

17. THE BIRDS OF THE CHAGOS GROUP, INDIAN OCEAN

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Introduction

The Chagos Archipelago (Fig. 3) consists of five island groups and one small outlier scattered over an area 240 km from north to south and 130 km from east to west, around the largely submerged Chagos Bank between 5°20' to 7°35' S and 71°20' to 72°40' E in the centre of the Indian Ocean. They lie 390 km south of Addu Atoll at the southern end of the physically rather similar Laccadive-Maldivé atoll chain, 1580 km east of the Seychelles, 1400 km SSW of Ceylon, 1930 km WSW of the East Indies, and 1610 km NNE of Mauritius, nearly as far from land as it is possible to be in this area. This is the region where the presence of inter-tropical fronts leads to an increased productivity in the sea and precipitation on land associated with the development in other oceans of particularly interesting natural communities. These are of even greater interest in this one, because of the occurrence of the monsoons associated with a seasonal reversal of the winds and ocean currents immediately to the north. Unfortunately there is little information on the birds, and that mostly for the largest island, Diego Garcia, which is now largely devastated from an ornithological point of view by nearly two centuries of the activities of man and other introduced animals. Because it seems possible that some of the comparatively unspoilt outlying islands and surrounding seas may still be of exceptional interest, and moreover in urgent need of conservation in view of current proposals for further development of the area, it may be useful to review what is known of the birds of the group as a whole and the waters close to it. The area is taken to include for convenience the seas lying between the equator and 15° S, and between 65° and 80° E.

A. Description and history of the group

The central Chagos Bank, 120 km across from east to west and approximately 80 km from north to south, is now entirely submerged except for half a dozen uninhabited islets along its western rim and one in the north. The main land area is now found in four outlying atolls, Diego Garcia and Egmont in the south, and Salomon and Peros Banhos in the north. According to Wiehe (1939) the soil of at least Iles du Coin, Peros Banhos, and Boddam Island, Salomon group, consists of layers of sand, organic matter, and old guano. Gardiner (1907) also reports that it is phosphatized on Egmont, so this is doubtless general. Guano has been exported

from Diego Garcia in recent years, indicating the presence of important seabird colonies in the past, though they are now much reduced on the inhabited islands. It appears from early reports (summarized by Scott, 1961, and in accompanying papers in this volume) that all the islands were originally heavily forested, apparently mainly with huge specimens of Intsia bijuga, the natural vegetation being of cosmopolitan or Asiatic origin.

The islands were apparently discovered by the Portuguese during their first exploration of the Indian Ocean at the end of the fifteenth century, and were subsequently visited deliberately or accidentally by a variety of people. But they were not settled for nearly three centuries, when they were very rapidly and successfully colonized in the 1780's by the French, who with the assistance of slave labour probably derived directly from West Africa (where they were major participants in the slave trade in this time: Ingham, 1962) soon felled the majority of the native woodland and replaced it with exceptionally productive coconut plantations wherever there was room for them. Timber continued to be exported to Mauritius from the last and most luxuriant forest on Boddam Island in the Salomon group, well into the nineteenth century, and tree stumps could still be seen there very recently.

The British retained Mauritius and its dependencies after the peace treaty of 1810. By the time they had reallocated the French leases and taken the first steps to control the slave trade in the islands to the north in 1813, there existed well-organised plantations with a large population and a wide variety of imported domestic animals and plants and doubtless also pests (notably rats) and weeds. There is little precise information on the state of affairs over the next few decades i.e. the period leading up to the final termination of slavery in British possessions in 1839, although it seems likely that a good deal of surreptitious communication with the slave-markets in East Africa took place for some years, bypassing the seat of government in Mauritius via such staging-posts as the Seychelles, Aldabra, Madagascar and Comoros. However, by the time a commission was sent to investigate the situation in 1859 the numerous human population was found to have been largely freed from restraint, although not encouraged to leave, and thereafter the main traffic was with Mauritius.

There was a considerable amount of whaling based on Diego Garcia in the middle of the nineteenth century. The main species sought was the sperm whale caught in January, February and April with a few in May and September (Townsend 1931, 1935). The island also served briefly as a coaling station during the early phase of the development of the steamship route between Aden and Australia in 1882-1888, with a consequent increase in the human population and amount of disturbance to the environment. The main seabird colonies appear to have been wiped out there about that time, despite attempts at conservation by the manager, James Spurs (not a totally enlightened individual, however, since he later introduced cats to Aldabra in the face of some opposition). Otherwise conditions appear to have remained fairly stable throughout the group for

over a century after the plantations were fully developed, until the smaller eastern islands which had always undergone vicissitudes finally had to be evacuated after their supply-ship the "Diego" was wrecked in 1935. Diego Garcia itself was further developed as a military base in the 1940s, and this is now under consideration again.

The description of the climate and local conditions on Diego Garcia in the accompanying chapters can probably be considered as typical for the group as a whole, and they will not be repeated here except in so far as they bear on the discussion of the ornithological findings.

B. The individual islands

1. Diego Garcia

This is the most southerly and largest of the islands. It consists of a bowed V convex to the east 19 km long, 10 km wide, and 50 km in circumference, with three small islets (West, Middle, and East Islands) spread across the mouth of the V. The birds have been investigated by a number of visitors, as follows:

Finsch (1887) made a brief excursion ashore while his ship was coaling on 8 July 1884. He remarks that this is the best atoll in the Indian Ocean, with more luxuriant vegetation but less wildlife and people than comparable sites in the Pacific, where he had vast comparative experience. He was most impressed by the number of terns, of which he took some eggs (Finsch and Blasius, 1887). They included possibly 100,000 Sooty Terns (scientific names are given in the systematic list in Section D), a tenth as many Common Noddies nesting on the ground inland, and a few White Terns nesting in the trees. He had seen boobies at sea offshore, but did not see them nesting (but he did not have time to visit the south end of the island). He only saw one frigate and no tropic-birds although he was told they occurred in small numbers. He remarks on the scarcity of heron and waders, though he saw a species of curlew. He only noticed one landbird, the fody, with a few males coming into breeding plumage, though the captain of the ship later reported that he saw doves at Pointe Marianne.

Bourne (1886) arrived for four months on 15 September the following year, 1885, and largely confirms this account. He reports that the inhabitants were taking many of the terns' eggs and he found boobies hatching chicks at the south end of the island, while he was told that frigates bred there at another season and shearwaters on the Ile des Oiseaux, though he did not see them himself. He made a useful collection, described at the time by Saunders (1886), and now mainly in the British Museum (Natural History), and including specimens of the Little Green Heron and Red-footed Booby, but apparently also failed to find the dove. Vanhoffen (1901) also made a small collection, now mainly in the Berlin Museum, during a brief stay by the research vessel Valdivia on 23 February 1899.

It includes specimens of the Madagascar Turtle Dove and Little Green Heron which were subsequently described by Reichenow (1900) as endemic forms, and also of the Lesser Noddy. The early phase of exploration of the group was brought to an end with the visit of the Percy Sladen Trust Expedition during an extensive tour of the whole archipelago on 7-13 July 1905. Unfortunately their notes on birds were always casual and particularly so here (Gardiner, 1907; Gadow and Gardiner, 1907), while none of the specimens that they took can be traced. They reported that terns, waders and herons were abundant, and that they saw a pair of White-tailed Tropicbirds nesting in a Pisonia tree said to have been in use for some years.

Thereafter there appears to have been a gap of half a century during which no important bird observations were made until Messrs. D. M. Neale and J. Branegan noticed ten species of seabird offshore during a brief visit by H.M.S. Gambia in July 1958 (Bourne, 1959). Two years later (December 1960) Loustau-Lalanne (1962) toured the inhabited islands of the archipelago briefly and made the most detailed survey yet reported. He recorded several new introductions to Diego Garcia, including the Grey Francolin at an unknown date, Cattle Egrets from the Seychelles in 1955, and the Barred Ground-dove in 1960. He also noted the occurrence of an unidentified moorhen and the reduction of the seabirds to a few hundred noddies on the outlying islands and a handful of White Terns in the trees. Lt. P. G. Odling-Smee added the Mynah to the list of recent introductions during a ten-day visit in July-August 1964 (Bourne, 1966), and Pocklington and Stoddart (Pocklington 1967a) found the introduced species still flourishing in May 1965 and July-August 1966 (when H. A. Fehlmann made a small collection for the Smithsonian Institution), so that it appears that if the seabirds are now largely lost a growing land-bird fauna is becoming established.

2. The western islands: Egmont Atoll, Danger and Eagle Islands, and the Brothers

These are a series of small islands or groups scattered at intervals of 15 to 30 km along the western margin of the Chagos Bank. In recent times they were served from a plantation on Eagle Island, and were deserted with it when the barque "Diego" which provided communication with the larger atolls was wrecked in 1935.

