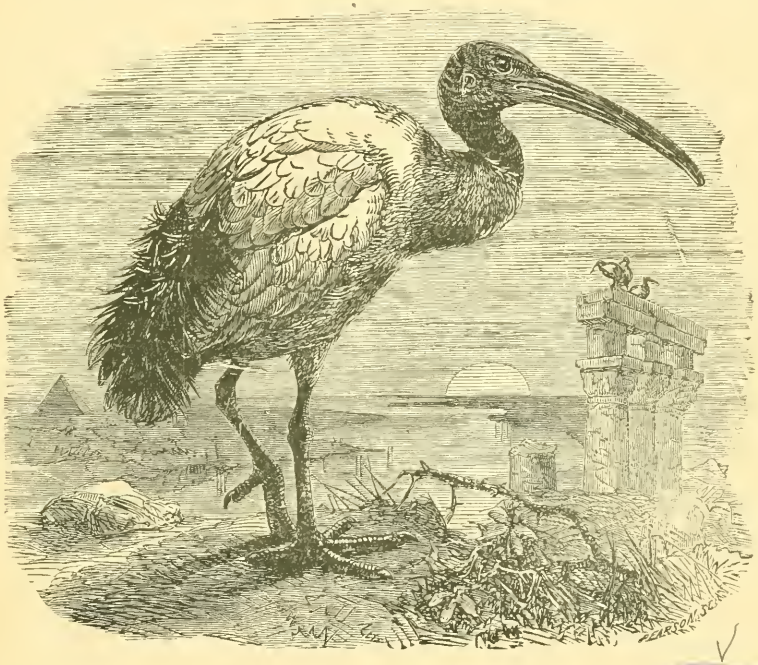
THE IBIS,

A

QUARTERLY JOURNAL OF ORNITHOLOGY.

EDITED BY

WILLIAM LUTLEY SCLATER, M.A., F.Z.S.



VOL. II. 1920.

ELEVENTH SERIES.

He prayeth well, who loveth well
Both man and bird and beast.

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XX.—*List of the Birds of the Canary Islands, with detailed reference to the Migratory Species and the Accidental Visitors.* Part VII. Summary and General Conclusions.

By David A. Bannerman, M.B.E., B.A., M.B.O.U., F.R.G.S.

(Plates XV. & XVI., and Sketch-map.)

[Continued from p. 360.]

Summary of Canarian Birds according to their Status.

The Canarian birds recognised in the present list number 217 in all. Of these 75 are regular breeding species and 142 are non-breeding.

The list may be further subdivided into the following categories, though it must be borne in mind that such classifications as these are necessarily not stringent; as with the B.O.U. List of Birds (though to a less extent) there are always some species which do not exactly fit into any of the groups.

The following abbreviations have been used, and when placed in square brackets after the specific name of a bird indicate that the species is also found in the list to which the letters refer, thus :—

[R.] = Resident ; [P.R.] = Partial Resident ; [S.V.] = Summer Visitor , [W.V.] = Winter Visitor ; [B. of P.] = Bird of Passage ; [A.V.] = Annual Visitor ; [O.V.] = Occasional Visitor ; [R.V.] = Rare Visitor.

A reference to the Part and to the page of 'The Ibis,' where the species is dealt with in detail, has also been appended.

The following species are **Residents**, *i. e.*, birds generally found in the Canary Islands throughout the year are included in this category ; it includes those which regularly breed in the Archipelago and which are not migratory in any way except perhaps between the islands. These number 61, viz. :—

	Part	Year	Page
Corvus corax [C. c. canariensis]	I.	1919	99
Pyrrhocorax pyrrhocorax	I.	,,	100
Carduelis carduelis parva	I.	,,	103
Serinus canarius	I.	,,	104
Erythrospiza githaginea amantium	I.	,,	104
Passer hispaniolensis hispaniolensis	I.	,,	104
Petronia petronia madeirensis	I.	,,	105
Fringilla cœlebs canariensis	I.	,,	106
Fringilla cœlebs palmæ	I.	,,	106
Fringilla cœlebs ombriosa	I.	,,	106
Fringilla teydea teydea	I.	,,	106
Fringilla teydea polatzeki	I.	,,	107
Acanthis cannabina meadewaldoi	I.	,,	107
Acanthis cannabina harterti	I.	,,	107
Emberiza calandra [E. c. thanneri]	I.	,,	107
Calandrella minor rufescens	I.	,,	111
Calandrella minor polatzeki	I.	,,	112
Motacilla cinerea [M. c. canariensis]	I.	,,	113
Anthus bertheloti bertheloti	I.	,,	116
Regulus regulus teneriffæ	I.	,,	119
Parus cæruleus teneriffæ	I.	,,	119
Parus cæruleus ombriosus	I.	,,	119
Parus cæruleus palmensis	I.	,,	120

	Part	Year	Page
Parus cæruleus degener	I.	1919	120
Lanius excubitor kœnigi	I.	,,	120
Sylvia atricapilla obscura	I.	,,	124
*[Sylvia atricapilla heineken]	I.	,,	125
Sylvia melanocephala leucogastra	I.	,,	125
Sylvia conspicillata bella	I.	,,	125
Phylloscopus collybita canariensis	I.	,,	130
Phylloscopus collybita exsul	I.	,,	131
Turdus merula cabreræ	II.	,,	297
Erithacus rubecula superbus	II.	,,	300
Erithacus rubecula microrhynchus	II.	,,	300
Saxicola dacotiæ dacotiæ	II.	,,	303
Saxicola dacotiæ murielæ	II.	,,	304
Dryobates major canariensis	III.	,,	457
Dryobates major thanneri	III.	,,	457
Tyto alba [? T. alba alba]	III.	,,	478
Tyto alba gracilirostris	III.	,,	478
Asio otus canariensis	III.	,,	479
Neophron percnopterus percnopterus	III.	,,	481
Buteo buteo insularum	III.	,,	482
Accipiter nisus teneriffæ	III.	,,	484
Milvus milvus milvus	III.	,,	485
Tinnunculus tinnunculus canariensis	III.	,,	492
Tinnunculus tinnunculus dacotiæ	III.	,,	492
Pandion haliaëtus haliaëtus	III.	,,	493
Chlamydotis undulata fuerteventuræ	IV.	,,	725
Œdicnemus œdicnemus insularum	IV.	,,	725
Œdicnemus œdicnemus distinctus	IV.	,,	725
Cursorius gallicus gallicus	IV.	,,	726
Scolopax rusticola	IV.	,,	728
Hæmatopus niger meadewaldoi	IV.	,,	732
Columba junoniæ	V.	1920	123
Columba bollei	V.	,,	124
Columba livia canariensis	V.	,,	124
Pterocles orientalis	V.	,,	127
Caccabis rufa [C. r. australis]	V.	,,	128
Caccabis petrosa kœnigi	V.	,,	128
Coturnix coturnix confisa	V.	,,	131

* An aberrant form of the preceding subspecies.

The following species are **Partial Residents**, *i. e.*, birds which are usually resident and breed in the islands, but which have their numbers augmented by fresh arrivals at certain seasons. These number 5, viz.:—

	Part	Year	Page
Upupa epops epops	III.	1919	472
Falco peregrinus pelegrinoides	III.	,,	487
Ardea cinerea [B. of P.]	IV.	,,	715
Ægialitis alexandrina alexandrina	IV.	,,	749
Larus argentatus cachinnans	IV.	,,	756

The following species are **Summer Visitors**, *i. e.*, birds which are found nesting regularly in the Canary Islands, but do not remain throughout the winter in the Archipelago. These number 9, viz. :—

	Part	Year	Page
Micropus murinus brehmorum	III.	1919	460
Micropus unicolor unicolor	III.	,,	465
Falco eleonoræ [B. of P.]	III.	,,	490
Sterna hirundo	IV.	,,	761
Puffinus kuhli fortunatus	V.	1920	106
Puffinus assimilis baroli	V.	,,	110
Bulweria bulweri bulweri	V.	,,	113
Streptopelia turtur turtur	V.	,,	124
Coturnix coturnix coturnix [B. of P.]	V.	,,	129

The following species are **Winter Visitors**, *i. e.*, birds found in the Canary Islands during the winter only, and which, when so denoted by an asterisk, have only exceptionally been known to breed in the Archipelago. These number 15, viz. :—

	Part	Year	Page
Sturnus vulgaris vulgaris [B. of P.]	I.	1919	100
Alauda arvensis arvensis [B. of P.]	I.	,,	110
Motacilla alba alba [B. of P.]	I.	,,	113
Turdus philomelus philomelus (*Turdus musicus* auctorum)	II.	,,	291
Anas platyrhynchos platyrhynchos [B. of P.]	IV.	,,	708
Querquedula crecca crecca	IV.	,,	710
Gallinago gallinago gallinago [B. of P.]	IV.	,,	729
Totanus hypoleucus	IV.	,,	738
Limosa limosa limosa	IV.	,,	740
Numenius phæopus phæopus [B. of P.]	IV.	,,	743
Squatarola squatarola [B. of P.]	IV.	,,	746
Vanellus vanellus [B. of P.]	IV.	,,	751
Arenaria interpres interpres [B. of P.]	IV.	,,	753
Larus fuscus affinis	IV.	,,	758
*Fulica atra atra	V.	1920	122

* Said to have bred.

The following species are **Birds of Passage**, *i. e.*, birds which pass regularly through the islands during the spring and autumn migration periods. These number 32, viz.:—

	Part	Year	Page
Sturnus vulgaris vulgaris [W. V.]	I.	1919	100
Alauda arvensis arvensis [W. V.]	I.	..	110
Motacilla alba alba [W. V.]	I.	,,	113
Anthus trivialis trivialis	I.	,,	116
Sylvia atricapilla atricapilla	I.	,,	123
Phylloscopus trochilus trochilus	I.	,,	127
Phylloscopus collybita collybita	I.	,,	129
Phœnicurus phœnicurus phœnicurus	II.	..	298
Phœnicurus ochrurus gibraltariensis (*Ruticilla titys* auctorum)	II.	,,	299
Saxicola rubicola rubicola	II.	,,	304
Saxicola rubetra rubetra	II.	,,	305
Œnanthe œnanthe [Œ. œ. leucorrhoa]	II.	,,	307
Muscicapa grisola grisola	II.	,,	312
Muscicapa atricapilla atricapilla	II.	,,	313
Hirundo rustica rustica	II.	,,	315
Delichon urbica urbica	II.	,,	317
Micropus apus apus	III.	,,	469
*Merops apiaster	III.	,,	470
Falco eleonoræ [S. V.]	III.	,,	490
Anas platyrhynchos platyrhynchos [W. V.].	IV.	,,	708
Ardea cinerea [P. R.]	IV.	,,	715
Gallinago gallinago gallinago [W. V.]	IV.	,,	729
Limnocryptes gallinula	IV.	,,	731
Tringa alpina alpina	IV.	,,	734
Calidris arenaria	IV.	,,	735
Machetes pugnax	IV.	,,	736
Numenius phæopus phæopus [W. V.]	IV.	,,	743
Squatarola squatarola [W. V.]	IV.	,,	746
Ægialitis hiaticula hiaticula	IV.	,,	747
Vanellus vanellus [W. V.]	IV.	,,	751
Arenaria interpres interpres [W. V.]	IV.	,,	753
Coturnix coturnix coturnix [S. V.]	V.	1920	129

* Said to have bred.

The following species are **Annual Visitors**, *i. e.*, birds which visit the Archipelago annually but at no fixed season of the year, and which have not been known to breed in any of the islands. These number 5, viz.:—

	Part	Year	Page
Thalassidroma pelagica	V.	1920	100
†Oceanodroma leucorrhoa leucorrhoa	V.	,,	101
Oceanites oceanicus oceanicus	V.	,,	103
Pelagodroma marina hypoleuca	V.	,,	103
Puffinus puffinus puffinus	V.	,,	105

† Usually in winter.

