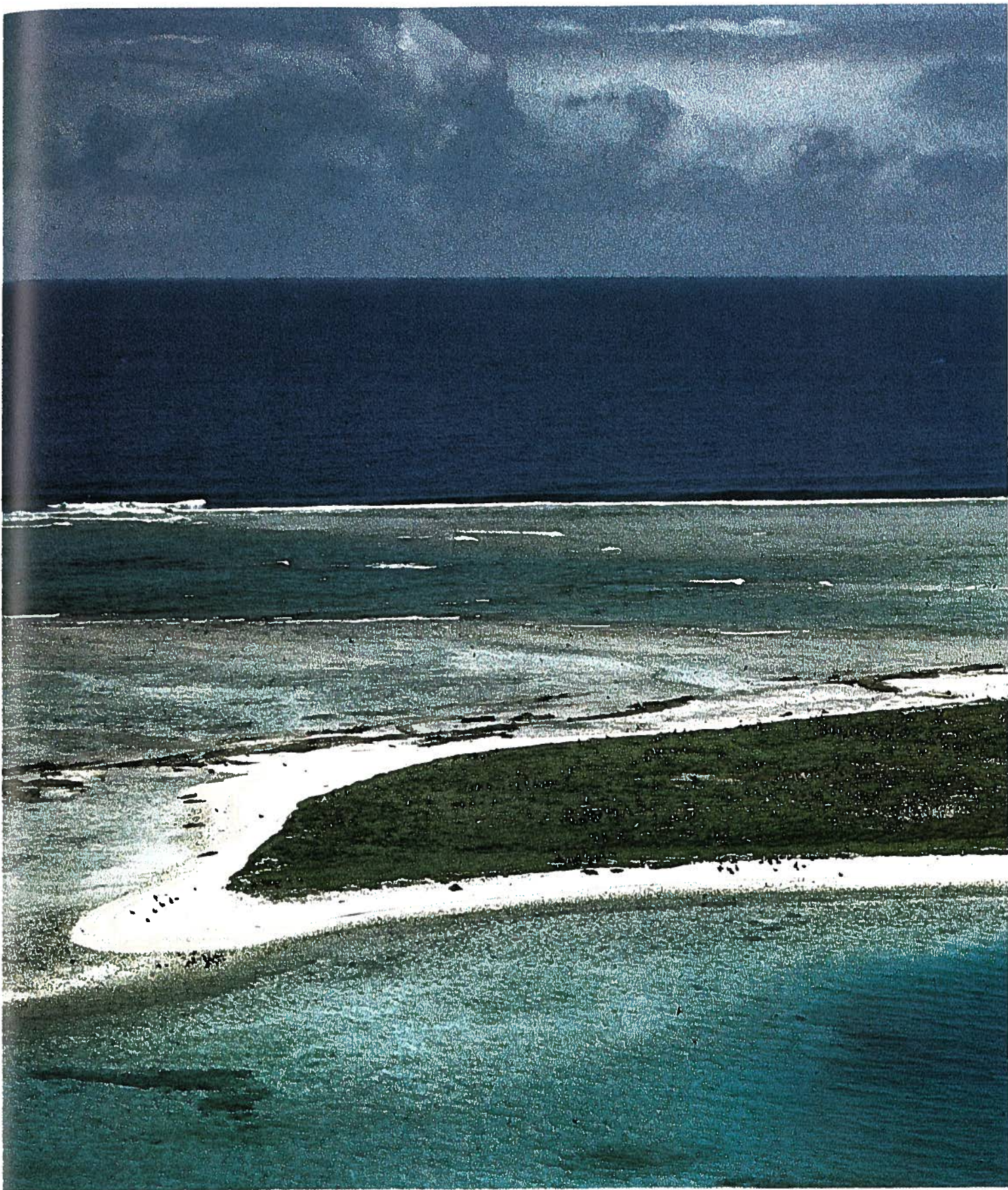
Pearl and Hermes is not one reef but a series of them—a small atoll—forming a 15-mile-wide circle of coral around a lagoon whose waters

