

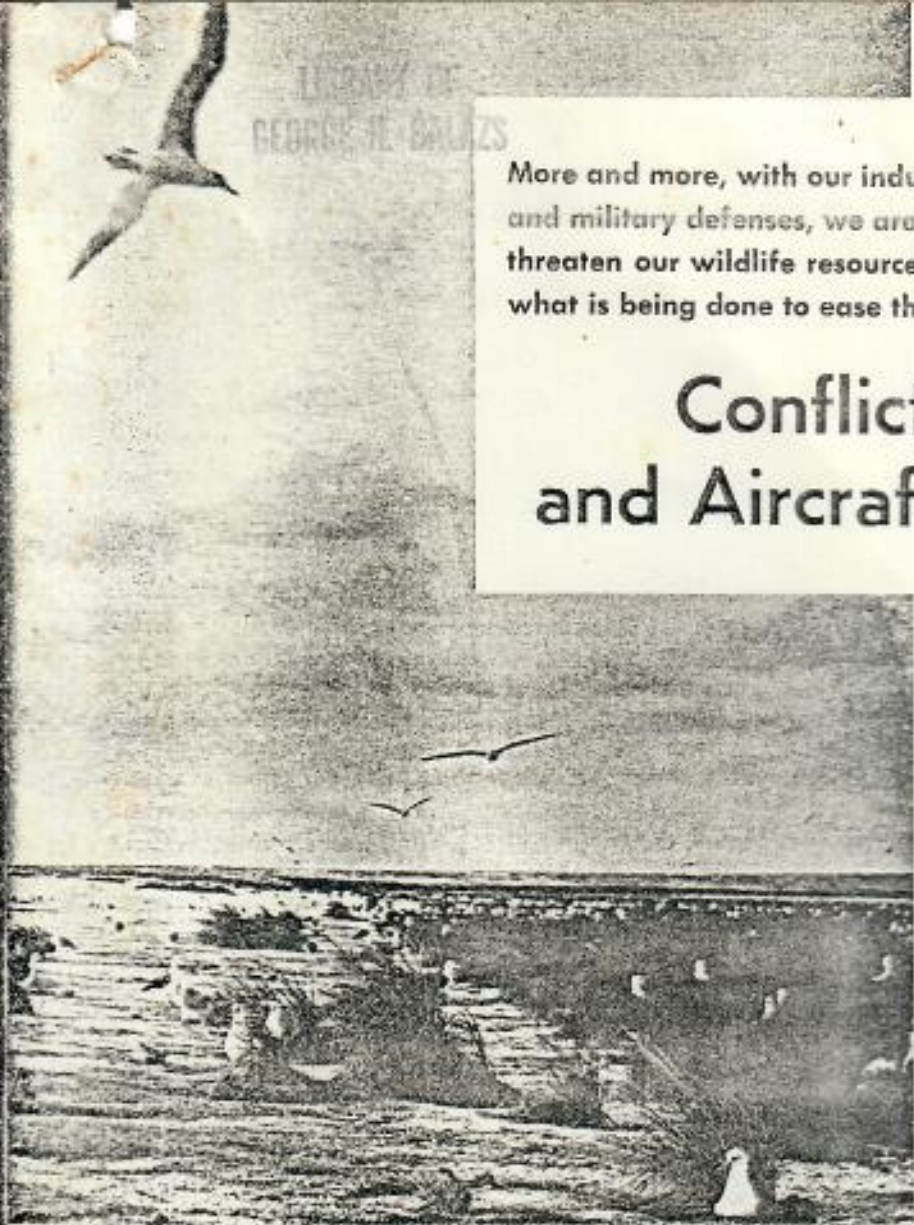
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GEORGE H. BALAZS

More and more, with our industrial progress, population growth, and military defenses, we are faced with problems that seriously threaten our wildlife resources. A government scientist explains what is being done to ease the

Audubon Magazine

# Conflict of Birds and Aircraft at Midway\*



Photograph of Laysan albatrosses at Midway by Alfred M. Bailey.

By John W. Aldrich

MIDWAY ISLAND is a coral reef encircling two islets of coral sand in the middle of the Pacific Ocean. Although these two little islands, about two miles apart, total only 1,282 acres, they are extremely important to the United States as a strategic naval base. The significance of the Battle of Midway in World War II is still fresh in our memories. At present Midway is the anchor of the Pacific DEW Line—the Distant Early Warning system—designed to protect our territory from future attacks like that at Pearl Harbor. Midway is, therefore, a naval air base of great strategic importance. It is also a steppingstone in the Military Air Transport Serv-

ice between the United States and its bases in the vicinity of Japan. The air base is on Sand Island, the larger of the two. Eastern Island is practically unoccupied by humans.

Midway is also important to vast numbers of birds of the open sea which must have some dry land on which to nest. Two-hundred-and-fifty-thousand albatrosses of two species—the Laysan albatross and the black-footed albatross—about one-third of the world population of these birds, choose Midway for this purpose, as do other thousands of sooty terns, tropic birds, petrels, and shearwaters. In fact there is very little space at Midway, either above or below ground, which is not occupied by a nesting sea bird at some time during the year. Unfortunately, considerable of the air space above the ground is also occupied by these birds when not actually engaged in their nesting duties. At any time of

day, but particularly early in the morning, a cloud of albatrosses is wheeling about overhead, some, unfortunately, over the vital strips of concrete where the aircraft land and take off. It is inevitable that many of these birds are hit by planes coming and going, and occasionally a plane is damaged. It is, therefore, not surprising that officials responsible for the safety of expensive aircraft and the lives of those who ride them are concerned and want to do something about the problem.

On November 17, 1956, I was one of a party of three biologists from the U. S. Fish and Wildlife Service that landed at Midway for the purpose of trying to solve this problem. Other members of the party were Chandler Robbins and Dale Rice. Robbins and I stayed on the island for a month. Karl Kenyon arrived there January 1, 1956 and remained until the end of June. Rice is still there.

The first task was to attempt to determine what part of the bird population is involved in the hazard to aircraft. It did not take long to discover that the albatrosses were the only ones which appeared in numbers in the air over the runways at that time of year. Further studies showed, that, of these, the ten times more numerous and more generally distributed Laysan albatross was the bird chiefly involved with aircraft. In fact, the black-footed albatross, in only about one per cent of total collisions, has now been discounted as a serious element in this problem. In the spring and summer when the sooty terns are nesting on the island they, too, are over the runways in large numbers. During the summer the red-tailed tropic birds frequently gather in groups of several hundred in the air to perform their curious

\* Dr. Aldrich presented this address at the 53rd Annual Convention of the National Audubon Society on November 11, 1957. He is in charge, Section of Bird Distribution, Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior, Washington, D. C.—The Editor.

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backward-flying aerial dances, and are occasionally struck by planes. Two abundant species of sea birds divide the night shift in the air over Midway—the Bonin Island petrel in the winter half of the year, and the wedge-tailed shearwater in the summer half. At the present time planes seldom operate in and out of Midway at night and so these nocturnal fliers have not become a hazard yet. The chief objection to these birds so far is that they dig up the lawns with their nesting burrows which are said, also, to weaken the foundations of buildings and pavements.

When it became apparent that the big, black-and-white Laysan albatross was of primary concern to aircraft safety, we focused our attention on finding out whether all or only part of the Midway population was involved; and, if the entire population was *not* involved, what portions of it were. This we did by coloring the plumage of albatrosses that represented segments of the population which were nesting at varying distances from the aircraft runways. First, only birds that were nesting were so marked, but later those which were not nesting were also colored. The non-nesting Laysan albatrosses make up about 15 per cent of the total population. Soon, birds with their white breasts blotched with brilliant red, yellow, blue, and green, much to the amusement of the

human population, began appearing, sitting solemnly on their nests all over the island.

I should tell you that the human occupants of Midway, consisting of about 600 military personnel and about 1,000 Hawaiian laborers, are very much interested in the "gooney birds," which is their name for the albatrosses. To these people, Laysan albatrosses are "white gooneys" and black-footed albatrosses are "black gooneys." Everyone talks about the gooney birds—their comings and goings and curious antics, and are very much concerned about their welfare. After all, the gooneys nest in their backyards and front yards, and around all the office buildings. They compete with pedestrians for the sidewalks and with cyclists for the streets of the settlements. They are very tame and awkward in their movements on land. There is a constant babble of gooney voices during the daylight hours, like those from a great barnyard. A most amazing assortment of sounds are made by these fowls. They cackle like hens, moo like cows, bleat like sheep, squeal like pigs, twitter like songbirds, and shriek like children at play. Hollow knocking sounds are made by snapping their beaks. This may be done slowly or with such rapidity that it sounds like a woodpecker drumming on a hollow stub.

The greatest public interest is

aroused by their dances. These are grotesque performances in which two or more birds join in the most exaggerated bowing and teetering, with whacking of bills together and many other quick gestures accompanied by amazing vocal sounds.

The gooneys are so much a part of the life and interest of the island that people miss them during the three months when the birds are at sea, and look forward to their return in the fall. Interest in the gooney birds is at its peak when they begin drifting in from the ocean—each bird on arrival sprawling headlong in a disorganized heap on the unfamiliar element of solid land. Coral sand and asphalt are not like water.

