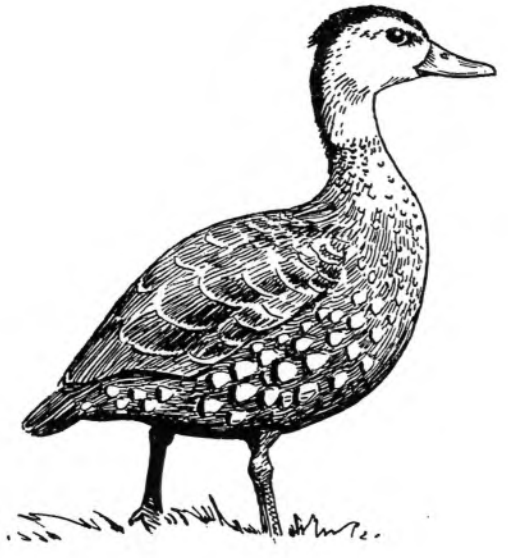
THE ELEVENTH ANNUAL REPORT OF

THE WILDFOWL TRUST

1958–1959



HUGH BOYD AND PETER SCOTT

Price Ten Shillings Net

Printed for The Wildfowl Trust by

F. BAILEY & SON, LTD.,
Dursley, Glos.
1960

THE WILDFOWL TRUST

Patron: HER MAJESTY THE QUEEN

President:	Field Marshal the Rt. Hon. the Viscount Alanbrooke, K.G., G.C.B., O.M., G.C.V.O., D.S.O.
Vice-Presidents:	Sir Percy Lister Captain R. G. W. Berkeley
Trustees:	The Rt. Hon. the Lord Kennet of the Dene, G.B.E., D.S.O., D.S.C. His Grace the Duke of Beaufort, K.G., P.C., G.C.V.O.
Hon. Treasurer:	Guy Benson
Hon. Director:	Peter Scott, C.B.E., D.S.C.

Council:

Capt. R. J. Berkeley
Dr. Bruce Campbell (S)
Michael Crichton (F)
H. H. Davis
* J. O. Death (F)
Harley C. Drayton (F)
James Fisher (F) (S)
K. Miller Jones
Dr. James Robertson Justice
* R. E. M. Pilcher (S)
Miss P. Talbot-Ponsonby (F)
Sir Landsborough Thomson, C.B., O.B.E. (*Chairman of Scientific Advisory Committee*)
Major General C. B. Wainwright, C.B. (S)
J. E. H. Blackie, O.B.E. (*Ministry of Education Assessor*)

(F) Member of Finance Committee; (S) Member of Scientific Advisory Committee

Scientific Advisory Committee:

Those members of Council marked (S) above, together with:

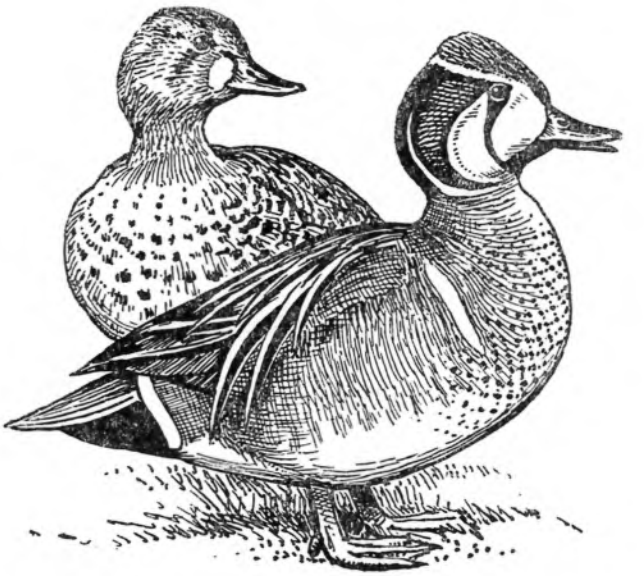
Dr. F. Fraser Darling, F.R.S.E.
Prof. John E. Harris, F.R.S.
Dr. Jeffery G. Harrison
Prof. H. R. Hewer
Dr. Edward Hindle, F.R.S.
R. C. Homes
Sir Julian Huxley, F.R.S.
A. R. Jennings
Dr. L. Harrison Matthews, F.R.S.
Dr. W. H. Thorpe, F.R.S.

and sixteen Corresponding Members

The collections of the Trust are at:

The New Grounds,
Slimbridge,
Gloucestershire.
Tel: Cambridge (Glos) 333
Stations: Coaley Junction (M.R.); Stroud (W.R.)

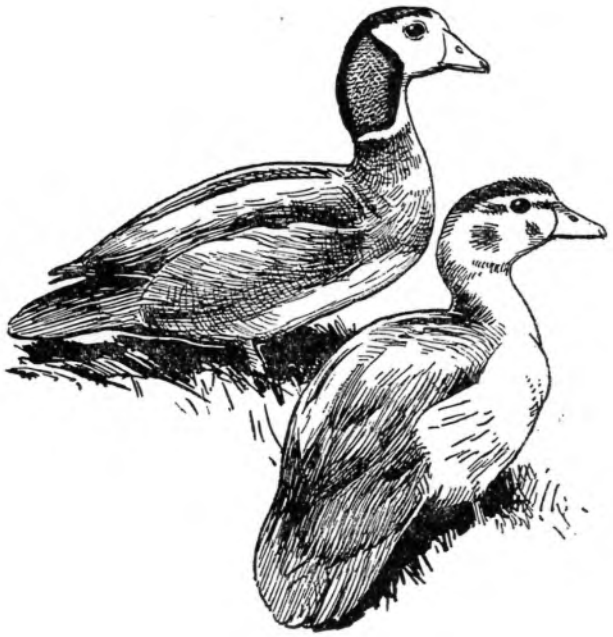
The Waterfowl Gardens.
Peakirk,
Peterborough,
Northamptonshire.
Tel: Glinton 271
Station: Peakirk (E.R.)



Baikal Teal *Anas formosa*

CONTENTS

CONTENTS (continued)



African Pygmy Goose *Nettapus auritus*

REPORT

THOUGH the activities of the Trust in the twelve months from 1st September, 1958 to 31st August, 1959, with which this Report is primarily concerned, included no dramatic new developments, interest in the work of the Trust and in the collections at Slimbridge and Peakirk was maintained in a gratifying way. The collections were visited by over 157,000 people, a record figure, but one giving no cause for complacency since the increase over the previous year was small although the summer weather of 1959 was as favourable as that of 1958 had been bad. We must continue to improve the attractions and amenities of the collections so that visitors will return and bring others. To make large numbers of people interested in ducks and geese and really care about their conservation is one of our major functions. We badly need new Members: an increase in Associates has been offset by a decline in Full Membership. The need is not solely a financial one. The understanding and support of Members is essential to the success of the Trust's activities in conservation.

This Report is grouped into five sections, of which the first (pp. 8-17) and fourth (pp. 158-167) are devoted to the Collections, Membership and the financial facts of our life. The breeding performance of the ornithic inhabitants of Slimbridge and Peakirk is an annual index which in 1959 again showed that we must not expect uninterrupted progress. Our satisfaction at the acquisition of new species, most notably a collection of Salvadori's Ducks brought back from New Guinea by the Curator, is tempered by the difficulties so often encountered in getting exotic birds adapted to life in captivity. Even such well-established geese as the Ne-Ne seem to be more accident-prone than their less valuable companions, and

the Slimbridge stock, though it has increased from 3 in 1950 to 99 in 1959, is still reproducing at a rate far below that to be expected from the numbers of eggs laid. New breeding records for the collection included the Laysan Teal, like the Ne-Ne a rare island form of which it is important to build up a 'reserve' population in captivity. The breeding success of the whole collection in 1959 was less than in 1958, despite the seemingly favourable weather and further improvements in artificial rearing technique. The difference was largely due to an unexplained drop in the number of eggs laid.

The organisation and work of the scientific staff is reviewed in Section II (pp. 18-30), which includes the traditional account of the numbers of wild geese at the New Grounds in the winter of 1958-59. The report on ringing includes notes by Miss E. A. Garden (p. 23), on her efforts to start duck ringing in Aberdeenshire: the marking of ducks in Scotland is badly needed, to correct the biased notions about migratory movements in Britain which have hitherto been very largely derived from ringing in southern England and Wales. Mr. W. A. Cook, the decoyman at Borough Fen, reports on his very encouraging results and on the improvements he has been making in the condition of the decoy (p. 21). Elsewhere (p. 118) he shows how the catches at Borough Fen have fluctuated in the course of 180 years. 1958-59 saw considerable activity in the study of the technique of aerial surveys, reviewed by Dr. S. K. Eltringham (p. 26). Two papers based on aerial surveys are printed here—an inspection of the breeding population of the north-west of Scotland (p. 103), and an investigation of the Shelduck population of Bridgwater Bay (p. 107). Mr. P. J. S. Olney's work (p. 29) on the food and feeding behaviour of wildfowl is now yielding valuable results. A sideline has been the demonstration that lead poisoning is a mortality factor to be thought of in Britain as well as North America and a review of its occurrence and effects is included (p. 123) to stimulate interest in this problem.

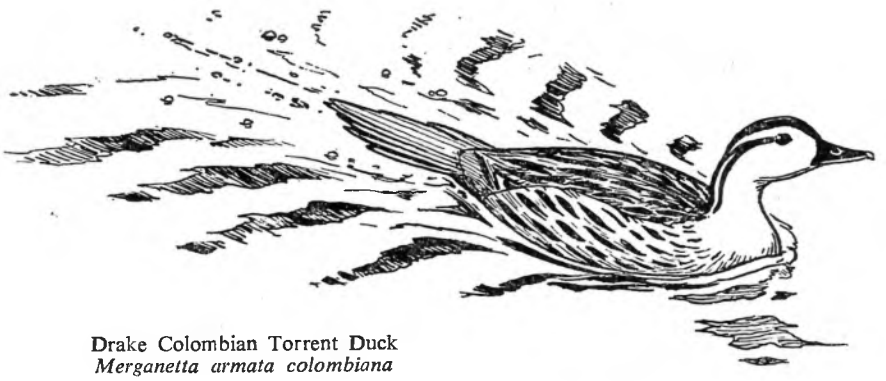
From January to March, 1959, the Hon. Director and Mrs. Scott, with Mr. Tony Soper, made a Darwin Centenary Expedition to the Galapagos Islands sponsored by the British Broadcasting Corporation and the International Union for the Conservation of Nature. Their journey took them to the West Indies and tropical America as well and though wildfowl represented only a tiny fraction of the naturalists' treasures they saw and photographed and recorded, Mr. and Mrs. Scott were able to see three species or forms new to them. Mr. Scott gives an account of his observations on the Masked Duck, the Colombian Torrent Duck and the Galapagos Pintail (p. 61).