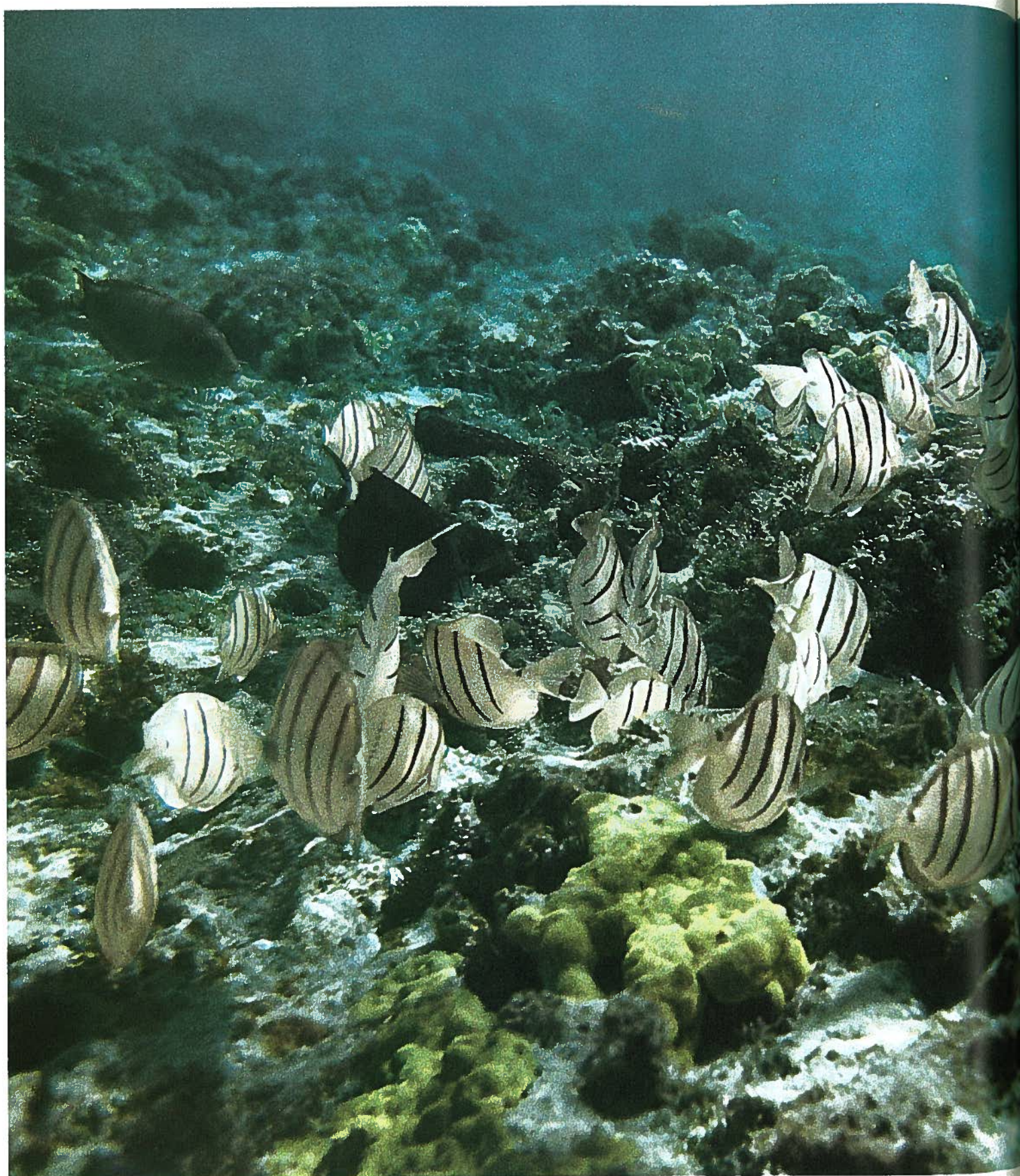
fill the site of a sunken volcano. Most of the atoll lies below the surface of the sea; the notable exception is a kidney-shaped 31-acre tract of coral and sand known as Southeast Island, which stands only 12 feet above sea level at its highest point.

Southeast Island, where most of the photographs on the following pages were taken, is no paradise for the creatures that tenant it. The climate is mostly hot and dry; the island is steadily whipped by trade winds, tempered only occasionally by brief tropical showers. Salinity poses a constant threat of dehydration. The only plants that survive are grasses and vines that retain a large quantity of water in their leaves. Though scrawny, they provide a dense matting that helps to anchor the thin blanket of sand on the coral.