We were interested to discover, from our color-marking experiments, that albatrosses which appear in the air over the runways, and thus are a hazard to aircraft, are about one-half birds which are either too young to nest, or have been displaced in their nesting by construction operations. Non-nesting birds comprise only one-sixth of the total island population, therefore it is significant that such a large percentage of the birds over the runways are of this class. Most of the nesting birds that fly over the aircraft runways, as one might expect, are from sites close to the runways; two-thirds of them within 750 feet.

Laysan albatrosses on their nesting grounds, Eastern Island, Midway, photographed by Thomas M. Blackman.







Black-footed albatross photographed by Lewis Wayne Walker.

A negligible number (one-half of one per cent) are from the built-up area which is everywhere several hundred yards from these vital air strips. Only one marked bird from Eastern Island, so far, has been recorded over the Sand Island runways.

All sorts of scaring devices and deterrents, such as sound and smoke, had previously proved ineffectual in moving these birds from their chosen lifelong nesting sites. Egg destruction even intensified the problem by causing more non-nesting birds to be in the air. One of the methods frequently suggested was to transport the birds away from Midway to such a distance that they would not return. To test the feasibility of this approach, 18 Laysan albatrosses were taken from their nests on Midway and shipped on naval planes to distant points around the Pacific Ocean. Fourteen of these returned from distances ranging from 1,315 miles to 4,120 miles—birds that were released in places ranging from Whidby Island, Washington, to Langley Point in the Philippines. An average of about 200 miles a day was traveled by the birds which returned. Enough said about the chances of solving the problem by moving the birds away from Midway in the hope they would take up their nesting elsewhere!

Early in the study of Sand Island, it was thought that satisfactory control of this bird hazard to aircraft could probably never be achieved without eliminating at least a part

During World War II, the enormous population of sooty terns on Ascension Island in the South Atlantic, off the west coast of Africa, caused considerable difficulty to U.S. Army aircraft landing there and taking off. Dr. James P. Chapin, then Associate Curator of Birds, American Museum of Natural History, New York City, was sent to Ascension Island to study the problem. Dr. Chapin discovered that if the eggs of the nesting terns were destroyed in the areas immediately adjacent to the aircraft runway, the terns moved away.

In an article "Wideawake Fair Invaded" (*Natural History Magazine*, September 1946), Dr. Chapin wrote: "No sooner had I related the success of my simple experience than the decision I was so reluctant to make was snatched from my control. . . . Major Brown took a detail of three soldiers, each with a long stick, and the breaking began. Every egg in the offending area must be destroyed, but no adult tern must be struck. We felt sure they would leave within a few days. . . . Gradually the numbers (of sooty terns) flying over the devastated area dwindled. I visited several other thriving colonies . . . at various points well away from the runway and made sure they were unmolested.

. . . Eleven days after the first wholesale destruction of eggs, I noticed few birds flying over the abandoned area, even after sundown, and none alighting."—THE EDITOR

of the albatross population. Therefore, after the color-marking experiments had shown that the occurrence of nesting birds over the runways was in proportion to the proximity of their nest sites to the runways, an experimental population reduction program was carried out. Sixty-two hundred albatrosses were killed in a centrally-located, triangular area bounded by runways. However, subsequent observations showed that the elimination of these birds had no noticeable effect on the frequency of birds soaring over runways adjacent to the depopulated area. It was concluded at this point that any killing program to achieve reasonable reduction of birds over runways would probably require the elimination of a large part of the Sand Island Laysan albatross population, a very distasteful prospect. Furthermore it is obvious that the program must be carried on year after year to eliminate the new birds which would certainly invade the depopulated area. It was concluded that these measures should be used only as a last resort.

The next step was to study the habits of the birds during the time they were in the air over the runways. It was noted that concentrations of soaring birds were definitely associated with unevenness of the terrain. Sand dunes and old revetments apparently deflect the constantly blowing winds upward and thus produce conditions favorable to

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## ESTABLISHMENT OF ARCTIC BIRD SANCTUARY

Establishment of the first bird sanctuary in Canada's Far North was announced in the fall of 1957 by Resources Minister Douglas S. Harkness.

"Establishment of the Dewey Soper Bird Sanctuary on Baffin Island, in the Northwest Territories, is an important development in the protection of migratory birds in Canada," the minister said, according to a Canadian government news release. The name of the Dewey Soper Bird Sanctuary was selected to honor the biologist, Dewey Soper, who discovered the breeding grounds of the blue goose in 1927.



The sanctuary is an area of 3,150 square miles which serves to protect the heart of the important blue, and snow, goose breeding grounds. The American brant and Hutchin's goose also breed in the same area. The sanctuary, on the southwest side of Baffin Island between Bowman Bay and the Koukdjuak River, is rated as the most important summer goose colony in the world. It is closely related to, and includes, the small 500-square mile Bowman Bay Game Preserve.

Within the newly established sanctuary, hunting is prohibited. Exploration and development of mineral resources, however, may be allowed under permit from the Canadian Wildlife Service of the Department of Northern Affairs and National Resources. Mineral developments may also be allowed provided that adequate steps are taken to prevent undue disturbance of the migratory birds in the area.

Dewey Soper's explorations on Baffin Island began in 1922 and continued until 1929, culminating in the discovery of the nesting grounds of the blue goose. Traveling often under most arduous conditions in winter and summer, Mr. Soper explored new territory, adding greatly to the knowledge of the fauna of Baffin Island.

Mr. Soper, who was a biologist with the Canadian Wildlife Service before his

retirement from the federal government, now lives in Edmonton. He has published many reports on his work and was made a Fellow of the American Ornithologists Union in recognition of his contributions to North American ornithology.

The sanctuary will be supervised by

### CONFLICT OF BIRDS

*Continued from page 29*

soaring. Under certain wind conditions the number of birds over the area with the highest trees and dunes is 165 times as great as over level areas. *This discovery suggested a method whereby effective control of the hazard to aircraft might be achieved without destruction of birdlife.* Leveling all land for several hundred feet on both sides of the runways might reduce to negligible the incidence of soaring birds in those areas. At present this method seems to be the most promising as the final solution in eliminating the aerial hazard of albatrosses to aircraft.

At this point it might be of interest to examine a little more closely the nature of the hazard to aircraft presented by albatrosses at Midway. All recorded collisions between airplanes and birds have occurred during daylight hours; these birds are rarely in flight over land at night.

During the period from April 8 to May 31, 1957, 29 albatrosses were struck or about five per cent of aircraft operations resulted in strikes. The black-footed albatross was involved in only about one per cent of the strikes. Ever since Midway has been used as an airbase, there have been no records of human lives being lost and of aircraft having crashed because of planes striking birds. Damage from bird strikes to seven planes was reported between November 20, 1956, and May 31, 1957. This damage was incurred by four-tenths of one per cent of planes which landed or took off. Despite a seemingly rather low incidence of damaging strikes, any repairs to aircraft are costly and the prospect of the loss of even one plane loaded with passengers is alarming.

The second bird hazard to aircraft studied was that presented by the sooty terns which nest in compact groups of many thousands and fly about in clouds over the runways at certain times. These birds are expected to be much more of a hazard when jet aircraft are used. At pres-

ent no jets operate through Midway, but it is inevitable that they will. It is believed that these small birds will be sucked into the air intakes of jet planes and will disable the motors.

When the sooty terns began arriving at Midway in the spring of 1957 everything we could think of was tried to discourage them from landing and establishing themselves on their traditional nesting area. Harassment experiments were conducted by using burning oil smoke, 12-gauge shotgun fire, and aircraft float lights, to keep the birds off the ground when they were first arriving to start nesting activities. It was found possible, by constant harassment around the clock, to keep the birds off the ground sufficiently to prevent them from making nests on ancestral sites. Yet these efforts were unsuccessful in driving them from the island, and did not prevent them from moving to other parts of the island to nest. In view of the vast number of sooty terns which are attached to Sand Island (150,000 in three distinct colonies) and the considerable amount of manpower and material expended with unsuccessful results, it was decided that harassment methods of this sort were impracticable.

Methods have been explored for making the surface of the ground unsuitable for nesting, with the purpose of forcing the birds to nest elsewhere. Wire netting raised slightly above the ground and hardtopping of the surface were both effective, but the difficulty of maintaining the wire netting and the expense of hard-topping are deterring factors. The present tern colonies occupy 420,000 square feet of Sand Island. To make these areas unsuitable for their nesting would probably result merely in shifting the colonies to other parts of the island. At present, everything considered, we are faced with the probability that some sort of a population reduction program will be necessary for sooty terns, which are, fortunately, among the

*Continued on page 41*



**A BLACK-TAILED DEER COMES OF AGE**  
Continued from page 13

the time he was 14 or 15 months old, he had only to stop when the dogs were chasing him, and they would turn and skulk homeward. The dogs no longer wanted to get near his hooves or within reach of his formidable spike horns which had been forming since his eleventh month. At that time, when Man's horns were mere nubbins beneath the slowly-stretching skin, there began the only disturbing theme, to us, in Man's life. A five-year-old girl had a habit of striking her pet sheep with a switch. She may have tried this on Man, which might have earned Man's dislike, for she received hoof bruises from him on her cheek and back. A few days later while we were burning brush, the two mutually-jealous and antagonistic little creatures—girl and deer—approached each other again. Up went Man's front hooves, and he danced forward, like a boxer "spar-ring." Then, as she backed away, he dropped on all four feet again.