The section 'Conservation and Research . . . ' includes a number of papers by authors not members of the Trust staff. Dr. J. G. Harrison, a member of the Scientific Advisory Committee, writes on the removal of wildfowl viscera for research (p. 135), with Mr. Olney on an unusual accidental death of a Mallard (p. 150) and, with Dr. J. M. Harrison, on tuberculosis in wild ducks. Others who have previously written for the Report are Mr. P. J. K. Burton (on Brent Geese, p. 94 and on a visit to Denmark, p. 99) and Mr. N. G. Blurton Jones (on the threat postures of Canada Geese, p. 46). We are very glad to have five contributions from overseas. Dr. P. A. Johnsgard, who is working at Slimbridge in 1959 and 1960, provides a valuable summary of behavioural studies and their role

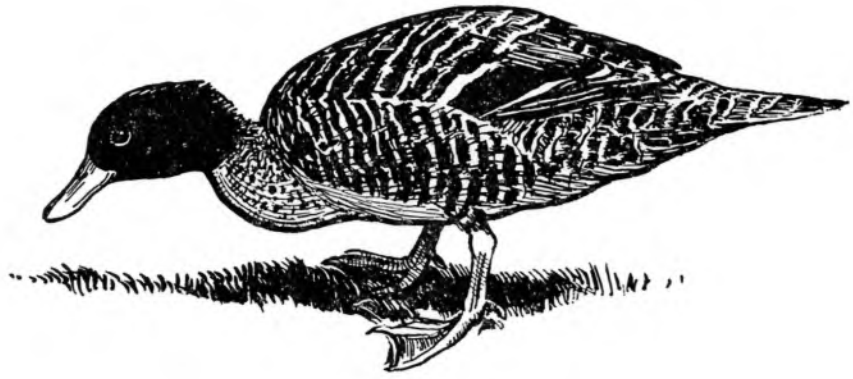
in solving the problems of evolution posed by the Anatidae (p. 31). Another American, Mr. F. V. Hebard, raises questions about the ubiquity of injury-feigning (p. 53) which we hope Members can help to answer. Mr. Salim Ali reviews the sad history of the Pink-headed Duck which seems to have become extinct within the last twenty-five years (p. 55). Mr. J. A. Eygenraam gives an account of the way in which the professional goose-netters of Holland have been converted to ringers and so made his organisation (ITBON) into our friendly rivals as goose-markers (p. 77). The fifth paper from overseas is a translation of a most valuable piece of research by Professor S. M. Uspenski on the status of the Brent Goose in the Soviet Union (p. 80) which demands wide circulation.

Mr. B. King, though not a member of the research staff, has been for so long so enthusiastic a contributor to our work that it is surprising he has not hitherto published papers in the report. His short notes on feeding behaviour (p. 154) will, we hope, encourage other Members to send us material for future Reports: and if his study of a Mallard population in Somerset (p. 137) helps to promote similar investigations elsewhere it may prevent British field ornithologists falling too far behind in research on breeding ducks.

Mr. Christopher Sellick, another enthusiast who has done much valuable work for the Trust, also makes his first appearance as an author with his lively account of a trip to Iceland which provided the Trust with a fine collection of Harlequins, Long-tailed Ducks and Scoters (p. 144).



Drake Colombian Torrent Duck
Merganetta armata colombiana



Salvadori's Duck *Anas waigiuensis*

SECTION I:
THE TRUST COLLECTIONS

STAFF:

S. T. Johnstone is Curator of the *Slimbridge Collection* and is assisted by six Wardens: M. Davy and Mrs. P. Hall (who share with the Curator the rearing of young birds) and L. de Bastyai, I. Fairbairn, M. W. Henchman and L. T. C. Shakespear. L. P. Alder is the gardener, with G. Huggins and J. Parsons as groundsmen. Mrs. S. T. Johnstone is in charge of the gate-hut and of sales, assisted by Miss J. Price and Mrs. E. Warren. Miss J. E. Overman is secretary to the Curator.

N. Dudley is Curator of the *Peakirk Collection* and is assisted by G. Cole and K. M. Crowson. Miss N. Hall is in charge of the gate-hut.

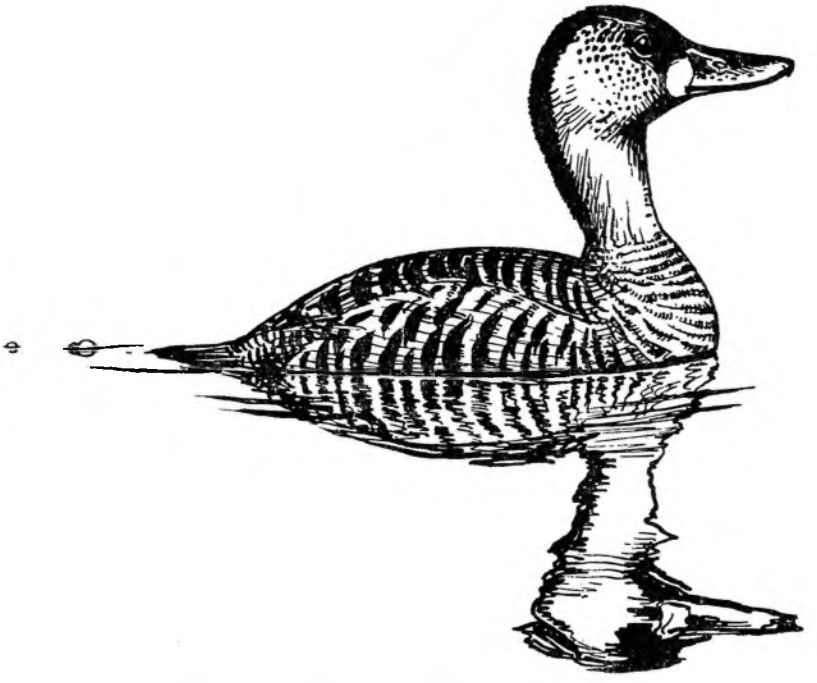
The senior members of the *Administrative staff* are the Secretary, E. A. Scholes, and the Bursar, H. G. Gower. D. Eccleston and C. M. Garside are assistant secretaries. Miss W. Young is in charge of the hostel, assisted by Mrs. H. Cobb.

THE development of the new piece of land at Slimbridge enclosed in November 1957 was completed in March 1959. Most of the new pens have already acquired quite a mature appearance and they add greatly to the attractiveness of the New Grounds. The lay-out of the whole area is illustrated by the map on the inside of the front cover.

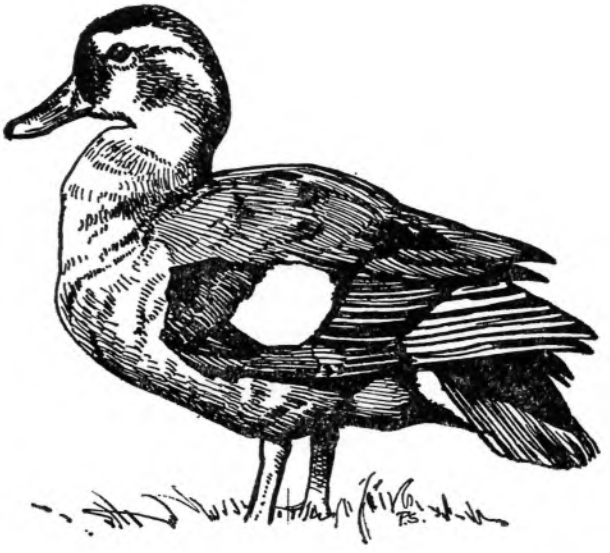
One of the problems of keeping a 'classified' collection grouped in separate pens (European, African, and so on) is to keep the pinioned birds where they belong. The multiplication of our pens, and of our visitors, created a need for devices enabling visitors to move readily through the collection without being constantly required to open and close gates. Several turnstiles and a variety of raised stiles alongside the gates on the roadway have been built, and in some cases rebuilt, and satisfactorily duck-proof patterns have been evolved. Full-winged birds (now more than 250, of 50 kinds, with up to 1500 wild additions) persist, of course, in making nonsense of the attempts at segregation, but the European Pen at least usually contains only what it claims to.

Several of the important additions to the collection at the end of 1958 which belong properly to the period covered by this Report (September 1958—August 1959) were mentioned in the Tenth Report. Of these, the Laysan Teal *Anas platyrhynchos laysanensis* and Australian White-eye *Aythya a. australis* claim repeated notice because, as recorded below, both bred in the summer of 1959, less than a year after arrival.

The principal additions in the first eight months of 1959 were a flock of Salvadori's Ducks *Anas waigiuensis,* brought from New Guinea by the Curator. We are greatly indebted to Sir Edward Hallstrom who not only made the birds available from his Collection at Nondugl but also contributed substantially towards the costs of flying them to England. Fifteen of these rare and little known ducks arrived at Slimbridge in May, 1959. Unfortunately they have proved difficult to establish and several died before the end of the year. They are shy and undemonstrative but it is greatly to be hoped that the survivors will acclimatise themselves. Though they have bred at Nondugl, the clutch size and incubation period are not recorded and, more important, no ethologist has yet seen their full sexual displays. Their taxonomic affinities are still far from certain and the information provided by a behaviour study is likely to be of decisive importance.



African Whitebacked Duck *Thalassornis leuconotus*



Female Ringed Teal *Anas leucophrys*

THE BREEDING SEASON 1959

S. T. Johnstone

Slimbridge

The ways of waterfowl are inscrutable. In 1959 we reared 140 cygnets and goslings and over 540 ducklings, substantial numbers, but 150 less than in the wet summer of 1958, despite the exceptionally fine weather. The difference was not due to increased difficulties in rearing, because in each year about 70% of all the young birds hatched were successfully reared, a proportion as great as would normally be found in the wild. But the number of eggs laid in 1959 was substantially less than in 1958, and only 46% of 1380 eggs set under hens or in incubators hatched, a disappointingly low figure due to low fertility and a large number of early embryonic deaths. It seems unlikely that there are any dramatically simple remedies awaiting discovery, but there is a pressing need for work on these problems in the avicultural field.

