NEW LIGHT ON THE CAHOW, *PTERODROMA CAHOW*

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EARLIER HISTORY

THE Bermuda Petrel, *Pterodroma cahow*, has been presented to the world as a mixture of legend and fact. Information from the early 17th century was voluminously quoted and oddly misinterpreted by A. E. Verrill (1902), whose several publications followed a gap of nearly 300 years during which there had appeared no unequivocal or original references to the living bird. Most 19th century writers had confused the species with Audubon's Shearwater, *Puffinus lherminieri*, or with the Manx Shearwater, *Puffinus puffinus*, both of which breed, or have bred, at Bermuda. The uncertainty is exemplified by the remarks of Newton (1896), Tristram (1902), and the more recent compilation by Bent (1922).

Verrill's account, reduced to brief summary, is that the first Bermudian settlers of 1609 encountered a fabulously abundant sea-fowl that came to the archipelago to nest in the winter season but was absent in summer. It was nocturnal and burrowing in its habits, extremely noisy, fearless of man, and had edible flesh and eggs. Its center of population in that period was at Cooper's Island, southwest of the eastern end of Bermuda. As human food, the Cahow saved some of the colonists from starvation, particularly in the famine of 1614–1615, but by reckless exploitation the bird itself was extirpated by 1621 or thereabouts.

Verrill, writing in the absence of specimens, inferred that this historic sea bird was a member of the auk family (Alcidae). It could not have been a petrel, he reasoned, because the bird and its egg were palatable. The argument has no force with anyone who has enjoyed meals of several kinds of squid-eating "mutton birds" and has found eggs of the Sooty Shearwater, *Puffinus griseus*, equal in taste to hens' eggs. Tristram (1902: 447), aware of this, had promptly responded: "The ten reasons assigned by Mr. Verrill for the cahowe not being a shearwater are most of them proofs that it is." If Tristram had written merely "petrel," instead of "shearwater," he would have been absolutely correct.

When relics of birds from Bermudian caves began to be studied (Shufeldt, 1916 and 1922), it became evident that at least three members of the Procellariiformes, including a form of the genus now called *Pterodroma*, had in glacial or early postglacial time occupied

Bermuda far more extensively than at the date of human colonization. In parts of this prehistoric period the land area was greater than now, owing to a lowering of ocean level during the Ice Age. The climate was also cooler, and the nature of the fossil birds' eggs suggests a more diversified avifauna than that of the present. Wood (1923) has reported upon ancient eggs of petrels and tropic-birds, but still unstudied specimens in the Government Museum at Flatts indicate that waterfowl of the size of swans were likewise present.

Shufeldt described and liberally figured the osteological remains. His statement that Bermuda caves are not more than five centuries old (1916: 624) is, of course, erroneous. Today many of the caves contain large stalagmites submerged under salt water at the current mean level of the ocean. These could have been built up only in the Pleistocene or during some marked postglacial lowering of sea level. Wood may be more nearly correct when he ascribes to some of the fossil eggs an age of the order of 100,000 years. It is equally likely that Cahows and other petrels that have left their bones in the limestone of caverns, fissures, and indurated dunes date in part from a similar period.

Early in the present century, the colonists' term "cahow," derived from the voice of the bird, had become definitely associated with a particular kind of petrel skeleton. But not until 1916 was a technical name, accompanied by a description of morphology and plumage, applied to the species. The type specimen, a mounted bird of undetermined sex, now in the American Museum of Natural History, was, so far as is recorded, the only example of the Cahow that had been seen alive in almost three centuries. It was captured on Gurnet Rock off Castle Roads by Louis L. Mowbray on February 22, 1906, and was first referred to in print as "*Aestrelata gularis*," the name of a New Zealand petrel (Bradlee, 1906). A decade later, it was described as *Aestrelata cahow* by Nichols and Mowbray (1916), and later in the same year Shufeldt described the species from skeletons as *Aestrelata vociferans*.

For a score of years thereafter nothing more was learned, but it seems to have been increasingly assumed that the Cahow is a close relative, or even a subspecies of, *Pterodroma hasitata* or "*caribbaea*," the West Indian petrel (Shufeldt, 1916, and Bond, 1950; 174, footnote).