Except with the one child, who had given him a good reason for his distrust of her, Man never exhibited the "dangerous" characteristics which male deer are supposed to have. He never turned on us, even when the velvet was gone from his horns and he needed places to whet the new, bony horn material. He often got one of my legs between his spikes, but always in a mild and courteous manner.

A gentle intelligent creature, even more sensitive than humans, he promised ever to be so, but we were not able to enjoy his companionship beyond his sixteenth month. The opening of hunting season, the fear of the small girl's mother, and Man's love of human companionship—all decided us in favor of taking him to Woodland Park Zoo in Seattle. There he now has constant human companionship—if not the exotic range of food and perfect freedom of movement which he enjoyed at our home. Man had adjusted to a world not his, and in his maturity, he needed the protection from it that only captivity could give him. Perhaps it was his human friends that had profited from his companionship, for his coming of age had been a wonderful, instructive experience for all of those who had known him.—THE END.

**CONFLICT OF BIRDS**

Continued from page 33

most abundant and widespread of sea birds. These terns are frequently struck by aircraft (an average of 1.2 birds per take-off or landing), but during the period of our observations none of these strikes resulted in damage to a plane. The fear is that with new types of aircraft, particularly with jets of the future, there may be trouble from sooty terns.

Our investigations at Midway are continuing. We expect to have additional personnel join Dale Rice there to delve further into the habits of the sea birds, and to seek ways and means of minimizing the conflict between birds and aircraft.

—THE END.



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Audubon Magazine

# Midway Islands

## MAN AND BIRDS IN CONFLICT

By Olin Sewall Pettingill, Jr.

There is no better example today of man and birds in tragic conflict than at Midway Islands.

This bit of land in the North Central Pacific is important both as a Navy air base and as a breeding ground for the Laysan and Black-footed albatrosses. The conflict is not new but has been sharpened in recent years by strengthening of our national defense.

Midway comprises one of the tiny coral atolls which form the Leeward Chain of the Hawaiian Islands that extends northwestward some 1,200 miles from Oahu and the other main islands. The most distant is Kure Atoll; the next most distant is Midway.

Like all typical atolls, Midway has its tide-washed coral reef encircling a lagoon. Out of this rises the "island" consisting of Sand Island, somewhat smaller Eastern Island, and three islets. Only Sand and Eastern Islands, with a combined area of about two square miles, are of any importance as breeding grounds for the albatrosses or as habitable land by man.

The Author—Dr. Olin Sewall Pettingill, Jr. is Director of the Laboratory of Ornithology at Cornell University. He will resume his popular Bird Finding column in the next issue of Audubon Magazine.

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Between Midway and Honolulu lies the Hawaiian Islands National Wildlife Refuge. (See article on page 160.) The refuge includes only those islands from Pearl and Hermes Reef to Nihoa Island, inclusive.

U.S. Fish and Wildlife Service

U.S. Navy



Midway Atoll, with Sand Island in foreground, Eastern Island at top.

Albatrosses won't nest on paved surface even though this runway on Eastern Island has been abandoned.

Carl W. Buchheiser





A glance at a map of the Pacific shows that Midway is indeed well placed, lying 8,200 miles west of San Francisco and 2,400 miles east of Tokyo. There is no land northward of Alaska or, except for Kure Atoll, eastward to Japan. Midway's strategic value, therefore, as a key link in our Pacific defense is obvious.

The United States took formal possession of Midway in 1867. It was the first island annexed by this country beyond its coastal waters. In 1903, owing to the recurring presence of Japanese squatters and poachers, President Theodore Roosevelt ordered it placed under the Navy where it has remained to this day. Midway never became a part of the territory of Hawaii and was not included in the organic act creating the State of Hawaii.

In the same year that the Navy took over Midway, the Commercial Pacific Cable Company established a relay station on Sand Island. An employee of the company was placed in charge as naval custodian and advised to prevent the "wanton destruction of birds that breed at Midway, and not let them be disturbed or killed except for purposes of food supply." Midway was continuously occupied thereafter by United States personnel.

When the Cable Company established operations, Sand Island—like Eastern—was treeless, with stretches of sand dunes, *Scaevola* bushes and scattered herbaceous growth. But the employees soon introduced shrubs and trees, including ironwood, which spread and provided shade over much of the surface inland.

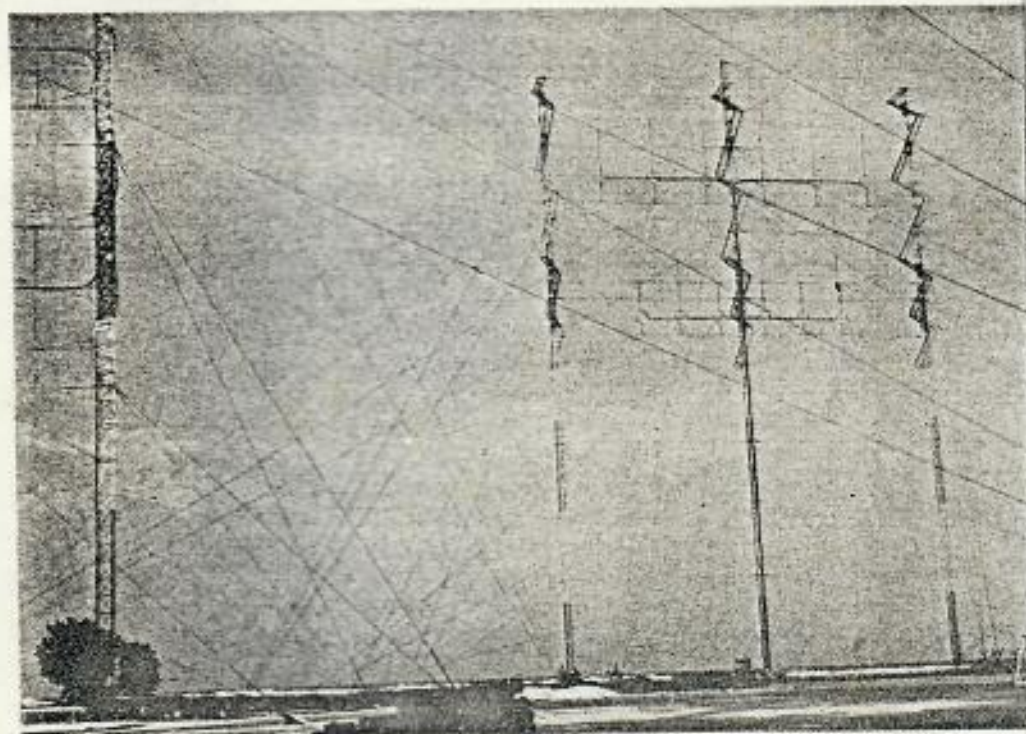
Four months after Midway became a commissioned naval station, it was bombarded by the Japanese on December 7, 1941. The following June a major Japanese invasion force was repulsed at sea by carrier aircraft and by aircraft based at Eastern Island. The Battle of Midway has since been regarded as the turning point of the Pacific war.

*Navy people and albatrosses live happily together—but planes are endangered. Can the species survive controls?*