Egmont is a small atoll with its main axis inclined WNW-ESE 120 km north-west of Diego Garcia and 30 km SSE of Danger Island on the South-west aspect of the Chagos Bank. It was described by Bergne (undated) as a string of islands forming an oval 9 km long by 3 km wide around a shallow central lagoon with a good anchorage. It was formerly entirely planted with coconuts, and had a population of about fifty people at the beginning of the century. Scott (1961) reports that a concession for development was first given to Victor Duparrel in 1808, and that conditions were very poor in the 1840s, when it was overrun by 600 pigs as well as dogs, cats, and rats; contemporary sailing directions (Horsburgh, 1852; Findlay, 1882) also mention poultry and pigeons among the supplies

available. The only ornithological observations were made by the Percy Sladen Trust Expedition during 14-23 July 1905 (Gardiner, 1907), who reported that Mynahs had also been introduced and that the "larger grey-headed tern" (presumably the Common Noddy?) had there taken to nesting in the trees, where Curlew and Whimbrel also took refuge when disturbed, and that there was a reed-marsh in the centre of Lubine Island.

Danger Island is about 2.4 km long by 1.2 km wide, and is described by Scott (1961) as inaccessible with palms and forest on the crown. Eagle Island itself, some 24 km to the north, is about 4 km long by 1.2 km across and was colonised by 1813. It held about sixty people and numerous donkeys by the beginning of this century, and is covered with palms. There is also a low outlier, the Ile aux Vaches Marines, two miles to the south. The Trois Frères lie along a NW-SE axis 8 km long 16 km farther to the ENE; the largest is 1.2 km long and also covered in palms; it was also inhabited for a time in the nineteenth century, but was apparently the first inhabited island to be abandoned. None of these islands ever appears to have been visited by an ornithologist, but Pocklington (1967a) reports that many birds can be seen at sea in the area, including numbers of Wedge-tailed and Audubon's Shearwaters, adult and immature Red-footed Boobies, and Sooty and Noddy Terns west of Eagle Island at 6°15'S, 71°10.5' E on 22 October 1963, and a male Lesser Frigate-bird and more boobies between Danger Island and Egmont Atoll in May 1965. Thus it seems likely that since they were deserted they have become important seabird colonies.

3. Nelson or Legonne

This is a small island 2.4 km long by a 0.5 km wide on the north side of the Chagos Bank nearly 80 km ENE of the Brothers and 32 km south of Peros Banhos and Salomon atolls. It appears never to have been inhabited, cultivated, or even visited at all frequently. Gardiner (1907) reports that boats used to visit it from Salomon and Peros Banhos to take the eggs and young of the frigate-birds, which breed there in December and January, and Loustau-Lalanne (1962) was informed that Brown Boobies and both shearwaters also breed there at much the same season. Otherwise nothing was known about the birds until J. Frazier (pers. comm.) visited it for an hour in July 1970 and found a clump of palms, a hut, and colonies of Red-footed and Brown Boobies, the two noddies, White Terns, and Great Frigate-birds displaying, although he did not notice any Lesser Frigates. Its status is therefore probably much the same as that of the western islands, which are of course now even less accessible.

4. Peros Banhos

This is a large atoll including some thirty islands and islets distributed in a rectangle around a lagoon about 24 km across from east to west and 21 km north to south, with a total land area just over 11.5 square km. It lies some 160 km north-west of Diego Garcia and 32 beyond Nelson Island at the northern extremity of the Chagos bank. The western islands are larger, and have long been cleared and planted with coconuts;

they include from south to north the headquarters on the Ile du Coin, Poule, which has feral chickens, Petite and Grande Soeur, Pierre and Diamante. Considerable seabird colonies survive on the many smaller eastern islands. Bourne (in Saunders, 1886) was informed that shearwaters bred on the Ile aux Vaches Marines in the south, while in June 1905 the Percy Sladen Trust Expedition (Gardiner 1907; Gadow and Gardiner, 1907) found Black-naped Terns nesting in trees on Yéyé and White Terns nesting on the shores on Petite Ile Coquillage, where noddies also had eggs and some chicks, preyed upon by Little Green Herons. At various places around the atoll they also recorded a party of House Sparrows and a variety of Palaearctic waders, and they were informed that Crab Plovers bred locally in holes in December and that a variety of landbird migrants including raptors, crows and hirundines also occurred with north winds at that season.

More recently Hartman collected four Fodies on the Ile du Coin on 23 October 1967 and two Little Green Herons, two Black-naped and a Sooty Tern and a Lesser Noddy there two days later, now all in the Peabody Museum, Yale University (N.P. Ashmole, in litt.). Loustau-Lalanne (1962) confirmed the presence of the Fody and Sparrow and saw or heard of a number of breeding seabirds among the eastern islands in December 1960, including from south to north Wedge-tailed and Audubon's Shearwaters and Brown Boobies on the Coin du Mire; both shearwaters, Sooty and White Terns on Grande Ile Coquillage; Sooty, Black-naped and White Terns and both noddies on Petite Ile Coquillage; both shearwaters and all five terns on Yéyé; and all the terns on Longue. Scott (1961) also reports that myriads of seabirds breed on Moresby Island in the north. Nobody has confirmed that Crab Plovers breed on the central Indian Ocean atolls and it seems possible that the report really referred to the shearwaters and that the Crab Plovers are really migrants from the north.

5. Salomon

This is a small atoll lying 32 km north of the Chagos Bank and 20 km east of Peros Banhos. According to Bergne (undated) it was once called the Twelve Islands, though there are now only eleven, distributed around an irregular oval 18 km long in a NE-SW axis by 8 km across, with a total land area of 5 square km, now all planted with coconuts except the Ile Diable. The main island, Boddam, is apparently the most fertile in the Archipelago, and originally supported a dense forest of huge trees up to 40 m high, probably mainly Intsia bijuga. According to Scott (1961) five islands were forested at least until 1838, supplying timber for Mauritius, and Takamaka still is. The Percy Sladen Trust Expedition noted the presence of House Sparrows imported from Mauritius, Little Green Herons, Guinea Fowl on Takamaka, Fouquet, and Anglaise Islands, and various seabirds and waders. Loustau-Lalanne (1962) reports the presence of Fodies and moorhens as well. However, the coconut plantations on this atoll always appear to have been particularly prosperous and the numerous human population in association with its small size does not appear to have been compatible with a rich avifauna.

C. Birds at sea

Finsch (1887) saw boobies shortly before arriving at Diego Garcia from the NW on 9 July 1884 and Vanhoffen (1901) also records that large flocks of Common Noddies were seen fishing low over the water in an area which produced a large catch of the blue copepod Poulellida one day before the Valdivia reached the same atoll from the north on 22 February 1899. Otherwise few notes appear to have been made on the occurrence of birds at sea in the area until very recently. However, following the development of the Royal Naval Bird-watching Society's sea report programme since the last war, a growing number of notes have become available from naval personnel visiting the area or sailors crossing it along the trade-routes between Aden and Western Australia or between South Africa and Singapore. It was also traversed by several of the lines of stations along meridians of longitude investigated systematically by ornithologists participating in the International Indian Ocean Expedition of 1962-1965. Taken together these observations now cover with varying accuracy and completeness some 30 voyages across the area in all months of the year except February, as seen in table 9. This is sufficient to provide at least an indication of the general character of the seabird population if not its detailed distribution, especially when compared with other surveys of the areas to the west by Bailey (1966) and Gill (1967) and the east by Japanese and Russian observers (Ozawa and Seno 1966; Shuntov 1968). The implications of these findings will be discussed later in Section E.

D. Notes on species

The order and nomenclature of the following systematic list of bird species are modified from those of the Smithsonian Institution Preliminary Field Guide to the Birds of the Indian Ocean (Watson et al. 1963), which also contains maps and a description of the archipelago and descriptions and figures of most birds species normally occurring in the area except for some of the dark petrels, discussed by Bourne (1960) and Bailey et al. (1968). In order to avoid continual repetition of a limited number of key references the origin of routine observations for each island is indicated by the date when this can be done without ambiguity, and the appropriate reference can be located in section B. In some groups identifications are uncertain, in which case species are dealt with collectively under generic or family headings.

Macronectes sp. Giant Petrel

J. Frazier (in litt.) bought a Giant Petrel in Diego Garcia in July 1970, currently deposited at the Ministry of Agriculture in the Seychelles. If as seems probable it is immature it may be difficult to determine which it is of two sibling species Macronectes giganteus and M. halli breeding in the subantarctic islands to the south (Bourne and Warham, 1966).

Table 9: Observations of birds at sea between 0-15°S, 65-80°E

(Observations taken from records of the Royal Naval Bird-watching Society deposited in the British Museum (Natural History) and published sources).

- January: C. B. Thomson passed NE of the Chagos group in 1954, P. P. O. Harrison to the SE in 1960, and J. B. Mitchell to the north in 1961.
- March: G. S. Willis passed to the NE in 1956, and F. E. Greaves in 1957.
- April: Elkington (1929) passed to the SW in 1929, F. W. Greaves in 1957, and R. S. Bailey (1968 and in litt.) and F. B. Gill (1967) investigated stations along the 67 1/2°E and 75°E meridians in 1964.
- May: R. Pocklington (1967a) sailed between Danger Island and Egmont Atoll in 1965.
- June: P. P. O. Harrison passed to the NE in 1955, and R. S. Bailey (1968 and in litt.) repeated investigations along the 67 1/2°E meridian in 1964.
- July: J. Branegan and D. M. Neale crossed the area from north to south calling at Diego Garcia in 1958, P. P. O. Harrison passed to the SW in 1958 and T. B. Scott in 1959, P. G. Odling-Smee spent ten days on Diego Garcia during the course of the cruise through the area in 1964 (Bourne, 1966), and A. J. Palmer passed to the SE in 1968.
- August: P. G. Odling-Smee completed his 1964 cruise.
- September: P. P. O. Harrison passed to the SE in 1957, and A. J. Palmer in 1968.
- October: Elkington (1930) passed to the NE in 1929 and P. P. O. Harrison in 1954 and to the SW in 1955, R. Pocklington and R. Risebrough (1964) passed west of Eagle Island in 1963, and K. Salwegter to the SE in 1963.
- November: C. B. Thomson passed to the NE in 1952, J. B. Mitchell to the SE in 1960, and K. Salwegter returned in 1969.
- December: Ozawa and Seno (1966) completed the majority of repeated surveys along the 78°E meridian in 1962 and 1963.