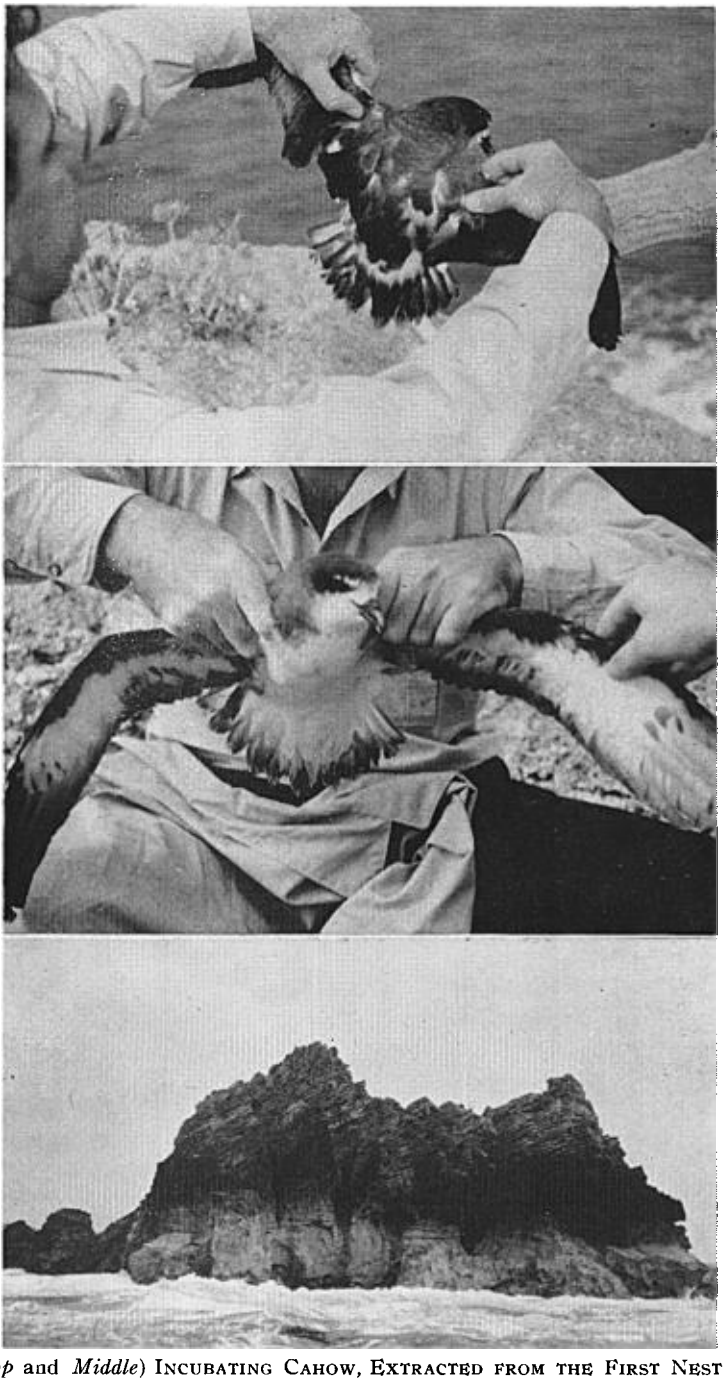
References to all publications relating to the Cahow, up to the year 1930, are included among the bibliographies of Verrill, Bent, and Bradlee, Mowbray, and Eaton (1931). For this reason no attempt is made to list them anew in the present paper.

On June 6, 1935, a fledgling female petrel of the same species as the type specimen struck St. David's Light, close to Cooper's Island, and came into possession of William Beebe (1935) who reported upon it. This example is likewise preserved in the American Museum. It differs from the type only in familiar criteria of youthfulness, which include slightly smaller feet and bill and a tuft of down on the lower belly. Its stomach contained 17 beaks of cephalopods and several crystalline lenses of the same organisms.

Dr. Beebe's spirited account of the rediscovery is exceedingly interesting. He left no doubt that the bird he had examined in the flesh was identical with that represented in the same vicinity by fossil and subfossil bones. He was the first to resurrect the pre-settlement account of the Spanish explorer, Diego Ramírez, which strongly suggests that, before the advent of men or pigs at Bermuda, the Cahows bred thickly over the greater part of the main islands. Ramírez and his crew devoured thousands and "brought away more than 1000 well dried and salted for the voyage" (Beebe, 1935: 187).