Each in its own way, the species that use the island as a base adapt to its living conditions. The birds, for example, have learned to tip their beaks up to catch a life-sustaining sip of rain; some use the plant matting as nesting places. Whatever their distinctive habits, seals, turtles and sea birds alike return periodically to the island to court, breed, nest, hatch, raise young—and thus perpetuate their kind.

A helicopter view of part of Pearl and Hermes Reef reveals its three distinct environments. In the foreground is the shallow lagoon, a lighter hue than the deep ocean (background). The third component, coral, appears in the form of a barrier reef, causing a white line of breakers, and as sand on Southeast Island, seen jutting into the lagoon.





A SCHOOL OF MANINI SWIMMING OVER PORITES CORAL

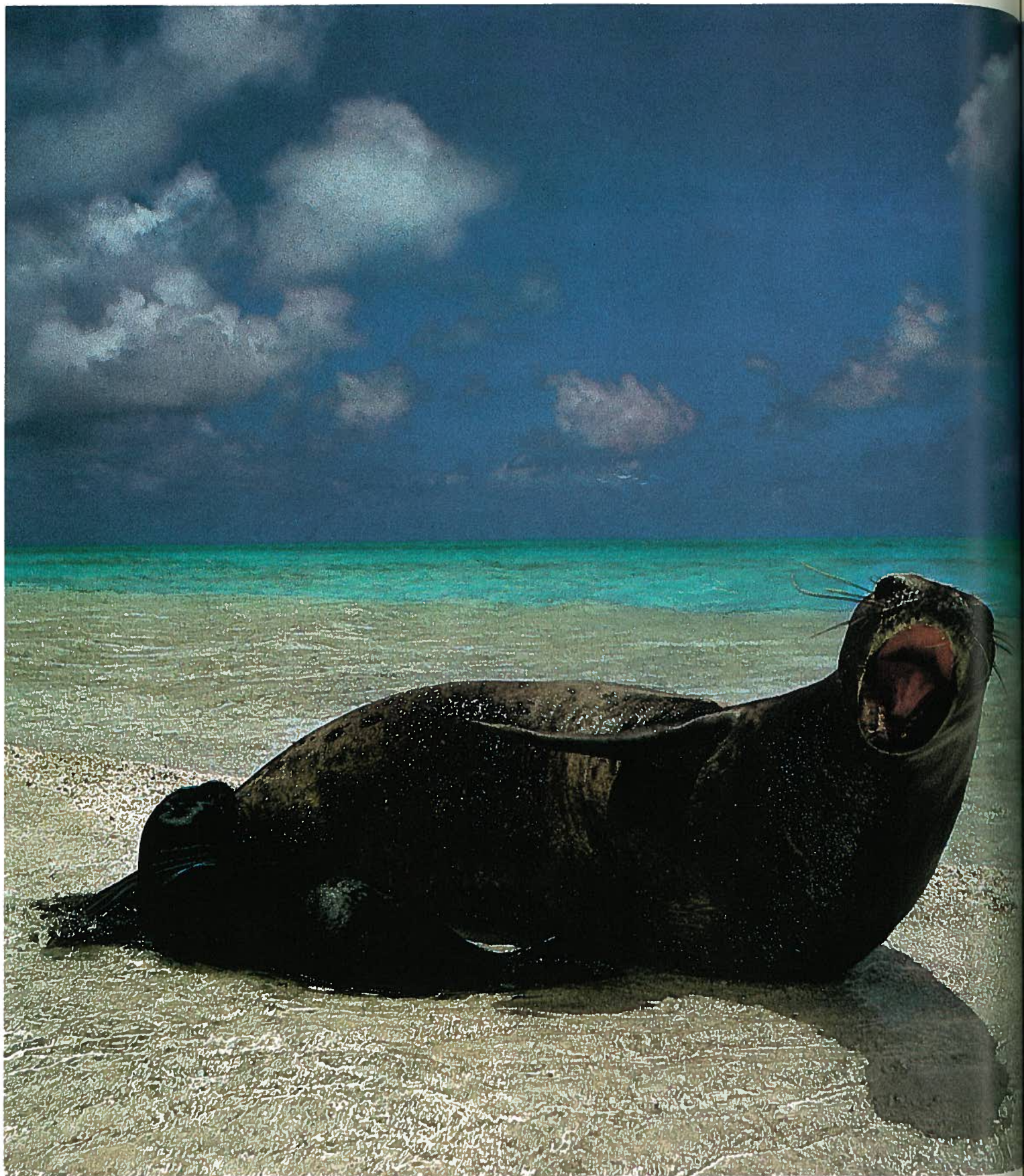


Life and Death in the Lagoon

The lagoon of Pearl and Hermes Reef is less than 10 feet deep in places, yet its shoals harbor a huge and diverse population of butterfly fish, parrot fish, starfish, squid, sea urchins and the ever-present black-striped manini (left). About nine inches long when mature, the manini belongs to the surgeonfish family, so called for the scalpel-like spine they use as a weapon of defense. Like the manini, which feeds on algae, most of its neighbors are also grazers, sustained by the detritus that drifts down through the underwater coral reefs, which are built up of the skeletons of tiny creatures such as porites and pocillopora.

Off limits to fishing and to the oystering once pursued there, the lagoon shields its own against all but their natural foes. A swooping sea bird nabs a fish venturing near the surface; doom also lurks in the form of larger fish—*ulua* and tiger sharks—that invade from the ocean via breaks in the barrier reef. The shark, omnivorous in its tastes, will make a pass at anything alive in the lagoon—seals and turtles in transit, an underwater photographer—but will settle for mouthfuls of the little lagoon dwellers.