The most serious example of low fertility and hatchability continues to be that of the Hawaiian Goose. A slight improvement in fertility occurred in 1959, 47 of the 91 eggs laid (52%) being fertile. (In 1958 the fertility was 45%). But only 24 hatched, from which 21 were reared. The total stock originating from the three brought to Slimbridge in 1950 now stands at 99—77 at Slimbridge, 2 at Peakirk, the remainder dispersed in seven other collections in Europe and North America. If the fertility of these birds approached that of other species of geese we would have had several hundred by now, which would have created a housing shortage but a welcome kind of embarrassment. Unfortunately our efforts to return Ne-nes to Hawaii, for release in the wild or to supplement the captive breeding stock there, are still held up.

There were several exciting new breeding records, including Spotted Whistling Duck, Laysan Teal, Australian White-eye, Trumpeter Swan, Baikal Teal and Hooded Merganser. The first three had never, so far as we know, previously bred in captivity, though Laysan Teal were successfully raised simultaneously in America. The Trumpeter Swan laid two eggs, but to our dismay one failed to hatch and the other was taken by an unknown predator. The nesting of the Hooded Mergansers also ended in tragedy; five of the six eggs reached the pipping stage but no ducklings emerged.

Other notable breeders included Hartlaub's Duck which nested unsuccessfully last year but raised five young this time—the first ever reared in captivity; Bewick's Swan for the third year, Black Brant for the second time, both forms of Comb Duck, Barrow's and European Goldeneye and Red-breasted Mergansers.

Downy Spotted Whistling Duck
Dendrocygna guttata

First breeding of the Spotted Whistling Duck (*Dendrocygna guttata*)

Five Spotted Whistling Ducks live in one of the heated aviaries. Late in August a female began laying in a wooden kennel. She laid eleven eggs in all. The eggs (not described hitherto, according to Delacour, *Waterfowl of the World,* vol. i, p. 35, 1954) were dead white like those of other Whistling Ducks, but more ovate and of a finer texture. The average size of the eggs was 52 mm. x 38 mm. and their fresh weight 49 grams.

The eggs were left for the parents to incubate. But on the twenty-first day both birds were in the run and the eggs cold. A small electric incubator is kept running for such emergencies and the eggs, after candling for fertility, were transferred to it. After a further ten days, all eleven eggs hatched.

The young are dark brown with the characteristic head and neck markings of the genus. There are two bands of cream running down the back, instead of the spots found in all other species except *D. eytoni.*

The ducklings were transferred to a brooder heated by an infra-red lamp. They quickly became 'imprinted' on the hand of the person tending them and would climb on to it whenever the feeding dishes were moved. Young *Dendrocygna* are usually very wild so that this tameness was as remarkable as it was enchanting.

They were offered freshwater shrimp, minced egg, duckweed and maggots, but they did not feed well. Two died after three days and a third on the following day. A change in treatment was clearly essential. No broody hen was available as a foster-mother, so it was decided to try offering the ducklings to a female Cuban Whistling Duck *D. arborea* that was rearing three month-old hybrid offspring of her own in the aviary. The Cuban mother was shut in her hut and her babies removed to the brooder. The

surviving Spotted ducklings were then put in with her—and an infra-red lamp as a precautionary source of heat. The female made no immediate attempt to take care of the brood, but at least refrained from attacking them. When a visit was paid to the hut after three hours, the female reacted by calling the youngsters to her and she seemed to be teaching them to eat turkey starter crumbs. After twenty four hours the hut was opened and the family allowed out in the run. All seemed well, but a later inspection showed that the female had left the brood and was walking up and down the wire netting trying to get out. Six of the ducklings sat huddled together. One was dead and the eighth was prostrate. The six were shut up in the hut and the prostrate one returned to the incubator. After a few hours it had revived and was returned to the brood.

Five days later the foster mother had forgotten her own ducklings and had become greatly attached to her new family. The remaining seven ducklings were reared without further trouble. Feathering began at 27 days and was complete in seven weeks. It was surprising to be able to rear these tropical ducks in an English October and November.

Breeding of the Laysan Teal (*Anas platyrhynchos laysanensis*)

The pair of Laysan Teal sent to us by the U.S. Fish and Wildlife Service, which only arrived at Slimbridge in 1958, seemed happy and very tame. The female first laid a clutch of four relatively enormous Mallard-like eggs, which proved infertile, then she produced a second clutch of six. We gave three to a broody bantam and left three with the parent. After 26 days she hatched one ginger-coloured duckling that was soon killed by a weasel. The bantam also hatched one duckling and this, a male, was safely reared.

Breeding of Hartlaub's Duck (*Cairina h. hartlaubi*)

The pair of Hartlaub's Ducks that had produced three clutches, 24 eggs in all, in 1958, but failed to rear any ducklings that year, were successful in 1959. Early in the year they had been moved to one of the new aviaries, with more space than in their old quarters. It seemed that the move might have disturbed them, for no eggs were laid until the end of July, more than two months after the date of the first egg in 1958. A clutch of nine was laid. The average size of the eggs was 53 x 40 mm. and their fresh weight 51 grams.

In 1958 the female made no attempt to incubate, but this year she sat very persistently. She produced a vast quantity of pale grey down. Eight ducklings hatched after 32 days. The ducklings are brown with a black cap on the head, yellow underparts and yellow blotches on the wings and the sides of the back. There is a distinct eye stripe. The bill and the longish tarsus and feet are black.

Both parents were very aggressive in defence of their brood. The ducklings began to feather at 28 days, and were fully-feathered at eight weeks. The five ducklings which survived were then separated from their parents because of the bellicose intentions of the male towards his offspring.

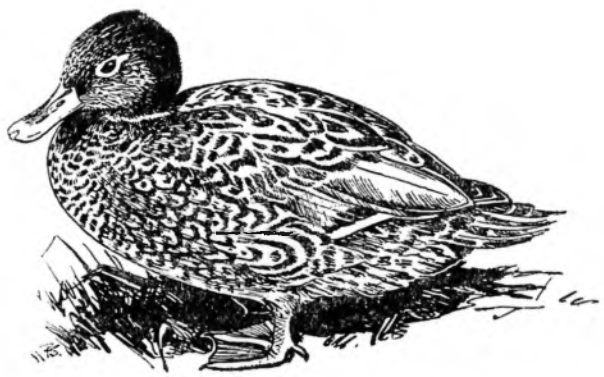
In contrast to the juvenile plumage of the related Comb Duck, which is mottled and quite different from the adults, the first plumage of young Hartlaub's Ducks is hardly different from the black head and chestnut body of their parents.

BREEDING ANALYSIS 1959—SLIMBRIDGE

ENTRIES in the column "reared by parents" are additional to those in "reared artificially." In many cases the numbers of eggs laid, and lost, by females left to incubate are not known; for uniformity no details of eggs laid are given under "reared by parents." Hybrids are omitted.

Species and race	reared artificially			reared by parents
	eggs set	hatched	reared	
Magpie Goose	8	1	1	7
Spotted Whistling Duck	11	11	7	
Wandering Whistling Duck	8	1	1	
Fulvous Whistling Duck	58	50	13	20
Cuban Whistling Duck	14	2	2	7
Red-billed Whistling Duck	12	2	2	10
Black Swan				5
Black-necked Swan				1
Bewick's Swan	5	0		2
Trumpeter Swan	2	0		
Swan Goose	9	3	3	
Pink-footed Goose	4	0		
European White-fronted Goose	6	1	0	
Greenland White-fronted Goose	16	0		
Lesser White-fronted Goose	6	3	3	
Western Greylag Goose	22	16	12	8
Bar-headed Goose	31	6	2	
Emperor Goose	31	11	3	
Lesser Snow/Blue Goose	17	7	4	
Greater Snow Goose	16	6	4	
Ross's Goose	17	8	8	
Great Basin Canada Goose	9	5	5	
Taverner's Canada Goose				3
Dusky Canada Goose	14	8	8	2
Cackling Canada Goose	1	0		
Hawaiian Goose	91	24	21	
Barnacle Goose	30	17	17	
Black Brant	7	4	3	
Red-breasted Goose	18	13	5	
Cape Shelduck				6
New Zealand Shelduck	2	0		
Common Shelduck	12	12	12	
Egyptian Goose	14	0		
Orinoco Goose	20	3	1	
Abyssinian Blue-winged Goose	9	3	1	
Ashy-headed Goose	17	14	11	
Ruddy-headed Goose	4	0		
Lesser Magellan Goose	12	6	2	
Greater Magellan Goose				5
Cereopsis				3
Andean Crested Duck	14	6	2	
Bronze-winged Duck	6	0		
Marbled Teal	21	13	13	
Cape Teal	15	9	9	4
Silver Teal	44	14	4	
Puna Teal	5	0		
Bahama Pintail	16	14	9	
Northern Pintail	11	7	2	
Chilean Teal	8	0		
Baikal Teal	6	5	2	
Falcated Teal	2	0		
Australian Grey Teal	6	0		
Chestnut-breasted Teal	32	26	26	5
Hawaiian Duck	7	3	2	
Laysan Teal	10	2	1	
N. American Black Duck	12	7	5	
Indian Spotbill	7	5	0	
Chinese Spotbill	18	18	15	

Species and race	reared artificially eggs set	hatched	reared	reared by parents
Australian Black Duck	9	0		7
Philippine Duck	29	16	14	
African Black Duck	25	13	9	
Gadwall	20	16	16	
European Wigeon	8	8	6	
American Wigeon	17	8	8	
Chiloe Wigeon	23	5	3	5
Blue-winged Teal	1	0		
Cinnamon Teal	42	31	15	
Red Shoveler	7	3	0	
Cape Shoveler	10	7	1	
Common Shoveler	16	14	5	
Ringed Teal	40	23	17	7
European Eider	12	6	5	
Red-creasted Pochard	71	32	28	2
Rosy-bill	11	4	2	
Southern Pochard	15	12	12	
Canvasback	7	7	0	
European Pochard	6	6	6	
Redhead	32	13	5	
Common White-eye	30	22	20	2
Australian White-eye	8	7	7	3
New Zealand Scaup	16	6	4	
Lesser Scaup	24	13	10	
European Greater Scaup	8	3	3	
Brazilian Teal	6	0		
Mandarin Duck	23	11	9	
N. American Wood Duck			66	
Comb Duck	6	0		
S. American Comb Duck	6	4	4	
Hartlaub's Duck				5
Spur-winged Goose	8	0		
Barrow's Goldeneye	15	6	3	
European Goldeneye	21	11	2	
Hooded Merganser	6	0		
Red-breasted Merganser	9	3	2	
N. American Ruddy Duck				over 30