The following species are **Occasional Visitors**, *i. e.*, birds which do not occur regularly in the Archipelago every year, but which have been recorded from time to time, almost invariably during the migration period. Only two have been known to breed in the islands. These number 30, viz.:—

	Part	Year	Page
*Oriolus oriolus oriolus	I.	1919	102
*Sylvia simplex	I.	,,	123
*Phylloscopus sibilatrix sibilatrix	I.	,,	128
†Turdus musicus (*iliacus* auctorum)	II.	,,	294
*Turdus pilaris	II.	,,	297
*Riparia riparia riparia	II.	,,	319
*Riparia rupestris	II.	,,	320
*Cuculus canorus [C. canorus canorus]	III.	,,	458
*Cuculus canorus minor	III.	,,	459
*Coracias garrulus garrulus	III.	,,	477
†Sula bassana	III.	,,	494
‡Anas angustirostris	IV.	,,	709
Ciconia ciconia ciconia	IV.	,,	722
Platalea leucorodia	IV.	,,	723
*Glareola pratincola pratincola	IV.	,,	727
*Tringa minuta minuta	IV.	,,	733
*Tringa ferruginea ferruginea	IV.	,,	735
*Totanus totanus	IV.	,,	737
*Totanus nebularius	IV.	,,	737
*Totanus ochropus	IV.	,,	739
*Totanus glareola	IV.	,,	740
Limosa lapponica lapponica	IV.	,,	741
Numenius arquatus arquatus	IV.	,,	741
†Larus ridibundus	IV.	,,	759
†Rissa tridactyla tridactyla	IV.	,,	760
Sterna minuta minuta	IV.	,,	763
†Sterna sandvicensis sandvicensis	IV.	,,	763
†Porzana pusilla intermedia	V.	1920	118
*Crex crex	V.	,,	119
‡Gallinula chloropus	V.	,,	120

* During the migration seasons. † In winter only
‡ Has been known to breed

The following species are **Rare Visitors**, *i. e.*, birds which have occurred in the islands on two or three occasions only, sometimes singly after violent storms, but usually in company with other species during migration. These number 72, viz.:—

	Part	Year	Page
Corvus monedula spermologus	I.	1919	99
Sturnus unicolor	I.	,,	100
Chloris chloris aurantiiventris	I.	,,	103
Montifringilla nivalis nivalis	I.	,,	105
Emberiza striolata sahari	I.	,,	109
Plectrophenax nivalis	I.	,,	109
Melanocorypha calandra calandra	I.	,,	112
Motacilla flava [? M. flava flava]	I.	,,	115
Anthus pratensis	I.	,,	118
Lanius collurio collurio	I.	,,	120
Lanius senator senator	I.	,,	121
Sylvia communis communis	I.	,,	122
Acrocephalus arundinaceus arundinaceus	I.	,,	126
Hypolais pallida elaeica	I.	,,	126
Erithacus rubecula [? E. r. rubecula]	II.	,,	300
Cyanosylvia suecica suecica	II.	,,	302
Cyanosylvia suecica cyanecula	II.	,,	303
Œnanthe œnanthe œnanthe	II.	,,	306
Œnanthe stapazina stapazina	II.	,,	310
Œnanthe deserti homochroa	II.	,,	311
Muscicapa parva parva	II.	,,	314
Iynx torquilla torquilla	III.	,,	457
Clamator glandarius	III.	,,	460
Micropus melba melba	III.	,,	468
Merops persicus [? M. p. chrysocercus]	III.	,,	471
Alcedo ispida [? A. i. pallida]	III.	,,	475
Strix aluco	III.	,,	478
Asio flammeus flammeus (*A. accipitrinus* auctorum)	III.	,,	480
Circus æruginosus æruginosus	III.	,,	481
Circus pygargus	III.	,,	481
Haliaëtus albicilla	III.	,,	483
Pernis apivorus apivorus	III.	,,	485
Falco peregrinus	III.	,,	486
Falco subbuteo	III.	,,	488
Falco vespertinus vespertinus	III.	,,	492
Phalacrocorax carbo carbo	III.	,,	493
Mareca penelope	IV.	,,	711
Spatula clypeata	IV.	,,	712
Nyroca nyroca	IV.	,,	712

	Part	Year	Page
Nyroca ferina ferina	IV.	1919	713
Œdemia nigra nigra	IV.	,,	714
Phœnicopterus antiquorum	IV.	,,	714
Ardea purpurea purpurea	IV.	,,	717
Egretta alba alba	IV.	,,	718
Egretta garzetta garzetta	IV.	,,	718
Ardeola ibis ibis	IV.	,,	718
Ardeola ralloides ralloides	IV.	,,	719
Ixobrychus minutus minutus	IV.	,,	719
Nycticorax nycticorax nycticorax	IV.	,,	720
Botaurus stellaris	IV.	,,	721
Botaurus lentiginosus	IV.	,,	721
Ardeirallus sturmi	IV.	,,	722
Otis tetrax	IV.	,,	724
Gallinago media	IV.	,,	731
Himantopus himantopus	IV.	,,	745
Recurvirostra avocetta	IV.	,,	745
Charadrius apricarius	IV.	,,	746
*Ægialitis dubius curonicus	IV.	,,	749
Eudromias morinellus	IV.	,,	750
Pluvianus ægyptius	IV.	,,	752
Larus canus canus	IV.	,,	754
Larus marinus	IV.	,,	755
Larus fuscus fuscus	IV.	,,	757
Alca torda	V.	1920	97
Uria troille troille	V.	,,	98
Fratercula arctica arctica	V.	,,	99
Oceanodroma castro castro	V.	,,	102
Podiceps nigricollis nigricollis	V.	,,	116
Podiceps fluviatilis	V.	,,	116
Porzana porzana porzana	V.	,,	117
Porzana parva	V.	,,	119
Streptopelia turtur arenicola	V.	,,	127

* Has bred in the islands, and I consider that it will probably henceforth have to be included with the Occasional Visitors. I shot two and saw eight or nine birds in Gran Canaria on the 12th and 13th of February, 1920, after a violent south-westerly gale and dust storm.

The following species are placed in **Appendix A** *, which includes all birds that have been recorded on evidence which requires further proof before the species can be admitted to the list of authentic occurrences. These number 25, viz.:—

* *Cf.* Part VI. 1920.

The following species are placed in **Appendix B** *, which includes all birds that have been recorded from unreliable sources and can be dismissed as absolutely valueless, though often quoted by more recent writers without additional proof. These number 54, viz. :—

* *Cf.* Part VI. 1920.

Review of the Ornis.—General Conclusions.

Having now completed the List of Birds of the Canary Islands and dealt at length with the migratory species, I propose to discuss some of the problems which the Ornis of the Archipelago suggests, especially as regards the distribution and affinities of the birds found therein and their bearing on the formation of the islands.

Geological Formation and Age of the Canary Archipelago.

Several theories have been advanced to explain the origin of the islands. It has been suggested that they are the remaining peaks of a sunken Atlantis which has long since been swallowed up in this region, or that the islands were formerly joined to the mainland of Africa, or again that they are merely "of volcanic origin." The evidence of geologists certainly points to the last explanation as the correct one.

Thanks to the famous voyages of the 'Challenger,' 'Michael Sars,' and other less celebrated ocean survey ships, the bed of the ocean west of Morocco is comparatively well known, and we are thus able to review this region with a certain amount of confidence. A glance at any recent map of the Atlantic Ocean reveals the fact that an enormous trough of great depth runs parallel with the West African coast-line, and is separated from a similar trough on the western side of the Atlantic by a gigantic submarine ridge. Glancing at the chart of the Eastern Atlantic we are struck by the fact that a long chain of islands lies on this submarine ridge or else between it and the African coast—the Azores, Porto Santo, Baixo Island, the Madeira Group, the Salvages and the Pitons, the Canaries, the Cape Verde Islands, St. Helena, Ascension, the Tristan da Cunha Group, and Gough Island. With the exception of two islands (Santa Maria and Majo) all these islands are mainly built up of volcanic rocks. Anyone who has travelled through the Canary Islands, particularly those of the eastern group, cannot but be struck by the volcanic nature of the ground. Evidence of terrible upheavals is to be seen on all sides—perfectly formed craters,

immense lava flows, miles of volcanic soil, cliffs of basalt, tuff and volcanic debris meet the eye on all sides as one travels through almost any island in the group. To remind us that the Canaries are still the centre of a great volcanic zone we need only go back as far as 1909, when a small eruption took place on the Peak of Tenerife (Geog. Journ. vol. xxxv.).

Geologists have therefore concluded that the Canary Islands were built up from the ocean bed by volcanic action; the recent volcanoes have been shown by von Buch and others to be seated on a foundation of older rocks.

The theory that the islands were once joined to the mainland is considered by Lyell and others to be impossible—no change in the ocean bed having taken place since the islands were formed. The fauna of the Canaries also strongly refutes those who believe that the Archipelago was once connected with the mainland.

As to the islands being the remaining peaks of a sunken Atlantis there is no evidence whatever to support this view. In fact there are many signs that elevation has taken place, and no evidence of subsidence. As recently as 1912 the legend of Atlantis was strikingly revived in Paris by a distinguished French geologist, but a careful perusal of his paper *, though extremely interesting, has done little to convince me of its truth.

Although varying views are held as to how the islands were formed, there seems to be general accord as to the geological age of the Archipelago—and all agree that the Canaries were probably formed in the Miocene Epoch. Fossiliferous remains in Gran Canaria have been discovered which tend to prove that the island was thrown up from the floor of the ocean in that part of the Middle Tertiary Age known as the Upper Miocene. In the north-east of this same island lies an immense marine terrace of mighty marine conglomerates imbedded in which are calcareous layers of Miocene date.

In thus dating the birth of the islands it is interesting to

* Smithsonian Inst. Annual Report, 1915, p. 222.

note that it was about this same time—in the late Oligocene and early Miocene periods—that the great physical disturbances commenced which gave rise to the elevation of the Alps, and it was in the middle and latter part of the Miocene that probably the whole system of mountain-folds from Morocco to the far East took place.

Of the vegetation and climate in Africa at this period of the earth's history little is known. Wallace tells us that in the Miocene we had in Europe indications of a luxuriant vegetation and subtropical climate. On the whole the birds of Europe at this time were very like those now living, with the addition of a few tropical forms. Further back in the Eocene only forms of birds now extinct were to be found.

Knipe gives us a glowing account of vegetation in Europe during the Miocene. From his book* we gather that the high temperature continued in Europe for some time during this period; and the central lands of the continent remained rich with subtropical vegetation. Meanwhile the hardier growths had pressed far to the north . . . In the course of the period some decline of the European temperature took place; for palms began to languish, and conifers, grasses, and various deciduous trees reoccupied portions of their lost southern territory. The reduction in the heat, however, cannot have been very great; for camphor and cinnamon trees continued in abundance, and palms, though greatly reduced in number, were not entirely suppressed. Dealing with the birds of this period Mr. Knipe remarks: "More remarkable than the evolution of seals and whales from land-mammals was the rise of birds from reptiles, and their subsequent development into a vast variety of forms."

The physical conditions of Europe which existed in the early days of the Canary Islands—when presumably that Archipelago began to be inhabited by birds—are important considerations when we come to review the Ornis of the islands at the present day.