In these harsh but necessary relationships between predator and prey, the waters of Pearl and Hermes Reef help preserve the delicate life-and-death balance ordained by nature, free of the upsets that human interference would bring.



MONK SEAL DEFENDING ITS PUP AT A VISITOR'S APPROACH

A Secluded Shore for a Seal Nursery

The Hawaiian monk seal, named for the cowl-like skin fold at the back of its neck, is only one of two species of seal that live permanently in tropical waters. (The other is the elephant seal.) The monk seal is faring particularly well at Pearl and Hermes Reef and all through the Hawaiian Islands National Wildlife Refuge—in conditions not shared by its kin elsewhere. In the Mediterranean declining numbers of the species have been driven back to a few small islands by man's encroachment, and in the Caribbean a lone pair of monk seals was last seen in 1949.

Even the Hawaiian seals were hunted to near-extinction by 19th Century sealers for their fur, meat and oil. By 1900 the monk-seal population in this area of the Pacific had dwindled to less than 100. When the Hawaiian wildlife refuge was established, they acquired a new lease on life, and now number about 1,500. Pearl and Hermes, with its smooth, sandy, isolated beaches, is one of their principal pupping grounds.

Monk seals mate once a year, but the cow bears young—a single pup—only every other year. This curious circumstance results from the fact that mating takes place soon after pupping time, but cows that have just given birth cannot conceive until the breeding season is past; since their pregnancy spans 11 months, they produce offspring in alternate years—a natural and automatic form of population control.