Laysan Teal *Anas wyvilliana laysanensis*
Immature male reared at the Trust

BREEDING ANALYSIS 1959—PEAKIRK

Species	No. of breeding pairs	Date of first egg	No. of eggs	Hatched	Reared
Fulvous Whistling Duck	2	18.5	30	—	—
Swan Goose	1	10.4	10	6	3
European White-fronted Goose	–	25.4	10	—	—
Lesser White-fronted Goose	1	19.4	3	—	—
Western Greylag Goose	1	24.3	7	7	7*
Eastern Greylag Goose	3	10.3	18	3	3*
Barheaded Goose	1	25.4	12	2	1
Emperor Goose	–	11.5	25	—	—
Blue Snow Goose	1	7.5	5	2	—
Greater Snow Goose	–	8.5	5	1	1
Ross's Snow Goose	1	14.5	3	—	—
Lesser Canada Goose	1	30.4	7	1	1
Dusky Canada Goose	1	3.5	5	2	—
Hawaiian Goose	1	17.3	3	2	1
Barnacle Goose	3	7.5	15	—	—
Cape Shelduck	1	20.2	7	5	5
Common Shelduck	2	5.4	11	9	9
Egyptian Goose	1	19.2	5	3	3*
Ashy-headed Goose	1	18.4	5	1	—
Lesser Magellan Goose	1	30.4	1	1	1
Greater Magellan Goose	1	24.3	12	2	1
Marbled Teal	1	25.4	4	4	4
Cape Teal	3	11.5	29	20	12
Puna Teal	1	4.4	4	2	2
Bahama Pintail	6	13.5	45	31	31
Pintail	1	13.5	4	—	—
Chile Teal	3	14.3	22	13	10
Chestnut-breasted Teal	2	30.3	11	9	9
North American Black Duck	1	10.4	20	10	10
Hawaiian Duck	1	19.4	5	—	—
Chinese Spotbill	1	12.4	27	12	12
New Zealand Grey Duck	1	12.5	7	6	4
Philippine Duck	4	10.5	25	7	5
African Black Duck	1	27.2	5	3	3
Gadwall	2	30.4	14	12	10
European Wigeon	–	25.5	14	—	—
American Wigeon	1	25.5	7	1	—
Chiloe Wigeon	1	13.5	10	—	—
Cinnamon Teal	4	20.4	33	22	13
Garganey	3	1.5	23	19	13
Cape Shoveler	1	21.8	9	—	—
Common Shoveler	1	1.5	9	6	3
Ringed Teal	1	1.7	3	3	2
Red-creasted Pochard	8	4.4	43	17	16
Rosybill	3	9.5	26	20	20
Redhead	1	11.5	9	3	2
Common White-eye	1	3.5	6	4	4
Tufted Duck	1	9.5	7	—	—
European Greater Scaup	1	12.6	5	—	—
Mandarin	6	3.5	15	20	14
Carolina	7	20.3	228	119	75
North American Ruddy Duck	2	15.6	14	12	6*

* reared by parents

VISITORS TO THE COLLECTIONS

THE promotion of public interest in wildfowl is one of the main objects of the Trust. The two Collections are our most important means of arousing and maintaining interest. The most direct measure of their success is provided by the numbers of people visiting Slimbridge and Peakirk each year. The graph of Figure 1 records these numbers. Exact figures were not compiled before 1957 so that the earlier part of the Slimbridge curve is only approximately correct—and even rough estimates seem to be lacking for 1950 and 1952. Peakirk was not opened until April 1957.

It appears that after the great surge in the number of visitors to Slimbridge from 1954 to 1956 the Collection is now established in the public mind as a rural attraction the popularity of which will vary from year to year with changes in the weather and other factors such as transport facilities, or for no obvious reasons, as happens at other zoos, or great country houses, or museums. We can never hope to attract nearly two million people a year as London Zoo now does and even Whipsnade's 600,000 might be difficult to satisfy, but it ought to be possible to increase our visitors to nearly twice their present level. Figure 2, which compares the numbers of visitors each month in the last three years at Slimbridge and at Peakirk, suggests how this might be attempted.

At present the busiest month at Slimbridge is August, although the largest daily numbers have been during the Whitsun holidays. At Peakirk the August peak is much less marked. The difference seems likely to be due to the large number of people who come to Slimbridge on passage to holiday resorts in the south-west, Peakirk not being close to such a stream. The sad fact is that July and August are the worst months to look at waterfowl, since most of the birds are miserably moulting or in ' eclipse,' so that if visitors are to be favourably impressed they must be encouraged to come at other times. The birds are at their most beautiful and entertaining on mild winter days. Such days will not occur at week-ends as often as we would wish, but efforts must be made to persuade potential visitors that the winter is more rewarding than the summer. A campaign to establish a winter-visiting tradition will stand a much greater chance of success if better facilities, such as shelters and a restaurant, can be provided to offset the discomforts of promenading on a typical winter's day.

From the attendance figures Peakirk appears to have made little progress in the last two years (thanks to the first flush of visitors after the opening) but closer inspection of Figure 2 shows that a significant improvement took place during 1959 and it is reasonable to suppose that an upward trend should continue for several years yet. It may be even harder to increase winter visiting here than at Slimbridge since it lacks the lure of wild geese in the immediate vicinity.

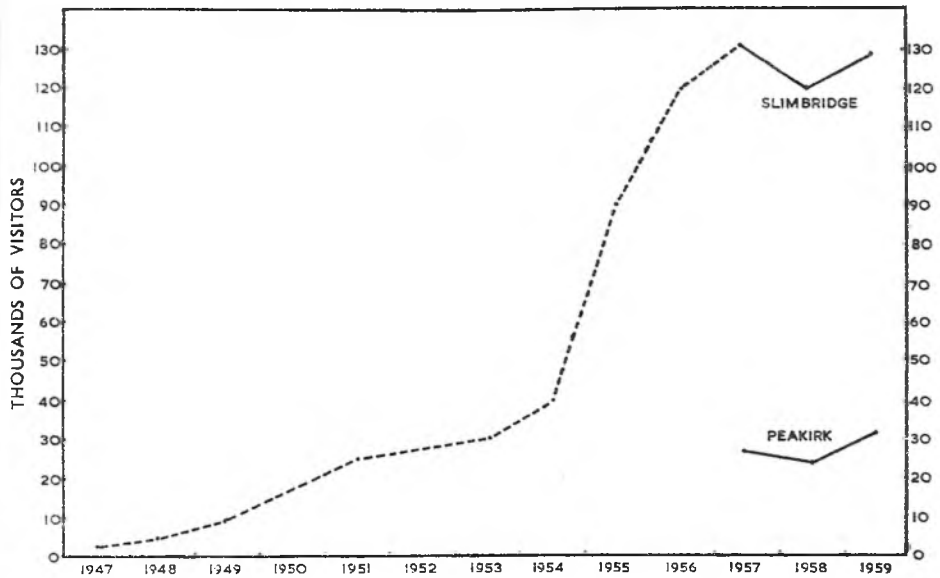


FIGURE 1

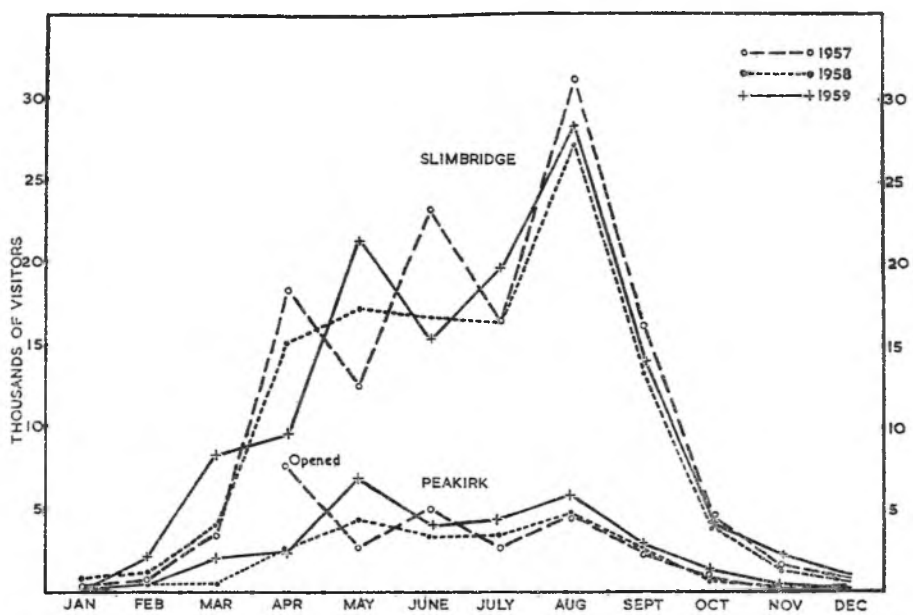


FIGURE 2

SECTION II: TRUST RESEARCH 1958-59

Dr. G. V. T. Matthews, Assistant Director (Research) is in charge of the *Research Unit*. His principal research interests are in the experimental study of migration and navigation. H. Boyd, Senior Biologist, is responsible for ringing and population studies, other than the national Wildfowl Count scheme, organised by G. L. Atkinson-Willes. J. V. Beer works chiefly on pathology and photography. Dr. S. K. Eltringham is biologist-pilot. P. J. S. Olney conducts research on wildfowl foods. Dr. Janet Kear (appointed October, 1959) will work on feeding behaviour. Miss E. Temple Carrington is secretary to the unit. N. Phillips is laboratory assistant. W. A. Cook operates Borough Fen Decoy.

WILD GEESE AT THE NEW GROUNDS, 1958-59

European White-fronted Goose *Anser albifrons albifrons*

The first autumn record was of three on 28th September, 1958. Numbers increased slowly through October to 170 on 31st. There were rather fewer in November. An influx early in December brought the total to over 700 on the 9th. It remained at that level until after Christmas, then rose to 920 on 28th and 1200 on 29th December. No major change was then seen until early February, when numbers rose to 3200 on 5th, 3700 on 6th and by 14th reached 5000. This peak was not long sustained and by the end of February only about 3000 were present. During March gradual dwindling occurred

until 1000 were left on 21st. The great majority of these departed on the night of 21st and the remainder on the bright moonlit night of 22nd.

1958 seems to have been the worst breeding season for this Whitefront population for many years. The small flock in October included only 12% young birds; in December this rose very slightly to 13.6%, with a mean brood size of only 2.5, only 15% of the geese in adult plumage being parents. As the two previous years had been good for breeding this small proportion of parents was obviously due to the presence of many pre-breeders as well as to poor breeding success. In mid-February, when the flock was at a maximum, only 7.2% were first-winter birds, and the mean brood-size had dropped to 2.2.