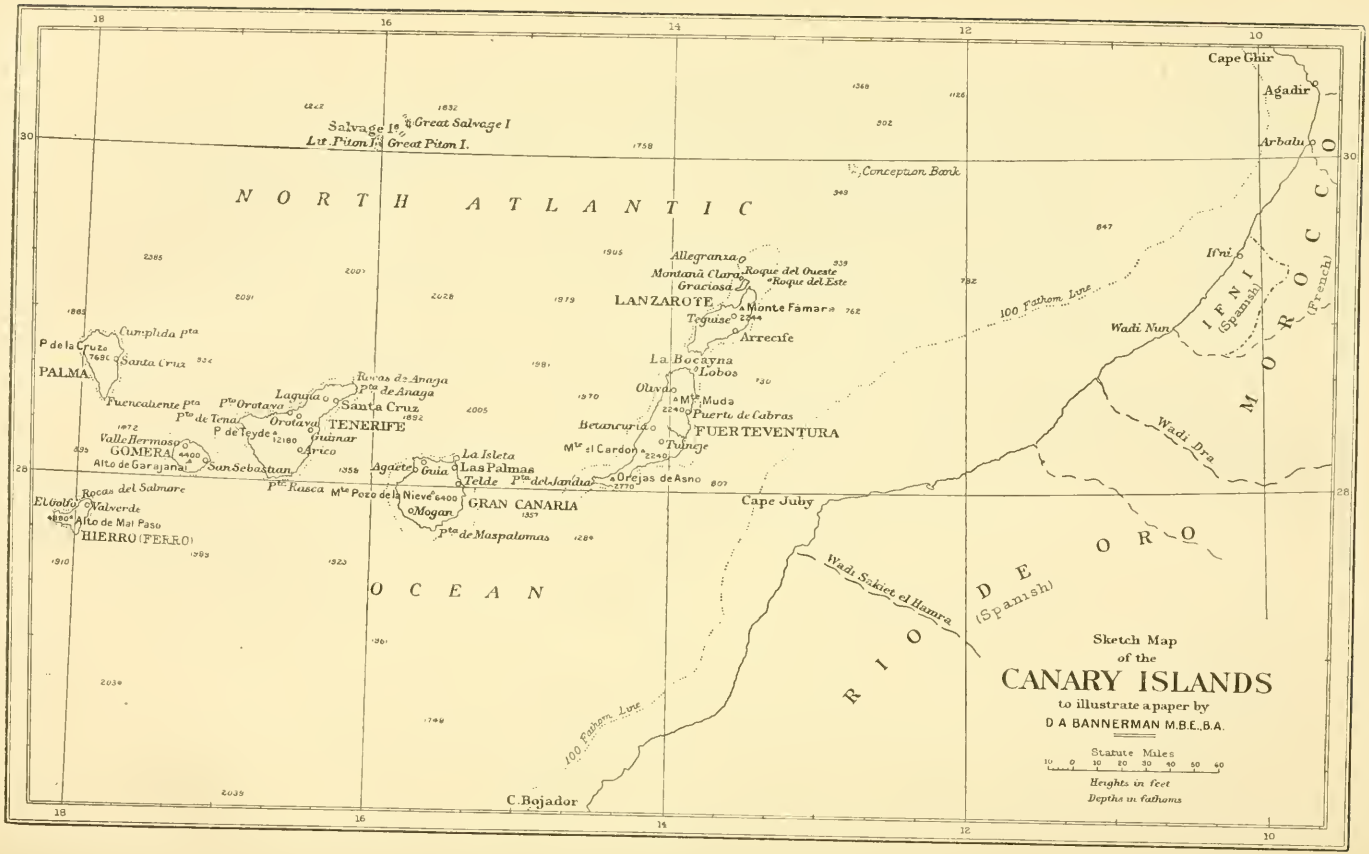
* 'Evolution in the Past,' 1912.

Physical characteristics of the islands at the present day.

In previous papers I have alluded to the remarkable difference which exists between the western islands and the eastern islands of the Canary Group and shall only briefly describe them here.

Eastern Group.

Generally speaking, the eastern group—Fuerteventura, Lanzarote, and their satellites—are of volcanic formation and consequently possessed of desert features. Fuerteventura viewed from the sea appears to be more mountainous than is really the case—the highest ground, a basaltic mass rising to 2770 feet, lying at the southern extremity of an isthmus of shifting sand dunes. The first impression is soon dispelled by a ride through the island—the hills on closer acquaintance are found to be low and undulating and bound great plains which stretch mile upon mile almost the entire length of the island. When I first set eyes upon these plains in the month of May, they were purple with the bloom of *Suæda fruticosa*, but otherwise, apart from a meagre desert vegetation, they are exceedingly bare and stony. Certainly in the neighbourhood of villages many acres are sown with wheat, but the corn is usually so poor in quality that it hardly serves to ameliorate the parched appearance of the country. Here and there rugged cone-shaped volcanoes stand out conspicuously, rising from 1500 to 2200 feet, and viewed from a distance appear almost beautiful in colour, the weathered lava, pumice, and scoriæ varying in tone from a deep terra-cotta to dull black. As the traveller looks down upon the plains from the central ridge, which forms a broken backbone to the island, several villages are spread out before his gaze—the little white houses scattered without plan over the desert waste. Perchance a cluster of date-palms indicates the homestead of one of the richer landowners, while only a few fig-trees or maybe a solitary pomegranate mark some poor farmer's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Alto de Garajanai
San Sebastian
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El Golfo
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Pta de Anaga
Laguna
Pta Orotava
Orotava
Santa Cruz
TENERIFE
Guimar
Arico
Agaete
Guia
La Isleta
Las Palmas
Telde
Pta de Jandia
Pta Rasca
Mte Pozo de la Nieve
Mogan
GRAN CANARIA
Pta de Maspalomas
Sketch Map
of the
CANARY ISLANDS
to illustrate a paper by
D A BANNERMAN M.B.E., B.A.
Statute Miles
10 0 10 20 30 40 50 60
Heights in feet
Depths in fathoms

dwelling. Should the track lead near the sea the traveller will have to cross several deep *barrancos*—dry nullahs, often as not lined with dark green tamarisks, upon which the eye rests with pleasure after the glare of the scorching plains. Otherwise not a sign of water, not a vestige of forest land nor even a wood in the humblest sense of the word, breaks the monotony of the scene. It seems perfectly natural to have exchanged the mules of the western islands for camels—the only beasts of burden in the eastern group.

Lanzarote is more mountainous than Fuerteventura, but the highest ground attains to only 2198 feet. Nevertheless, its surface contains much more evidence of former volcanic activity—in the shape of many extinct volcanoes, from the rent craters of which great lava-flows wind their way to the sea. A ride from north to south of Lanzarote is much more instructive of the terrible visitations through which the island has passed than would be a similar journey through Fuerteventura.

The outlying islets embrace the same general characters—flat plains upon which miniature volcanoes stand up in vivid contrast, as typified by Graciosa; or else the half-buried lip of a giant crater-wall, so strikingly shown in the Roque del Este, rearing its crest above the waves.

The vegetation on these eastern islands is in keeping with their geological character—of engrossing interest to the student of desert flora,—the shrubs and plants are many of them peculiar to the islands upon which they grow. Apart from date-palms, figs, and pomegranates already noted, trees are conspicuous by their absence. Oranges, bananas, and almond trees are decidedly rare.

As previously indicated, many of the *barrancos* are lined with tamarisks, and in all the islands Euphorbias of several varieties are perhaps the commonest form of vegetation. Wheat and beans, vines and tomatoes are cultivated in certain districts, while quantities of onions are exported annually from Lanzarote. Through lack of water thousands of acres lie uncultivated in any way and may be classed as desert waste.

Such, then, are the eastern Canary Islands. Owing to their having the same geological formation and uniform climate, added to the similarity in their altitude and consequent absence of variety as regards vegetation zones, these barren outliers of the Sahara are best considered as one distinct faunal area.

The Western Group.

The first island of the western group encountered when sailing westwards from Fuerteventura is Gran Canaria—the subject of a paper which I wrote in 'The Ibis' in 1912. I then divided up the island into six faunal divisions :—(i.) The Monte and Vega : (ii.) the Cumbres : (iii.) the Pinar ; (iv.) Desert-like plains ; (v.) the "Charco" ; (vi.) the western division (wild mountainous country). These are perfectly natural divisions and still, of course, hold good ; their general features will be found fully discussed in the paper mentioned, where a map, showing the divisions here noted, is given.

During subsequent visits to the island in 1913 and 1920 I worked out the faunal divisions strictly according to the zones of vegetation, which are necessarily rough. The conclusions which I formed are as follows :—

Zone i. Maritime or African zone, sea-level to 1000 feet.

Zone ii. District of cultivation, 1000–3000 feet (including remnants of Chestnut and Laurel forest between 1400 and 2700 feet).

Zone iii. "Pinar" (Pine forest), 3000–4000 feet (on the south of the island only). The country between these altitudes in the north of the island may be included in

Zone iv. "Cumbres" mountainous unforested zone, 4000–6100 feet.

In comparison with the eastern islands water is plentiful ; the result is abundantly evident, particularly in Zone ii. (*vide* Ibis, 1912, pp. 557–567).

When we turn to the island of Tenerife we find the zones of vegetation much more clearly defined—moreover, more attention has been paid to the botany of Tenerife than to any other member of the group, and we have, therefore, ample material upon which to base our deductions.

Humboldt recognised four distinct zones of vegetation: Dr. Christ preferred three great zones; Guppy divided the vegetation into six belts. Lastly, we have the thoroughly up to date and clearly expressed opinions of Dr. J. H. Salter, whose treatise on the Regional Distribution of the Native Flora in Tenerife appeared as part vii. of vol. lxii. of the Manchester Memoirs (1918).

Dr. Salter, with Dr. Christ, recognises three main regions —each of which he subdivides into more or less clearly defined zones. With Dr. Salter's conclusions, in so far as I have studied the regional distribution in Tenerife, I entirely concur; moreover, from personal observation I can endorse his remark that the zones can only be characterized in general terms and that they are separated by no hard and fast lines—the range of most species extending higher upon the southern side of the central ridge than upon its northern slope. Strict demarcation of the zones is quite impossible; bearing this in mind, let us examine the vegetation belts propounded by Dr. Salter:—

A. *The Coast Region and Lower Slopes* from sea-level to 2400 ft., comprising (on the southern coast*):—

1. Foreshore.
2. Desert (stony, rocky, or black sand).
3. Orchards, plantations, vineyards (banana, tomato, orange, vine), extending to about 1300 ft.
4. Cultivated lands (wheat, potatoes, lupins, broad beans), extending to about 2060 ft.

B. *The Cloud Region,* 2300–6500 ft.

1. The Monte Verde, from 2400–4000 ft., characterized by woods and thickets of evergreens (far from being a continuous belt).

* Upon the northern slopes the desert strip is much reduced or altogether absent.

2. The Pinar, from 4000–6000 ft., characterized by *Pinus canariensis*.
3. Zone of shrubby foliose Leguminosæ, 6000–6500 ft., the Escobón (*Cytisus prolifer*), and the Codéseo (*Adenocarpus viscosus*), the chief fodder plants.

C. *Above the Clouds*, 6500–12,180* ft.

1. The Cañadas, Zone of the Retáma (*Spartocytisus nubigenus*), reaching to almost 10,000 ft.
2. The Alpine Zone, 10,000–12,180* ft., where an endemic viola, a moss, and a lichen occur.