*Laysan albatross coming in for a landing at Midway.*

Carl W. Buchheiser

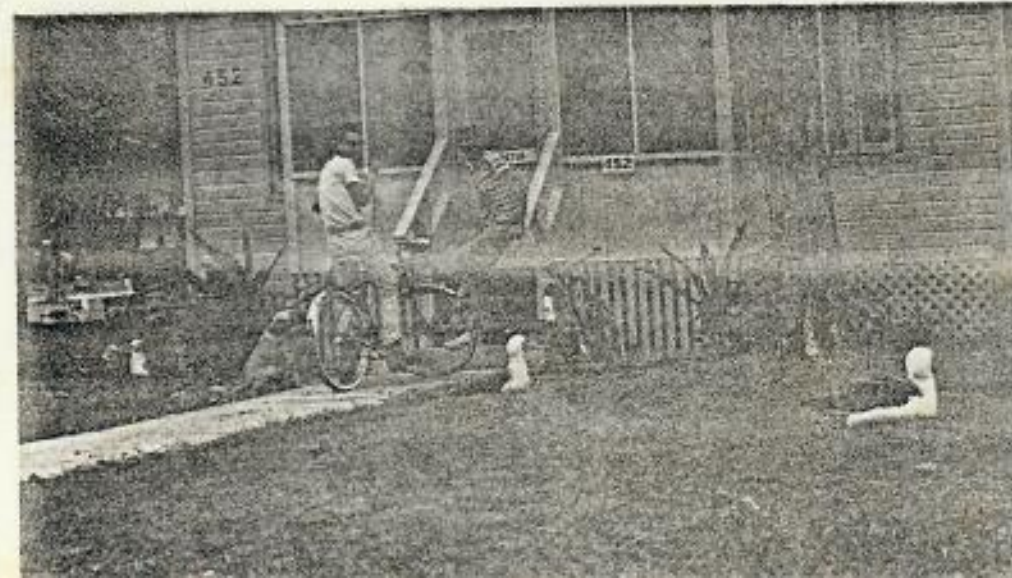


Carl W. Buchheiser

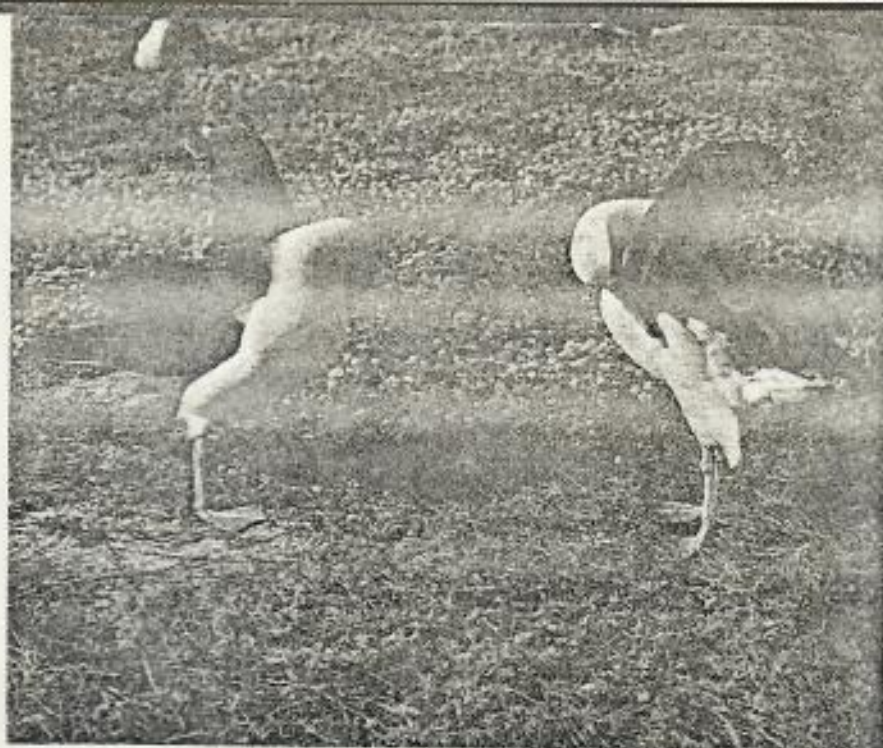
*Midway's radio and radar towers with guy wires kill about 100 albatrosses a week.*

*At this Sand Island home, albatrosses nest oblivious to dog and boys.*

O. S. Pettingill, Jr.







*A Laysan albatross (left) spots a prospective mate. Encountering each other on the display grounds (above), both preen madly as part of the mating ritual shown on the magazine cover. Then closer contact (far right) is made. . .*

As the war progressed, an airfield with three landing strips capable of accommodating large planes was developed on Sand Island. The airfield on Eastern Island gradually played a lesser role and was finally abandoned. The Sand Island airfield continued as a unit in the Military Air Transport Service. Then in 1956, when the Distant Early Warning radar line (the DEW Line) was extended from Alaska to Midway, Sand Island became a major operational base for Airborne Barrier Squadrons and has so remained to this day.

The Laysan and black-footed albatrosses, which nest at Midway, have a remarkably restricted breeding range, being confined to the Hawaiian chain. Except for the short-tailed albatross, now exceedingly rare, they are the only two albatrosses, among the 13 or 14 species in the world, that breed in the Northern Hemisphere.

Like all albatrosses, the Laysan and black-footed are sea wanderers, spending their time over or on the water. Their roaming is confined to the North Pacific. The black-footed is frequently seen from ships, as it is inclined to follow them hopefully in search of edible refuse and is recorded regularly off our North American coast from Alaska to Baja California.

The Laysan is less often observed, being indifferent to ocean traffic and seldom moving in over coastal

waters. Both avoid land—until they must nest. Then, as with all birds, land becomes the all-important habitat requirement.

Though potentially capable of reaching any island or continental shore for breeding purposes, all albatrosses are inherently nesting-site tenacious and none are more so than the Laysan and black-footed. Pairs return to the same few square feet of ground where they nested previously and their offspring, as far as we know, to the same general area—if not to the same island, at least to the same island group.

The black-footed prefers the beaches above the tideline and the bare stretches of sand between barrier dunes; the Laysan prefers the island interiors back from the dunes where there may or may not be sheltering bushes and trees.

Both species begin coming to land in late October and early November, the males a few days in advance of the females. Then follows the remarkably ritualized courtship displays ("dances") and nest-building.

The eggs, one per nest, appear in late November. Incubated alternately by both sexes, they hatch 65 days later. The chicks are cared for by both parents. Black-footed chicks require about 140 days and the Laysan 165 days of development before going to sea in mid-June and mid-July, respectively.

When the Navy took over Mid-

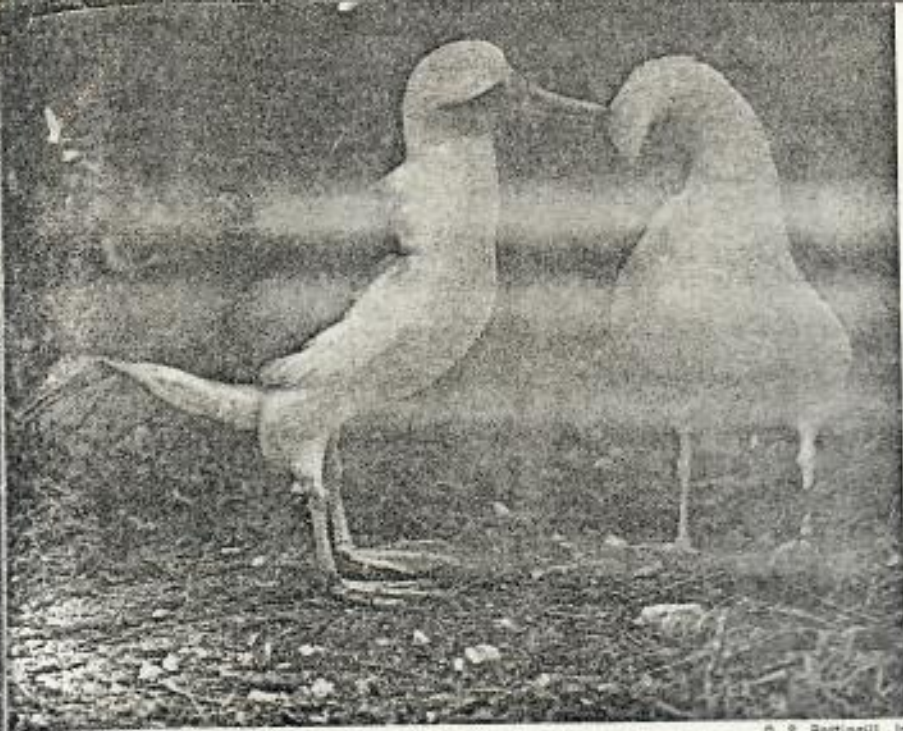
way, only a few albatrosses were nesting, the population having been decimated by Japanese feather hunters. But with protection by the Cable Company employees, the population began to build back. Introduced vegetation seemed to favor an increase of the Laysan, perhaps by providing shelter from blowing sand, and at the same time to slow the increase of the black-footed as the vegetation crept closer to the beaches.

Except for a temporary decline after 1941, due possibly to the war, the population of Laysan has grown steadily. In 1963 it was estimated at 133,000 pairs. The black-footed population increased until the war, then went into a steady decline to about 10,000 pairs today.

Late last year it was my good fortune to visit Midway, assisting Dr. Harvey I. Fisher of Southern Illinois University with his study, sponsored by the Office of Naval Research, on the breeding biology of the Laysan albatross. We arrived by air on November 19. The ensuing three weeks produced a host of unique experiences and life-lasting impressions having to do with birds, people—and birds and people. I have space here merely to relate some of the birds-and-people matters.

I had long known that the gooney birds at Midway literally get in the





O. S. Pettingill, Jr.

... Now the not-so-gooney bird nibbles gently while his mate preens. Once these birds have nested they will use virtually the same site for future nesting unless the site has been paved.

way of human activities. Photographs had showed me gooney birds nesting in dooryards, walking in streets, and so on. Even so, I was in for a surprise.

Here on Sand Island is a thriving, busy, military establishment with 3,000 people—mostly Navy personnel and their families. There are two-story apartments and homes graced by lawns, flowering shrubbery and gardens shaded by immense ironwood trees; barracks; clubhouses for the various strata of military society; a lovely nondenominational church; a modern school; a hospital; a big store, post office, and theater unit; airplane hangars, fuel dumps,

docks and dozens of workshops and warehouses; an air terminal building and three tremendous swaths—the cement runways.

All of the buildings are accessible by paved roads and are in an area of one and one-half square miles.

Where are the gooney birds amidst this bustling community? I saw the white gooneys (that is, the Laysan albatrosses) everywhere. They were along all the roads, on the lawns—on almost any spot that wasn't paved. They roamed about with leisurely aplomb, "absent-mindedly" crossing streets, and sometimes bringing traffic to a standstill. They were oblivious to noise and all human activities.

Like penguins, they showed concern and waddled away only when someone showed an obvious intent to touch or molest them.

For nest sites practically any place seemed to suffice as long as it was off the streets and sidewalks and the ground was reasonably soft. On the lawn, in a garden, under a shrub, close to the front-door steps—there was no rule.

I saw one bird nesting in a child's abandoned sand box. I marveled at another bird in a front yard sitting placidly on its nest, surrounded by children's carts and tricycles. Two others in another yard were on nests within the area where boys played baseball.

There were few houses without a dozen or more birds nesting around them. At least 50 birds nested on the tidy lawn surrounding the residence of the commanding officer, Captain G. W. Davis, V.