After a late start due to the unsuitable condition of the ground, the first week of March was devoted to rocket-netting. Only one catch was made, but this was of 129 birds, the most of this species yet caught at one time. There were only 10 first-winter birds. The catch included four geese previously ringed at Slimbridge, in February 1958. Subsequently, in a week's intensive watch, 44 rings from the 1959 catch and 19 from 1958 were read, producing useful data on pair and family groupings. The Dutch are now ringing substantial numbers of Whitefronts and six of their birds were distinguished, the ring numbers of four being read. (See photograph on p. 170).

Four of the geese ringed on 9th March, 1959 were recovered within a few weeks. SWT 337 was found dead on 19th March near Assal, Niedersachsen, Germany (53°41′N, 9°26′E); 1007398 was shot on or about 30th March at Petkum, near Emden, also in Niedersachsen; SWT 364 was shot on 30th March at Borycz, Poland (51°12′N, 20°23′E); and SWT 370 was reported on 17th April from Chluderia, Poland (53°10′N, 22°00′E). These were the first recoveries we had had for five years in the period March—mid-April. They give a rather different impression of the earlier stages of the spring migration. The confirmation that our geese actually do stop in Poland is particularly valuable, though it is remarkable that it has taken seven years to obtain our first Polish recoveries. Does this imply that the kill in Poland is normally small, or has there hitherto been a disinclination to report rings?

Greenland White-fronted Goose *Anser albifrons flavirostris*

A first-winter bird, wearing a ring, was seen on 14th and 16th March, 1959. On the first occasion the observer (G. V. T. Matthews) was able to read the address on the ring—Zool. Museum, Copenhagen, Denmark—and the number 271698. Dr. Finn Salomonsen has told us that this was marked as a gosling at Sarqaq, Nugssuaq Peninsula, Jakobshavn District, N.W. Greenland (70°06′N, 52°08′W) on 1st August, 1958.

From 4th to 13th April, 1959 a single *flavirostris* accompanying a Lesser White-fronted Goose was seen in the area. This was definitely a second bird, having no ring.

Lesser White-fronted Goose *Anser erythropus*

At least two adults present in the late winter: one seen at times from 14th to 27th February, the second from 15th February to 21st March, 1959.

This bird, a male, was apparently paired to an European White-front female. One, with a Greenland White-front, present from 4th to 13th April, 1959 was not certainly identified as either of these individuals.

In November, 1958, a full-winged adult from the collection joined the wild White-fronts for several weeks, but it eventually returned to the pens. [It has now been recaptured and pinioned].

Pink-footed Goose *Anser brachyrhynchus*

Six seen on 27th September, 1958 were the first in autumn. From 12th October further arrivals increased the total to a maximum of 42 on 18th. The autumn flock was not seen after 10th November, but a few small groups appeared later and flocks of 92 and 61 were seen on 30th and 31st December respectively. 45 were present on 3rd January, but thereafter only one was noted. This stayed until 19th March.

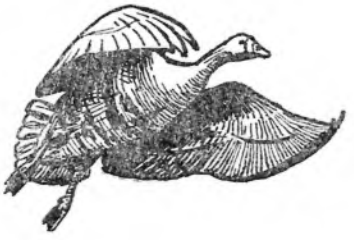
The autumn flock of 42 included 18 juveniles (43%) in 8 broods, 16 of the 24 birds in adult plumage being parents. No ringed birds were noticed. The transient flocks in late December and January were not examined critically.

[**Barnacle Goose** *Branta leucopsis*

Several were seen with the White-fronts at various times, but so far as could be made out all were full-winged birds from the collection].

Red-breasted Goose *Branta ruficollis*

An adult male was seen many times, between 24th January and 13th March, 1959. Two photographs appear on p. 169. This is the third to have been found at Slimbridge, and the sixteenth in Britain.



RINGING 1958-59

Duck Ringing

There were no major changes in the pattern of ringing, most of which continued to be done at the Trust Decoys at Slimbridge and Peakirk and the permanent trapping station at Abberton. The numbers ringed are recorded in Table I. The grand total of 4087 was substantially smaller than in the previous season, due chiefly to reductions of 1389 in the Teal caught at Abberton and of 997 in the Mallard caught at Slimbridge. These big changes show only too clearly that sustained catching efforts do not inevitably yield large catches, seasonal differences in the numbers of ducks available being of decisive importance.

Abberton, Essex — cage traps, operated by Major-General C. B. Wainwright, C.B., assisted by R. King.

This station has been the principal site of British Teal ringing since 1950. Large fluctuations in the Teal catch from year to year are normal. The decline in the number of Wigeon ringed, from 111 to 8, is notable, but less so than the increase in Shelduck from 7 to 37. The Shelduck shows signs of spreading inland in England, as it has recently done in Denmark, and Abberton is probably the most favoured inland locality at present. The history of these ringed birds promises to be unusually interesting.

Borough Fen Decoy, Northants — The decoyman W. A. Cook reports: The season opened on 20th August with a catch of 12 in the East pipe. During the summer three pipes had been completely rebuilt with metal hoops, four pipes were repaired with willow hoops and one pipe, the South, was left in an unworkable condition.

Of the new pipes, the East was disappointing in that the ducks were difficult to drive and frequently flushed out into the pond when shown over. On one occasion 35 were dogged into the pipe but only 6 captured, though the wind was S.E. and moderate. This reluctance was probably due to large trees on the left of and opposite the small end of the pipe.

The South East pipe, also of metal construction, was very successful and over 30% of the total catch were inveigled into this pipe. The dimensions of the S.E. pipe are: length 157 ft., width at mouth 24 ft., height at mouth 12½ ft. — this is about 2½ ft. higher than the original pipes built with wooden hoops.

TABLE I

Ducks Ringed 1958-59

	Abberton	Slimbridge	Borough Fen	Deeping Lake	Other Stations	Total
Shelduck ..	37	1	—	—	—	38
Pintail	—	4	—	10	1	15
Teal	751	7	145	33	176	1112
Mallard	277	647	1712	8	61	2705
Gadwall	2	—	—	8	—	10
Wigeon	8	—	1	17	—	26
Garganey ..	10	—	—	—	—	10
Shoveler	20	—	8	2	21	51
Pochard	3	—	—	24	—	27
Tufted Duck ..	2	—	—	56	1	59
Eider	—	—	—	—	34	34
Total 1958-59 ..	1110	659	1866	158	294	4087
Total 1957-58 ..	*2897*	*1704*	*1467*	*82*	*272*	*6422*

In April, 1958, I acquired a puppy to train as a decoy dog. He is of doubtful ancestry and has been called a Peakirk Terrier for want of a more definite pedigree. I have named him Piper, the traditional name for a decoy dog. He is foxy in appearance with white feet and a white tip to his collie-like tail. The existing decoy dog, Bob, trained by the late Billy Williams, was a black Labrador which I felt was too big for the job. The theory was that Piper, looking like a natural predator, a fox, would induce more ducks into the pipes. I actually tried Bob and Piper under identical conditions and while the ducks followed Piper well into the pipe they failed to follow Bob more than two hoops down.

Piper was first worked 2nd September and 14 ducks were caught as the result of his efforts. The number of duck on the pond built up to a peak of 1,800—2,000 from 12th September to 14th October and then slowly receded, reaching a semi-resident population of about 500 until the frost in early January. The hard spell started 4th January. The ice was broken each morning and I fed the West pipe in a lead of clear water 20 yards into the pond. This resulted in three catches of 5, 29 and 30. After 8th January the ice was two inches thick and the ducks had left for the open gravel pits and river. The hard frosts continued until 10th February when the ice was practically solid—I chipped a hole in the centre of the pond and measured five inches of ice. There was very little rain and no wind during the next two weeks and the ice was still present up to 24th February, by which time most of the migratory ducks had moved away. The total catch of 103 during February and March made a disappointing finale to the season, in which altogether 1866 ducks were caught.

Recaptures in 1958/59 totalled 181, including one Slimbridge-ringed bird 944906—ringed 19.12.57; one Abberton—940116—ringed 17.9.57; one Belgian—2H5083—ringed Meetkerke, near Bruges, 51.14N, 3.09E, on 28.7.57; one Finnish—H26158—ringed Pori, S.W. Finland, 61.30N, 21.45E, on 14.8.58; and one hand-reared bird carrying a W.A.G.B.I. ring.

Of the 181 recaptured 15 were caught twice after being ringed and 7 caught three times. 2 ducks were caught and ringed before lunch and recaptured feeding later the same day. On 4th November 4 Mallard were recaptured in the West pipe having been ringed at that pipe the previous afternoon.

Seasons in which recaptured ducks were first ringed at Peakirk

	1958/59	1957/58	1956/57	1955/56	1954/55	Total
1958 Sept.	13	1	–	–	–	14
,, Oct.	24	5	–	–	–	29
,, Nov.	49	9	–	–	–	58
,, Dec.	34	6	1	–	–	41
1959 Jan.	17	2	–	–	–	19
,, Feb.	3	1	–	–	1	5
,, Mar.	11	1	2	–	1	15
Total ..	151	25	3	0	2	181

The absence of recaptures of birds ringed during 1955/56 is probably due to the small number (352) ringed that year.

A good hide is necessary to enable one to see into all the pipes A site was selected on the point between the North and North East pipes and a Canadian-type log hut was built. This was near the site of an earlier hide built by Mr. Scott in 1932. The advantages of this position are that the prevailing S.W. wind enables it to be approached safely on more days than any other, and that it is possible to see into five of the eight pipes.

Much of the thick undergrowth was cut away from the East and South-West pipes, 170 big trees being cut and moved from the decoy. Many of the poplars were over 90 feet high and the trunks contained 240 cubic feet of timber. A large number, however, were hollow and their limbs rotten. No doubt many of these trees would have crashed to the ground during the next few years had they not been felled. Much of the elder and hazel on the points between the pipes was thinned and cut down to 3 or 4 feet. Before cutting this growth the pond appeared to be surrounded by a solid green wall 30 feet high. Now the pond looks much bigger I hope the ducks will feel safer, resulting in easier and bigger catches. Unfortunately it has not been possible to complete the removal of all the timber which has had to be felled in order to improve the duck-catching efficiency, so that the decoy will not be looking its best until after next summer.

The South pipe was built with metal hoops of similar dimensions to the South East pipe built in 1958. This South pipe has been a good Teal pipe in the past, probably due to the position of the reed bed. The Teal still winter in the district in quantity though I am at a loss to think why they ceased to frequent the decoy pond in catchable numbers.

Deeping Lake, Lincs. — operated by D. Dandridge.