The island of Palma, famous for its immense crater—over four miles in diameter and 5000–6000 feet deep—is the only other of the western islands the vegetation of which we shall discuss. Deforestation has taken place to a much less extent than in Tenerife, and *Pinus canariensis* covers a large area of country. Accounts of the vegetation of Palma are scarce—the best and most recent paper, by T. A. Sprague and J. A. Hutchinson, appeared in the Kew Bulletin, 1913, part 8, pp. 287–299. These gentlemen visited the island in May–June 1913. From their account we gather that cultivation takes place mainly between 1000 and 2000 feet, the principal crops being onions, grapes, maize, and wheat, while mulberry and fig trees are numerous. The woods of the lower slopes of the cloud-belt appear to consist mainly of typical Laurel, *Myrica faya*, *Erica arborea*, and *Ilex canariensis*, with undergrowth of *Cistus* and bracken reaching their fullest development between 3000 and 4000 feet. At 4700 feet the vegetation consists mainly of Pines, tree-heaths, and bracken; above this altitude the upper ridges are clothed with pine woods practically destitute of vegetation. The highest ridge reaches an altitude of 7690 feet, culminating in the Pico de Muchachos above the Gran Caldera, but the greater part of the central backbone of the island lies between 4750 and 6590 feet.

* Dr. Salter gives this figure as 12,912 ft., probably a misprint for 12,192. I am informed at the Royal Geographical Society that the Peak of Tenerife was ascertained to be 12,180 ft. according to the latest maps.

Before these pages are in print I shall, I hope, have visited Gomera and Hierro in person, and shall take special note of the vegetation zones which in the last two islands, at any rate, appear to be little known; Gomera, I understand, somewhat resembles Palma in its vegetation—the high ground being clothed with forests. Hierro, on the other hand, is much less wooded, but the vegetation zones of these two islands require to be more carefully studied before we can say to what extent the indigenous birds have been affected by the local conditions. To this I shall pay particular attention during my forthcoming trip *.

Factors influencing the character of the native flora are summed up by Salter under three headings: (1) long isolation, (2) volcanic origin, (3) climate. It is particularly interesting to the ornithologist to learn that, as pointed out by Hooker many years ago, the Canarian flora is more nearly allied to Mediterranean species than to Moroccan forms, and that from this Engler considered the flora of the islands in all probability to be a survival of the flora of the Tertiary period—more tropical in character than that which belongs to North Africa and the Mediterranean Region at the present time. According to Sauer, out of a total of 1250 Canarian plants, 333 are endemic. If a fresh census were taken now, I believe both the number of Canarian plants and of the endemic forms could be greatly increased.

Turning once more to the birds, ornithologists have often marvelled that the Canaries are inhabited by such a remarkable number of good geographical subspecies, and I have on several occasions been asked to explain the reason.

Knowing the islands as I do, I feel that this can never be accomplished satisfactorily until some knowledge of the widely differing types of country which are to be found in the Group—often, indeed, in the same island—has been acquired. I therefore make no apology for having attempted to place the reader in possession of some, at any rate, of the all-important physical conditions existing in the islands,

* The writer succeeded in riding across and partly exploring Gomera in March of this year, but was unable to visit Hierro.

both in the past and at the present day*. It will be apparent how important a part the vegetation of the Canaries has played as an element in the variation of species.

Distribution of Species and Subspecies.

In studying the distribution of insular fauna it would be difficult to find a more ideal Archipelago upon which to centre one's attention than the one under discussion, at any rate in the Atlantic Ocean.

For the variety of peculiar forms which it contains and the remarkable distribution of many of the species, the Canary Archipelago can be considered second to none.

The Azores have, I am aware, been cited as the most interesting of all the Atlantic Archipelagos from an ornithological point of view, but that was before the birds of the Canary Islands were as well known as to-day, and the idea arose in no small part from their great distance from any continent.

Let us first turn our attention to the truly Resident Birds of the Canary Islands and glance down the list of these on pp. 520, 521. We find that they number 61, all of which (with a single exception) are what we may term land birds. The exception is an Oystercatcher, of which more hereafter.

Of these 61 Resident Birds no fewer than 52 are confined to the Atlantic Islands [the Canaries, Madeira, Azores, and Cape Verde Groups]. These are divided as follows:—

42 are confined to the Canary Islands.
6 „ „ „ Canaries and Madeira.
3 „ „ „ Canaries, Madeira, and Azores.
1 is „ „ Canaries, Madeira, and Cape Verde Is.
9 have a general distribution in Europe and Africa.

* In this connexion, and to save repetition, I would draw the attention of the reader to 'Ibis,' 1890, pp. 67–76 (a description of Palma by Canon Tristram); 'Ibis,' 1912, pp. 557–567 (a description of Gran Canaria, map, and photographic illustrations); and 'Ibis,' 1914, pp. 38–90 (a description of all the islands of the Eastern Group, map, and illustrations), the last two articles by the present writer.

Restricted to the Canaries.

1. Corvus c. canariensis.
2. Erythrospiza g. amantium.
3. Fringilla c. canariensis.
4. Fringilla c. palmæ.
5. Fringilla c. ombriosa.
6. Fringilla teydea teydea.
7. Fringilla teydea polatzeki.
8. Acanthis c. meadewaldoi.
9. Acanthis c. harterti.
10. Emberiza c. thanneri.
11. Calandrella m. rufescens.
12. Calandrella m. polatzeki.
13. Motacilla c. canariensis.
14. Anthus b. bertheloti.
15. Regulus r. teneriffæ.
16. Parus c. teneriffæ.
17. Parus c. ombriosus.
18. Parus c. palmensis.
19. Parus c. degener.
20. Lanius e. koenigi.
21. Sylvia m. leucogastra.
22. Phylloscopus c. canariensis.
23. Phylloscopus c. exsul.
24. Erithacus r. superbus.
25. Saxicola dacotiæ dacotiæ.
26. Saxicola dacotiæ murielæ.
27. Dryobates m. canariensis.
28. Dryobates m. thanneri.
29. Tyto a. gracilirostris.
30. Asio o. canariensis.
31. Buteo b. insularum.
32. Accipiter n. teneriffæ.
33. Tinnunculus t. dacotiæ.
34. Chlamydotis u. fuerteventuræ.
35. Œdicnemus œ. insularum.
36. Œdicnemus œ. distinctus.
37. Hæmatopus n. meadewaldoi.
38. Columba junoniæ.
39. Columba bollei.
40. Columba l. canariensis.
41. Caccabis r. australis.
42. Caccabis b. koenigi.

Restricted to Canaries and Madeira.

1. Petronia p. madeirensis.
2. Sylvia a. obscura.
3. Turdus m. cabreræ.
4. Erithacus r. microrhynchus.
5. Tinnunculus t. canariensis.
6. Coturnix c. confisa.

Restricted to Canaries, Madeira, and Azores.

1. Carduelis c. parva.
2. Serinus canarius.
3. Sylvia a. heineken.

Restricted to Canaries, Madeira, & Cape Verde Is.

1. Sylvia c. bella.

Of General Distribution.

1. Pyrrhocorax pyrrhocorax.
2. Passer h. hispaniolensis.
3. Tyto alba.
4. Neophron p. percnopterus.
5. Milvus m. milvus.
6. Pandion h. haliaëtus.
7. Cursorius g. gallicus.
8. Scolopax r. rusticola.
9. Pterocles orientalis.

Apart from anything else such restricted insular distribution is very remarkable, but of more interest still is the distribution of the different groups of birds in the various islands.

Those who have read my description of an expedition which I made to the Eastern Canary Group in 1913 (the report of which appeared in 'The Ibis,' 1914, pp. 38–90, 228–293) will not be surprised to learn how strikingly different is the avifauna in those barren islands, for they will be already aware of the peculiar physical characteristics enjoyed by Fuerteventura and Lanzarote and the contrast which exists between them and the islands of the western group—Gran Canaria, Tenerife, Palma, Gomera and Hierro —briefly alluded to in the early part of this paper. Detailed insular distribution in the Archipelago is given for each bird in the Systematic List in my present paper, but a more general review of the range of certain species will serve to show how limited this distribution often is.

There are very few Resident birds which can be said to have anything like a general distribution in the Archipelago—that is to say, the same species or subspecies being found on all the seven large islands—in fact, only seven in all :—*Corvus corax canariensis*, *Emberiza calandra thanneri*, *Anthus bertheloti bertheloti*, *Sylvia melanocephala leucogastra*, *Buteo buteo insularum*, *Pandion haliaëtus haliaëtus*, and *Columba livia canariensis*.

The Kestrel is also found in all the islands, but is represented in the western and eastern groups by two distinct geographical races, *Tinnunculus t. canariensis* in the western, *T. t. dacotiæ* in the eastern group.

The Brown Linnet has found its way to every island, and is represented in the eastern group by *Acanthis cannabina harterti*, and in the western group by *A. c. meadewaldoi*.

The same remark applies to the Thick-knee, *Œdicnemus œ. distinctus* being found in the western group, *Œ. œ. insularum* in the eastern group.

Likewise the Titmice have spread over the entire Archipelago, but have branched into various subspecies, each race

1. PARUS CÆRULEUS DEGENER. 2. PARUS CÆRULEUS TENERIFFÆ.
3. PARUS CÆRULEUS PALMENSIS. 4. PARUS CÆRULEUS OMBRIOSUS.

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inhabiting one or more islands, but never, of course, more than one form in an island. We find *Parus cæruleus teneriffæ* in Gran Canaria, Tenerife, and Gomera, *P. c. ombriosus* in Hierro, *P. c. palmensis* in Palma, *P. c. degener* in Fuerteventura and Lanzarote.

The above mentioned are the only Canarian species with representative races in all the large islands.

Of the rest of the Resident Avifauna the most interesting from the point of view of distribution are the Chaffinches, of which there are five representatives in the western islands and none in the eastern islands. The remarkable Blue Chaffinch, confined to the pine forests of Tenerife, *Fringilla teydea teydea*, and its subspecies (*F. t. polatzeki*) confined to the pine forests of Gran Canaria, are perhaps the most ancient types of bird-life to be found in the Archipelago, for they have no closely allied form anywhere in the world.

The other three Canarian Chaffinches are by some ornithologists concluded to be geographical races of our European bird *Fringilla cœlebs*, i. e. *Fringilla cœlebs canariensis*, which inhabits Gran Canaria, Tenerife, and Gomera, *F. c. palmæ*, which is confined to Palma, and *F. c. ombriosa* to Hierro. They are such distinct forms that many consider them "good species," and although I have treated them as subspecies in this paper, I feel that I am perhaps in error in having done so.

It will be noticeable that this is the same insular distribution as we found amongst the Titmice. The same Chaffinch and the same Titmouse inhabit Gran Canaria, Tenerife, and Gomera, while two different Chaffinches and two different Titmice frequent Palma and Hierro respectively. The only difference is that whereas the Titmice have a representative race in the eastern group the Chaffinches are confined to the western islands.

There are other curious instances of distribution where two distinct races are found in the western group alone. For instance, Tenerife and Gran Canaria, each has its own Great Spotted Woodpecker, *Dryobates major canariensis* and *D. m. thanneri* respectively.

There are two Redbreasts: *Erithacus rubecula superbus* in Gran Canaria and Tenerife, *E. r. microrhynchus* in Palma, Gomera, and Hierro.

Two Short-toed Larks: *Calandrella minor rufescens* confined to Tenerife, *C. m. polatzeki* found in Gran Canaria in the western group but also living in Fuerteventura and Lanzarote in the eastern group; though according to some authorities the Gran Canarian Lark is intermediate between the two forms and has been named by Sassi *C. m. distincta*.

In the eastern group we find a similar case in the two Chats, *Saxicola dacotiæ dacotiæ* confined to Fuerteventura, *S. d. murielæ* occurring only on Allegranza and Montaña Clara, two of the outer islets.

Several birds are found in one island only without representative races. The Sand-Grouse (*Pterocles orientalis*) is confined to Fuerteventura; the Chough (*Pyrrhocorax pyrrhocorax*) to Palma.