During World War II, an American naturalist and Army officer, Fred T. Hall, now director of the Buffalo Museum of Science, was stationed at Bermuda close to the Castle Roads area. Encouraged by the junior author, he made a hunt for the Cahow, finding old bones, fragments of birds apparently killed by rats, and, on March 14, 1945, he came into possession of a partly disintegrated adult that had floated ashore. It was particularly the experiences of Mr. Hall that led the writers of the present report to renew the search in 1951. Funds for field work were provided through gifts to the American Museum of Natural History by Mr. Childs Frick, and by the Pan-American Section of the International Committee for the Preservation of Bird Life, of which Mr. Marshall McLean is treasurer.

Much cooperation in Bermuda was also enjoyed by the authors during their field work. Dr. Louis W. Hutchins, Director of the Bermuda Biological Station for Research, put all the facilities of the laboratory at our disposal. Mr. Bernard Wilkinson gave us *carte blanche* in Crystal Cave, Mr. A. Elystan Haycock in Wonderland Cave, and Mr. Idwald Hughes in an unexploited cave at the Government Quarry. Colonel T. H. Watkins, Executive Officer at the United States Air Base, supplied transportation for a reconnaissance on Cooper's Island. Messrs. James Williams and S. L. Perinchief, of the Bermuda News Bureau, accompanied us to some of the islands and have been lavish in making and supplying photographs. To all of these, and to many other citizens or residents of Bermuda we are deeply grateful.



(*Top* and *Middle*) INCUBATING CAHOW, EXTRACTED FROM THE FIRST NEST DISCOVERED, JANUARY 28, 1951. (*Bottom*) WESTERLY FACE OF GURNET ROCK, THE TYPE LOCALITY OF THE CAHOW. (ALL THREE PHOTOGRAPHS BY R. C. MURPHY.)

It should be recorded here that for more than a quarter-century the junior author has remained convinced of the persistence of the Cahow as a breeding Bermudian bird. Visits to the islets with his father, beginning in January, 1924, when courting Audubon's Shearwaters were discovered, were followed at frequent intervals by observations that indicated the presence of an additional local petrel. These led in turn to recommendations to the Bermuda Legislature concerning the protection of probable breeding grounds, and finally, in 1951, to the discovery of the nesting population.

PRESENT STATUS

The condition of the islands off Castle Roads has undergone recent change due to engineering and military activities. Cooper's Island has been linked up with the larger St. David's Island through dredging and filling, and it now forms part of the Bermuda Air Base. We were given the privilege of making a reconnaissance of the old Cooper's Island breeding ground. Superficial digging with pick and shovel was undertaken in likely spots, but no trace of Cahows was discovered. It is probable, however, as suggested by Verrill, that pockets of ancient bones may yet be unearthed in a vicinity once so densely populated.

Islets offshore, like Cooper's Island itself, have evidently fallen within the war-time target area, for the tops of some of them are peppered with green, corroded, and distorted bullets of small arms. So far as could be judged, this has had no deterrent effect upon the return of the Cahows. Even more remarkable is the fact that the petrels still come back seasonally to their ancestral homes despite the blinding glare of beacons on the nearby air field and the roar of planes that pass overhead day and night from one year's end to another.

For our investigations among the islets we made use of a seaworthy diesel launch belonging to the Government Aquarium of which the junior author is curator. This craft could be anchored offshore or sent back to its base, according to weather conditions, leaving us a towed skiff for our landings. It proved feasible to moor the skiff well out from the surge around the rocks during inspections lasting from an hour or less to as long as 16 hours (overnight). For a voyage to western Bermuda, including an examination of Daniel's Islet, off Somerset, we used a fast gasoline launch generously offered and operated by its owner, Mr. Warren Lutz.

The period of field work extended from January 25 to February 10. Practically all islets off Castle Roads were visited, except Gurnet Rock, the type locality of the Cahow. Landing is possible on this stack only after prolonged calm. During weather too inclement for

work at sea, we investigated a number of Bermudian caves and quarries, obtaining a quantity of ancient Cahow bones but no integrated skeletons. In former years, one or more caverns in the steep western coast of Castle Harbor were famous for rows of calcified petrel skeletons ranged along natural shelves of the walls. These became inaccessible when the caves were filled in the course of building operations.