A SEAL PUP NURSING



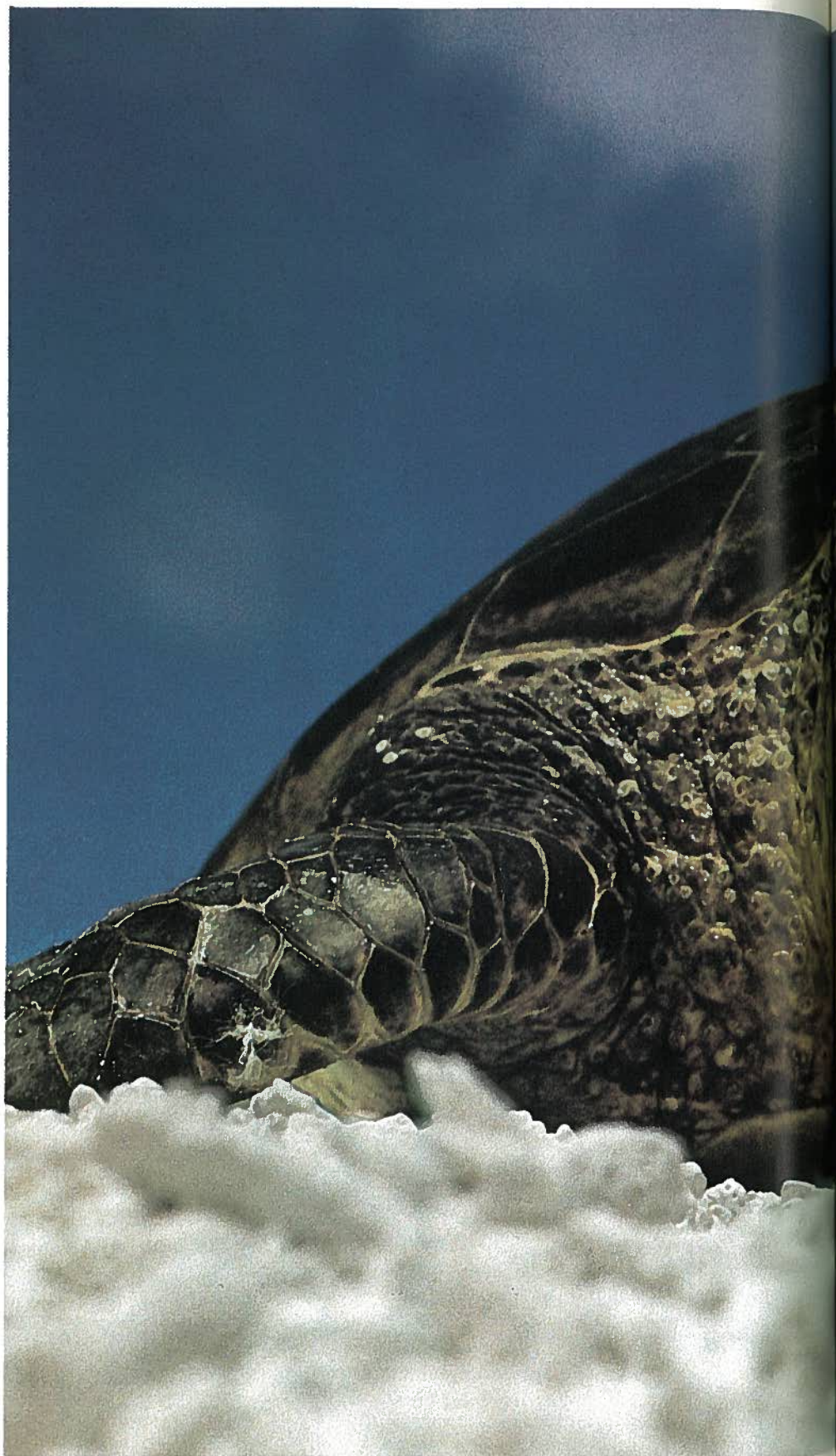
A YOUNG ADULT RELAXING ON THE BEACH

The Behemoth of the Beach

On any given day the coral sand beach at Southeast Island may be host to half a dozen or so giant green turtles. Having fed at sea on algae and seaweed, they come ashore to sleep—sometimes for days.

The turtle population on the beach increases somewhat from May to July as females arrive to lay their eggs. While they nest only every third year they do so on a grand scale, each depositing 400 to 500 eggs in the process. After seven weeks of incubation in the gentle heat of the sand, hatchlings make an instinctive dash for the lagoon, running a gauntlet of predatory frigate birds. Once in the water, they are prey to sharks and *uluu*; only two per cent of them reach maturity.

Despite this low rate of survival, a turtle herd can maintain or even increase its numbers because those that do survive can live a century or more. Their longevity depends to a certain extent on their wanderlust, or lack of it. Green turtles have been known to roam the Pacific for distances of as much as 600 miles. The more they travel the more they are likely to end up as turtle meat, a gourmet delicacy. The state of Hawaii has no closed season on turtle hunting, and no restrictions on the number or size that may be captured. But the secluded waters of the wildlife refuge provide the turtles with reasonable security against poaching, and currently about 1,000 of them enjoy its protection.





ABOUT 300 POUNDS OF GREEN SEA TURTLE, HEAD ON



A SPHINX MOTH REPOSING ON SETARIA GRASS

A Precarious Foothold for Plants and Insects

The fact that there are plants and insects at all at Pearl and Hermes is a miracle of nature. Vegetation is vital to the islands of the atoll because it anchors the sand and provides nesting shelter for many sea birds. Yet prevailing conditions conspire to thwart the growth of all but the hardiest plants. Fresh water is available only from occasional tropical showers. Average tides rise two feet, washing over the mostly flat ground and dappling it with salt.

Seeds borne by the trade winds and the birds take hold only if they are of plant species that are endowed with fleshy leaves to store water and hairy surfaces to retard evaporation. Setaria grass is one of the handful of plants that have managed to establish themselves and another, perhaps the most successful, is the puncture vine. In 1931 only one of its seedlings was reported on Southeast Island; today it is a mainstay of higher ground there, which it covers with a dense matting.