These are not by any means the only cases of curious distribution which we might instance; the apparent absence of the Egyptian Vulture, Kite, and Partridge from Palma are all difficult of explanation, but there must be a reason for the anomaly if only we could find it. These birds all swarm in the adjoining islands. Food may account for the absence of the Partridge, but not for the other birds named.

Even more remarkable is the apparent absence of any Woodpecker from the pine forests of Palma, Gomera, and Hierro, although the genus is represented by distinct subspecies of the Great Spotted Woodpecker in both Tenerife and Gran Canaria. From the pines of Tenerife we practically gaze down upon the island of Gomera! but the Woodpeckers have never spread beyond their own domain.

Undoubtedly the distribution of many Canarian land forms depends to a very large extent on the physical characteristics of each island. We should naturally not expect to find Chaffinches in the desert eastern islands where trees are

rarer than volcanoes, any more than we should look for Sand-Grouse in Palma. Even in such islands as Tenerife and Gran Canaria the distribution of the two Teydean Chaffinches is bounded absolutely by the limits of the pine forests, which once covered a much larger extent of land than they do at the present day. Marsh breeding-birds—such as the Marbled Duck, the Coot, and the Moorhen—must, since the ancient lake at Laguna is no more, be restricted almost entirely to the Charco's of Maspalomas and Arguineguin in Gran Canaria.

Special vegetation means special food upon which many seed- and fruit-eating species are entirely dependent. The two fine Canarian Pigeons live almost entirely on the seeds of certain trees; *Columba bollei* and *Columba junoniæ* subsist to such an extent on the fruit of *Laurus fœtens* that when the laurel was exterminated in Gran Canaria *C. bollei*, which formerly thrived in that island, completely disappeared. There is no Laurel Pigeon in Hierro, for the Laurel and Til-tree are almost absent. Instances could be multiplied, but that mentioned will illustrate my point.

Reference must be made here to the remarkable distribution of two of the Tubinares which visit the Canaries to breed. *Puffinus assimilis baroli* is the only form of the *assimilis*-group of Shearwaters which is found in the Atlantic, where it is confined to the north Atlantides from the Azores to the Canaries. The other members of the group inhabit widely separated localities in the Pacific and Indian Oceans.

Perhaps the most remarkable case of all is that of Bulwer's Petrel. In the Atlantic it inhabits the same Archipelagos as the Madeiran Allied Shearwater, but its nearest allied race inhabits the Sandwich Islands in the Pacific; no intermediate subspecific races are known.

The explanation of this discontinuous distribution must be looked for in the great antiquity of the order to which the Petrels and Shearwaters belong, combined with the changes which have taken place in the distribution of land

and water on the surface of the earth. The Atlantic Islands, at any rate the Canaries, were probably formed in the Miocene. The Hawaiian Islands are apparently of earlier date, and it was during, or prior to, the Eocene that the Atlantic and Pacific Oceans were joined—for the isthmus of Panama had not then appeared above the waves. There was then free communication between the two oceans, the fauna of which was similar in certain features. As a relic of this fauna we may instance the curious Blenny (*Enneanectes carminalis*) which was found by Dr. Lowe on the Atlantic side of the isthmus and which had previously only been known from the Pacific. Once the continents of North and South America were connected by land, an insuperable barrier would prevent the birds on the Pacific side from having any communication with the birds on the other. Bulwer's Petrel (and probably other forms as well) would then be isolated on the Hawaiian Islands and cut off from intercourse with the species on the Atlantic side. Each would tend to differentiate, but being sea-roving species, when conditions are much alike, they would naturally not be influenced by such diverse factors as if they had been land birds. As a result, the representatives of Bulwer's Petrel in the Atlantic and in the Sandwich and Bonin Islands in the Pacific are very slightly differentiated, and have until quite recently been considered identical.

Whether Bulwer's Petrel ever inhabited any of the islands off the Atlantic coast of America is unknown. If it did so it has long been exterminated and no trace of its former existence in this region has been left. The evidence seems to point to the conclusion that the Canarian Bulwer's Petrel is descended from the Pacific birds, and not the Pacific subspecies from the typical Atlantic form. An even more remarkable fact in the distribution of Bulwer's Petrel was pointed out by Messrs. Iredale and Mathews (Ibis, 1915, pp. 607, 608). These authors note the difficulty of separating even subspecifically Atlantic Island birds from those of the Sandwich Islands and the Bonin Islands, while in the Fiji Islands a distinct *species* of *Bulweria* occurs.

Formation of Insular Races.

In recent years very close attention has been paid to the investigation of geographical races—subspecies as we term them to-day. As a result of this search for new forms (which has been sadly abused by some, who have thus brought the careful work of many systematic workers under the lash of those ornithologists who have clung to the older traditions) the trinomial system of nomenclature has gradually come more and more into general use. This is not the place to enter into a discussion as to the merits or demerits of the system, but in a paper dealing with insular races the utility of the trinomial system is indisputable and must be apparent to anyone who studies the question with an unbiased mind. Whereas under the old binomial system the geographical races of the Canarian avifauna were given the status of species, we now realise that many of the birds in these islands are really only insular forms of a continental parent race from which they have sprung. In some cases the distinction may be only small, in others much greater differentiation will be found, depending on the amount of variation which has taken place; but in both cases the bird can be considered a subspecies (and for the purposes of classification it is usually more convenient to do so), and as such is named trinomially. The dividing line between a subspecies and a species is difficult to define, and this is where the champion of the binomial system generally commences his argument!

All field naturalists and many purely systematic ornithologists know how many and varied are the factors which combine to bring about variation in a bird. It may be quite by chance—for a few wanderers blown out of their usual course may have been compelled to take refuge on some oceanic island and there have come under the influence of the very factors which would most likely tend to produce variation in their case.

This is exactly what has happened in certain cases in the Canary Islands, and although those who have studied the

evolution of birds will not find anything new in the following pages, yet to some the facts contained may be of interest, and I shall therefore attempt to describe the factors which have brought about such a remarkable differentiation of forms as we find in the Canary Islands to-day.

Let us suppose for a moment that a small flock of Passerine birds which have been wintering on the Guinea coast are wending their way north to breed in Europe. Strong westerly winds prevail, and the birds which usually hug the coast of Africa are blown considerably out to sea, till by chance they sight the island of Tenerife and make towards it. Having gained the island they find themselves in an environment which, from their point of view, is all that can be desired. An abundance of fruit and of insect life, plenty of food, no lack of cover, a climate very similar at this time of early spring to that which they had hoped to find at their journey's end—hundreds of miles farther north. Is it to be wondered that of this little flock, when the wind drops and the rest set out again on their long journey, a pair or two should remain and breed in the island.

Having escaped the worst enemies in the form of Sparrow-Hawks, a brood is successfully reared; and in course of time the species increases and spreads to other islands of the group. These newly arrived immigrants at once come under a host of fresh influences. In course of ages variation takes place in more than one direction brought about by the varied factors which they meet with in the different islands, some of which we shall now discuss.

Darwin has shown that the **Presence of Enemies** or the presence or otherwise of other species, with which an immigrant has to compete in its struggle for existence, has as much to do with the differentiation of a species as the physical conditions of the country. Had the Canary Islands been of continental origin, we should probably have found terrestrial mammals and rodents, as well as snakes, living in most of the islands, which would have preyed on the ground-nesting birds, and in various ways influenced the avifauna. But it is a remarkable fact, and one which strongly negatives

the view that the Canaries were ever joined to the continent, that the only mammals which have found their own way to the Archipelago and have not been introduced, are those which could fly there—members of the family Vespertilionidæ or Typical Bats.

The birds which had already settled in the islands are then the only species with which succeeding immigrants would have to contend ; for it does not appear that mammalia in any form inhabited the Archipelago in past epochs of its history.

"Enemies" in the Canary Islands at the present day are few in kind—small boys, "sportsmen"—collectors of eggs and of cage-birds being the most destructive.

Of Raptorial birds the Barbary Falcon, Buzzard, ? Kite, and Sparrow-Hawk probably do the most harm, for the Kestrels, which swarm, pay little attention to the other birds in the islands. The mongoose and snakes are unknown and rats are confined to the towns, so that, on the whole, the islands may be said to be singularly free from many of the dangers which beset continental species. Of pugnacious varieties which live in the islands the Spanish Sparrow easily takes first place, and to this bird is probably due the failure of the Hirundinidæ to nest in the Archipelago. Swallows or Martins would have little chance of using the nests which they built.

The fact that many of the birds of the same species in the Canaries are differently modified, although the islands are all within sight of one another, requires more explanation than is at first apparent. Undoubtedly the difference in the physical conditions, which I have shown to exist between islands of the eastern group and those of the western group, is sufficient to explain the distinctive characters in the birds inhabiting the two groups. The Brown Linnet, Short-toed Lark, Blue Titmouse, Chiffchaff, Barn Owl, Kestrel, and Thick-knee are all subspecifically distinct in the eastern group from the corresponding race in the western islands ; those from the eastern group show in their plumage or structure characters which have undoubtedly

been brought out by the desert-like conditions appertaining in the eastern Canary Islands.

But the islands of the western group, perhaps excepting Hierro, are fairly similar in climate and in their geographical nature to one another. Why, then, are the Titmice and Chaffinches (I do not here refer to the Blue Chaffinches) so distributed in the five islands of the western group? It has been remarked elsewhere that the distribution is similar in each case.

This state of things points to the Tits and the Chaffinches having arrived in a single immigration in the islands of Tenerife, Gomera, and Gran Canaria, where identical forms of both Tit and Chaffinch are found. The islands of Palma and Hierro would then have received their Chaffinch and Titmouse (distinct forms of each bird being found in both islands) at widely separated periods, and in the case of the Tits the immigration has extended to Fuerteventura and Lanzarote, where still another race has been formed.

Had the Titmice and Chaffinches spread over all the islands of the Archipelago in a single immigration, we should doubtless have found that if differentiation had taken place, only one form existed, at any rate in the western islands; but the movement having been gradual (*i. e.*, having taken place at widely separated periods) the birds have met with fresh organisms in the different islands where they have gained a footing. They have thus been influenced by the various factors with which they have come in contact, those factors having themselves altered considerably through lapse of time.

Instances of the case just mentioned are afforded by those species which are peculiar to the Archipelago, and which are universally distributed amongst the islands, but of which there exists only one race respectively in all the Archipelago. The Canarian birds in point are *Anthus berthelotii berthelotii*, *Sylvia melanocephala leucogastra*, *Emberiza calandra thanneri*, *Buteo buteo insularum*, and *Columba livia canariensis*. Darwin's explanation of this fact would have been that these species emigrated in a body, so that

1. FRINGILLA CŒLEBS CANARIENSIS.
2. FRINGILLA CŒLEBS OMBRIOSA.
3. FRINGILLA CŒLEBS PALMÆ.
4. FRINGILLA TEYDEA TEYDEA.
5. FRINGILLA TEYDEA POLATZEKI.

their relations were not much disturbed, and that if variation took place this would have been all in the same direction.

The fact that neither the Courser of the Canaries nor the Sand-Grouse has become modified in any way may be attributed to the almost identical conditions which exist between the continental and island homes of these birds, although we might reasonably have expected the island forms to have become darker, as the Bustard has done. Possibly migration to the mainland takes place, but we have no proof of this in either case.

The fact that the Osprey is similar to the continental form is easily understood, for it can hardly be termed isolated in the Archipelago, and being a coast-frequenting species would not meet with an environment much altered from continental conditions.