The Navy personnel thoroughly enjoy the gooneys. Captain Davis strictly enforces his order that none shall be harmed (one sailor was shipped from the base because he put a gooney bird on his roommate's bed), but this is hardly necessary. The birds are attractive in their spotless dress, comical in their every action, and so appealing in their aloofness to human affairs as to suggest (erroneously, of course) a deep trust in man and his ways.

Except for bill clappings, whinnings and low trumpeting, gooneys are relatively quiet for sea birds; and they are generally silent at night except when they are kept alert by street lights. Sanitationwise they are scarcely objectionable as they stay

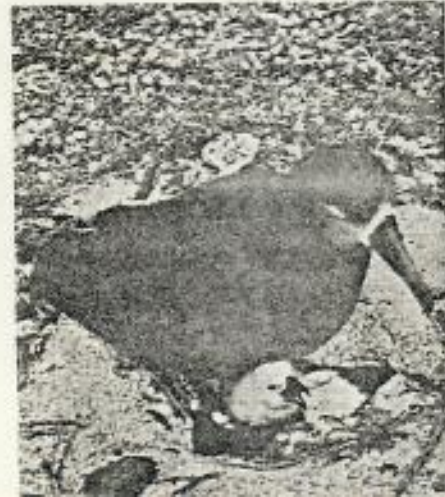
Society President Carl W. Buchheister inspects an egg in which an albatross chick has pecked its exit.

Chandler Robbins



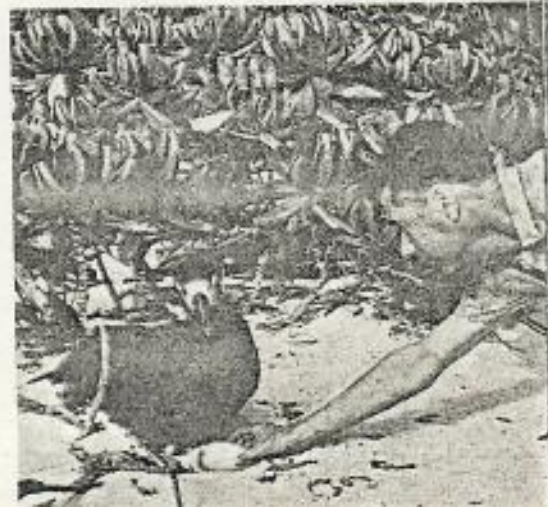
A black-footed albatross with its hours-old chick, one of the first to hatch in 1964. This species nests along the beaches and dunes.

Carl W. Buchheister



Chandler Robbins, U. S. Fish and Wildlife Service biologist, demonstrates how an egg of a black-footed albatross can be inspected with impunity.

Carl W. Buchheister





ashore for many days at a time without feeding and consequently void little excrement. Only when the chicks are developing is there much whitewashing of the ground—and this is confined to the immediate vicinity of the nests.

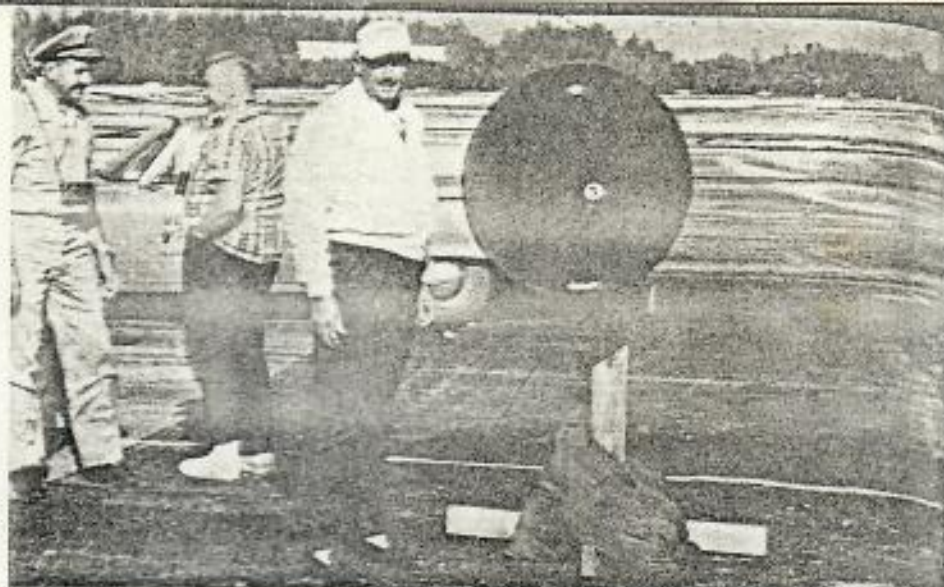
Many a Navy man and many a family arrive at Midway with no interest in or knowledge of birds, only to become fascinated. This was the case with Captain and Mrs. Davis who found themselves entranced with the goings-on in their yard. They plied Dr. Fisher and me with questions on habits of their gooneys and insisted that we color mark the birds so that they could know for sure "which bird was doing what and when."

There's no denying that adults and children alike get an education in the ways of birds. They watch the gooneys arrive, quarrel, establish territories and mate, build nests and lay eggs, and go through the long period of incubation and young-rearing.

For children there is soon no mystery as to when and how birds mate. The domestic activities of such big, goose-sized birds, deliberate in their every action, cannot be ignored. No one seems to mind when a pair proceeds to build a nest on a well-kept lawn, pulling up the grass within reach of the nest and then scratching and piling up the soil to form the high nesting-mound, deeply cupped, in which the egg is laid. Indeed, some of the more thoughtful gooney admirers carry in sand from the beach and put it beside the nests so the birds will have enough material for their mounds. After the nesting season, the nests are raked away, the ground leveled and the spots reseeded.

All in all, I was most favorably impressed with the attitude of Navy personnel toward the gooneys, also with the attitude of Captain Davis and his officers toward Dr. Fisher's research. The fact that Dr. Fisher's work is being sponsored by the Navy is testimony to the Navy's intent to learn more about the species in order to effect ways and means of protecting it.

The only calumnious remarks we heard were from the men who fly the Barrier aircraft—and for an understandable reason. They are the



Carl W. Buchheiser

*Amplifier to broadcast albatross distress calls has yielded encouraging results. Gordon W. Boudreau (in white cap) a biosonics expert, is testing this method for the Navy. Others are Cmdr. Charles F. Zirzow, USN, and Dr. Ira M. Gabrielson, president, Wildlife Management Institute.*

persons who run the risk of damaging their planes and losing their lives. This is where man and birds at Midway are in conflict. The airmen have a job to do, whether they like it or not, and the birds are there—as they have been for many centuries.

During the nesting season the aircraft strike albatrosses on the average of 100 a month. Often the damage is considerable, requiring many man-hours for repairs. The total cost per year to the Navy runs well into six figures. Meanwhile there is the ever-present danger of a plane being so severely damaged as to crash, perhaps with a loss of human life.

Air strikes occur during the nesting season when the albatrosses move in from the sea. Large, slow-flying birds, more often soaring or sailing but sometimes indulging in straight-forward flapping flight, they are inept at changing course quickly. Thus, they easily collide with any plane that crosses their paths.

The birds fly only during the day and are more frequently in the air when there is a high wind. Seldom are they more than 200 feet above land or sea.

During the nesting season the albatrosses soar low over the runways, taking advantage of the wind deflected upward by the adjacent dunes and vegetation. On a windy day the birds are especially active and it is then that they collide with planes either landing or taking off. The Navy has leveled some of the irregu-

larities caused by terrain and vegetation but this has had little appreciable effect in reducing strikes.

Since the majority of birds over the runways were those nesting adjacent to them, the Navy widened the runways with asphalt so as to keep the albatrosses farther away from the planes. Before the asphalt was put down in January of 1964, nearly 18,000 incubating birds were picked up (albatrosses will not leave their nests when approached) and put in canopied trucks where they were asphyxiated by re-directed motor exhausts.

This procedure was recommended by the U. S. Fish and Wildlife Service. The question may be rightfully asked: Why did the Service not recommend widening the runways between July and October when the albatrosses are absent?

The answer is that the albatrosses, being strongly nesting-site tenacious, will return to the identical area and be a hazard on the runways even though they cannot succeed in nesting on the asphalt. In this "unemployed" status they would fly over the runway much more frequently than if they were occupied with nesting activities.

While at Midway I met Gordon W. Boudreau, a biosonics control expert, under special contract with the Navy to find a means of reducing air strikes by creating a sound barrier (that is, by playing back recorded



distress calls of albatrosses through powerful amplifiers) that would discourage the albatrosses from flying over the runways. His project was showing some promise of success.

On returning from Midway in December I alerted the National Audubon Society to the impending slaughter and the fact that it might not be necessary if the sound barrier now being tested proved to be successful. President Carl W. Buchheister thereupon called a special meeting at Audubon House in New York. Attending were representatives of the Society, the Fish and Wildlife Service, and the Navy. All agreed that the danger from air strikes should be reduced but that every possibility for reduction short of killing the birds should first be tried.

After the meeting Mr. Buchheister sent a telegram to Secretary of the Navy Paul H. Nitze urging him to delay the killing until Mr. Boudreau's results could be evaluated. In January Mr. Buchheister and Dr. Ira M. Gabrielson, President of the Wildlife Management Institute, visited Midway to see the problem for themselves. As Mr. Buchheister explained in "The President Reports to You" (*Audubon Magazine*, March-April 1964): "While deeply distressing to all of us . . . the plan worked out by biologists of the Fish and Wildlife Service appeared to be the only immediate remedy."