Fulmarus glacialisoides Southern Fulmar

D. M. Neale provisionally identified as this species a large grey shearwater with a pale head, white underparts, a dark wing-tip and pale bill seen at 10°S 69°E on 11 July 1958.

Pachyptila sp. Prions

R. S. Bailey saw one at 12°42'S 67°18'E on 28 June 1964, and other possible examples at 13°40'S 67°24'E and 15°10'S 67°12'E over the next two days with water temperatures between 23-26°C; P. P. O. Harrison reported one and then two at 12°32'S 74°41'E with a water temperature of 27°C on 17 July 1958. They have been recorded even further north off East Africa (Bailey, 1968); it is debatable which of six similar species they may be.

Puffinus carneipes Flesh-footed Shearwater

Gill (1967) saw a possible bird at 4°11'S 75°00'E on 22 April 1964, and two at 2°14'S 75°14'E next day, Pocklington four at 8°30'S 66°50'E on 17 May 1965, P. G. Odling-Smee several between Diego Garcia and Gan in late July 1964, P. P. O. Harrison some ten large shearwaters, in three parties, at 2°13'S 71°30'E on 9 September 1957, and K. Salwegter one at 11°23'S 70°30'E on 10 Oct. 1969 and fifteen at 8°45'S 74°02'E next day. It appears that this species, which breeds in south-west Australia, must regularly pass the Chagos group on migration to its winter quarters around the northern periphery of the Indian Ocean, and some birds may winter in the area.

Puffinus pacificus Wedge-tailed Shearwater

Fouquets (the Creole name for shearwaters) were reported to breed on the Ile des Oiseaux, Diego Garcia, and the Ile des Vaches Marines at Peros Banhos, and it seems possible that the "Crab Plovers" reported in 1905 to breed in burrows in December on the latter atoll were really also shearwaters. Wedge-tailed Shearwaters were reported to breed on Coin de Mire, Grand Coquillage, and Yéyé islands, Peros Banhos, and Nelson Island in the period Nov.-Feb. (normal in the southern hemisphere) in 1960, and Bailey encountered them at sea along the 67 1/2°E meridian four times between 15°00'S and 0°50'S in April, and twice at 1°28'S in June; Neale saw them off Diego Garcia, Odling-Smee one at 3°04'S 73°11'E and Palmer one at 12°28'S 70°11'E in July; Odling-Smee saw several at 4°28'S 66°10'E in August, Harrison saw four at 6°04'S 76°18'S in September, and Salwegter saw two at 8°45'S 74°02'E and Pocklington (1967a) a number with other seabirds west of Eagle Island in October, so that they appear to occur both in the offshore waters and scattered widely at sea during most or all the year.

D. M. Neale identified ten white-breasted, wedge-tailed shearwaters seen on the equator at 78°E on 7 July 1958 as the pale phase of P. pacificus, previously only recorded in the Indian Ocean as breeding at Shark's Bay, Western Australia; he reported single individuals again the following day at 2°40'S 76°E and on 11 July at 10°S 69°E. What these birds may have been is questionable but it may be noted that white-breasted shearwaters of doubtful identity, thought on that occasion to be the Fluttering Shearwater, Puffinus gavia of New Zealand, have also recently been reported by Shuntov (1968) in the Indian Ocean off north-west Australia during the SE monsoon of 1967. They might possibly be the White-faced or Streaked Shearwater Calonectris leucomelas of the North Pacific, which visits the Malacca Strait and has reached Ceylon. It would be surprising to find them in the Indian Ocean in July, but the North Pacific storm-petrels also occur there then.

Puffinus l'herminieri Audubon's Shearwater

These were reported to breed with the Wedge-tailed Shearwaters at the same season in 1960, and were also seen with them off Diego Garcia on 9 July 1958 and west of Eagle Island on 22 Oct. 1963. There are fewer records of them at sea than with the last species, but these are also widely scattered. Mitchell saw one at 3°48'S 65°01'E on 12 Jan. 1961, and three with other birds over shoaling fish at 3°55'S 70°25'E next day; Bailey saw one at 15°00'S 67°29'E on 15 April 1964, and Harrison one at 6°00'S 76°15'E on 30 Oct. 1959. It may be remarked that in contradistinction to the Wedge-tailed Shearwater this species shows much geographical variation and often appears to have a prolonged or continuous breeding season elsewhere, so that both the characters of the Chagos population, which does not appear to have been collected yet, and its breeding behaviour particularly merit investigation.

Pterodroma sp. Gadfly petrels

A number of isolated records of dark or white-breasted petrels from widely separated parts of the tropical Indian Ocean appear to be referable to gadfly petrels of the genus Pterodroma. This includes numerous species known to breed or winter widely in the tropical parts of other oceans (Murphy and Pennoyer 1952). Their numbers are now often greatly reduced by predators introduced by man to their island breeding stations, and they may be elusive even where they have escaped them (Bourne, 1965). Three medium-sized petrels reported by Bailey from the Chagos area in June 1964 among other records appear to belong to this class:

1. A bird with dark upperparts and underwing but a white breast, seen at 0°06'S 65°13'E on 18 June, also thirty petrels brown above and white below with a dark underwing and bill seen by J. Branegan at 10°S 69°E on 11 July 1958, and possibly another slaty grey above with a dark underwing, a white breast, a short stubby tail, and a flapping, gliding flight low over the water, reported by P. P. O. Harrison further west (3°S 59°30'E, 28 July 1964) might all be the Soft-plumaged petrel, which has been recorded further south (Bailey 1968), or the pale phase of the Trinidade Petrel, Pterodroma arminjoniana. This is so far only

known to breed in very small numbers on Round Island off Mauritius in the Indian Ocean, although it is widespread along the southern border of the tropics in other oceans, but there usually has a mottled underwing. These birds could also have been the Phoenix Petrel Pterodroma alba or the Tahiti Petrel Pterodroma rostrata of the tropical Pacific, which are similar with dark underwings. Of these four species, it is notable that the Trinidade and especially the Phoenix Petrels breed on low islands very like the Chagos group in the tropical Pacific, whereas the Tahiti Petrel prefers the mountains of high islands like the Seychelles; the absence of these three species from the central Indian Ocean is frankly surprising, and it seems possible that colonies may have been exterminated in the past, or so seriously reduced that they have been overlooked.

2. Birds with dark upperparts and underwing margins but a white centre to the underwing and breast (3°43'S 67°24'E, 21 June) and also three seen by Harrison further west (3°S 54°E, 29 July) and another seen by Gill (1967) even further west beyond the Seychelles (5°23'S 48°08'E, 1 June) all described in much the same words except that Harrison mentions that they were the size of a Wedge-tailed Shearwater with a swooping, soaring type of flight, resemble Barau's Petrel Pterodroma barau although two of the observers apparently exclude the possibility. Barau's Petrel was recently discovered on Réunion, where it appears to be a summer breeder (Jouanin and Gill 1967); its very close ally, the Juan Fernandez Petrel Pterodroma externa, is a strong northward migrant in the Pacific (King, 1970), and it seems likely that Barau's Petrel migrates north in the Indian Ocean too, and is responsible for a number of confusing records there.
3. A uniformly dark bird with an erratic flight distinct from that of the next two species seen at 12°52'S 67°21'E on 28 June might be the Great-winged Petrel Pterodroma macroptera, which however is large and usually stays far south. It might also be the dark phase of the Trinidade Petrel, or the long lost Réunion Petrel Pterodroma aterrima recently rediscovered on that island and which may itself be a dark phase of the Tahiti Petrel (Jouanin, 1970).

Bulweria bulwerii and Bulweria fallax Bulwer's and Jouanin's Petrels

These are two closely-related medium to small dark brown petrels that differ mainly in size. Bulwer's Petrel, which is smaller and breeds in the summer in the northern subtropical Atlantic and Pacific, has been collected once in the Indian Ocean, immediately to the north of the Chagos group on Gan on 23 Aug. 1958. It seems possible that it is not uncommon among the smaller dark petrels that frequent the area (Bailey et al. 1968). Jouanin's Petrel, which is substantially larger and has not yet been found breeding, seems likely to do so somewhere along the south coast of Arabia in the summer. It has also been collected as far

south as Malindi, Kenya, in December, and reported at $8\ 1/2^{\circ}\text{S}\ 58^{\circ}\text{E}$ in July (Jouanin 1957; Bailey 1966, 1968). However, the full distribution of the two species remains somewhat obscure because they have to be distinguished not only from each other but also from the larger dark shearwaters and gadfly petrels and the smaller dark storm-petrels, and until very recently few observers realised that the majority of these species might occur anywhere near the area. In consequence, many records can only tentatively be allocated identifications, as follows:

Harrison identified a Jouanin's Petrel at $5^{\circ}23'\text{S}\ 66^{\circ}52'\text{E}$ on 26 Jan. 1960, and also reported some small-medium, chocolate brown petrels with a paler shade on the wing at $4^{\circ}56'\text{S}\ 66^{\circ}21'\text{E}$ the same day which may have been either Bulwer's Petrels or storm-petrels.