Among the few insects that have triumphed over the vicissitudes of life on the atoll are the miller moth and the sphinx moth. A particularly remarkable adaptation was made by the sphinx moth. It is equipped with a long tongue to collect the nectar deep inside trumpet-shaped flowers—none of which grow on Southeast Island. As a result, it has learned to feed on the puncture vine's unfurled buds, which resemble the sphinx moth's favored trumpet blooms.





A SPHINX-MOTH CATERPILLAR



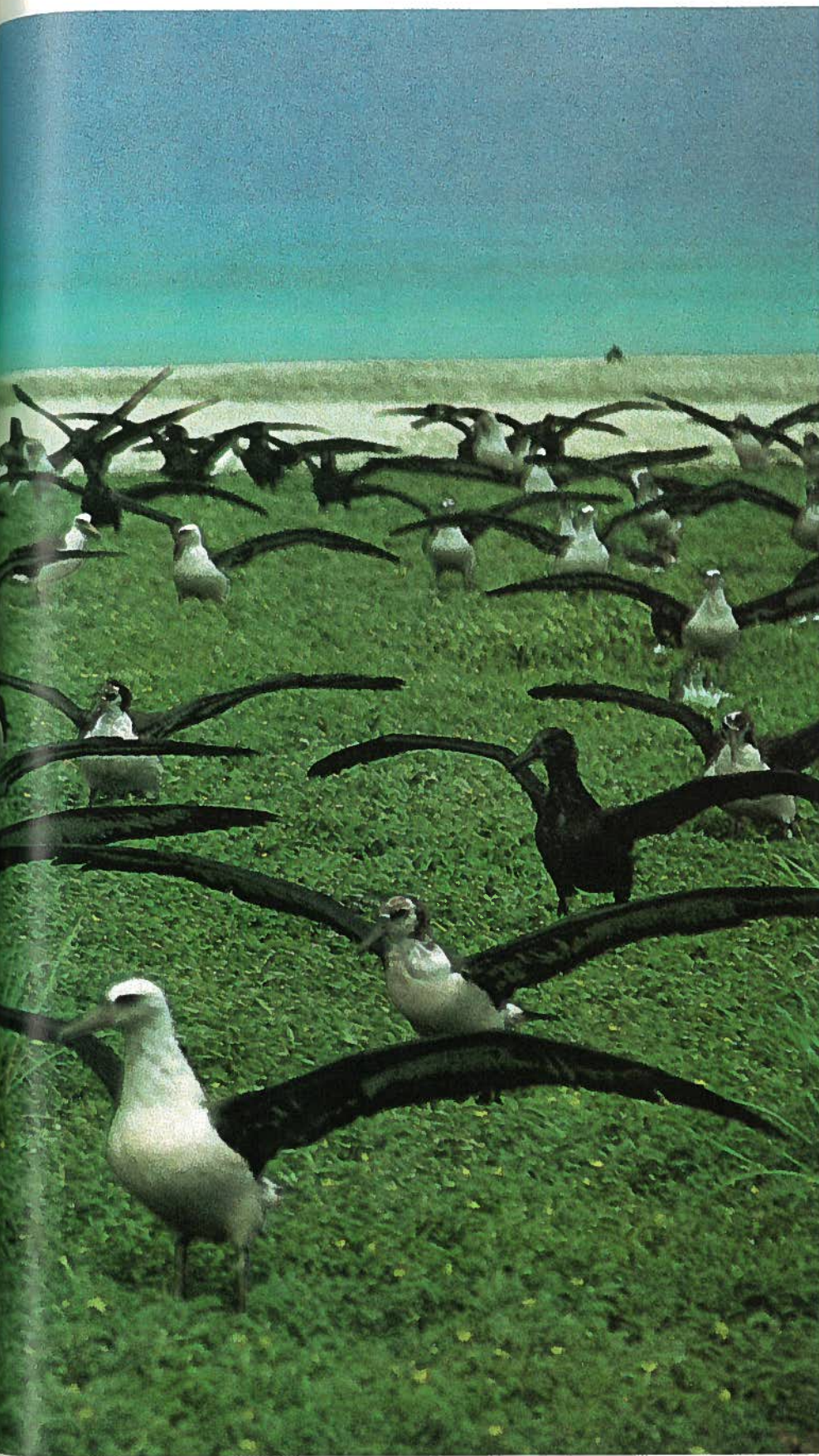
PUNCTURE VINE IN FULL BLOOM



A MILLER MOTH ON A PUNCTURE VINE



FLEDGLING ALBATROSSES START LEARNING TO FLY



A Serene Haven for Sea Birds

Legions of sea birds (*left and overleaf*) have turned Pearl and Hermes into one gigantic rookery. By the tens of thousands, albatrosses, terns, boobies, tropic birds, shearwaters, noddies and other species claim just about every square inch of available nesting space. The shearwaters, in fact, raise their chicks in burrows underground, thus creating a double-decker kind of hatchery.