Similarly, none of the birds which I have termed Partial Residents in the Canary Islands have become differentiated, the frequent arrival of unmodified migrants from the mainland with which they interbreed being sufficient to keep up the continental strain. The Hoopoes, however, are making a great fight to establish themselves as an island race.

Isolation is one of the strongest factors—if not the strongest factor—to be reckoned with in the differentiation of a species. Once a bird is isolated and cut off from the stock from which it sprang, whether of continental or insular origin, it can no longer keep up the old strain ; and unless all the new conditions are exactly similar to those which it has left, the bird begins to develop along its own lines, influenced by the changed environment in which it finds itself.

In the Canary Islands most of the birds are completely isolated and many are confined to this Archipelago, where perfectly distinct geographical races have been formed ; but in one or two cases where insular races have been recognised, this isolation is not complete. The Resident Canarian Quail (*Coturnix c. confisa*) occasionally interbreeds with the Migratory Quail, which visits and breeds in the

Archipelago. The island Blackcap (*Sylvia atricapilla obscura*) probably occasionally interbreeds with the typical European species, which passes regularly through the islands on migration. If these visitors to the island sometimes interbreed with the residents, and we can hardly believe that they do not, then the purity of the island races is not kept up and intermediate forms are found. As this is probably the case with the Blackcaps, at any rate, it may explain why some systematists prefer to unite the Canarian Blackcaps with the typical race on the ground that complete intergradation exists.

The case of the Canarian Chiffchaffs (*P. c. canariensis* and *P. c. exsul*) is rather different; these two forms are so distinct that the European Chiffchaffs (*P. collybita collybita*), which pass regularly through the Archipelago on migration, do not appear ever to interbreed with them.

In a group of islands such as the Canaries we must remember that **Altitude** plays its part, if only a small part, in its bearing on the bird-life. It was long ago noticed that the Quails inhabiting the higher ground in the Canaries were of a darker and richer coloration than those in the lowlands, and it has now been established that this highland Quail is a distinct subspecies—resident in the Canaries and in the highlands of Madeira—*Coturnix coturnix confisa*.

In 'The Ibis,' 1914, pp. 240–243 and again in this paper (Part I., pp. 107–109) I have drawn attention to the curious fact that Corn Buntings living in the high lands of Gran Canaria (above 1500 feet), known as *Emberiza calandra thanneri*, are darker than the Corn Buntings which I shot on the coast, as can be verified by examining the skins I obtained, in the National Collection.

If the island of Tenerife, which rises above 12,000 feet, had been clothed with tropical vegetation we should find the **Zones of Vegetation** more pronounced than they are at present, and this would undoubtedly have influenced the bird population more than is now evident, witness the remarkable avifauna to be found on the Cameroon Mountain, 13,353 feet (*cf.* Ibis, 1915, pp. 473–526).

Whether altitude is indirectly responsible for the Blue Chaffinch (*Fringilla teydea teydea*) and the Woodpecker (*Dryobates major canariensis*), which inhabit the pine forests of Tenerife at an altitude of from 4000 to 6000 feet, differing in minute but perfectly distinct points from the corresponding subspecies *Fringilla teydea polatzeki* and *Dryobates major thanneri* inhabiting the pine forest of Gran Canaria, which are found at a lower altitude of from 3000 to 4000 feet, it is beyond my power to say. The pine forests of Tenerife, though more often being in heavy cloud than the Pinar of Gran Canaria, are probably damper than those in the latter island, but of the two forms the Gran Canarian race is decidedly duller in general colouring than the clear blue Tenerifian bird, and this brings us to the striking effect which **Climate** and **Light** can have on, at any rate, the plumage of a bird.

That Quails are affected to a very marked extent by the degree of moisture in the atmosphere was instanced at a former meeting of the British Ornithologists' Club, when it was shown by Mr. Ogilvie-Grant that in a large series of Bustard Quails, ranging from India to the Loo Choo Islands, the amount of rainfall in the various districts could be fairly accurately estimated from the colour of the plumage of the Quails. It is undoubtedly the dry desert climate of Fuerteventura and Lanzarote which is responsible for the pale plumaged birds found in those islands, of which a list has already been given.

The air in these islands is remarkably clear, the light extremely bright, and as Colonel Meinertzhagen remarks in his thoughtful paper on "Geographical Distribution and Migration" (Ibis, 1919, pp. 379–392), from observations in Palestine and elsewhere, "a high temperature, a dry atmosphere, and a bright light seem to produce that bleached effect usual in desert forms." What better instance of this can be quoted than that of the Fuerteventuran and Lanzarote Titmouse (*Parus cæruleus degener*), see Plate XV. fig. 1, when compared with the Titmice inhabiting the higher, moister, and more verdant islands of the western Canaries,

Parus c. teneriffæ (Plate XV. fig. 2), *Parus c. ombriosus* (Plate XV. fig. 4), and *Parus c. palmensis* (Plate XV. fig. 3).

Can it be the brighter reflected light from the snows of the Peak of Tenerife which has affected the plumage of *Fringilla teydea teydea* and so caused it to be brighter than the Gran Canarian Blue Chaffinch living in the Pinar Pajonal, where the light may be slightly less bright?

The daily **search for food** is more likely to cause structural differentiation than any other factor which we can name. The Barn Owl of the eastern islands (*Tyto alba gracilirostris*) is structurally modified by having a long slender bill, so as more easily to obtain its food among the holes of the lava rocks, for it lives chiefly on lizards. This is a fairly obvious change which has taken place in the bird to aid it in its struggle for existence, for the western Canarian Barn Owl has many more opportunities of feeding on mice and beetles than the allied form we have been considering, and is therefore unmodified in this respect. Doubtless there are other less obvious instances in the avifauna of the Canaries, the birds of which tend to possess stronger tarsi and longer bills than their Continental allies, though this character is not always constant.

The presence of enemies in an island has already been mentioned, and this leads to the need of **Protective Resemblance** and possible requirement of **Mimicry** for purposes of aggression; the two expressions "protective resemblance" and "mimicry" must not be confused. There are no instances of mimicry among the birds of the Canary Islands, and indeed it is very rare among all birds, being confined almost entirely to the Cuckoos, of which there is no resident form in the Archipelago.

Protective Resemblance, on the other hand, is well illustrated. We need only instance the Rock-Sparrow, the Courser, the Sand-Grouse, the Quail, and the Bustard, although the instances in the Canarian avifauna could be greatly multiplied, especially among the young of many species. Of the cases cited the Bustard is the most instructive, obviously descended from the Houbara Bustard of North-West Africa;

the Canarian form has in a previous epoch crossed from a home among the sandy wastes of Africa, and finding itself in an island (Fuerteventura) geologically different from the Saharan deserts has become modified in just such a way as best to afford it protection from its enemies by the remarkable resemblance of its plumage to the ground on which it lives; for the back of the island bird has become darker than that of the Continental form, thereby being less conspicuous among the lava rocks, with which the Fuerteventuran plains are scattered, than would otherwise have been the case. The Fuerteventuran Bustard is now regarded as a perfectly distinct geographical race and has been named *Chlamydotis undulata fuerteventuræ.*

In this connexion it is interesting to note that in the eastern Canary Islands, where the reefs which are found on many parts of the coast are formed of black water-worn lava, the Oystercatcher is black in plumage, and were it not for its red bill—which must serve some purpose to aid it in its search for food—would be most inconspicuous.

Variation, then, is *commenced* in a species by any one of the factors which we have been discussing, or more probably by a combination of most or all of them. It is obviously impossible to say which has had the greatest influence on the island birds that are the subject of this paper. Many of them are only very slightly modified, as, for instance, the Trumpeter Bullfinch, Least Goldfinch, Madeiran Rock-Sparrow, Kœnig's Shrike, Spectacled Warbler, etc., etc. The variation having once started it is maintained by natural selection—that process whereby certain of the same species are more or less rapidly eliminated while others are able to survive and thrive. This is the natural outcome of the struggle for existence; only a certain number of birds can exist in an island such as Hierro or Lanzarote, if they continually keep on increasing: finally, there must be a scarcity of food—particularly in desert islands,—the birds fight for the food amongst themselves, the fittest survive, the weakest perish. Thus the progressive modification of species by the agency of variation and natural selection which we

term evolution continues—new geographical forms arise, and the laws of heredity complete the process.

Affinities of Canarian Avifauna.

The affinities of the Resident birds of the Archipelago of the present day were discussed by Dr. Hartert in 1901 (Nov. Zool. vol. ix. pp. 301–312), who came to the conclusion that they were chiefly European in character, and he therefore included the fauna of the islands in the Palæarctic Region, and has discussed the forms in his valuable 'Vögel Paläarktischen Fauna'; the opinion which he formed then was absolutely correct, and recent investigation of the migratory species helps to strengthen this view.

To deal first with the 61 Resident species, my own opinion is as follows:—I consider that 41 are most nearly allied to forms found to-day in northern Europe, and, as will be seen by referring to the list on page 520, are all closely related to forms inhabiting the British Islands; then of the remainder 8 are either south European forms or closely allied to species inhabiting the Mediterranean sub-region. With these I include *Erythrospiza g. amantium*, *Petronia p. madeirensis*, *Passer h. hispaniolensis*, *Calandrella minor polatzeki*, and *C. m. rufescens*, *Sylvia melanocephala leucogastra*, *Sylvia conspicillata bella*, *Caccabis petrosa kœnigi*.

Three species I consider to be more truly north African than European, *i. e.*, *Chlamydotis undulata fuerteventuræ*, *Cursorius g. gallicus*, and *Pterocles orientalis*; while of birds whose nearest relatives can only be considered African there are but two, *Neophron p. percnopterus* and *Hæmatopus niger meadewaldoi*. Of these two the Oystercatcher belongs to a cosmopolitan genus widely represented in Europe, but of which the black species are not found in the Palæarctic region. There are, however, 7 other Resident birds in the Canaries confined to these islands of which it is more difficult to trace the immediate affinities: these are *Fringilla teydea teydea* and *F. t. polatzeki*, *Anthus bertheloti bertheloti*, *Saxicola dacotiæ dacotiæ* and *S. d.*

murielæ, *Columba junoniæ*, and *Columba bollei*. All (except the first two mentioned) belong to genera of wide distribution, and of the 5 species here represented *Fringilla teydea* is probably of most ancient origin. No bird which we can consider to be closely allied to the Blue Chaffinches of the Canary Islands is to be found anywhere in the world, but the family Fringillidæ, to which they belong, is, of course, typically Palæarctic, we might almost say European. In bygone days a Blue Chaffinch may have lived in the extensive forests which clothed the mountains of southern Europe, and the ancient pine forests of the Atlas Mountains may have held the last representatives of this remarkable bird, from which the now unique island races have sprung.

Indeed, I have always cherished the idea that a thorough investigation of the Ornis of the Southern-Atlas Mountains and the country lying to the south of this range might throw some light on the origin of certain of the resident birds in the Canaries. The recent interesting discovery in Morocco of a Nuthatch by Captain Lynes, R.N., lends colour to my theory *. For the present we must include the Blue Chaffinches as having their affinities rather with Europe than with any other part of the world.

The Pipit and the Chats I believe to have been descended from species of northern Africa; indeed I should not be surprised to find a Chat closely allied to *Saxicola dacotiæ* inhabiting the unexplored coasts of the continent which lie opposite the Canary Archipelago.