Bailey identified a Jouanin's Petrel at $0^{\circ}06'\text{S}\ 65^{\circ}13'\text{E}$ on 19 June 1964, other possible ones near the equator at 67°E next day and at $7\ 1/2^{\circ}\text{S}\ 67\ 1/2^{\circ}\text{E}$ on 22 April, and five dark petrels about ten inches long that could again have been either Bulwer's Petrels or storm-petrels at $10^{\circ}\text{S}\ 67\ 1/2^{\circ}\text{E}$ on 20 April. Pocklington saw three small all-dark petrels at $7^{\circ}54'\text{S}\ 70^{\circ}00'\text{E}$, on 18 May 1965 and another at $5^{\circ}04'\text{S}\ 66^{\circ}25'\text{E}$, three days later.

Harrison saw two medium-sized dark petrels at $15^{\circ}40'\text{S}\ 77^{\circ}20'\text{E}$ on 6 Oct. 1955, and two more with very pointed wings flying in a rather erratic way at $6^{\circ}49'\text{S}\ 67^{\circ}26'\text{E}$ two days later which might very well have been B. fallax.

Pocklington (in Bailey et al. 1968 and in litt.) saw dark petrels of two sizes in a mixed flock of birds feeding at $6^{\circ}15'\text{S}\ 71^{\circ}\text{E}$ west of Eagle Island on 22 Oct. 1963 which may have been the two species of Bulweria.

Oceanodroma matsudairae and O. (Leucorhoa) monorhis, Matsudaira's and Swinhoe's Storm-petrels.

These are another pair of medium to small brown storm-petrels with paler wing-coverts which differ from the last two mainly in having forked rather than wedge-shaped tails. They have both so far only been found breeding in the north-west Pacific, but wander into the Indian Ocean, where Matsudaira's Storm-petrel has been recorded mainly along the equator and Swinhoe's Storm-petrel in the Arabian Sea (Bailey et al. 1968). A closely allied form with a white rump, Leach's Storm-petrel O. leucorhoa has also been reported twice in the Indian Ocean area recently (Lapthorn et al. 1968), but not in the central part yet, though it is likely to occur there as well. As in the last case, identifications can only be tentative at present, as follows:

Gill (1967) saw a large bird at $11^{\circ}47'\text{S}\ 74^{\circ}43'\text{E}$ on 19 April 1964, and Bailey (Bailey et al. 1968) another at $1^{\circ}51'\text{S}\ 67^{\circ}47'\text{E}$ on the 25th when he also saw a smaller bird on the water at $0^{\circ}03'\text{S}\ 67^{\circ}37'\text{E}$; he had seen another at $0^{\circ}05'\text{S}\ 67^{\circ}40'\text{E}$ two days before. Pocklington recorded one at $5^{\circ}04'\text{S}\ 66^{\circ}46'\text{E}$ on 21 May 1965. Bailey saw three large birds at $0^{\circ}07'\text{S}\ 65^{\circ}41'\text{E}$ on 18 June 1964, and another with a smaller one near the equator at 67°E next day; Harrison also noted a small, all-dark storm-petrel at $6^{\circ}49'\text{S}\ 67^{\circ}26'\text{E}$ on 8 Nov. 1955.

Oceanites oceanicus Wilson's Storm-petrel

This species breeds in the far south and migrates north in all oceans. Bailey collected one at 13°39'S 67°41'E on 17 April 1964, and saw another at 7 1/2°S 67 1/2°E five days later, and again at 1°28'S 67°24'E on 20 June. Odling-Smee recorded a number of storm-petrels in the Chagos area in July and Aug. 1964. Harrison also reported several storm-petrels in July 1958 and Sept. 1957. Pocklington (1967a) saw the last in a mixed flock of seabirds feeding at 6°15'S 71°10.5'E west of Eagle Island on 22 Oct. 1963.

Pelagodroma marina White-faced Storm-petrel

In the Indian Ocean area, this species breeds off south-west Australia and at least in the past in the St. Paul-Amsterdam group, and also migrates north across the equator in winter. Greaves saw a doubtful bird at 6°S 70°E on 14 March 1957, Neale three six miles north of Diego Garcia on 9 July 1958, Harrison one at 12°32'S 74°41'E on 17 July 1958, and Odling-Smee two birds of this species or the next group at 0°25'S 76°08'E on 16 July 1964.

Fregetta tropica and F. grallaria Black- and White-bellied Storm-petrels

These are a complex closely-related group breeding on subantarctic islands and wintering in the tropical parts of all oceans. The Black-bellied Storm-petrel breeds relatively far south, on Kerguelen and the Crozets in the Indian Ocean area, and normally has a dark line down the centre of the white breast, though this may be entirely white, and proportionately long tarsi and toes. The White-bellied Storm-petrel breeds further north and has been collected at sea off the St. Paul-Amsterdam group in the Indian Ocean area, and normally has a white breast (though this may be dark in at least one Pacific population) and proportionately short tarsi and toes. What appears to be an intermediate, possibly hybrid, population occurs on Gough Island in the South Atlantic (Bourne, 1962). The breast markings are hard to see at sea, and which species occurs most commonly in the Indian Ocean has been disputed, though the Black-bellied Storm-petrel certainly occurs rather widely (Bailey, 1968). Pocklington saw two members of the group twice at 8°29'S 66°55'E and 7°54'S 70°00'E on 17 and 18 May 1965, and thought that the second two at least were white below. Two other possible records are listed under the preceding species. Bailey had a clear view of the dark line down the breast of a Black-bellied Storm-petrel at 5°43'S 67°26'E on 22 June 1964, and saw another member of the group at 11°04'S 67°18'E five days later.

Phaethon aethereus Red-billed Tropic-bird

This species breeds in the eastern Pacific and Atlantic with an isolated population in the Arabian Sea. It has been recorded several times in the Bay of Bengal and reported with inadequate evidence in the South China Sea, but its status in the last two areas is still obscure. Neale reported one on the equator at 78°E on 7 July 1958; he was

familiar with the species in the Arabian Sea, and mentions the red bill.

Phaethon rubricauda Red-tailed Tropic-bird

This species appears to be characteristic of the trade-wind areas of the central and western Pacific and southern Indian Ocean. Loustau-Lalanne (1962) writes that it was seen around the three inhabited atolls in late 1960, and that Gadow and Gardiner (1907) reported it breeding (in point of fact, this was the next species). However, Pocklington (1967a) was also informed by residents on Diego Garcia that it occurred fairly commonly in the north-west of that atoll, so that it seems likely it does breed. Harrison saw a tropic-bird "with a dark tail" at 5°23'S on 26 Jan. 1960, another at 2°12'S 72°12'E on 29 Oct. 1964, and Bailey a bird of this species at 12°52'S 67°21'E on 28 June 1964. However, it appears to be much less common at sea than the White-tailed Tropic-bird.

Phaethon lepturus White-tailed Tropic-bird

On Diego Garcia in July 1905, the Percy Sladen Trust Expedition were shown a pair nesting in a Pisonia tree which they had been using for some years. Loustau-Lalanne saw the species around the three inhabited atolls in Nov.-Dec. 1960, and Branegan saw it off Diego Garcia again on 9 July 1958. It appears to be the commonest of the tropic-birds found widely scattered over surrounding seas, but more to the north than the south, with a total of some twenty reports of birds identified as this species, two in March, three in April, four in June, ten in July (eight from Odling-Smee), and one in November. Taking all records of tropic birds from between 65-80°E together, 24 come from the area between 0-5°S, nine from between 5-10°S, and five from between 10-15°S which suggests that there is a definite concentration of records in the vicinity of the equator, though possibly more at the time when the southern equatorial current moves north with the development of the southerly monsoon than when the counter-current becomes established during the northern winter. So far there are no reports of the distinctive yellow race P. l. fulvus which breeds on Christmas Island and was recorded at sea north-west of Australia (Pocklington 1967b, Shuntov 1968) so that they likely must disperse to the east.

Sula abbotti Abbott's Booby

Mitchell reported two possible birds of this highly distinctive species, apparently never previously recognized at sea far from the breeding stations, at 3°55'S 70°25'E on 13 Jan. 1961. There is still a substantial population of about 5,000 birds nesting on Christmas Island to the east, although it is now threatened by phosphate mining which already led to the extermination of the other known colony on Assumption to the west (Nelson, 1971). It seems possible that the species may also once have bred on the Chagos group, which occupies an exactly intermediate position and was originally covered by the tall forests utilised by this species for breeding, but if so it was lost following the destruction of the forests. It might be useful if the subfossil deposits likely

to exist on some of the islands could be searched for evidence of its past occurrence, especially since consideration might be given to the reintroduction of the species to the Chagos group or Assumption if its position becomes more seriously threatened on Christmas Island.