Though the catch here was numerically small it was again of remarkable diversity. The traps could not be used for long periods. because Mr. Dandridge was ill, so that the doubling of the previous season's catch to a total of 158, of 8 duck species, was a satisfactory achievement.

Berkeley New Decoy, Slimbridge — operated by divers persons.

The Slimbridge ringing figures are disappointingly low. The most interesting development of catching technique here was the use of a stuffed fox and stuffed stoats as substitutes for a decoy dog. The models were quite effective, but further experiments are needed. They have the advantage of being usable by anyone, whereas a dog usually only works well for one person.

Orielton Decoy, Pembroke — operated by R. M. Lockley and R. Greenslade.

The number of ducks using the Decoy continued to be small in comparison with its former abundance. The most notable event of the season was the use of the last of the historic series of Orielton rings, made before the war.

Newburgh, Aberdeenshire — Miss E. A. Garden reports:

Early in 1958 two Abberton-type traps were placed at the Meikle Loch of Slains. During the autumn the shooting tenant complained that one trap

interfered with the shooting, so it has now been re-erected in a slightly different position. The other trap was not a success, being wrongly sited. It only caught one Teal and several Coots. Towards the end of the year it was moved to the Cotehill Loch and during November and the first few days of December four Teal and five Mallard were caught, one Mallard drake coming to the trap every day for a week. I then had to abandon trapping for the rest of the season. In 1959-60 I hope the traps at the Meikle and Cotehill Lochs will produce better results. Another trap is being put up at the shallow pools at the north end of Forvie Moor, which is a very good place for Teal.

A large tidal trap on the Ythan estuary near the mill at Newburgh only caught 5 Mallard. Despite baiting with both grain and mussels no Eiders were caught. It was therefore moved further upstream, to the island Inch Geck, where I hope it will catch Wigeon.

The floating Eider trap, which started off quite well in 1957, failed completely in 1958-59. I am at a loss to understand the reason for this. 26 Eiders were caught by rocket net, in an experimental firing by the Trust netting team early in October, when large numbers frequent the estuary.

The total number of wildfowl ringed in the district in 1958-59 was 55, comprising 6 Mute Swans, 34 Eiders, 10 Mallard and 5 Teal. The Teal produced two interesting recoveries: a female ringed 25th September, 1958 was shot on 15th January, 1959 on the Downpatrick Marshes, N. Ireland; and a male ringed on 29th October, 1958 was killed at Grand Couronne, Seine-Maritime, northern France, on 21st February, 1959. One of the Mute Swans was found dead at the Loch of Strathbeg, 25 miles north, a year after ringing. One Mallard was shot locally.

Abbotsbury, Dorset

The ancient and well-known decoy at Abbotsbury, operated by Mr. Fred Lexster for the Earl of Ilchester, is not a Trust responsibility, but the ducks caught in late winter are marked with Trust rings, continuing the tradition of ringing at Abbotsbury begun in 1937. The numbers marked at Abbotsbury have never been large, but have yielded some remarkable recoveries.

Other duck ringing

Small numbers of Mallard were ringed in Cheshire, by Mr. R. C. Green; in Somerset; and in Sutherland. Twenty young Shovelers were marked on the shore of Loch Lomond, Dunbartonshire, in May 1959. Mr. E. A. Maxwell plans to develop a ringing station near Loch Lomond.

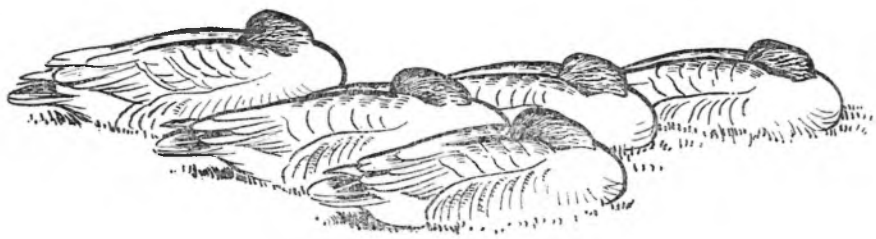
No ringing was possible at **Ludham**, Norfolk in 1958-59.

Goose Ringing

The Pinkfoot-netting expedition in October 1958 yielded a total catch of 2167 in ten firings. Though over a thousand fewer than the record catch of 1957 this was the second largest annual sample yet obtained. The recovery-rate of Pinkfoot rings has been lower in recent years than in the early part of the study, largely because ringed geese are no longer novelties, but recoveries and recaptures together are providing an instructive picture of the

continuous changes in distribution in Britain in winter, as well as data on annual survival.

A week after the nets had been laid in a field near the Trust headquarters, a catch of 129 Whitefronts was made on 9th March, 1959. This was our biggest catch of Whitefronts, which are more difficult to concentrate in a small area than are Pinkfeet (record catch 490) or Greylags (218). Four geese ringed at Slimbridge a year earlier were recaptured, but no Dutch-ringed ones were caught though six were seen during the winter.



Pinkfeet

Swan Ringing

161 Mute Swans were ringed at Abberton during the season, half of them in two nights in August—using a brilliant spotlight to dazzle the birds. Most of the others were caught by day in the reed beds. In the autumn many of the Abberton swans were affected by a helminth infestation coupled with a food shortage and their later history promises to be of unusual interest.

Small numbers of Mute Swans were also ringed in Gloucestershire, Somerset and Aberdeenshire. Our concern has been to develop a method of large-scale capture suitable for use on major concentrations, to supplement the marking of families and small groups which is being done by several B.T.O. registered ringers in various parts of the country. The use of lights at night showed promise but is not satisfactory since it requires a powerful boat (which must be large enough to produce transport problems), is unsuitable for work in estuaries and attracts public attention in an undesirable way.

AERIAL SURVEYS

THE first full season of aerial surveys conducted by the Wildfowl Trust was 1957-58. Much of the flying was exploratory and a large part of the funds set aside for this project was spent in visiting Canada to observe the aerial surveys carried out there by the U.S. Fish and Wildlife Service. With this experience behind us we hoped to establish the practicability of aerial surveys in this country on a firm basis in 1958-59. Unfortunately our efforts were seriously curtailed in the winter by the exceptional sequence of bad weather which allowed flying on only 50 of 151 days between November and March. However, about 158 flying hours were spent on survey in the twelve months from September 1958 to August 1959—a satisfactory total considering that flying did not begin until the end of November. The time was divided between a number of surveys which are considered in more detail below.

The first task attempted was a census of the wintering population of Greylag Geese in Scotland which required nearly 20 hours flying in November, 1958. This was followed by a survey of Barnacles and Brents in Ireland during March, 1959 taking 27½ flying hours. A shorter flight to count the Brents on the east coast of England in February, 1959 utilised another 4½ hours. A further Greylag survey was made in the early summer, but this time we were interested in the size of the breeding population of resident geese in mainland Scotland. The survey, flown in May and June 1959, took about 28 flying hours.

The rest of the flying was carried out from our home base at Staverton Airport near Gloucester with an Auster VD of the Cotswold Aero Club. Much of this flying has been concerned with a study of the population of Shelduck in Bridgwater Bay which is the only known moulting area used by substantial numbers in this country. Up to the end of November 1959 twenty flights (totalling nearly 44 hours) had been made over the Bay. These surveys were not devoted exclusively to Shelduck and other commitments were fulfilled during the flights.

Details of Aerial Surveys flown

Greylags

The results of the Greylag survey flown in November 1958 were published in the last Annual Report (H. Boyd. 1959. Greylag Geese in Britain in Winter. *W.T. 10th Annual Report*: 43-58) though more properly the study falls into the period covered by this report. The beginning of the survey coincided with the onset of foggy weather and it proved impossible to fly our aircraft from Bristol to Scotland where the survey was to begin. Consequently a last minute change of plan was made and we completed the survey with an aircraft hired from Airwork Ltd., at Perth. Flying conditions in Scotland were good but the fog persisted for most of the time in England. This and other experiences later in the winter have convinced us that the best policy is to hire an aircraft as close to the centre of operations as possible.

The same aircraft, an Auster Aiglet, was used for the summer survey. This survey, which is described elsewhere in this report (pp. 103-106) took us over the Highlands of Sutherland and Ross and Cromarty and into

Caithness. Most of the flights were made from Inverness (Dalcross) Airport, which is the nearest airfield to the N.W. Highlands. A base on the West Coast would have been most useful, especially on those days when we were unable to cross over from the east because of cloud covering the high ground.

Barnacles

The Irish survey of Barnacles was made with an aircraft and pilot hired from Skycraft Services Ltd., Dublin, as it proved impracticable to fly an aircraft over from England. The survey, from 3rd to 15th March, 1959, took 27½ flying hours and covered the coast between Down and Waterford as well as much of the coast and most of the islands of Galway, Mayo and North Donegal. Although incomplete (2330 Barnacles were seen in 12 places) the survey was of great value in paving the way for further work in Ireland, in particular a census of Barnacle Geese in December, 1959.

Brents

Sixteen of the twenty-two known haunts of the Pale-bellied Brent in Ireland were visited during the survey described above, and small flocks were seen in two places where Brent had not previously been reported. The number of birds seen was 970, neither of the two major wintering places (Tralee Bay and Strangford Lough) being searched.

The single survey of the Dark-bellied Brent in eastern England was made after four plans for earlier flights had had to be abandoned because of bad weather. These surveys can only be made at week-ends, when the several military firing ranges in the search areas are inactive, and this restriction further reduces the chance of completing a successful census. The main areas searched lie between Ipswich and Southend in Essex and along the coast of Lincolnshire and Norfolk from Skegness to Blakeney Harbour. On an earlier attempt at the survey we flew from Staverton to Ipswich, only to be confronted next day with misty weather which continued for 15 days during which the visibility did not lift above a mile. This, together with low cloud, effectively prevented the survey as well as a return to Staverton. Subsequent surveys have been made with aircraft hired from Ipswich and Skegness Flying Clubs. On 21st and 23rd February, 1959, 7200 Brent were found along the shore from Southend to Skegness.

Shelduck

As the Bridgwater Bay moulting area is almost on our doorstep we have taken the opportunity of investigating the number of birds found there and in contiguous areas of the Bristol Channel during the moulting period. The results of our first season's work, which showed a maximum of 3300 birds in early September, are discussed elsewhere in this report (pp. 107-117). They have revealed some interesting features calling for further investigation. The ease with which routine flights can be made over the area has shown that an aircraft is the most efficient tool for tackling this type of problem.

Miscellaneous Flights

We had hoped to develop a technique for investigating the breeding population of ducks through a transect system similar to that employed in North America. However, it became apparent after a few flights in Shropshire, Gloucestershire and Somerset that the density of ducks was much too low or their distribution too discontinuous to permit the use of this sampling method, which requires a fairly uniformly distributed population.