With the object of furthering the safety of the surviving Cahow population, the localities known or suspected to be inhabited by the birds will not here be precisely identified. All but two lie in the Castle Roads group of islands. One is situated not far from the opposite or western extremity of Bermuda. A third area of probable occupation is in a high cut-bank near the north shore of one of the main Bermudian islands. Nocturnal observations for verifying presence of the birds at the two last-named sites have not yet been made.

Early in the course of our field work we learned that the likelihood of finding Cahows was in inverse ratio to the prevalence of rats. Castle Island, for example, is large, readily accessible, and frequently visited because of its well-preserved 17th century fortifications. Brown rats abound and can even be seen along the limestone walls at midday and in bright sunlight. Quite naturally, the island appears to have no burrowing or ground-nesting birds of any sort.

Remains of rats, mingled with bird bones, were found at three sites. They comprise jaws with teeth, limb bones, and various fragments, but, according to Mr. George G. Goodwin of the American Museum Department of Mammals, it cannot be certainly ascertained whether they represent the brown rat, *Rattus norvegicus*, or its earlier congener, one of the forms of *Rattus rattus*.

The oldest rodent remains, to judge from their calcareous incrustation, were found with bones of the Cahow under phosphatic earth in a chasm of the Crystal Cave remote from the routes followed by visitors. Similar bones of considerable age are from recently exposed caverns in the face of the Bermuda Government quarry on the west side of Castle Harbor.

On Outer Pear Islet, in Castle Roads, much more recent rat bones were found on the surface, or just under the surface, of soil on the plateau of the island. These were among bones of both the Cahow and Audubon's Shearwater, including a substantially complete skull of each of these two petrels. The point of special interest is that there was no trace of living birds here or in any other locality discovered to be occupied, or to have been occupied, by rats.

The first proof of Cahows in residence was found on January 28, 1951, at an islet which may be called "A." Like others of the group, it is greatly eroded, broken into several nearly distinct parts, and overgrown on the crown with grass, prickly pear, sea lavender, *Mesembryanthemum*, and a few other halophytic plants. We scrambled ashore in the forenoon, accompanied by a youthful Bermudian ornithologist, David B. Wingate, of Aldie, Smith's Parish. In several places at levels 20 to 30 feet above the water there were holes in interbedded reddish soil under or between the limestone strata. Fresh earth at the entrances revealed neither scratches nor footprints, but there were soft patches of green and whitish excreta such as are characteristic of squid-eating sea birds. It seemed discouraging at the time that we could detect no trace whatsoever of the familiar musky odor that is ordinarily a tell-tale of petrels within.

Most of the tunnels were not only deep but were also curved or bent. Presently we located one in which, by the aid of an electric flashlight, a bird could be seen in the nest chamber. The entrance was situated at the rear of a rocky niche large enough to accommodate a man's head and shoulders. Four feet within this niche a nearly level excavation, seven to eight inches in width and somewhat less in height, had been bored in a straight line to a horizontal depth of just over six feet. With a noose at the end of a pole we presently succeeded in hauling out the bird. It was the hoped-for but only half-anticipated Cahow. The egg that it had been covering could then be seen in the nest.

Our exciting captive bit the hands that grasped it, but only briefly and half-heartedly. Within a moment it became completely nonresistant, allowing itself to be stroked, tickled, and passed from hand to hand. We photographed it, jotted down hasty descriptions of its flesh colors, and other features, and placed it on the sandy floor of its cave, whereupon it entered the burrow and scurried back to its egg. During the whole period of badgering, extraction, and handling, it had neither uttered a sound nor ejected oil from the throat or nostrils. The last point is noteworthy. No Cahow handled during our visit spewed out stomach oil in the reaction that is so common among petrels. All the birds remained calm, dry, and fluffy, as well as practically devoid of odor.

Without the expected aid of vocal indications and the "petrel smell," it was difficult to make a census of neighboring burrows. We found, however, one other in which our flashlights revealed a sitting bird, and we concluded that the distinctive excreta, the appearance of the moist spoil of digging at the entrances, and a litter of green twigs in the passages were all indications of occupancy. Barricades of tooth-

pick size were set up by us in the loose soil of several burrows in order that the comings and goings of Cahows might be determined on a subsequent visit.

Observations during the next week indicated that islet "A" might be the current home of as many as nine pairs of Cahows, islet "B" of three or possibly four pairs, islet "C" of one pair. Eight other islands, including Castle and Nonsuch, yielded only negative indications. Gurnet Rock, as noted above, could not be closely inspected because of rough seas.