Sula dactylatra Blue-faced Booby

Bailey recorded one immature bird at 1°42'S 67°38'E on 26 April 1964, another possible one at 6°20'S 67°26'E on 22 June 1964, and a third at 7°50'S 67°22'E next day, and Odling-Smee two at 4°30'S 73°12'E on 18 July 1964. While adults usually stay fairly close to the breeding colonies, young birds are sometimes found at sea far from land (Bailey 1968; King 1970) and the birds recorded may be wanderers from distant colonies to the east or west, although it will be surprising if this booby is not found to breed locally.

Sula sula Red-footed Booby

G. C. Bourne (1886) collected an adult in the white phase on Diego Garcia so that the "gannets" he reported to be hatching their eggs at the south end of the island in Sept. 1885 were likely this species. Pocklington (1967a) saw parties of up to fifty between Egmont Atoll and Eagle Island in October 1963 and May 1965, and J. Frazier found a colony on Nelson Island in July 1970, so that there are probably still a number of colonies in the uninhabited islands although this booby has not been reported from the inhabited ones in recent years. There are also five records of the occurrence of up to ten birds within 250 miles north-west of the islands, including a white individual seen by Mitchell (3°55'S 70°25'E, 13 Jan. 1961), five seen by Greaves (6°20'S 68°20'E, 2 April 1967), an immature examined on board by Bailey (5°03'S 67°25'E, 21 June 1964), four and then ten recorded by Salwegter (1°54'S 70°52'E, 8 Nov. 1968), one of which stayed on board overnight, and three and then ten which he saw at 6°17'S 67°19'E next day.

Measurements of the white adult male collected by Bourne and the brown bird examined by Bailey are: wing 377, 372 mm, tail 210, ca. 260 mm, culmen 78, 84.5 mm, tarsus 34, 36 mm; the brown bird weighed 1,000 g and had renewed the inner primaries, while the 5th was half grown, the outer four and two under wing coverts were old, and there were a mixture of old and new feathers in the tail. It vomited flying fish and an Ommastrephid squid, thought by Dr. Malcolm Clark to belong to the genus Symplectoteuthis. The feet were deep pink, the bill bluish-lilac, with the end of the lower mandible dark brown and the gape pink, and the iris was bluish. Dr J. B. Nelson informs me the appearance agrees with that of an immature bird of the white phase.

Sula leucogaster Brown Booby

This species was first recorded by Loustau-Lalanne who saw it around all three inhabited atolls in Nov.-Dec. 1960, and said that it was reported to breed from December to March on Coin de Mire island, Peros Banhos,

and Nelson Island. Frazier found a colony on the latter island in July 1970. Mitchell reports two or three from 3°55'S 70°25'E on 13 Jan. 1961, and Salvegter one which stayed on board overnight at 1°54'S 70°52'E on 8 Nov. 1968. It would appear that while the other boobies predominate out to sea, this is the common species among the islands, as it is among the Maldives and Laccadives to the north (Phillips 1963).

Fregata minor and F. ariel Greater and Lesser Frigate-birds

The precise status of the two frigate-birds is uncertain, but both certainly occur and probably breed in the Chagos area. Bourne was informed on Diego Garcia that they bred but not at the season when he was there; he collected an immature male on 29 Sept. 1885 which is almost exactly intermediate between the two species in appearance; measurements: wing 559 mm, tail 355 mm, culmen 92 mm long and 27 mm wide at base. The Percy Sladen Trust Expedition were informed that the birds breed on Nelson Island and have eggs and young in December and January, and Frazier saw Greater Frigate-birds displaying there in July 1970, while Loustau-Lalanne saw Lesser Frigates elsewhere throughout the inhabited islands, and especially at Yéyé Island, Peros Banhos, and West Island, Diego Garcia, in December 1960, though he did not find them breeding. Among a number of other records from among the islands, Branegan saw Greater Frigate-birds off Diego Garcia on 9 July 1958, Odling-Smee a male Lesser Frigate among a dozen birds over West Island there in July-Aug. 1964.

As with the boobies and to a lesser extent the tropic-birds, the frigates have been reported more frequently at sea between 65-80°E to the north than to the south, with twelve records between the equator and 5°S, five away from the islands between 5-10°S, and only one south of 10°S. Most pelagic records were not identified to species, and one is referred with confidence and two doubtfully to each of the two species. G. S. Willis saw two possible Greater Frigates at 4°26'S 73°18'E on 7 March 1950, Bailey one male Lesser and four birds with white breasts at 00°50'S 67°40'E on 27 April 1964, Pocklington a male Lesser at 7°54'S, 70°00'E on 18 May 1965, Odling-Smee a possible Lesser Frigate at 00°40'S 74°E on 17 July 1964, Harrison another at 2°29'S 63°30'E on 9 Oct. 1955, Palmer two Greater Frigates at 5°55'S 76°20'E on 13 Sept. 1968, and Mitchell two possible ones at 5°02'S 79°26'E on 6 Nov. 1960. Ozawa and Seno (1966) record that during transects along the 78°E meridian in Dec. 1962 and 1963 frigates were seen circling over flocks of Sooty Terns feeding above skipjack tuna shoals on four days while they were crossing the counter-current area.

Ardea cinerea (?) Grey Heron

Vanhoffen (1901) saw a large grey heron, presumably Ardea cinerea, feeding on the reef at Diego Garcia on 23 Feb. 1899.

Butorides striatus albolimbatus Little Green Heron

G. C. Bourne collected a pair on Diego Garcia on 22 Sept. and 28 Oct. 1885, now in the British Museum (Natural History), and Vanhoffen two more on 24 Feb. 1899, described by Reichenow (1900) as an endemic race, and now in the Berlin Museum. The Percy Sladen Trust Expedition found young birds on Petit Coquillage, Peros Banhos, in June 1905, where the birds were eating terns' eggs and young, and they collected four specimens which cannot be traced. Hartman also collected a pair on Coin du Mire there on 25 Oct. 1957, now in the Peabody Museum of Natural History, Yale University, and Fehlmann took three more on Diego Garcia in June 1967, which have been reassessed by Ripley (1969), who considers them very similar to B. s. javanicus of Ceylon and Java, but with more olive on the side of the throat, a character which becomes more pronounced in B. s. degens of the Seychelles. Loustau-Lalanne and other recent visitors confirm that on the inhabited atolls the species is still common both along the shore and inland.

Dr. G. Mauersberger has recently been good enough to examine the type and an immature male and reports that they are distinctly paler below than twelve adult B. s. javanicus, with the green gloss on the crown, back, and wings slightly weaker and less golden, the elongated back feathers paler and greyer rather than greenish, and the light rims to the wing feathers slightly wider than in freshly-moulted B. s. javanicus, not pure white though not as buff as some of the latter (though one from Malacca in 1853 also has white edges). This description agrees well with my own notes on the two specimens in the British Museum (Natural History), which I thought slightly paler and greyer with less green and more marked pale feather edges above and slightly paler below than B. s. javanicus. They show an early stage of the trend towards pale coloration found more markedly in B. s. albidula and especially semi-albinistic B. s. didi (Phillips and Sims 1958) in the Maldives to the north, and B. s. crawfordi and B. s. rhizophorae on Assumption and the Comoros to the west, as already pointed out by White (1951). I am inclined to wonder whether Dr. Ripley may have been misled by the heavier markings of the females already remarked by Benson (1960) in his evaluation of the Chagos birds. I find their wing measurements much the same, and they compare with those of the other races mentioned as follows:

<u>Race</u>	<u>Origin</u>	<u>Specimens</u>	<u>Wing: range and mean, mm</u>
<u>javanicus</u>	SE Asia	3 males, 3 females	175-193 (180)
<u>albolimbatus</u>	Chagos	type, immature male taken with it, male and female (?) in British Museum (Nat. Hist.)	174, 169 (174) 176, 171
<u>albidula</u>	S. Maldives	3 males, 3 females	164-176 (167)
<u>didi</u>	N. Maldives	3 males, 3 females	165-174 (170)
<u>crawfordi</u>	Assumption, Aldabra	3 males, 1 female (Benson, 1967)	157-161 (159)
<u>rhizophorae</u>	Comoros	range of 16 (Benson 1960)	170-180 ?

From the inadequate information available I conclude that B. s. albolimbatus is an intermediate form doubtfully distinguishable from B. s. javanicus of the mainland in one direction and B. s. albidula of the southern Maldives in the other, of mild interest because it shows a barely perceptible development of the trend towards pale coloration and small size found in the populations of a number of the smaller Indian Ocean islands.

Bubulcus ibis Cattle Egret

Saunders (1886) reports that G. C. Bourne found it a rare visitor during the north-west monsoon, and collected a male of the Asiatic form B. i. coromandas on Diego Garcia in September 1885. The species does not appear to have been reported again until Loustau-Lalanne (1962) recorded it as introduced to the same island from the Seychelles in 1955, and with an established colony of 27 nests at Point Est in December 1960. It has been reported in similar terms by most subsequent visitors while Pocklington found it breeding in May 1965. This population presumably belongs to the disputed race B. i. seychellarum (Salomonsen 1934, Vaurie 1963, Dawson 1966, Benson 1971), which is said to have a white throat like the nominate race from the west but reddish plumes in the breeding season like B. i. coromandas from the east, and to be somewhat small. The situation clearly deserves further investigation, but it seems possible that as with the more westerly Indian Ocean populations of the last species, the peculiar characters of the island populations may result from hybridisation between strays of both Asiatic and Ethiopian origin.