The two Pigeons (a third remarkable form, *Columba trocaz*, inhabits Madeira) must have been isolated in their island homes for many centuries, so specialized have they become and so distinct from all other races of Pigeons known in Europe or Africa. With the Blue Chaffinches their original

* Since this paper was written I have received the January 'Ibis' containing the highly valuable paper by Captain Lynes on his explorations in the Atlas Range. I regret that owing to absence abroad my paper had to be printed before I had read Captain Lynes's conclusions. I have therefore not made the use of them which I should otherwise have done.—D. A. B., Gran Canaria, February 1920.

home must remain a mystery, but whereas the genus *Fringilla* is typically Palæarctic the genus *Columba* is cosmopolitan. It would be useless, therefore, to speculate as to where their nearest allies may be found at the present day, or whether they are the direct descendants of European or African stock.

In dealing with the affinities of an insular fauna, it is, of course, the *endemic forms* which throw most light upon the subject. It is of much less importance to study those birds which still have connexion with a continent : but, nevertheless, certain lessons can be learned by a critical review of the Birds of Passage and Visitors.

Before passing on to the Birds of Passage let us see whether the Partial Residents can upset the conclusions at which we have arrived. I might have included the Partial Residents with the Residents, but perhaps, as they still have connexion with a continent, they are best dealt with separately. Only five in number, the Hoopoe, the Heron, and the Kentish Plover are all Palæarctic birds with an enormous range, the Peregrine belongs to a north African race and is closely allied to our European bird, while the Herring-Gull is the Mediterranean race and allied to the Gull which breeds on our own coasts in England.

We note, therefore, that the Partial Residents all appear to be of European origin.

Of the Summer Visitors the Pale Swift is a north African species, but as representative races are found in southern Dalmatia it is best considered as belonging to the Mediterranean sub-region.

The Black Swift is not found in Europe, its true home being the Atlantic islands, representative races being found in the Cape Verde Islands and in Fernando Po.

The Eleonore Falcon is a Mediterranean bird.

The Common Tern and the Migratory Quail are both the well-known European birds, while the Turtle Dove is obviously of European origin if not the identical bird.

Puffinus k. fortunatus is a race of *P. kuhli,* geographical forms of which range from the Mediterranean to the Cape Seas.

More interesting are the affinities of the other Shearwater and Petrel. *P. a. baroli* is represented by allied forms in several widely separated localities in the Pacific and Indian Oceans, but is the only form known to occur in the Atlantic, where it is isolated in the Archipelagos from the Azores to the Canaries.

Bulweria bulweri bulweri enjoys the same distribution in the Atlantic as the Madeiran Allied Shearwater. In the Pacific the allied races known are confined to the Hawaiian and Bonin Islands—another interesting case of discontinuous distribution.

These last two cases have been more fully discussed on pp. 543-544.

The 15 Winter Visitors without exception are all north European species—many having a wide range—especially the Ducks, the Waders, and the Coots.

The 33 Birds of Passage are likewise chiefly north European, but *Merops apiaster* and *Falco eleonoræ* belong more to the Mediterranean fauna. Of the Waders all are species with an extensive range which visit the Canaries on migration to and from their breeding-quarters in the far north of Europe and Asia.

The 5 Annual Visitors are all members of the Order Tubinares, with extensive distribution in the Atlantic and Pacific.

Amongst the 30 Occasional Visitors we find several south European and Mediterranean species, as, for instance, the Golden Oriole, Rock-Martin, Lesser Cuckoo, Roller, White Stork, and Marbled Duck : the remainder are north European birds, the Waders breeding also in northern Asia.

We have now only to consider the Rare Visitors, and here it will be noticed that the south European forms increase in number and African species occur—a state of things which we can easily understand.

Of the 72 species and subspecies which come under this category

45 are well-known European species.

5 are central European species, *i. e.*, the West European Jackdaw, White-eyed Pochard, Little Bittern, Night Heron, and Black-necked Grebe.

10 are south European species, *i. e.*, the Snow Finch, Southern Tree-Warbler, Great Spotted Cuckoo*, Alpine Swift, Persian Bee-eater, Flamingo*, Purple Heron*, Great White Heron, Little Egret*, and Buff-backed Heron*. (Those birds marked with an asterisk are also found throughout Africa.)

4 belong to the Mediterranean countries, *i. e.*, the Sardinian Starling, Golden-bellied Greenfinch, Calandra Lark, and Western Black-eared Wheatear.

4 are typically north African birds, *i. e.*, the Saharan Bunting, Tristram's Desert Wheatear, the Egyptian Plover, and North African Turtle-Dove.

2 birds are confined principally to Africa, *i. e.*, the Squacco Heron (which is also a Summer Visitor to southern Europe), and Sturm's Bittern, which is confined to Africa.

1 bird—the Madeiran Fork-tailed Petrel—inhabits all the Atlantic Archipelagos with the one exception of the Canaries, and even breeds in St. Helena. In the Pacific a closely-allied form of this Petrel occurs in the Hawaiian and Galapagos Archipelagos.

1 bird—the American Bittern—has its home in northern America and winters in central America. It is an Occasional Visitor to Europe, and has occurred in the Azores.

The figures speak for themselves, and the close European relationship of the Canarian Avifauna—both as regards its Resident species, Regular Migrants, and Accidental Visitors—needs no further elaborating. I unhesitatingly endorse Dr. Hartert's de ision (made, be it remembered, nearly

twenty years ago, when we had much less material to guide us) to include the Canary Archipelago in the Palæarctic Region.

Connexion between the Birds of the Canaries and the other Atlantic Archipelagos.

The connexion between the birds of the North Atlantic islands can only be kept up by the migratory species. Communication of the Resident Birds has, I believe, long ceased to exist, except, perhaps, in one or two doubtful cases, such as the Woodcock and the Courser—the migratory movements of which, if they take place at all, are quite unknown. It must be borne in mind, however, that Woodcocks are found in some numbers in the Azores as well as in the Canary Islands, and that the Courser is found in the Cape Verde Islands as well as in the Canaries, and that those birds inhabiting the one group of islands are not in any way distinguishable from those inhabiting the other group or from the typical Continental forms.

The Azores lie so far out of the line of flight of migrating birds that these islands can hardly be considered in this connexion, but it is worth noting how Guppy, when working out the affinities of the Azorean flora, regarded the connexion between the plants of the woods of the Azores and the Canaries as kept up. This he attributed to the activities in recent times of frugivorous birds—a conclusion which points, in Guppy's opinion, to the intercommunication between the Azores and Canaries of fruit-eating species—in my opinion more probably of ground-nesting species, such as the Woodcock and Quail, for it is well known how such birds carry the seeds of plants on the mud or earth which becomes attached to the feet or tarsi, or even to the feathers.

The Resident birds common to the Azores and Canaries are only four in number: the Least Goldfinch, the Canary, an aberrant Blackcap, and the Woodcock already mentioned, but these show, particularly the Canary and Blackcap, that at one time there must have been some connexion

between the birds of these two groups. The Buzzard of the Azores can no longer be allied with the Canarian race, although I united them in an earlier Part of this List, and I am sure that the Buzzard* of the Cape Verde Archipelago is now distinguishable, but this form I kept distinct when dealing with Buzzards in my List (Part iii., Ibis, 1919, p. 482). Guppy drew attention to the fact that the plants in the woods of the Atlantic islands shewed specific and varietal differentiation and that this divergence corresponded with the specific and subspecific differentiation of the pigeons of the genus *Columba* inhabiting these islands.

A much closer bond exists between the avifauna of Madeira and of the Canaries. Here we find there are eleven Resident birds which are found in both groups: the Least Goldfinch, Canary, Madeiran Rock-Sparrow, Dusky and Heineken's Blackcaps, Madeiran Spectacled Warbler, Cabrera's Blackbird, Madeiran Redbreast, Canarian Kestrel, Woodcock, and Madeiran Quail. An additional link, which is now severed, is to be found in a race of Berthelot's Pipit, *Anthus bertheloti madeirensis*, inhabiting Madeira and Porto Santo, while the typical and only allied form inhabits the Canaries.

Undoubtedly the majority of the species which are included in my list of the Birds of Passage of the Canaries occur similarly in the islands of Madeira, Porto Santo, and the Salvages. I have not closely compared Padre Schmitz's List of the Migratory Birds of Madeira, but have little doubt that all occur there also and thus form a link between the Archipelagos.

The Cape Verde Archipelago has very few connecting links with the Canaries, the only Resident birds common to both being the Spanish Sparrow, Madeiran Spectacled

* Since the above was written Mr. Kirke Swann has named the Azores Buzzard *Buteo b. rothschildi*, the Madeiran Buzzard *B. b. harterti*, and the Cape Verde Islands Buzzard *B. b. bannermani* [Syn. List of Accipitres, Part ii. 1919, pp. 43, 44].

Warbler, Egyptian Vulture, Osprey, Courser, and Migratory Quail. Ethiopian types prevail in the Cape Verde Islands, as is only to be expected, and this Archipelago cannot by any stretch of imagination be included in the Palæarctic region.

The curious distribution of the Shearwaters and Petrels in the Atlantic islands was the subject of a paper which I published in 'The Ibis' in 1914, pp. 438–494, and I then pointed out that although the same species were in certain cases found breeding in islands as widely separated as the Cape Verdes and the Azores, yet this did not necessarily indicate that the birds from one colony had any connexion with the birds of other breeding stations. The fact that in the Cape Verde Islands is found a form of *Puffinus kuhli* [*P. k. edwardsi*] perfectly distinct from the race inhabiting the more northern Archipelagos, strengthens this view, as also does the fact that *Oceanodroma castro castro* breeds in all the North Atlantic islands *except* the Canaries, which islands lie in the centre of its breeding range and form the missing link in an otherwise connected chain of Atlantic breeding stations. There are other instances, but these will suffice to emphasize my point.

The Birds of Passage.

In the J. f. O. 1890, Kœnig makes the astounding statement "I declare plainly that the Canaries are visited quite by chance by Palæarctic birds on their flight, and that there can be no question of regular appearances of migratory birds there"! The inaccuracy of this remark is obvious to anyone who has passed even one spring and one autumn in the islands.

No fewer than 33 Palæarctic species pass *regularly* through the Canaries in spring and autumn (probably a great many more). These are the birds which follow the coast of Spain and Portugal and take the extreme westerly course passing far out to sea *via* Madeira, the Salvages, and the

Canaries, possibly touching the continent again near Cape Blanco. This is, of course, a hypothetical line, but it is well known that migrating birds have a strong tendency to follow an extended coast-line. Moreover, birds passing from Spain and northern Africa (where food is plentiful) to tropical Africa, if they do not hug the coast, find they have to pass through the most inhospitable land of the Great Sahara *, where food is scarce over a very large area. It follows, then, that the birds passing in autumn from north to south have a reason to stick to the African coast-line, and as they cannot possibly see the land at night, many pass over the sea and use the islands of the Madeira and Canary groups as halting places where they can rest awhile and secure plenty of food with very little trouble.

The "front" upon which this great migratory advance is made is a very wide one—the Canary Islands being at the extreme westerly end, and, as I have tried to shew, would certainly not have so many migrants passing through them were it not for the proximity of the African shores. Farther to the east hundreds of birds must follow the Nile Valley, while again countless numbers pass down the eastern shores of the continent. Dr. Hartert's interesting remarks on Bird Migration in Algeria (Nov. Zool. xx. 1913, pp. 73–76) strongly support the theory of coastal migration. In this article the writer seems to suggest that the Canaries are visited through the migrants following the west European shores, which have a south-westerly direction, and, maintaining this direction during their flight, the birds pass out to sea and eventually come to the Canary Archipelago. That the birds which pass through the Canary Islands come again to the mainland, and do not all perish at sea, is surely proved by the regularity with which many species occur there on migration, shewing to my mind that this is the most western extreme of the *regular* flight and that the

* That, nevertheless, large numbers of migratory birds pass over the Sahara itself is well known. At the migration season the oases of the Sahara are teeming with bird-life while at other times of the year they are practically deserted.

occurrence of the migratory species in these islands is not by any means a matter of chance alone.