NOTES ON BEHAVIOR

The Cahow comes to its nest after dark and departs long before daylight. This is typical of petrels of its group and is, moreover, precisely described in accounts of the Bermuda species dating from the days of colonization.

The next step, therefore, was to take stations on islet "A" in late afternoon of January 29 and to stand watch through the night. The swell was high in Castle Roads and the ocean still rougher off Gurnet Rock and outside the boiling skerries, but we found quieter waters as soon as we had passed through a gap in the reef just east of the tip of Cooper's Island. Mrs. Murphy and Mr. Wingate were landed with us on a convenient ledge and, because of boisterous weather, the launch was sent back by way of St. David's Head and the north shore to the Aquarium at Flatts. With the aid of a seven-foot ladder we transported our gear over a miniature precipice to the top of the islet and made everything shipshape before daylight wholly faded.

For the early evening, all hands stationed themselves beside the gully leading to the first Cahow's nest we had discovered. Later we spread out into several parts of the islet so as to keep as many nests as possible under observation.

After dark, revolving signals of Kindley Field periodically touched the summit of our island with faint gleams, and even the fixed lights were strong enough to make our own shadows perceptible on rocky walls. Moreover, the drone and thunder of planes rarely ceased. Yet as soon as the sky had lost all trace of afterglow, we began to see swift silhouettes of birds overhead, and from time to time to hear single, soft, *screepy* notes. At 8:32 p. m. a Cahow fluttered above our huddled forms on the ledge, passing several times back and forth in front of the niche. Then it dropped silently into the entrance. Three torches were turned upon it, and the bird was picked up. It made no struggle and did not offer to bite. We all examined it, then

put it on the earth in the niche, from where it walked unhurriedly into the burrow, carrying its wings slightly spread and drooped.

The night became overcast, and showers fell at intervals. Shortly after nine o'clock a group of Cahows flitted about, each bird glimpsed in a twinkling against the dark sky. Our watchers had by this time dispersed to their several stations. Each member saw birds, and David Wingate, the youngest, heard the single soft note more often than the rest of us. It was not easy to estimate the number of Cahows in flight, because they all scouted to and fro briefly before coming down to their subterranean retreats. Thirty individuals might be a reasonable guess.

At this stage of our operations the homing problem impressed us with particular force. The Bermudas are surrounded for a long distance by a relatively featureless ocean, by which is meant that the surface water on one side could hardly be distinguished by physical characters from that on any other side. This would be true for distances of scores or even of hundreds of miles. Furthermore, the breeze blows all around the compass in any week, or sometimes on any day. There would be nothing like a steady trade wind or westerly to serve as a guide for the petrels. Yet the Cahows set forth in darkness, fly no doubt for many hours out of sight of a land area totalling only one-fourth that of Staten Island, New York, and of considerably less altitude and visibility, and then, after the customary interval, head back in darkness to relieve their mates on the egg. As a feat of navigation, this is more remarkable than the much longer migratory flights by certain birds along routes possessing landmarks or their equivalent.

Mrs. Murphy and the senior author remained at the first nest except when one of them left briefly to exchange reports with Mowbray and Wingate. At frequent intervals they crawled to the burrow, turned torches down the tunnel, and watched the pair of Cahows. The birds made no audible sound, but they expressed mutual satisfaction or affection in many other ways. The beam of light apparently created no disturbance. They could be seen nibbling each other's beaks and necks and then launching into an "ecstatic" turn-around in the small chamber, puffing up their plumage and shuffling about each other on flat tarsi. At such times it was not always possible to discern whether one remained on the egg or whether the latter merely lay in the middle of the melée.

At 11:40 p. m., when the light was switched on the burrow, one bird was sitting at the threshold quietly, as if ready to depart. The other was far within, presumably on the egg. The mates had thus

remained together, carrying on their connubial display for approximately three hours. As we prepared to make a flashlight photograph, the Cahow at the door suddenly turned and retreated into the tunnel. But some time between then and midnight it slipped away silently into the blackness. From then until morning no further activity was observed.