Francolinus pondicerianus Grey Francolin

The Chagos group may be covered by the general statement by Gadow and Gardiner (1907) that this species has been introduced to many Indian Ocean islands; otherwise it was first reported from Diego Garcia by Loustau-Lalanne in 1960. A species of francolin was encountered there again by Odling-Smee in 1964.

Numida (meleagris ?) Guinea Fowl

A species of guinea fowl was reported on Takamaka, Fouquet, and Anglaise Islands in the Salomon group by The Percy Sladen Trust Expedition in 1905, but Loustau-Lalanne failed to find it in 1960.

Gallus gallus Domestic fowl

Chickens have been reported to run wild on the Ile Poule in the Peros Banhos group, but the character of the population and its recent welfare do not appear to be recorded.

Gallinula sp.? Moorhen

Loustau-Lalanne was informed that a moorhen occurred on Diego Garcia and Salomon atolls in Dec. 1960, and it was reported again to Odling-Smee

on Diego Garcia in July-Aug. 1964, but it has not been identified yet. While the Common Moorhen Gallinula chloropus has colonised many islands throughout the world, the White-breasted Waterhen Amaurornis phoenicurus from the adjacent coast is widely resident in the Maldives to the north, with a local race which shows much white, A. p. maldivus, on North and South Malé atolls (Phillips and Sims 1958), so that it might be this species which occurs, and the population might moreover be a distinct one.

Arenaria interpres Turnstone

Collected on Diego Garcia by G. C. Bourne on 22 Oct. 1885, who reported that it occurred in flocks of twenty or thirty, and again in similar terms by visitors to all the islands at any time of year since then. Two were collected again on Diego Garcia by Fehlmann in June 1967. This species is even said to have been found breeding in the past (Farquhar, 1900).

Charadrius squatarola Grey Plover

The Percy Sladen Trust Expedition obtained an immature bird on Peros Banhos and saw others on Salomon atoll in June 1905, and Loustau-Lalanne saw several more on the Ile du Coin, Peros Banhos, in Nov.-Dec. 1960.

Numenius phaeopus Whimbrel

Collected on Diego Garcia by G. C. Bourne in 1885, who found it common but shy, and again by Vanhoffen in Feb. 1899. Loustau-Lalanne found it on all three inhabited atolls in Dec. 1960, feeding under the palms, Odling-Smee saw one on Middle Island, Diego Garcia, in July-Aug. 1964, and Fehlmann collected one there in June 1967.

Numenius arquata Common Curlew

Loustau-Lalanne reports one shot on Diego Garcia in Dec. 1960.

Crocethia alba Sanderling

Loustau-Lalanne saw two on Diego Garcia in Dec. 1960.

Calidris testacea Curlew Sandpiper

G. C. Bourne collected a male on Diego Garcia in Sept.-Oct. 1885, and reported it was "tolerably common." The specimen is in winter plumage and advanced wing moult, but still retaining the outer three old primaries. The Percy Sladen Trust Expedition obtained one on Salomon atoll in May 1905, and Pocklington saw one fly over the Atlantis II off Eagle Island on 22 Oct. 1963.

Dromas ardeola Crab Plover

G. C. Bourne shot one on Diego Garcia in Sept.-Oct. 1885, and reported it was common, but shy; the specimen is in moult, with new feathers in the mantle but still retaining the old outer three or four primaries. It was collected there again by Vanhoffen on 24 Feb. 1899. The Percy Sladen Trust Expedition were informed it bred in December in burrows on Peros Banhos: this species does nest in burrows but there could also have been some confusion with the shearwaters that nest there then. It was found to be common on Diego Garcia, and one was seen on Ile du Coin, Peros Banhos, by Loustau-Lalanne in Dec. 1960.

Catharacta skua Great Skua

Bailey saw a rather dark bird at 12°00'S 67°27'E on 19 April 1964, and Mitchell a possible bird in the distance at 3°48'S 65°01'E on 12 Jan. 1961. Occasional individuals are found considerably further north in the Indian Ocean.

Sterna sumatrana Black-naped Tern

G. C. Bourne found them common at Diego Garcia and collected one on 9 Oct. 1885. The Percy Sladen Trust Expedition found eggs on broken trunks of Tournefortia trees and the leaf bases of coconuts on Yéyé Island, Peros Banhos, in June 1905; where Hartman also collected a pair on the Ile du Coin on 25 Oct. 1957; Loustau-Lalanne found them present on Yéyé, Longue and Petit Coquillage Islands but not breeding in Dec. 1960. Odling-Smee found them numerous around Middle Island, Diego Garcia, in July-Aug. 1964, among other recent reports of their continued presence in the lagoon there.

Sterna fuscata Sooty Tern

Finsch (1887) found them breeding in vast numbers, estimated as of the order of 100,000, in a bare area in the centre of a thicket on Diego Garcia on 9 July 1884; they had eggs and were reported to start breeding about June and leave by November. The following year G. C. Bourne found eggs still present there on 17 September and took a female on 8 October; however, they were being severely persecuted at this time despite attempts by the Manager, Henry Spurs, to conserve them, and these may have been repeated layings. The birds appear to have deserted this atoll soon afterwards, though Branegan reported dark-backed terns (identified as Bridled Terns Sterna anaethetus, which are otherwise unrecorded, and possibly this species ?) offshore on 9 July 1958. The Percy Sladen Trust Expedition failed to find them anywhere in the group in May-July 1905, but Hartman collected a male on the Ile du Coin, Peros Banhos, on 25 Oct. 1957, and Loustau-Lalanne found several thousand with groups of hundreds starting to lay on Grand Coquillage, Yéyé and Longue Islands in December 1960. Pocklington (1967a) also saw many off Eagle Island on 22 Oct. 1963. Loustau-Lalanne reports that the main breeding season was considered

locally to start with the south-east monsoon in May and to last till July or August, with a second breeding season from November to February, but the available evidence is not entirely compatible with this, and it seems possible that the season may vary locally or from year to year, or that the birds may breed more often than once a year, as for example they do where they nest every 9.6 months on Ascension or twice a year in the central Pacific (Ashmole, 1963).

This species is very widespread at sea in flocks which often run into hundreds and exceptionally thousands, and as remarked by Bailey (1968) their distribution varies in a confusing way. They have been recorded somewhere in the area considered during most months of the year, though the numbers reported on individual voyages vary considerably, from reports of continuous views of flocks to complete blanks. When the records are considered as a whole, it is notable that few were reported in the area over the southern equatorial current south of 10°S and east of 70°E , notably by the Japanese expeditions which carried out transects along the 78° meridian in December 1962 and 1963. They found the birds concentrated over the equatorial counter-current further north where they were feeding over shoals of skipjack tuna (Ozawa and Seno 1966). Gill (1967) also saw few south of the Chagos group during a transect along the 75°E meridian in April 1964, whereas further west Bailey (1968) saw flocks scattered all along the 68°E meridian in April and June 1964, though the numbers seen in the central part of the area increased in June. Harrison, Palmer and others also have records of flocks on either side of the Chagos group in July, and they and other observers noted several more in September, October and November.

Because Bailey remarks on the absence of records of young birds in the well-populated breeding areas to the west, and none have been reported around the Chagos group either, it may be worth drawing attention to one bird moulting out of winter plumage photographed by Price when it came on board at $1^{\circ}10'\text{N } 79^{\circ}30'\text{E}$ far from land to the north-east on 14 Aug. 1966 (Bourne, 1970). This occurrence suggests the possibility that western Indian Ocean Sooty Terns may spend their immature period further east in the way that western Atlantic ones breeding on the Dry Tortugas off Florida have now been shown to spend their youth in the Gulf of Guinea to the south-east (Robertson, 1969).

Thalasseus bergii Crested Tern

G. C. Bourne collected an immature male in fresh plumage at Diego Garcia on 9 Oct. 1885, but did not find them common. Neale and Pocklington have seen them there again on 9 July 1968 and 19 May 1965, and Odling-Smee thought the Lesser Crested Tern T. bengalensis, otherwise unrecorded, might also have been present in July-Aug. 1964. The Percy Sladen Trust Expedition collected several birds at Peros Banhos in May-June 1905, and found two or three pairs occupying trees on Ile Lubine, Egmont Atoll, in June; Loustau-Lalanne saw a bird in Salomon lagoon in Dec. 1960, but breeding has not been proved yet.