Because the adult birds feed themselves and their young on marine animals such as flying fish and squid, there is perpetual swarming overhead as they commute between water and nest. A human visitor can take few steps without the risk of being buzzed by an incoming tern, sinking knee-deep in a nesting burrow or crushing a newly laid egg. In fact, he can even reach up and pluck a bird right out of the air.

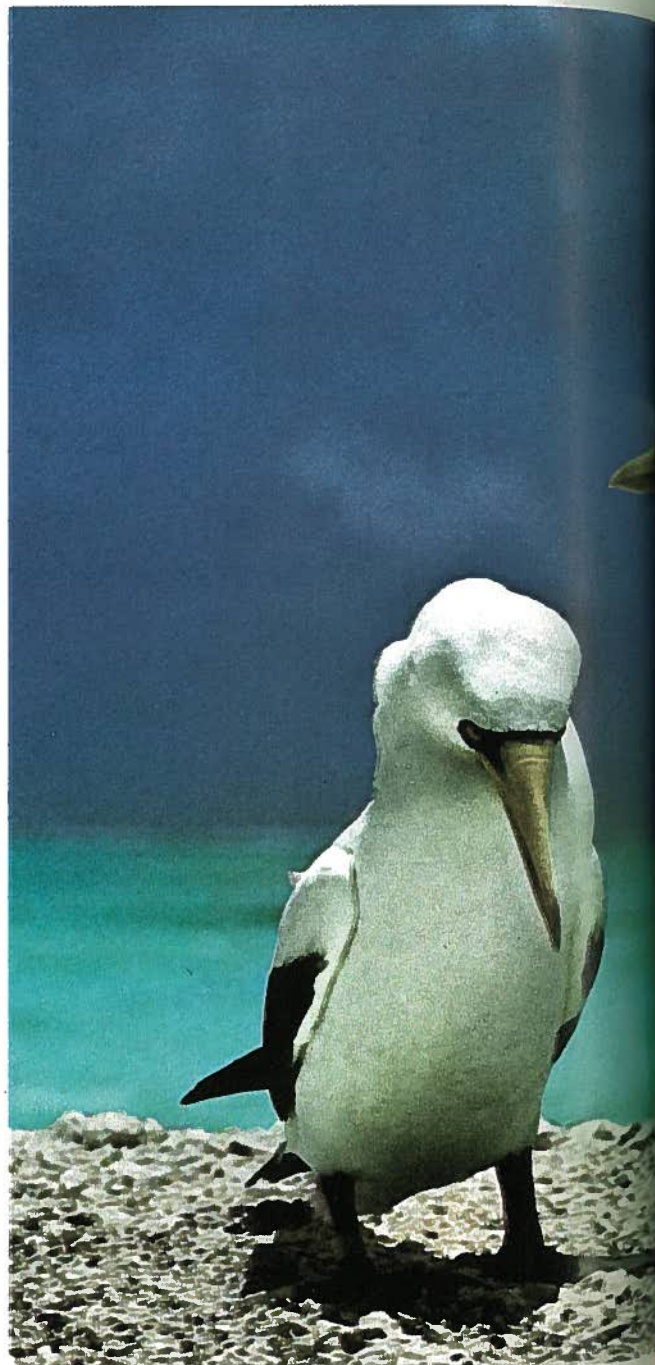
In all the apparent chaos there is, however, some order. Each species of bird stakes out a different area for its nesting ground. On Southeast Island, for example, black-footed albatrosses tend to hang around the beach; the Laysan albatrosses favor the grassy stretches farther inland. Sooty terns flock by the tidal basin; white fairy terns perch separately on craggy coral. Blue-faced, or masked, boobies prefer the bare coral beach; their red-footed cousins build their nests on higher ground amid the puncture vines. The shearwaters, in a sense, have the best of it: an underground kingdom all their own.