Traditionally, the Cahows are vociferous fowl, as is to be expected of all petrels. The significance of their silence throughout our midwinter survey first came into mind as a result of the contrasting behavior of a pair of Audubon's Shearwaters in a small limestone niche about ten feet from a Cahow burrow. All night, and well into the following forenoon, the shearwaters kept up their mellow whistling chorus, which had the timbre and pitch of a tree-frog call. In Bermuda the old name of Audubon's Shearwater is "Pimlico" and, if the pattern of the song be put into words, it may be rendered '*ca-pímlico, ca-pímlico co-co-co-co.*'

Now the Pimlicos had perhaps just migrated back to their nesting stations. They had laid no eggs (which come in March), and their current business was courtship, as expressed by posturing and endless mutual warbling. The Cahows, on the other hand, were in the incubating phase of their reproductive cycle. To learn the song which may, as the old stories allege, make the welkin ring, an observer would need to bide with the birds at least as early as December.

Another notable contrast between Pimlico and Cahow lay in the nature of their respective nesting cavities. The shearwaters were in a crevice, with rock for the floor as well as the roof. The orifice was too small to admit a man's hand, although the chamber two feet within was larger. But the Cahows, without exception so far as our limited experience goes, had burrowed into soil or decomposed rock. The roofs might be stone but the floors were earth. Approximately level beds of such soft material were likewise a necessity; wherever the aeolian limestone strata were tilted, neither the scarp nor the dip slope offered suitable approaches for tunneling. These distinctions are important because the 17th century accounts state that the Cahow is a burrower rather than a cleft-dweller. When huge numbers inhabited flat turf-bearing surfaces available on the 75 acres of Cooper's Island, they no doubt dwelt mainly in earth burrows, whereas on the small and nearly naked islets of their last stronghold only thin flat beds of soil under layers of rock afford the slight security they retain.

While awaiting the return of our launch in the forenoon of January 30, we attempted to snare and extract Cahows with the purpose of placing Fish and Wildlife Service bands upon their legs. This was

accompanied by a regrettable accident which, nevertheless, revealed a clue to the seasonal stage in the life history of the species. One sitting Cahow held its egg between the bare brood patch on its belly and its forward-turned legs. When bird and egg were dragged out together, the egg was found to be broken. It contained an embryo estimated to be very slightly past half-term. For some time thereafter, this burrow remained deserted by both adult birds, but a month later, on March 2, the junior author had the satisfaction of finding it reoccupied.

At noon of February 2, we finally found means of inspecting a Cahow nest without continuing the risky procedure of poking into the long tunnels. At the top of a steep rock that forms almost a separate moiety of islet "A," we located a straight burrow running under a massive limestone dome. Measured with a bamboo, it proved to be 11 feet deep, but with our flashlights we could discern at the inner end both adults of a pair. By laying the fish pole along the surface above the burrow, we found that the occupants and their egg were beyond the heavy dome. It was then only a short task with a prospector's pick to pry off the roof of the actual nest chamber. One bird retreated down the tunnel toward the entrance, but the other remained on the egg until we lifted it off, and unconcernedly resumed its task as soon as we had replaced it.

The cavity was about a foot in diameter and somewhat irregular, its plan being controlled by salients of the rock. The nest itself was bulky and was made up of a profusion of soft twigs and of green and wilted leaves, all gathered from shrubbery within a few feet of the entrance. This material made a loose platform with a diameter as great as the length of the sitting bird, but in the middle of it was a tight cup of the same kind of vegetation only large enough to hold the egg itself. The brooding bird evidently turned in the nest and used the bill to rake small twigs and leaves close against its body, thus forming a true nest in the middle of a larger mat.

We finished with a careful job of shingling. Gathering slabs that had flaked away from the underlying rock, we laid them in a well-arranged mound above the chamber until the latter was quite as dark and even more rain-proof than before. It would thereafter require only a few minutes to remove the roof at any time for inspection.

On March 2, the junior author found that the chick had hatched, its probable age being about five days. At the next examination, on March 20, it had tripled in bulk. The longer down was by this time of a brownish gray, with white contour plumage beginning to show on the breast. Tips of quills were about to break through the skin of

the wings. The nestling was lively, pecking at fingers in self defense. The twigs of the nest had been matted down. As might be expected of petrels, both parents evidently remained away from their offspring during daylight hours.