Anous stolidus Brown or Common Noddy

Finsch found these nesting with Sooty Terns on Diego Garcia on 9 July 1884, and estimated that there were about a tenth as many, or perhaps 10,000. G. C. Bourne also found them nesting there on 15 Sept. the following year, and took a female on 2 October. He comments that many were nesting in trees so it seems possible he encountered Lesser Noddies as well. Vanhoffen observed flocks fishing over an area of sea swarming with the copepod Poulellida on 22 Feb. 1899, the day before arriving at Diego Garcia from the north, and also found the birds nesting in the palms there. Dr. G. Mauersberger reports that the two skins he collected on 24 February have fresh primaries, old central tail-feathers, and new growing outer ones. In June 1905 the Percy Sladen Trust Expedition found the birds nesting both on the ground and in trees and with eggs and young on Petit Coquillage, Peros Banhos, and nesting in trees on Egmont Atoll but they were informed that it was not the main breeding season on Peros Banhos. Loustau-Lalanne also found noddies nesting both on the ground and in the trees on West Island, Diego Garcia, and Grand and Petit Coquillage, Longue and Yéyé Islands, Peros Banhos, with both eggs and young in Nov.-Dec. 1960. He was informed that there are two main breeding seasons, the main one from May to August with another from December to February. A number of other visitors have also found the noddies breeding on the three small islands at the mouth of Diego Garcia lagoon in the period from May to August, while Pocklington saw many off Eagle Island on 22 Oct. 1963, and Mitchell a large flock at sea at 3°55'S 70°25'E on 13 Jan. 1961, in much the same area where they had been noted in February by Vanhoffen.

Anous tenuirostris Black or Lesser Noddy

This species was apparently overlooked among the Common Noddies by the earlier visitors, but Vanhoffen collected a male on Diego Garcia on 24 Feb. 1899, and the Percy Sladen Trust Expedition found it breeding in trees alongside the Common Noddies on Petit Coquillage, Peros Banhos, in June 1905, where Hartman also collected a male on the Ile du Coin on 25 Oct. 1957. Loustau-Lalanne found it breeding in trees alongside the Common Noddies on the lagoon islets of both Diego Garcia and Peros Banhos in Nov.-Dec. 1960, and several other visitors have recorded occasional birds or flocks at Diego Garcia since then. G. S. Willis also saw a possible bird at sea at 6°43'S 74°42'E on 8 March 1956, but like the Common Noddy it does not seem common far from land.

Gygis alba White or Fairy Tern

This species has been found breeding on Diego Garcia by most visitors, including Finsch in July 1884, G. C. Bourne in Sept.-Oct. 1885, Vanhoffen in Feb. 1899, the Percy Sladen Trust Expedition in July 1905, Loustau-Lalanne in December 1960, Pocklington in May 1965 and Stoddart in July 1967. It nests in trees on all the islands. The Percy Sladen Trust Expedition found it on Petit and Grand Coquillage, Yéyé and Longue Islands in June 1905, and Loustau-Lalanne on the Ile du Coin in December 1960 at

Peros Banhos, where it has also been found nesting on the ground. It has been reported to breed throughout the year. It does not appear to have been recorded far out at sea in this region.

Streptopelia picturata chuni Madagascar Turtle Dove*

The status of this species is uncertain. Pigeons are mentioned among the supplies available on Egmont Atoll in the first half of the 19th century (Horsburgh, 1842) though they do not appear to have been reported there since then. Neither Finsch (1887) nor G. C. Bourne (1886) found them on Diego Garcia, but the former mentions that when Captain Baudissin from his ship visited the island he saw a number of pigeons at Point Marianne, which seemed likely to have been introduced from Mauritius or Madagascar. Presumably this was the species eventually collected among some low bushes by Vanhoffen on 24 Feb. 1899, and described by Reichenow (1900) as a new race of the Madagascar Turtle-dove, a species already widely distributed by both natural and artificial means among the islands to the west of Chagos, and differing mainly from the nominate Madagascar form in its darker coloration. Thereafter it does not appear to have been noticed again until Loustau-Lalanne found it well distributed on Diego Garcia, and apparently largely parasitic on man, feeding at the copra driers, in December 1960, when he found a nest with one young. It has since been recorded by most visitors, and Fehlmann obtained two specimens, now in the Smithsonian Institution, on 13 June and 5 July 1967.

The three females so far available have recently been discussed by Benson (1970), who agrees that they are rather dark and concludes that they might be either a hybrid population combining characters of the races S. p. picturata of Madagascar and the darker form S. p. comorensis of the Comoros. The latter might have been introduced when the island was first colonized with slaves imported from East Africa in the late 18th and early 19th centuries. But possibly the Diego Garcia population

* The two specimens of Turtle Dove, Streptopelia picturata chuni (Reichenow) collected by Fehlmann and Payet on Diego Garcia in 1967 impress me on reexamination (Feb. 1971) as being a valid endemic race. In size they are identical to S. p. saturata (wing 160-162) from the Amirante group of islets south of the Seychelles and some 1300 miles west of the Chagos Archipelago. They differ, however, in lighter color, thus approaching typical picturata of Madagascar. The likelihood of this population being a hybrid one with the smaller rostrata of the Seychelles seems remote (contra Benson, 1970), and as the species is widely distributed in the western Indian Ocean islands and divided into some seven other subspecies, it seems credible to believe that chuni is indeed an endemic island population.--S. Dillon Ripley

might be the result of recent evolution of typical birds imported from Mauritius. Clearly the study of more specimens including males is still needed, as well as the investigation of their further evolution.

Geopelia striata Barred Ground-dove

Loustau-Lalanne reports that this species, already found feral on a number of other Indian Ocean islands, was first introduced to Diego Garcia from the Seychelles in 1960, and that 14 were present at Point Est by December that year. Pocklington saw one in May 1965, and wondered whether they were successful, but Fehlmann was still able to collect six in June 1967.

Acridotheres tristis Indian Mynah

This species, also introduced to many Indian Ocean islands, was found to be common on Egmont Atoll by the Percy Sladen Trust Expedition as early as 1905, but has apparently only reached Diego Garcia recently, according to one report in 1953. It was not noticed by Loustau-Lalanne in Dec. 1960, but was already considered to be the commonest land-bird by Odling-Smee in July-Aug. 1964, while Stoddart also found noisy flocks of forty to sixty everywhere in June 1967.

Passer domesticus House Sparrow

This is the only passerine mentioned by the Percy Sladen Trust Expedition as occurring on Peros Banhos and Salomon in 1905, and they were informed that it had been introduced from Mauritius. In December 1960, Loustau-Lalanne found that it was still the commonest land-bird on both atolls and was told that they breed throughout the year, but could not confirm this.

Foudia madagascariensis Madagascar Fody

This Madagascar species, also widely introduced to Indian Ocean islands and to St. Helena in the Atlantic from Madagascar, was first noticed on Diego Garcia by Finsch on 9 July 1884, who found it common, with most birds in the green eclipse plumage though a few cocks were beginning to show the scarlet breeding dress. G. C. Bourne obtained a male with a red head on 30 September the following year which closely resembles the allied species Foudia eminentissima in appearance, but the bill is short and the wing small for that species so it seems likely that it is actually F. madagascariensis in mid-moult. It was collected again on Diego Garcia by Vanhoffen in 1899, but does not appear to have been noticed by the Percy Sladen Trust Expedition in June-July 1905, possibly because birds in eclipse dress were mistaken for sparrows. Hartman next collected four males, three in breeding dress and one just starting to assume it, on the Ile du Coin, Peros Banhos, on 23 Oct. 1957, while Loustau-Lalanne found it the commonest land-bird on Diego Garcia but outnumbered by House Sparrows on Peros Banhos and Salomon in Nov. and Dec. 1960. He was informed that the males assume breeding dress from

Oct. to May, and found eggs, about two months later than in the Seychelles; he found 47 clutches of two, four of three and one of four eggs, an average clutch size of 2.1 compared to an average of 2.7 for sixteen clutches in the Seychelles (Crook, 1961). Subsequently, Odling-Smee and Stoddart have each noticed single males coming into breeding dress in July and August in 1964 and 1967.

Other migrants

Loustau-Lalanne saw flocks of ducks on the barachois Sylvain of Diego Garcia in Nov.-Dec. 1960. Seven species of duck have been recorded in the Maldives, and the Garganey Anas querquedula have even reached Rodriguez far to the south (Vinson, 1947).

The Percy Sladen Trust Expedition recorded a "snipe" on Diego Garcia in July 1905, and like Bourne twenty years before were informed that raptors, and also crows, pigeons and hirundines, occurred during the northerly monsoon. They saw at least two species of the latter, probably the Swallow Hirundo rustica and House Martin Delichon urbica in May-June 1905. Loustau-Lalanne also saw several hirundines, possible House Martins, on Peros Banhos and Salomon atolls in December 1960. At sea Elkington (1929) noticed a hawk seize a small white bird, and later two parrots Kakatoe tenuirostris escape from his ship and fly away towards the Chagos group 145 km away at 6°59'S 69°02'E on 15 April 1929. Later (Elkington 1930) he saw two small grey and white finch-like landbirds fly by his ship at 2°24'S 73°08'E on 23 Oct. 1929. There seems little doubt that with further study the islands would be found to receive much the same type of stray migrants as the Maldives to the north, which have a list of between ninety and a hundred species (Phillips, 1963), though the numbers would be smaller because of the greater distance from the mainland.

E. Discussion

The Chagos group occupy a strategic position, not only militarily but ornithologically. They are isolated in the remotest possible position in the tropical Indian Ocean, in a situation lying in the path of both landbird vagrants from three directions, the east, north and west, and seabird migrants from four, the north and south and dispersing east and west along the equatorial current systems. They provide a major breeding station for pelagic seabirds and an interesting potential site for colonisation by landbirds. It is one of the numerous unpublicized tragedies of insular ornithology that their natural history was not investigated before major changes had resulted from human colonisation of the larger islands, and another may result from further careless developments on the still comparatively unspoilt lesser islands if strict attention is not paid to conservation during the expansion of military facilities on Diego Garcia.