Fortunately the black-footed albatrosses (black gooneys) were not seriously involved in the killing program as they are comparatively few in number at Midway and most of them nest on the beaches and other open areas away from the runways. But one wonders about the future of the Laysan albatross.

We hope that the elimination of nearly 18,000 birds will be effective enough to require no further reduction in the Midway population. There is always the possibility that the DEW Line may soon be unnecessary as a defense stronghold, in which case runways at Midway will not be needed by Barrier squadrons.

Rather than helping the situation, the end of Barrier flights could create a more serious one, as the runways might then be made available to commercial airlines. Since jet planes are particularly vulnerable to bird strikes, the airlines might want to

eliminate even more albatrosses, perhaps even "sterilize" the whole area.

Unfortunately the half square mile of Eastern Island does not now offer a safe refuge. Although the runways there have been abandoned since the war, the Navy has been building a new, more sophisticated unit in its system of cross-Pacific radio communications. Practically dominating a large section of the land area are 18 towers 300 feet high with aerials and guy wires spreading out over many acres.

During high winds the albatrosses hit the guy wires and are killed or mortally injured. On November 24 we counted 350 Laysan albatrosses lying dead or dying under the offending wires.

How important is Midway to the survival of the Laysan albatross? Dale W. Rice and Karl W. Kenyon have recently estimated the world population to be 1,500,000 individuals. This figure, considered conservative, includes "unemployed" birds which visit the breeding ground but do not nest, and "innubile" birds which remain at sea during the period of five to seven years between fledging and breeding maturity. Nesting pairs total only about 315,000. Thus, close to half of the breeding population depends on Midway.

One other island presumably supports about as many breeding Laysan albatrosses as Midway and that is Lisianski Island has 30,000 pairs, Pearl and Hermes Reef 17,800, and Necker Island 2,500. Eight other islands in the Hawaiian chain have the remaining 2,000 or so pairs. All of the figures for these islands, except Midway, are Rice's and Kenyon's.

Laysan, Lisianski, Pearl and Hermes Reef, and Necker are part of the Hawaiian National Wildlife Refuge. While the protection of their breeding birds may thus seem assured, it is a fact that the Fish and Wildlife Service under which the refuge is managed does not have the vessels, aircraft, and personnel to patrol these islands.

At the same time the Fish and Wildlife Service is under constant pressure to release the islands for various purposes, commercial and otherwise. Why, critics say, should it hold them if it cannot patrol them?

Obviously, the entire world population of the Laysan albatross is endangered. Even more so is the black-

footed of which there are only 55,000 breeding pairs, the bulk of them being on Midway (10,000) and Laysan (34,000). All of us must be vigilant in promoting protection for these species whenever we can and by every means possible.

As Carl Buchheister so forcefully stated in his telegram to the Secretary of the Navy:

"It should be kept in mind that the Laysan and black-footed albatrosses are resources we share with the whole world and that ornithologists and conservationists of all nations would be justly concerned should the breeding populations and their essential habitat be reduced to the danger point. The United States has a special responsibility for the conservation of these birds." THE END

President Buchheister adds another slide to his extensive film record of the Midway albatrosses' plight.

W. M. Ord





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*The slanting, tower-supporting wires of Eastern Island's radio relay system are a death trap for the Laysan albatrosses, with their six-foot wingspreads, which must negotiate the steel spider web.*

# Midway's Deadly Antennas

*A maze of cables takes a critical toll  
of the world's Laysan albatross population*

By HARVEY I. FISHER

PHOTOGRAPHS BY THE AUTHOR  
EXCEPT AS INDICATED



In earlier issues of Audubon Magazine, Dr. Olin Sewall Pettingill, Jr. ("Midway Islands: Man and Birds in Conflict," May-June 1964) and Dr. John Aldrich ("Conflict of Birds and Aircraft at Midway," January-February 1958) have written of the gooneys—the Laysan albatrosses (*Diomedea immutabilis*) of Midway Atoll in the North Pacific Ocean. Both mentioned the deaths of albatrosses caused by the birds flying into antennas, but no year-round data were available to enable these men to calculate the annual toll of birds.

The world may lose one-sixth of its 1,500,000 Laysan albatrosses because of one small forest of antennas at Midway Atoll in the North Pacific. The first full-year count of the antenna toll leads to this conclusion. Midway is a major breeding site for this great oceanic flier, affectionately known as the gooney.

While studying the Laysan albatross under a contract with the Office of Naval Research since 1961, I have been privileged to live on Midway some 18 months in the past five years. The longest stay was from October, 1964, to June, 1965. Every two or three days of this period I searched the ground beneath the towers and antennas on Eastern

Island, Midway's smaller isle, for newly killed birds.

Employees of the Page Communications Engineers and several responsible Navy men were most cooperative in supplying information on birds that were killed by the wires between my visits. They also recovered the bands from many dead birds and gave them to me. The Page engineers are specialists employed by a New York company that handles communications for the Armed Services.

Earl Meseth, of Southern Illinois University, and I personally saw and counted more than 95 per cent of the dead birds recorded in 1964-65, the period of this report. The deaths listed here must be regarded as merely the major part of the total. On several occasions maintenance crews disposed of the carcasses before any count could be made; in one instance the uncounted kill filled a pickup truck.

The most deadly parts of the antennal setup are the slanting cables supporting the 300-foot towers of the SCATTER communications apparatus. SCATTER is a radio relay system operated for the U.S. military forces by the Page firm on Eastern Island. Relatively few birds hit any of the wires of the antennas operated by the U.S. Navy or, in-

deed, the horizontal or vertical parts of the SCATTER antennas, either.

For every albatross killed by naval wires 20 or more are struck down by the rigging of the SCATTER antennas. The apparent difference is the presence of insulators which make the Navy cables more visible.

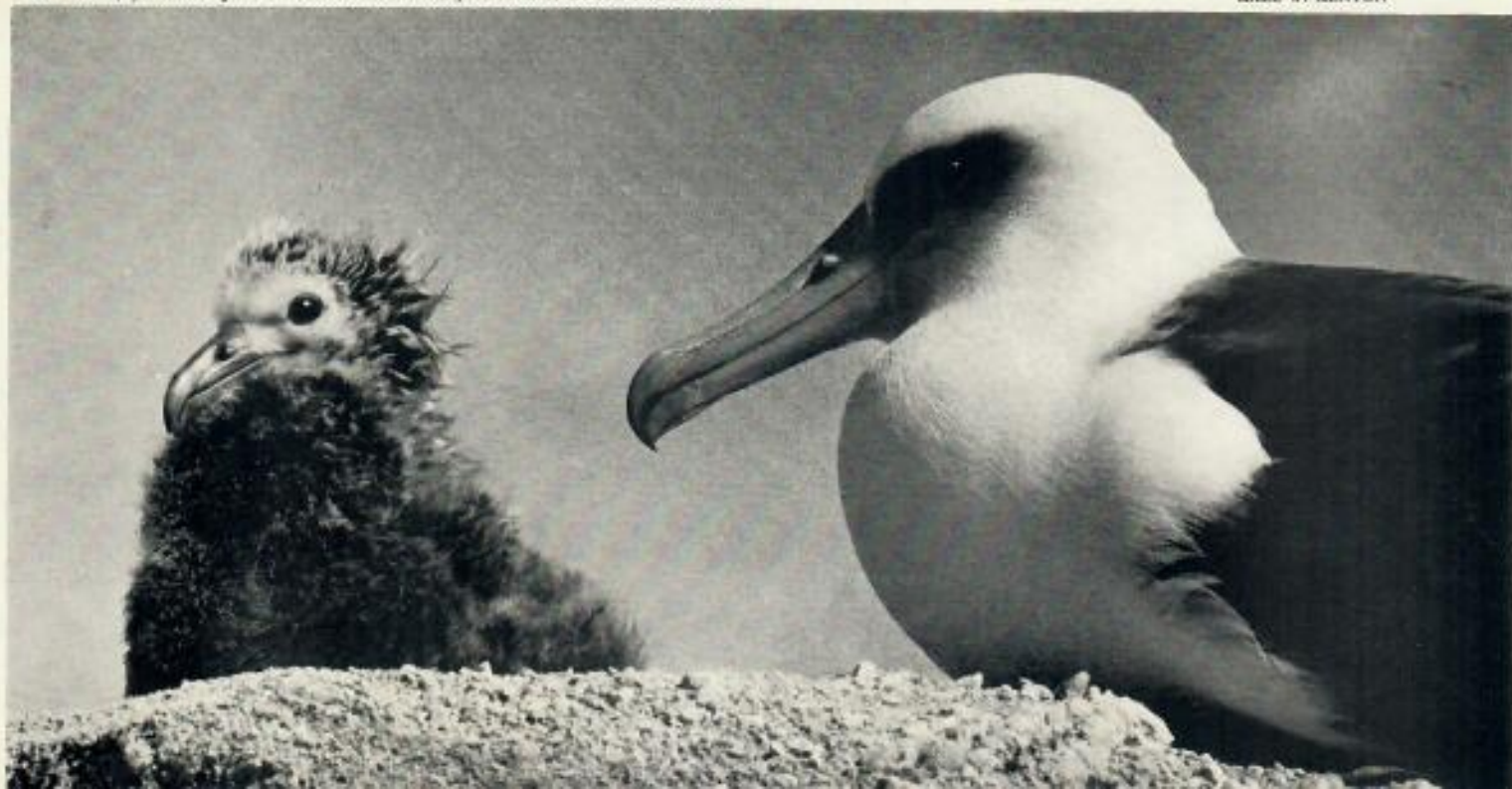
The toll caused by the SCATTER system antennas began in the mid-1950's. Most of the albatrosses collide with the structures during high winds and rain, or when salt mist is blown high and driven inland from waves crashing on the coral reef or shore. Visibility is reduced then, and strong gusty winds make difficult the abrupt maneuvers necessary for the birds to dodge the wires.