Another promising use of aerial survey seemed to be flights up and down the course of rivers (which are not adequately represented in the 'waters' of the National Wildfowl Count Scheme). Test flights were made not only to collect information on distribution but also to test our consistency in returning similar figures for the two legs of the flight. For the latter purpose they were extremely helpful. But the use of rivers by ducks was found to be so limited that sampling extensive enough to add a useful amount of information to the Counts would be disproportionately expensive.

Duck counts on reservoirs were found to be a more difficult proposition. With practice, some progress has been made, particularly in counting breeding ducks on the North Somerset reservoirs. These surveys, made during the Shelduck flights, were compared with counts from the ground, usually made on the next day. The ground/air comparisons showed good enough agreement to justify the belief that this type of aerial survey is valuable in areas where ground counts are not available. Counts of ducks on heavily-populated lakes and reservoirs outside the breeding season give a fair picture of the total numbers present but are, not surprisingly, less reliable for individual species than thorough counts from the ground. On some large estuaries, however, aerial counts are better in both respects.

Finally we have used an aircraft for a limited number of photographic sorties to test equipment and films and on one occasion to get a 'goose's-eye' view of the Dumbles for a film which is being made about our local Whitefronts. Our experience has shown very clearly that in British conditions photographic recording of wildfowl numbers is so difficult and unreliable that it must be subordinated to direct observation.

WILDFOWL FOOD RESEARCH

P. J. S. Olney

THAT there is some sort of relationship between population size and density and the quality and quantity of food available and consumed is obvious, but the extent of this relationship is rarely known and then only when a detailed study of a particular species has been made. For most conservation work it is of fundamental importance to know how far food can be a limiting factor.

Since 1957 the Wildfowl Trust has been carrying out a study of the food and feeding habits of various British wildfowl. This report is a summary of the work involved up to date. Some of the problems entailed in a study of this sort have already been reviewed in previous papers (*Wildfowl Trust Ninth Annual Report*, pp. 47-51, 1958; and *Bull. B.O.C.* 80, pp. 33-5, 1960). Most of the work has been based on stomach analyses and field observations, correlated where possible with floral and faunal surveys of the areas involved. Approximately 1500 viscera have been received for analysis since the scheme began in 1957. These have been collected by clubs affiliated to the Wildfowling Association of Great Britain and Ireland and by a number of individuals. Instructions as to the removal and preservation of the viscera, since described by Harrison (p. 135 of this Report), were sent to each collector. As the viscera were received at the Trust a standard procedure was adopted. They were numbered in sequence by areas and their particulars entered on a record card. The contents of the oesophagus, proventriculus and gizzard were then removed and sorted into inorganic and organic material, the volume of each being expressed as a percentage of the total volume. The organic material was then separated into plant and animal food and where possible each specific item was expressed as a percentage of the total organic volume. Any item of less than 0.05 ml. was referred to as a trace only. The number of each species was also recorded. As far as possible each item was identified to specific level. With some of the material this was not always feasible, either because digestion had proceeded too far or because diagnostic keys are not yet available.

It should be emphasised that this survey was only possible during the shooting season (between 1st September and 31st January inland, extending to 20th February on the foreshore) on birds not on the protected list, and it must therefore be accepted as incomplete.

The three most commonly shot duck in this country, the Mallard (*Anas p. platyrhynchos*), Teal (*Anas c. crecca*) and Wigeon (*Anas penelope*) have provided the main bulk of the material. For these three species 476, 440 and 387 viscera have been collected. Much smaller numbers of Pintail (*Anas a. acuta*), Shoveler (*Anas clypeata*), Tufted Duck (*Aythya fuligula*) and Pochard (*Aythya ferina*) have been received and these at the moment can only provide an index of the foods taken. Examples of the first three species have been received from a wide variety of areas of differing ecological types, and in future publications each habitat will be considered separately. Though the largest numbers have been of birds shot over saltmarsh areas, many have come from inland waters. There are examples from water meadows, rivers, reservoirs, lakes, smaller bodies of water and from a number of flight ponds. As is to be expected, within the same species there are differences in the food

taken depending on where the birds were feeding and on the time of year. Where practicable, botanical surveys of the areas involved have been made in order to show what sort of food is available and the preferences, if any, of the birds concerned.

Once the food habits of a particular species and what food is available are known, then any necessary conservation measures can be planned. Experimental plantings of species of known food value have been started in Kent. Six plant species whose seed was known to be taken by Mallard and Teal in that district were planted in the ' virgin ' soil created by brickwork excavations, part of which is now a wildfowl refuge. The species used were Persicaria (*Polygonum persicaria* L.), Water-pepper (*Polygonum hydropiper* L.), Amphibious Bistort (*Polygonum amphibium* L.), Knotted Persicaria (*Polygonum nodosum* Pers.), Marestail (*Hippuris vulgaris* L.) and Bur-reed (*Sparganium erectum* L.).

Some supplementary information has been gleaned from the viscera examination. For example, of all the Mallard examined so far, approximately 7% contained *ingested lead* pellets and it has been shown experimentally in America that 70% of adult Mallard with only *one* lead pellet will die of lead poisoning, if they are feeding on a diet of wild seeds (see p. 126 of this Report).

Occasionally birds are shot in which whole seeds are found down to the rectum, apparently undamaged. The question whether they are still viable or not has obvious botanical importance, for in this way some plant species may be spread from area to area. Experiments are being conducted to test the viability of such seeds.

It is important in a survey of this sort to know how long it takes for food to be digested. Using methylene blue as an indicator it was found that in adult Mallard feeding on a corn mixture, mainly Barley, the rate of food passage averaged $2\frac{3}{4}$ hours. Details of these experiments will be published later.

In order to facilitate the identification of wildfowl foods a reference collection of plant and animal material is being accumulated and housed at the Trust.

SECTION III: CONSERVATION AND RESEARCH AT HOME AND ABROAD

COMPARATIVE BEHAVIOUR OF THE ANATIDAE AND ITS EVOLUTIONARY IMPLICATIONS

Paul A. Johnsgard[1]

Summary

AN attempt has been made to summarize, in broad outline, the variations encountered in the behaviour of the Anatidae, and to relate these variations to their probable evolutionary significance. In particular, variations in manner of pair formation and pair bond length, in geographic distribution and ecology, and the related conditions of allopatry or sympatry with other species are discussed and their probable effects on behaviour are suggested. Instances are mentioned where a knowledge of behaviour would be helpful in judging evolutionary relationships that have thus far eluded taxonomists (*e.g., Stictonetta, Heteronetta, Thalassornis*), and likewise examples are pointed out where behavioural evidence suggests different relationships from those which are currently accepted (*e.g.,* " *Lophonetta,*" " *Anas* " *leucophrys,* and the eiders).

Introduction

The critical use of instinctive, or "species-typical," behaviour in systematic studies is a relatively recent, but increasingly important, taxonomic tool. Mayr (1958) has summarized the most important literature in this field, and has shown that behavioural information can often help to solve difficult evolutionary problems. Some of the classical contributions of behaviour to avian systematics, such as those of Heinroth (1911), Lorenz (1941; 1951-1953), and Delacour and Mayr (1945), have concerned waterfowl, and this group is particularly well suited to such a comparative approach.

An understanding of the significance of pair formation, pair bond strength, and the effects of sexual selection is vital to a proper taxonomic evaluation of instinctive, and especially sexual, behaviour, particularly because it varies greatly within the Anatidae. Thus in the subfamilies Anseranatinae and Anserinae (Delacour, 1954) the pair bond is normally lifelong, whereas in most of the Anatinae (except the Tadornini) the pair bond frequently lasts only for a single breeding season. As a result the former groups possess a much smaller capacity for genetic mixing in a large population. This is strengthened in geese and swans (Anserini) by the tendency for a pair's progeny to return to their place of hatching and to mate with closely related individuals, resulting in local inbreeding and thus favouring subspeciation (Mayr, 1942). In migratory ducks of the genus *Anas,* however, males normally mate on the wintering grounds and follow their mates to the females' natal homes, which may be a great distance from the males' birthplaces. This, of course, increases the tendency towards panmixia in duck populations and thus reduces subspeciation. Geese and swans do not become sexually mature until several years after hatching, resulting in a longer life cycle and a correspondingly reduced potential rate of genetic change. Most ducks, however, mature in their first year, and thus evolutionary adaptation is potentially much more rapid. This is also enhanced

[1]Visiting scientist at Slimbridge from August, 1959; U.S. National Science Foundation Fellow.

by the larger average clutch size of ducks, which may provide a greater opportunity for selection to act on favourable genotypes. Finally, since in the Anseranatinae, Anserinae and possibly, the Tadornini pair bonds are permanent, mate selection normally takes place only once, and seems to be a very gradual process which allows for the " correction " of incipient mating errors between species. Correlated with this is the fact that in most species of these groups there is but a single moult per year (there is less need for a nuptial plumage after a pair bond is once formed), sexual dimorphism is generally almost lacking (apparently because of reduced sexual selection) and sexual displays are normally simple and are mutually performed by both sexes, since their primary function is probably sexual synchronization. In the rest of the Anatinae sexual selection is enhanced by the fact that mate selection generally occurs yearly, there is much sympatry of closely related species, and females " select " their mates (which are usually in surplus numbers and hence must compete for mates). These factors result in selection for species-recognition signals and male heterosexual stimuli, which generally include elaborate plumage and/or soft part colouration and conspicuous prenuptial displays. These morphological specializations and displays must differ enough among closely related, sympatric species to provide for species recognition and thus prevent hybridization. The evolution of male nuptial plumages, the compression of the winter plumage into the short " eclipse " plumage, the staggered period of pair formation among different species, and the other mechanisms which have been evolved as a result of these selective pressures have been described by Sibley (1957), and will not be further elaborated on here. Sibley has also reviewed the interesting examples of isolated populations (such as *Anas acuta eatoni* and *Anas platyrhynchos wyvilliana*) that have lost their sexual dimorphism as a probable result of the diminished selective pressures for species recognition in areas where no other closely related forms occur.

Summarizing these points, we should expect to find in inbreeding species with a long life cycle and permanent pair bond a relatively slow rate of adaptation, but a fairly strong tendency towards speciation and simple, mutual displays combined with sexual monomorphism and non-elaborate plumages. Conversely, in outbreeding species with a short pair bond and short life cycle we should expect a comparatively rapid rate of evolutionary adaptation but a relatively weak tendency towards continental speciation, and heterosexual, elaborate displays combined with plumage dimorphism. Males of sympatric, closely related species should differ in plumages and/or displays, although one would expect that the most closely related forms would share the greatest number of homologous, if somewhat modified, behaviourial patterns. We may now examine the anatid groups, by tribes, to correlate these generalizations with individual cases. Except where recent evidence has suggested modifications, the groupings and scientific nomenclature used is that of Delacour and Mayr (1945) or Delacour (1954-1959).