THE CAHOW'S CALENDAR

Far too little is yet known about the respective durations of courtship, incubation, growth of the chick, etc., among the petrels. We

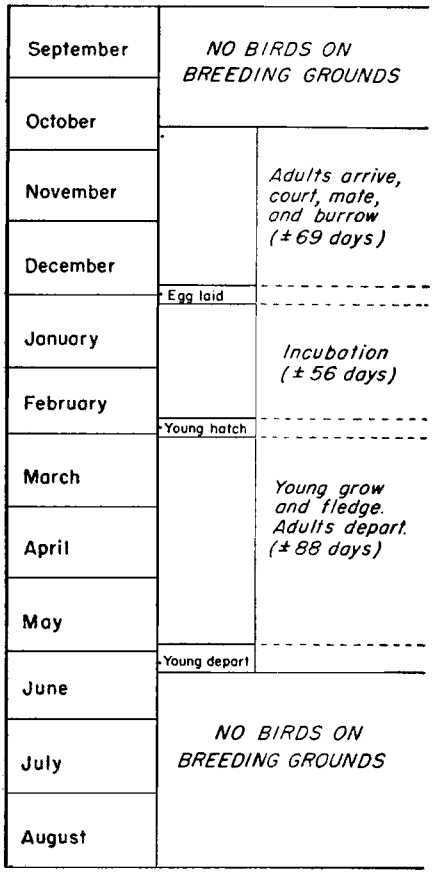


FIGURE 1. The Cahow's calendar.

have, however, certain data for species of several sizes through the field researches of Lockley (1942), Roberts (1940), Richdale (1943) and others. Bergtold (1917) also has published a brief compilation on incubation periods of the Procellariiformes.

(*Top*) NEST CHAMBER AND EGG OF A CAHOW AT THE END OF AN 11-FOOT BURROW, JANUARY 29, 1951. THIS EGG HATCHED ON OR ABOUT FEBRUARY 25. (PHOTOGRAPH BY S. L. PERINCHIEF.) (*Middle*) CAHOW CHICK WHICH HATCHED FROM THE EGG SHOWN AT TOP. PHOTOGRAPHED ON MARCH 20, 1951, AT AN APPROXIMATE AGE OF 23 DAYS. (PHOTOGRAPH BY S. L. PERINCHIEF.) (*Bottom*) GURNET ROCK, THE TYPE LOCALITY OF THE CAHOW, BEARING EASTWARD FROM CHARLES ISLAND, CASTLE ROADS. (PHOTOGRAPH BY R. C. MURPHY.)

In the case of the Cahow, assuming that its general schedule agrees with that of its relatives, we have several facts or reasonable inferences that may serve as nodal points for reconstructing a seasonal pattern of the life history. Tradition records that the petrels appear at Bermuda in autumn and that they breed in the coldest period of the year. An egg accidentally broken had passed the midpoint of incubation on January 29. A chick in a neighboring burrow, as observed by the junior author, hatched about February 25. The fledgling received by Dr. Beebe had, to judge by the down on its belly, left its nest only a day or two before June 6. We may assume that the adults abandon the young and depart on their summer exodus some 12 days before that date, or about May 24.

From such information it is possible to devise a tentative calendar (Fig. 1) subject to emendation as the species is further studied.

THE AFFINITIES OF THE CAHOW

The systematic position of the Cahow has not previously been determined. This is understandable because, so far as we can learn, only four examples have been skinned and preserved. Three of these, namely the type specimen and the birds obtained by Beebe and Hall, are before us as we write. The fourth, which struck a telephone wire in Bermuda in June, 1941, is likewise said to have been preserved as a specimen but we have been unable to locate it.

The Cahow is obviously related to *Pterodroma hasitata* of the West Indies, but not so closely that the problem may be settled by the simple process of calling it a subspecies. It seems to be equally near *Pterodroma mollis*, the typical form of which nests at the Tristan da Cunha group and Gough Island in the South Atlantic. It should be remembered that *Pterodroma mollis* has also a northern hemisphere representative at eastern North Atlantic islands from the Cape Verde group to Madeira. It might, indeed, be tempting to assume that the path of original distribution of petrels of this assemblage had been from the southern hemisphere by way of the cooler surface waters of the eastern intertropical Atlantic. By this route Bermuda lies a mere 2380 geographical miles across the Sargasso Sea from Madeira. On the other hand, the distance from the Cape Verde islands to the nearest member of the Lesser Antillean chain in the same latitude is only 2095 geographic miles. We are probably justified in assuming that the related populations of the eastern Atlantic islands, the West Indies, and Bermuda, respectively, have been segregated from one another throughout postglacial time.