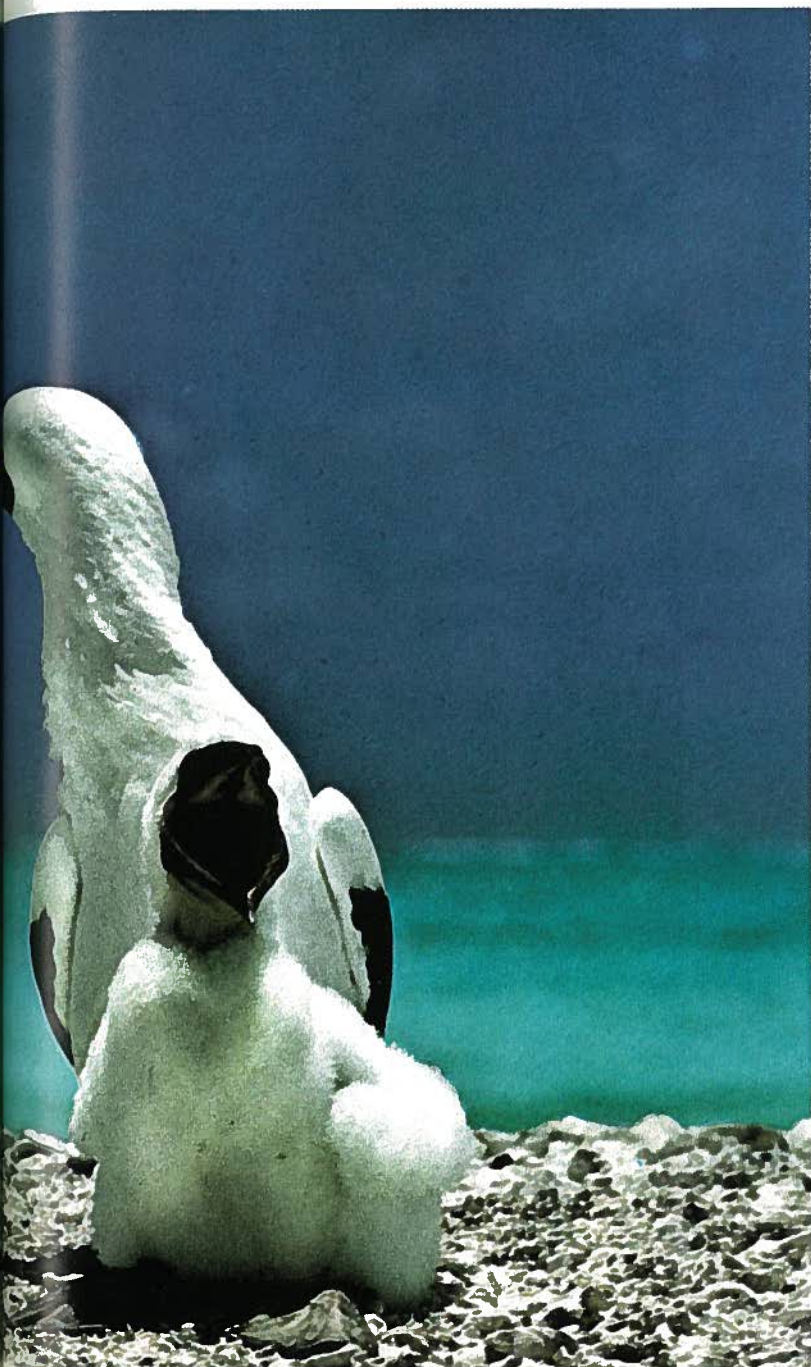
A NODDY TERN BROODING IN ERAGROSTIS GRASS



A WEDGE-TAILED SHEARWATER IN ITS BURROW



MASKED BOOBIES AND CHICK



A RED-TAILED TROPIC BIRD



A FAIRY TERN RESTING ON CORAL



A RED-FOOTED BOOBY WITH ITS FLUFFY YOUNG



Converging from every point on the horizon, sooty terns head back for Pearl and Hermes Reef at sunset after a long and vigorous day



of ocean fishing. Their stomachs are replete with squid and small fish, which they will regurgitate and feed to their waiting nestlings.