Storms from the north and northwest are the most disastrous, for then many of the birds swinging in upwind must approach their part of the nesting colony through the tangle of wires on the southeast part of the island.

One two-day blow from the north in December, 1964, cost the lives of 401 adult Laysans, and another the following March 6-8 killed 437. But even on clear, quiet days, when the trade winds are gentle from the northeast or east, an average of five albatrosses misjudge wires and die.

*A Laysan albatross—the white gooney—and its single young on Midway Atoll. The loss of just one parent to the antenna forest will doom the chick.*

KARL W. KENYON





Although all the deaths are significant for the survival of the species on Eastern Island, the loss of birds of breeding age is especially disastrous. Our studies of reproductive loss from the time of egg laying to breeding age (seven to eight years) indicate that eight or ten eggs must be laid to produce one bird old enough to breed.

The table shows that the kill of banded juveniles equaled 22 per cent of the deaths of the breeding birds. Without too much statistical legerdemain, we may judge that at least 75 per cent of the unbanded birds were breeders or at least old enough to be breeders. Add these to the 272 breeding age birds known to have been killed, and the total loss is 2,200 breeding birds.

When we consider that the breeding colony on Eastern Island for the 1964-65 season consisted of fewer than 30,000 pairs, the full significance of the loss begins to emerge. Although both parents seldom are killed, one parent can neither successfully incubate an egg nor feed a chick to the fledgling stage. The surviving parent usually does not nest the year after losing its mate. Thus, loss of one parent typically means the loss of the reproductive potential of two birds for two years.

If, as we believe, it requires the equivalent of eight or ten eggs to produce a breeding bird, the death of 2,200 breeding-age birds in one year means that the effect of perhaps 20,000 eggs laid in the past has been nullified. In other words, since these albatrosses lay but one egg per year, the death of 2,200 birds of breeding age offsets the annual production of 20,000 of the 30,000 pairs on the island.

The effect of this single set of antennas, this one man-made mortality factor, on the experienced birds in the colony is to reduce the effective reproduction by two-thirds, or down to fewer than 10,000 pairs, since

death by hitting an antenna is not a normal hazard in the open-ocean life of a bird which nests on low coral atolls.

The effect of the deaths of the juveniles is more difficult to judge because of the different age groups involved, but our studies of the species indicate that a live five-year-old bird is the sole remaining evidence of at least five eggs laid in previous years. And age five is about the average for the juvenile Laysans we found on Midway Atoll.

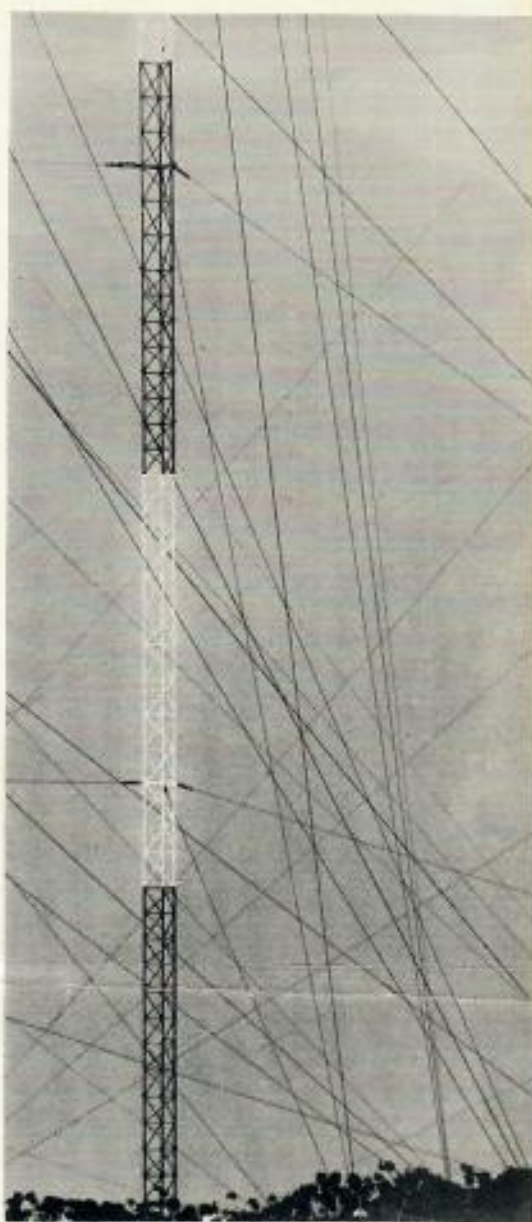
The loss of antenna-killed juveniles in 1964-65, then, countered the effect of 3,510 eggs (702 deaths times a factor of five), or the work of another 3,500 pairs! The effectiveness of our colony of 30,000 pairs has now been slashed to that of a colony of perhaps 6,500 pairs. One must remember that this decrease comes from a new death-causing feature of the habitat superimposed on the natural environment to which the life cycle of the albatross has become adapted during the millions of years of evolution of the species.

With luck, these 6,500 effective pairs of albatrosses will produce 500 to 1,000 pairs for the next generation. If this mortality continues, the following generation, some 15 or 20 years hence, may be down to perhaps 500 pairs, plus whatever other adults of this long-lived species remain at that time.

The potent dangers in the mortality caused by these ever-set traps are, first of all, that the decline in numbers will be hidden, gradual and unnoticed, rather than dramatic and evident. The birds that will maintain the breeding colony for the next eight years are already hatched and in the colony, or living at sea. Not until eight years have elapsed is the decreased number of young breeders entering the colony likely to be noticed.

Second, most of the present breeding birds were alive before most of the antennas were erected and started taking their toll.

Finally, the colony is always being replenished from an ocean-located reservoir of maturing birds and of birds which have bred in the past but are not breeding in any particular year. The reservoir is of unknown size, but there is no doubt that Eastern Island's share of that supply is draining away. The population on



Fixing colored streamers to grey cables of the 300-foot SCATTER towers might halt the albatross slaughter.

this island can do nothing but spiral downward.

Because Laysan albatrosses usually return to their natal island to breed, Midway's larder of birds can at best be restocked only very slowly by immigration—by young albatrosses from other islands in the Hawaiian group to which the species is restricted for breeding. Midway's contribution to the reservoir at sea was approximately one-third of the entire increment in former years, and Eastern Island's part was about half of the Midway total.

The seriousness of the situation is clear.

As I stated in the opening sentence

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of this article, we may be facing the elimination of one-sixth of the world's population of Laysan albatrosses because of one group of antennas on Eastern Island.

What can be done? Apparently very little; at least nothing yet has developed from past proposals. Since 1961 I have recommended that brightly colored, plastic streamers be fixed to the slanting cables at intervals of 15 or 20 feet. Carl W. Buchheister, president of the National Audubon Society, made the same recommendation two years ago. Only in 1965 did I hear that my proposal had been considered and deemed impracticable.

A request to put streamers on a single cluster of guy cables, as a test installation to check their effectiveness, was denied. The engineers felt the narrow strips of thin plastic would offer too much resistance to

strong winds and might cause a cable to snap. It would seem, however, that the effect of the streamers would be considerably less than the impact of a seven-pound albatross hitting a cable at 60 miles per hour. And no cables have ever been broken by any one of the thousands of birds which have hit them.

A second suggestion would be to break up the acres of pavement in the unusable airplane runways on Eastern Island and restore them as breeding grounds for the albatrosses. We are not certain, however, that this would encourage the breeding of more pairs. There is little evidence that the birds effectively use the areas now available to them. The breeding areas often are only sparsely occupied as compared to known breeding grounds elsewhere.

It is possible that removal of the concrete in the southwestern and

northeastern parts of the island, away from these antennas, might eventually result in larger colonies there. Such colonies might benefit simply by being located farther from the antennas and thus being less subject to this destructive feature of their environment.

Although my interest has been centered on the Laysan albatross on Midway, I should mention the effect the antennas have on other avian species.

Sooty terns (*Sterna fuscata*) die by the thousands on the ground beneath the wires in April and May as they settle onto land to begin laying eggs. The deaths continue at the rate of 30 to 50 or more per day as long as the birds are on the island. The deaths, though deplorable, offer no immediate danger to the existence of the several colonies of this species.

Very few black-footed albatrosses (*Diomedea nigripes*) hit the wires; we counted only five in 1964-65. Relatively few of these birds nest near the antennas. They typically rear their young on the windswept fringes of the sandy land and do not need to wend their way through the complex mazes of antenna wires.

Despite the presence of considerable numbers of wedge-tailed shearwaters (*Puffinus pacificus*) and Bonin Island petrels (*Pterodroma leucoptera hypoleuca*), we found fewer than 50 antenna-killed individuals of each species during 1964-65. Perhaps the vision of these nocturnal birds is better and their maneuverability greater than that of the albatrosses. Certainly their smaller size would permit them to negotiate more easily the curtains of wire.