The genus *Pterodroma* is made up in large part of closely related birds. Nevertheless, there are certain clearly defined natural groupings among the species. Comparison of all the known forms akin to the Cahow shows that they comprise a well-defined superspecies distributed over the greater part of the world oceans between the subtropical convergences of the northern and southern hemispheres. In other words, they are all petrels of tropical or subtropical ranges. The group is made up of the following eight forms, specific and subspecific names being here used without distinction: *hasitata* (*caribbaea*), *cahow*, *mollis*, *feae*, *phaeopygia*, *sandwichensis*, *externa*, *cervicalis*. A more detailed study of this group, which may be called the *hasitata* superspecies, is reserved for publication elsewhere.

Pterodroma cahow is a consistently smaller petrel than *Pterodroma hasitata*, except in the tail, which is disproportionately long when compared with that of either *hasitata* or *mollis*. In other respects its dimensions agree closely with those of the two recognized races of *mollis*.

From *Pterodroma hasitata* the Cahow differs markedly in two respects, first in the absence of a conspicuous white rump patch, and second in that the pileum is not distinctly darker than the back and is not separated from the back by a nuchal band of lighter feathers. From *Pterodroma mollis* the Cahow differs most strikingly in that the underwing is medially white (as in *hasitata*) instead of being prevailingly dark as in both subspecies of *mollis*.

In general appearance the Cahow might be called almost exactly intermediate between *hasitata* and *mollis*. For the present its systematic status may best be left at the specific level. Further consideration of interrelationships within the superspecies mentioned above is in preparation and will include comparative measurements of all the forms. We may here report that the dimensions of the three known specimens of *Pterodroma cahow*, one of which is a fledgling, are as follows: Total length in the flesh, 348.0–375.0 (361.5); total wingspread in the flesh, 896.6–914.4 (905.5); wing, 260.0–262.0 (260.7); tail, 118.0–123.8 (120.9); exposed culmen, 27.4–29.6 (28.6); depth of bill, in front of nostrils, 8.8–9.9 (9.4); width of maxilla at base, 12.2–14.4 (13.3); tarsus, 34.4–37.3 (35.4); middle toe and claw, 46.2–49.0 (47.1) mm.

PROTECTION OF THE CAHOW

The once spacious nesting grounds of this sea bird at Bermuda are, to all practical intents, permanently destroyed. The greatest hazard to the Cahow is the narrow margin of safety provided by its greatly

reduced numbers which are confined to small islets. The present population is perhaps of the order of 100 adult birds. There may be fewer, but there are not likely to be more.

The fact that the islets on which the birds persist are rather difficult of access, and offer little to attract visitors, is in favor of their preservation as safe nesting sites. So likewise is the great depth of the burrows, which have probably been used and, in many instances, annually deepened for long terms of years.

Unrelenting destruction of rats, which exist or have formerly existed on even relatively isolated rocks in Castle Roads, is a prime necessity. By the use of "Warfarin," "1080," or other recently developed poisons, the complete elimination of rats would be by no means impossible. If in the meanwhile the present breeding islets are kept secure, the larger insular stations, such as Castle and Nonsuch, may eventually become available for an overflow population from the smaller breeding grounds. It seems probable that the very limited situations in which the petrels can now burrow on the rocky islets have resulted in intense competition for the few safe nesting places. Since Bermuda limestone is usually much harder on the surface, after long exposure to the atmosphere, than at deeper levels, the junior author is experimenting with artificial burrows. It has proved easy to chisel openings at sites adjacent to occupied burrows and thus to put relatively soft and friable material within reach of the birds. If they take advantage of such assistance at the next breeding period, a campaign of further encouragement will be undertaken.

Happily, both public and official sentiment in Bermuda bodes well for the Cahow. "The Protection of Birds Act, 1949," which has superseded earlier legislation, effectively guards all but a few specified kinds of wild birds and their eggs. Shooting for sport has been abolished, and the privilege of scientific collecting is wisely controlled. Recommendations by the junior author, in his capacity as Curator of the Government Aquarium and Museum, are the designated legal route toward proclamations by the Governor-in-Council which establish certain areas as sanctuaries. If a suitable alteration of present circumstances may eventually enable the Cahows to spread to neighboring islands well covered with soil, the future of a beautiful and historic sea bird will be assured.

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