To convince ourselves that the Canary Islands have for centuries been in the direct flight of migratory birds we have only to glance down the list of the Resident species (non-migratory at the present day). Among these we see certain birds which with hardly any doubt got a footing in the islands when the species (not necessarily the geographical race into which some have now evolved) passed on its regular flight through the islands: the Chiffchaff, Warblers, Kestrels, Woodcock, and Madeiran Quail come to mind as typical examples, most of which have now entirely ceased to migrate, and all of which, save the Woodcock, have become differentiated to a lesser or greater extent.

In Dr. Lowe's fascinating book 'A Naturalist on Desert Islands' (p. 48) the question is asked, "How came these birds to drop their migratory habit? Did the climate and the conditions generally, in the Canaries, gradually come to fulfil exactly throughout the whole year the requirements of the Chiffchaff, and so gradually do away with the necessity for periodical migration? Under these conditions we can conceive that those birds which did return annually to Europe in the spring would gradually become fewer and fewer, until at length there would be none left, and this migratory branch-route north to south or south to north would cease to exist, and the Canary Island birds would be cut off from any autumnal influx of birds which had bred in the north, and would be completely isolated." In a later chapter Dr. Lowe remarks: "Isolation, of itself alone, does not seem capable of producing fresh varieties any more than segregation. Natural selection is only the final arbiter in determining what variations shall survive, *after* they have been produced by the influence of external conditions. If the external conditions are the same all the world over, natural selection cannot come into action."

The same thing is going on to-day: witness those species which I consider Partial Residents and which have not yet entirely dispensed with the migratory habit; such are the

Hoopoe, Barbary Falcon, Heron, Kentish Plover, and Yellow-legged Herring Gull in the Canary Archipelago. We must not forget that (as mentioned by Meinertzhagen) it is probably the environment of the breeding quarters which chiefly influences differentiation.

Yet again we have numerous other migrants, some arriving in the summer, some in the winter, while the largest list of all the general visitors contains the Birds of Passage passing to and fro regularly twice a year. In a hundred years time how many of these true Birds of Passage which now pass *through* the islands will have remained to breed, ceased to pass beyond the Archipelago, and become resident and in their turn differentiated? The birds peculiar to the Canary Islands will, I am convinced, increase in numbers as the years go on.

Although I maintain that many of the Passerine species got a footing in the Canary Islands in the first instance through the agency of regular migration, yet, as Colonel Meinertzhagen has recently emphasized, there are various types of migration which he groups under the headings of "periodic" and "regular" migration, "sporadic invasion" or "extensive wanderings," discussed at greater length by Seebohm in his 'Geographical Distribution of the Charadriidæ.' Certain birds of the Canaries may well have arrived through the agency of the movements here noted. It is more than likely, for instance, that both the Sand-Grouse and the Courser arrived in the eastern islands during a sudden invasion (immigration), for neither is differentiated in the slightest degree. The Great Spotted Woodpeckers have, on the contrary, in past years gradually extended their range south until they reached the Canaries; their course can be plainly followed through southern Spain, the Mediterranean islands, and Morocco (in all of which places local races have been formed), until finally they crossed the sea and formed the two races which now inhabit Tenerife and Gran Canaria. Amongst other examples sprung from European stock whose southern range ceases in the Canary Islands, are the Raven, Chough, Goldfinch, Rock-

Sparrow, Chaffinches (of the *F. cœlebs* group), Linnet, Corn Bunting, Titmice, etc. The list could be increased of those residents which have probably never passed south beyond the latitude of the Canary Archipelago.

The remarkable fact that we have in the Canaries a *Black* Oystercatcher may possibly be put down to the same cause. Its nearest ally is an inhabitant of South Africa, but does not now extend farther north than Damaraland on the West Coast. Either the bird has gradually pushed farther and farther north until its present home was reached, or it once lived commonly in these latitudes and for some reason has been slowly pushed southwards down the coast of West Africa, leaving no trace save the fast disappearing subspecies; for it has become markedly differentiated, isolated in the desert islands of the eastern Canary group. I lean to the former explanation of its presence there, otherwise surely we should find other races in the islands or on the mainland between the Canaries and the habitat of its nearest ally. The lessons to be learnt from studying this bird alone are typical of what may be gleaned when the avifauna of a whole Archipelago is under examination.

Only migration from the continent to the islands and *vice versa* has been discussed here. That a certain amount of local migration takes place in the islands themselves (not *between* the islands) seems evident, caused by local weather conditions or even influenced by human agency.

Meade-Waldo (Ibis, 1889, p. 2) speaks of the immigration of the Blackbird (*Turdus merula cabreræ*) in Tenerife from the lowlands to the highlands of that island. Curiously enough they "swarmed in the high forests during the winter," when one would imagine they would seek the warmer zone of the coast. The same observer notes that large numbers of Canaries ascend to the high mountain woods to breed, going up about the end of April. Apparently they returned to the lowland valleys after breeding.

Von Thanner remarks that it is quite the exception to find a Hoopoe in the higher districts of Gran Canaria and Tenerife during the winter, though he has found them

breeding at this time of year on the coast. To human agency may be put down the migration (if not the extermination) of *Columba bollei* from Gran Canaria by the destruction of the laurel forests, a sad fact which has already been chronicled earlier in this paper. The drying up of the lake at Laguna has enormously influenced the migrations of the duck family; while the reclaiming of the Laguna plateau, once much more of a "swamp" than can possibly be imagined now, has had the same effect on the Rails and Herons and other marsh-loving species.

If the pine forests of Tenerife and Gran Canaria suffer the same fate as the laurel in Gran Canaria we shall either see the total extermination of the beautiful Blue Chaffinches, not to speak of the Woodpeckers, or else happily their migration to the island of Palma, where the pines are in less danger of total destruction.

Should the evergreen forests of the Canaries be destroyed in generations to come through short-sighted human agency, then the climate of these islands will itself change remarkably, and who can tell what disastrous effects this may have on the bird population. Birds which have lived for centuries in the islands may then be compelled to migrate, faced by the destruction of their favourite food, nesting-sites, or even cover itself.

I have hardly alluded to intermigration between the actual islands which make up the Canary Archipelago. Evidence in favour of this taking place is extremely scanty, and although certain islands—notably Fuerteventura and Lanzarote, Tenerife and Gomera—are situated very close to one another, yet it is remarkable what little communication appears to take place between them. We know that the Bustard very seldom passes from Fuerteventura to Lanzarote, and even more rarely crosses to the south-eastern plains of Gran Canaria, where, however, the Courser is now a breeding bird, as it is in the south of Tenerife: obviously, with the Trumpeter Bullfinch, it has extended its range from the eastern islands.

The Sand-Grouse has likewise been known to occur in

Gran Canaria from its true home in Fuerteventura. The Courser and the Sand-Grouse are both birds of powerful flight, and it is not surprising that they should move about. I am inclined to think that when Sand-Grouse appear in Gran Canaria (it is now many years since they have been recorded) they make the journey in search of water. For at times so severe a drought is experienced in Fuerteventura that men and animals have to be transported to Gran Canaria to prevent the latter dying of thirst. This may have accounted for the Courser's starting colonies in Gran Canaria and Tenerife, which islands are never so badly off for fresh water as those of the eastern group.

The Corn Bunting is said by Polatzek (Orn. Jahrb. 1908, p. 196) to be a Summer Visitor to Fuerteventura and Lanzarote, arriving in February, breeding in March and April, and leaving after the harvest to return again in the spring. Whether this bird comes from the other islands or from the continent is difficult to prove, and it is undoubtedly very locally distributed in the eastern islands in the summer time, as I have proved for myself. Certainly the only bird I procured there in the summer belonged to the dark-breasted race which, if recognised as distinct, is apparently confined to the Canary Archipelago.

The case of the Chat (*Saxicola dacotiæ murielæ*) must be cited as a last instance, though the possibility of this race occurring also on the mainland of Africa must not be lost sight of. A small flock of these birds was discovered on the tiny islet of Montaña Clara two days after I landed there in June 1913. Four or five birds were seen and two secured, the others dispersed, and although I spent eight days on this island, and there was very little cover, I never saw a single Chat again. On the small island of Allegranza, not far distant, these birds were fairly common. Doubtless my three individuals migrated to this island when so rudely disturbed. They are restricted to these two outlying islets, having been found nowhere else in the Archipelago.

We know, of course, that birds occasionally pass from Lanzarote across the narrow strait which divides it

from Graciosa. I have myself watched a Thick-knee flying to the former island from Graciosa, although at the time this very bird was breeding close to my camp. The distance is infinitesimal and cannot be taken into consideration.

Between the seven large islands it seems evident that remarkably little migration takes place of those birds which we include amongst the list of Residents. Of those, however, which have been known to migrate from one island to another within recent years, we must confess to almost complete ignorance. The cases cited (with the possible exception of the Corn Bunting) belong rather to chance migration brought about by exceptional circumstances than to a regular seasonal flight from one island to another.

Lastly, if any readers of this paper should find themselves in the Canary Islands with time on their hands, may I beg them to turn their attention to some of those problems which are still unsolved, a few of which I have but lightly touched upon in the course of my paper. In particular would the study of migration repay the observer. The island of Allegranza would be an ideal "Heligoland," and our knowledge of this fascinating branch of ornithology would, I confidently predict, be increased beyond all expectations.

In the preceding pages I have attempted to describe some of the engrossing problems which the Canaries present—to give to the readers of 'The Ibis' something beyond the "bare lists" of which complaint is so often made. In this "Part" I have attempted to atone for publishing "A List of the Birds of the Canary Islands," and more especially for having taken up so much valuable space in seven consecutive numbers of our Journal, a crime which weighs heavily on my conscience and for which I here apologise.

Finally, lest we forget! I should like to endorse very strongly the statement made by Lieut.-Col. Meinertzhagen in his essay on "Geographical Distribution and Migration," that "*no killing of birds can be justified merely to compile a list of species obtained in a certain locality.*" A sounder statement was never made. Far too much attention is given

to the mere amassing of skins—undoubtedly (I would remind some biologists) the means to the end, but not the end in itself. Nine-tenths of the value of a collection of birds is to be found in the *deductions* which we can make from it, but it must not be overlooked that without the incomparable material, such as that contained in the British and Tring Museums, such deductions could never be made, and the great Principles built up by such men as Darwin, Wallace, and P. L. Sclater upon which Zoology is based could never have been formulated.

[Concluded.]

XXI.—*A Nominal List of the Birds at present known to inhabit Siam.* By Count Nils Gyldenstolpe, D.Sc., F.M.B.O.U.

[Continued from p. 496.]

Family Campophagidæ.

Artamides sumatrensis S. Müll.

Ceblepyris sumatrensis S. Müller, Verhandl. Natuurl. Gesch., Land- en Volkenk. 1844, p. 190: Sumatra.

Recorded by Barton from Me Taw near Raheng, but identification most certainly wrong.

Graucalus macei siamensis Stuart Baker.

Graucalus macei siamensis Stuart Baker, Bull. Brit. Ornith. Club, xxxviii. 1918, p. 69.

The Siamese representative of the Large Cuckoo-Shrike has recently been separated by Stuart Baker under the above-mentioned name. It is fairly common in suitable localities throughout the whole country.

Volvocivora lugubris saturata Swinh.

Volvocivora saturata Swinhoe, Ibis, 1870, p. 242: Hainan.

Only recorded from Koon Tan in northern Siam.

Volvocivora lugubris intermedia Hume.

Volvocivora intermedia Hume, Stray Feathers, v. 1877, p. 205: Tenasserim.

Apparently an inhabitat of eastern Siam, where specimens