At the present time the information is insufficient to provide a full account of the ornithology of the group, and in the preceding attempt to assess the character of its avifauna there has had to be a strong speculative element. This is regrettable but necessary. The evidence is still inadequate to draw many general conclusions, but it may be useful to comment on some of the main points arising if only because they provide useful indications of the directions in which it might be desirable to carry out more work. The birds are probably best considered under two main headings, landbirds and seabirds.

1. The landbirds

It would be rather surprising if the original dense forests of the larger islands held no terrestrial landbirds, probably including at least one passerine, a dove, and perhaps a flightless rail. Since they were probably richly fertilized by seabird guano, and it is clear that at the present time the archipelago still receives a fair number of stray vagrants from the north during the northern monsoon, and quite likely others from the east when the south-east trades replace it, it seems possible that there was once quite a rich landbird community, comparable to that of Christmas Island further east (Gibson-Hill 1948). If so, it would appear to have been largely or entirely wiped out with the destruction of the native forests and the introduction of mammalian predators, with the possible exception of the "waterhen," which might still prove to be an interesting endemic form comparable to the flightless rail of Aldabra, and of course the weak local race of little Green Heron, perhaps the most widespread and locally variable of all Indian Ocean island birds.

Whatever the original landbird community may have been, it seems highly probable that with the exception of the waterhen and heron it now consists entirely of human introductions. At least two widespread Malagasy forms, the fody and turtle-dove, were apparently already present when the first ornithologist, Finsch (1887) arrived in 1884, and the second shows local peculiarities of a simple kind. However it seems rather less probable that these reached the islands naturally with the weak westerly winds that sometimes extend across the Indian Ocean in the vicinity of the equator during the northern winter than that they were imported by man together with the bulk of the first human colonists and such distinctive food-supplies as giant tortoises in the days of the slave-trade from East Africa (Ingham, 1962, and references quoted by Benson, 1970), possibly via Mauritius, the Comoros, or the Seychelles. Subsequently the next wave of introductions, notably the House Sparrow, appear to have come from the seat of government in Mauritius, while recently another group including the Ground-dove and Cattle Egret have been introduced from the Seychelles following the addition of the group to the British Indian Ocean Territory, administered from Mahé.

It is notable that whatever the fate of any original landbirds may have been they were confronted with the destruction of their habitat and the introduction of such predators as rats, cats, and hogs, all of which

appear to have been widespread by the middle of the 19th century (although Finsch noticed no rats on Diego Garcia in 1884, so that their introduction by vessels coaling there in the 1880s might explain the extermination of the terns at that time), the more recent introductions have often been extremely successful at least in the first instance. The fody is clearly extremely numerous on Diego Garcia although Loustau-Lalanne (1962) reports it is outnumbered by the House Sparrow where that species is also present as on Salomon and Peros Banhos. This is possibly an interesting example of the effects of competition between species with a similar ecology which deserves further study. The Mynah was also extremely common on Egmont in 1905, and has increased explosively following its introduction to Diego Garcia within the last twenty years. The doves are apparently also fairly successful in Diego Garcia, but there is unfortunately little information about the larger ground birds such as the moorhen, francolin, guinea fowl and feral chickens. The success of these introduced birds could also provide an interesting study, especially in comparison with the situation on the numerous other islands of the Indian Ocean area where they have also been introduced (Watson et al. 1963), and in relation to their effect on other elements in the island ecosystem including endemic plants and invertebrates.

Meanwhile, Loustau-Lalanne (1962) provides a few important indications of their ecology, including a list of plants whose flowers or seeds are eaten by the birds, and potential hazards, notably introduced mammals, Little Green Herons, which eat eggs and young birds, and sticky Pisonia seeds. It is notable that the fody and ground-dove, whose original area of origin presumably lies further south in the region of Madagascar, have so far been found breeding only in the southern summer, whereas the cosmopolitan House Sparrow is reputed to breed throughout the year, which might be one of the factors giving it an advantage over the fody where they occur together. So far the Little Green Heron, which is apparently of Asiatic origin, has only been found with young in the northern summer, while the cosmopolitan Cattle Egret has been seen at the nest sites in both December and June (Loustau-Lalanne 1962; Pocklington 1967), but it is notoriously unwise to draw conclusions about the breeding of water-birds from scanty evidence. However, as far as the evidence goes, it appears at the moment that local breeding seasons agree mainly with those found elsewhere, southern forms nesting in the southern summer, northern ones in the northern summer, and cosmopolitan ones continuously. It remains to be seen whether local factors also influence these breeding-seasons.

It may be noted that the two poorly-studied but clearly weak hypothetical endemic races show a simple type of geographical variation in conformity with trends widely established on other Indian Ocean islands, the Little Green Heron being slightly smaller and paler than the mainland population, and the Turtle Dove darker than the Madagascar one. The significance of these variations, if they exist, seems doubtful, and that of the Turtle Dove at least seems to have arisen very recently as the species was probably introduced within the last two hundred years only.

They deserve study in a wider context, and meanwhile it is satisfactory to be able to remark that both forms appear to be well established and unlikely to be harmed by any reasonable foreseeable developments.

2. The seabirds

The islands clearly have a rich seabird community, including both the breeding species and migrants from elsewhere. At the present time the breeding population is only known to include common pan-tropical species, but it has only been investigated superficially so far, and further examination of the outlying islands and subfossil deposits might yield evidence for the presence at least in the past of a variety of other more unusual species such as members of the protean gadfly petrel genus Pterodroma or the remarkable endemic tropical seabird community now only found further east on Christmas Island. Abbott's Booby Sula abbotti in particular may once have bred on the Chagos group. If it or any other scarce species does by any chance survive on outlying islands in the Chagos group, there is a very urgent need for conservation of the population in view of the many threats now arising to affect more accessible seabird colonies elsewhere.

Meanwhile, if we analyse the known breeding seabird community, it appears rather poor in species feeding inshore such as some of the terns, but rich in more pelagic species, some of which such as the Sooty Tern were clearly at one time extremely numerous, although they have now been either much reduced or driven to the less accessible outer islands. Observations during the International Indian Ocean Expedition, notably by the Japanese participants (Ozawa and Seno 1966) suggest that these pelagic species may feed largely to the north in the vicinity of the equatorial counter-current when it is well-developed at the end of the northern winter, which is also reported to be the main breeding season at least in the northern islands. Further south on Diego Garcia the terns were however found breeding at the opposite season of the year in the last century, and they may be exploiting instead the southern equatorial current when it extends north across the equator past the islands to become the monsoon drift during the period of onset of the SW monsoon in the Arabian Sea.

The precise oceanographic phenomena giving rise to the clearly substantial food-supply supporting these, at least originally, vast seabird communities are still unclear, but it could be as at other stations near the equator in the Pacific (Ashmole and Ashmole, 1967) and elsewhere, largely the descent of tropical water in regions of turbulence around the islands and in areas of convergence along the boundaries of the equatorial counter-current, resulting in an accumulation of floating food-organisms, in sharp contrast to the upwelling which results in a high marine productivity along the lee shores of the land-masses. In this connection, it is perhaps worthy of note that the rather distinct seabird community of Christmas Island, including two endemic species and a very well-marked race, Abbott's Booby Sula abbotti, the Christmas

Frigate-bird Fregata andrewsi and the Golden Tropic-bird Phaethon lepturus fulvus, may have evolved adaptations to exploit an equally distinct local phenomenon, a local area of upwelling to the east, south of Java and Sumbawa during the south-east monsoon (Wyrтки 1962, Cushing 1969) which appears to form the special feeding-area of the tropic-bird at least (Pocklington 1967b, Shuntov 1968). This might explain why these birds are not found further west, except for Abbott's Booby's occurrence in the past in a potentially similar area of upwelling north of Madagascar.

While the breeding seabird community of the Chagos islands may or may not be found to include additional species on further investigation, it seems extremely probable that more species are likely to be found as visitors offshore, either on migration between breeding and wintering areas in higher latitudes to the north and south, or passing the period of immaturity and between breeding-seasons in the high marine productivity regions in the vicinity of the equator. These may well include more northern skuas and terns (Stercorariidae and Sternidae) then have been suggested yet, and additional petrels such as the White-faced or Streaked Shearwater Calonectris leucomelas from the North Pacific, already known to winter commonly around the East Indies, and especially gadfly petrels of the genus Pterodroma, with strays of a wide variety of other species from the south. It is still unclear to what extent visitors already reported offshore, let alone any possible additions, occur there primarily as regular visitors over long periods, or merely as passing through on migration. It seems likely that the Chagos group may lie in the path of at least two important streams of migration, of Wilson's and "Fregetta" Storm-Petrels (Oceanites oceanicus and Fregetta spp.) north from the Southern Ocean to the northern coasts of the Indian Ocean, and of Flesh-footed Shearwaters (Puffinus carneipes) and White-faced Storm-petrels (Pelagodroma marina) which breed off south-west Australia and winter in the Arabian Sea. Other species such as the Oceanodroma storm-petrels which enter the Indian Ocean from the Pacific (Bailey et al. 1968) may also tend to pass through the area in numbers following the equatorial counter-current. Therefore the birds occurring at sea may also repay more detailed study in the future.

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