Only half a dozen of the thousands of red-tailed tropicbirds (*Phaethon rubricauda*) met death.

Of special interest was our discovery of an antenna-killed Bulwer's petrel (*Bulweria bulwerii*) on March 20, 1965, and another on April 4. This species was breeding on Eastern Island when I visited there in 1945 and 1946, but we had not found a single specimen during intensive searches in the last five years.

The two dead birds indicate that these petrels at least still visit Midway. Perhaps a few have escaped the rats and breed in the darkness beneath dense clumps of brush and beneath boards and sheets of iron, where I found them before. ■

Minimal Kill of Laysan Albatrosses, 1964-65, by SCATTER Antennas

	Banded Birds		Unbanded	Total
	Juvenils*	Breeding Age	Birds*	
November 15	3	77	303	383
December	3	69	808	880
January	3	53	296	352
February	1	18	108	127
March	30	37	789	856
April	16	11	211	238
May 1-22	3	7	55	65
	59	272	2,570	2,901

\*At least two years old, and most more than three years old



After a storm from the northwest, torn bodies of Laysan albatrosses almost cover the ground near the buried anchor for a cluster of antenna cables.



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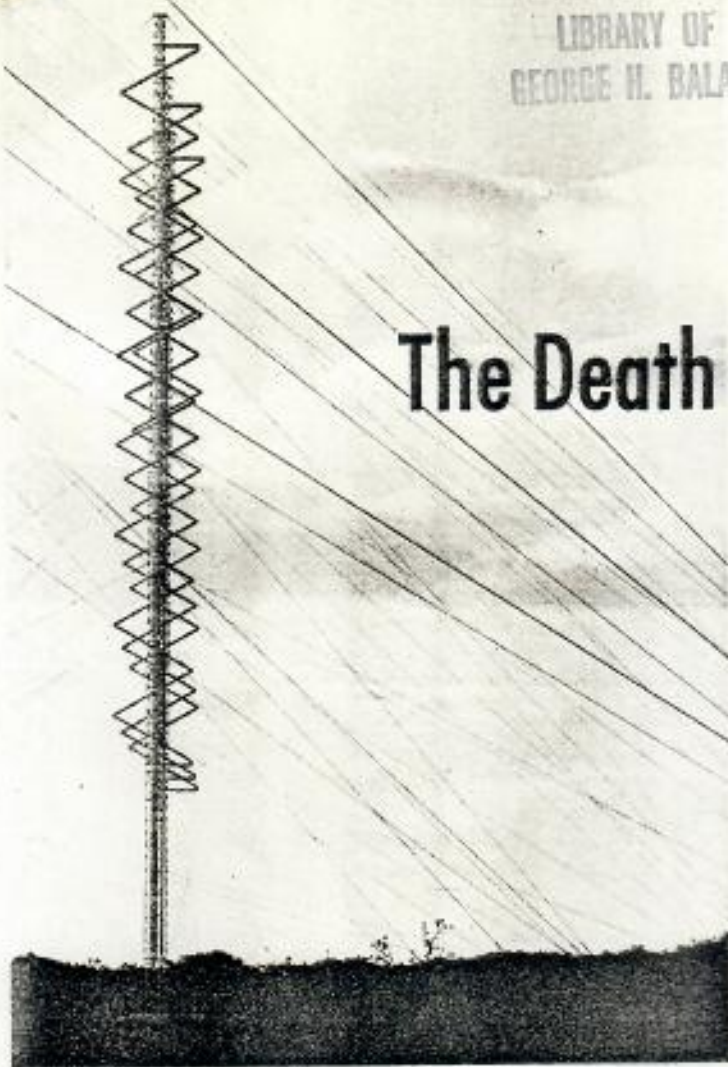
Jan 1970 V 72 N 1

Audubon Magazine

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The Hawaiian Islands of  
Birds by George Laycock

## The Death of Midway's Antennas

story and photography  
by HARVEY I. FISHER



The Pacific atoll of Midway includes two major islands—Sand and Eastern. It was on Eastern that the military erected massive antennas with mazes of cables that took an incredible toll of albatrosses. The antennas, like the one above, have now been demolished and pushed into the sea, and gooneybirds nest amidst their remains.



**M**IDWAY'S DEADLY ANTENNAS are themselves defunct. It was in the July 1966 issue of *Audubon* that I first reported the high toll of Laysan albatrosses exacted by the 300- to 400-foot spires of angle irons and slanting cables operated by the Page Communications Engineers to weld a link in the chain of military communications across the Pacific Ocean. The first of these antennas was erected in the mid-1950's and the last in the early 1960's. Throughout their existence they claimed an avian sacrifice to man's technological progress.

In 1964-65 these towering obstacles killed more than 3,000 mature Laysan albatrosses and thereby nullified the reproductive contribution by the total of 30,000 pairs of albatrosses that nested that year on Midway Atoll's Eastern Island.

But no more, for now the antennas are flat, their metal etched by the force of the wind-driven sand and rusted by the salty brine of the sea. The snarled masses of cables, wires, tubes, and lengths of formed steel serve man still, but now as unsightly anti-erosion devices along the southeastern shore of the island. Theirs was an ignominious fate for, as plastic explosives blew apart the supporting guy wires, the towers crumpled into shapeless masses that bulldozers later shoved toward the sea, trailing copper wires and aluminum tubing like eviscerated entrails.

The destiny of the antennas was decided not by the men who molded the explosives around their supports, but by persons thousands of miles away, men whose resolution of problems is based upon economics, military desirability, and expediency. In this instance the need was to facilitate the transmission of messages for the Armed Services. Other ways had been found to bounce signals off the clouds, and pronged satellites whirling across the skies formed pinpoint connections between senders and receivers. For Midway, at least, new systems were in vogue and the antenna site was abandoned in 1967.

The demise of the structures was not an event resulting from a cool-headed resolution of the problem of conserving perhaps a third of the world's population of





Laysan albatrosses, although I wish I could say it were.

It was the "Plan of the Day" of the United States Naval Station at Midway that officially broke the news of the destruction of the antennas and their towers to the residents of the atoll. Amid notices of retirements, the results of captain's masts, and the softball schedule was Item 6: "Tower demolition: PACSCATTER antennas on Eastern Island will be demolished Thursday, 18 April. All personnel are requested to remain clear of the area."

But sooty terns are not privy to man's messages and, even were they, they would not desert their eggs in the antenna field. Thousands perished as steel and coral missiles blasted the area.

Only a few young Laysan albatrosses shared this fate. Most of them were moved to safety by Lieutenant Commander Lamey, the officer then in charge of the Navy Security Group on Eastern Island, and his men.

Today, breeding Laysan albatrosses fly unimpeded between their nests and the sea. Some incubate eggs alongside the prone steel skeletons or court on patches of sand between piles of tangled cables. Black-footed albatrosses are on their nests in the seaside tracks of the old sand-and-coral roadways used by men that operated the station. A trio of Hawaiian owls perches on the cold domes of hardened steel that formed the single vertical support for each tower, and solitary noddy terns preen on the slanting I beams that jut upward from the massive cable anchors of concrete that still lie buried in the porous coral. Now and then a pair of fairy terns inspects the giant toggle bolts still attached to the I beams, hunting perhaps for a suitable thumbnail depression for next year's egg. Frigatebirds chase red-footed boobies through sky freed of obstructions, and then perch on the ironwood trees as the boobies retreat seaward.

On the ground below, the last of the year's crop of young wedge-tailed shearwaters mingles with the adult

*Dr. Harvey I. Fisher is chairman of the Department of Zoology at Southern Illinois University.*

Bonin petrels just arrived to court and breed. The late young "wedgies," the down on the tips of their feathers ruffled by the salty breeze, crawl from beneath boards and irons and coils of wire, where their parents deposited them as eggs last summer. They must make way for the petrels which will use many of the same nooks and crannies for their own young. A few speckled chicks of late-nesting red-tailed tropicbirds crouch defensively and growl as I stroll past.

Individual golden plovers in dull winter plumage, here for the winter or on their migratory trail to New Zealand, occasionally associate with small flocks of ruddy turnstones foraging between weather-beaten wooden cable spools and around heaps of broken ceramic insulators. An emperor goose, one of a dozen that came to Midway, tugs at sparse dry grass sticking up from a skein of copper wire. Five of its companions are dead, and it is thin and exhausted from its struggle to reach some terrestrial haven from the harsh winter storm that blew the flock thousands of miles east of its normal course.

Perhaps the crown on this inadvertent triumph of avian justice is that we (Dr. Robert D. Klemm of Kansas State University and myself) use the main building of the abandoned installation as our headquarters as we continue our long-term study of the Laysan albatross. The building is cavernous and dark. Spaces which used to be light and air-conditioned and silent, save for the low voices of electronic technicians and the hum and click of machines spitting out messages, are now dark and musty and even quieter. One room, for spare parts, is our laboratory where Bob works on the embryology of the albatross. Another serves as a cage for albatrosses held temporarily while we attempt to fathom their use of saltwater rather than fresh. The old electronics workshop is our bunkroom, not warm but free of the wind and cold rain and free of the depredations of the ever-present rats that roam outside. On stormy nights, especially, the cold concrete walls form an inviting retreat, and we appreciate the water, the electricity and the bunks graciously supplied by the United States Navy. ■