SUBFAMILY ANSERANATINAE

The monotypic Magpie Goose, *Anseranas semipalmata,* differs from all other members of the Anatidae in numerous anatomical respects and in its general behaviour as well. Males and females are coloured alike, and differ

only slightly in voice and head shape; one would thus expect that any displays would be of a mutual nature. Delacour and Mayr (1945) state that there is no sign of any real display in the species, and the lack of any close relatives probably reduces selective pressures for species-specific behaviour. McKinney (1953) recorded wing-shaking derived from comfort movements as an epigamic display, but no detailed information on sexual behaviour is yet available. It would be of great interest to compare copulatory behaviour in this species with that of the South American screamers (Anhimidae) and the true geese.

SUBFAMILY ANSERINAE

Tribe Anserini

Sexual display in the geese and swans is mutual, and the sexes are generally almost identical in appearance. Sexual recognition and pair formation behaviour seems to have evolved from derivations of the threat displays towards other birds into mutual "triumph ceremonies," described well by Heinroth (1911). Precopulatory behaviour is essentially the same throughout the whole group, involving a rapid head-dipping in and out of the water by both sexes, reminiscent of and probably derived from bathing movements or, possibly, nest-building movements. Post-copulatory behaviour is also mutual and varies considerably among different species. Thus it may serve as an isolating mechanism, since "incorrect" post-copulatory responses can inhibit the formation of a permanent pair bond between two species (Heinroth, 1911).

The swans of the genus *Cygnus* can be divided behaviourally into two major groups. In one group (*olor, atratus,* and *melanocoryphus*) vocalizations are reduced, the wings are closed (*melanocoryphus*) or raised while folded (*atratus, olor*) during threat display, and the wings remain closed during post-copulatory display. In addition the species wing-flap with the bill pointed upwards (Poulsen, 1949), and in some species at least this wing flapping appears to be modified, or "ritualized" into a threat. The Black-necked Swan (*C. melanocoryphus*) deviates considerably from the other two, but all three species carry their young on the parents' backs, which the other species apparently never do. In the second group (*buccinator, cygnus, bewickii, columbianus* and *jankowskii*) vocalizations are elaborate (and visual plumage signals are correspondingly reduced), the wings are spread during threat display, and are flapped or waved during post-copulatory display and during triumph ceremonies. Species in this group wing-flap with a curved neck (as in geese).

Geese differ mainly from swans in their greater vocal versatility; their behaviour has been described at length by Heinroth (1911). Heinroth felt that the triumph ceremony serves an important role in pair formation, family bond development, sexual synchronization, and other important functions. Blurton Jones and Gillmor (1954) have investigated the components of the triumph displays of *Branta* and *Anser,* and have found that species differ in the number and elaboration of these various components, indicating their probable importance in species recognition. Pre-copulatory display consists of the typical head-dipping found in the swans, and post-copulatory display

is also mutual. The genus *Branta* appears to have fewer vocal signals than does *Anser,* and shows a corresponding increase in plumage pattern differentiation. This is especially true of head patterns, where the cheek and throat patches of *Branta* seem to be associated with flight intention head-tossing. Many species of *Branta* and *Anser* have striations on the neck feathering, which seems associated with the vibrating of the neck feathers in threat situations. All species of *Branta* and *Anser* but one (*A. canagicus*) have white under tail coverts, which is undoubtedly related to the male's courtship behaviour of swimming ahead of the female with the rear part of the body high in the water. Balham's (1954) exhaustive study of the Canada Goose (*Branta canadensis*) provides a basis for specific behavioural comparisons with other species.

The Cape Barren Goose (*Cereopsis novae-hollandiae*) has been placed, because of its general aggressiveness and downy young pattern, in the Tadornini, but numerous skeletal features indicate a closer relationship with the true geese (Verheyen, 1953). A conspicuous triumph ceremony is present in this species, and the similarity of the sexes in voice and display also suggests anserine affinities.

The Coscoroba (*Coscoroba coscoroba*) somewhat resembles the Mute Swan (*Cygnus olor*) in its threat and sexual behaviour, but it apparently forms a true link between the Anserini and the whistling ducks (Dendrocygnini). Pre-copulatory display is of the typical anserine type, although copulation occurs in shallow water (as in the Tadornini). Following copulation there is a mutual display in which both sexes stand together with their necks outstretched and their heads held high, as in the true geese.

Tribe Dendrocygnini

The whistling, or tree, ducks comprise eight species in the single genus *Dendrocygna.* As is true of geese, they are gregarious, highly vocal, and they pair for life. Thus there is little or no sexual dimorphism in plumage or voice, and their visual displays are simple and mutual. All species are very similar in their threat behaviour, which resembles that of true geese, but, as in the geese, these threat displays differ somewhat among different species and may provide clues to intrageneric relationships. No detailed behavioural studies have been done on the group, but evidently pre-copulatory display is the same as in geese and swans. Following copulation, the birds rise up side by side, call, and open one (the far) wing (Finn, 1919, Meanley and Meanley, 1958). Wing colouration in this group is very uniform, usually being black, which may be related to this display, although other body parts vary greatly in plumage and colour pattern. Their specialized downy pattern and tracheal structure indicate that they are more advanced than the Anserini, and are distinctly isolated from them and from the shelduck group.

Stictonetta

There is considerable anatomical evidence that the Freckled Duck (*Stictonetta naevosa*) is more closely related to the geese and swans than to the Anatinae (Verheyen, 1953), as indicated by its large lacrymal, reticulated tarsus, palatine shape, lack of tracheal bulla and the number of cervical

vertebrae. If this is true, it possibly should be accorded a monotypic tribal rank (" Stictonettini "). Its sexual behaviour is still unknown, and a knowledge of it would doubtless aid much in determining the relationships of this extremely aberrant species.

SUBFAMILY ANATINAE

Tribe Tadornini

The sheldgeese and shelducks form a smooth transition between the Anserinae and the Anatinae, indicating the largely artificial distinction between the groups. Like geese and swans, most species pair for life, and in some the sexes are coloured alike. However, in the shelducks at least, there are two molts per year (as in true ducks), and pair bonds are not always permanent (Heinroth, 1911). In most species the pre-copulatory display is of the typical anserine type. However, the sexes differ in their vocalizations, threat, and sexual displays, and in some forms the sexes are coloured very differently. Threat displays usually involve a lifting of the folded wings, the upper and under coverts of which are generally white and very conspicuous. Metallic coloured wing specula (and associated mock preening) are also first encountered in this group, as is the " Inciting " behaviour of females; these characteristics are typical of most of the Anatinae.

The group seems most closely linked with the true geese (and *Cereopsis*) through the Abyssinian Blue-winged Goose (*Cyanochen cyanopterus*), which lacks white wing coverts and, a sharply distinct speculum, both sexes having very similar voices and displays. In the closely related genus *Chloëphaga* there is a remarkable, and as yet unexplained, variation between plumage monomorphism and dimorphism in the two sexes. In all, however, the sexes' voices and displays are very different, the female exhibiting typical inciting behaviour and the male possessing various threat postures. These threat postures reach their highest degree of elaboration in the Andean Goose (*C. melanoptera*). Modifications of the anserine dipping movements are used in pre-copulatory display, which occurs on land or calm water. The closely related genera *Neochen* and *Alopochen* link the typical sheldgeese with the shelducks (*Tadorna*) both in behaviour and morphology. In *Tadorna* the pre-copulatory behaviour may involve mutual bathing, head-dipping, or head-bobbing motions, or the female may assume the receptive posture without previous mutual display (Poulsen, 1957). Pre-copulatory preening occurs in *T. tadorna*; ritualized preening is typical of most of the other Anatinae. Post-copulatory display in *Tadorna* usually consists of the male raising one wing while the female remains crouched, as is also true in *Alopochen* and *Chloëphaga.*

The steamer ducks of South America (*Tachyeres*) are of dubious relationships; Moynihan (1958) found that their threat and pre-copulatory displays are of the typical Tadornini pattern, but that other displays are distinct enough to warrant their placement in a special, separate tribe (" Tachyerini "). Post-copulatory displays involve both sexes swimming apart in an alert posture, with " Head-flagging " and " Grunting."

Tribe Cairinini

The perching ducks were placed by Delacour and Mayr (1945) between the Aythyini and the Mergini, apparently largely because their nesting habits are similar to the latter, but hybridization evidence indicates, rather, that they belong between the Tadornini and the Anatini (Johnsgard, 1960a). The group consists of about a dozen species which possess a strange mixture of very generalized, or " primitive," and highly specialized features. Part of the tribe (*Plectropterus, Cairina,* and *Sarkidiornis*) seems, in fact, to represent a group of " relict " species which probably most closely approximate the generalized anatine condition, from which the more specialized groups have radiated. In this more generalized group plumages are generally metallic in both sexes and lack specialized patterns, vocalizations are poorly developed, displays are rudimentary, and pair bonds are weak or absent. No eclipse plumage is present, and even during the breeding season the sexes rarely associate. Copulation in at least two genera (*Cairina* and *Sarkidiornis*) is characterized by the male brutally attacking and raping the female, and the great size dimorphism of the sexes in these species seems to be related to this fact. The African Hartlaub's Duck (" *Cairina* " *hartlaubi*) shows little behavioural similarity to the other species of *Cairina*; likewise both the adult and downy plumages deviate from that genus and suggest affinities with the Anatini. It seems likely that it should be maintained in a separate genus (*Pteronetta*) until its relationships are better understood.

The rest of the Cairinini consists of several genera which show striking similarities to representatives of other tribes (*e.g., Chenonetta* with Tadornini, *Aix* with *Anas, Amazonetta* with *Aythya*), thus emphasizing the central position of the Cairinini in the subfamily Anatinae. Unlike the previous group, plumages are usually different in the two sexes, and metallic colouration usually occurs in restricted areas (usually wing and head regions) and in highly specialized patterns. Vocalizations are relatively complex, displays are often elaborate, and pair bonds are stronger. An eclipse plumage occurs in two genera (*Aix* and *Nettapus*), and the sexes associate throughout the year.

There is little known about the behaviour and displays of the pigmy geese (*Nettapus*), but apparently the striking wing patterns are displayed in some species (Delacour and Mayr, 1945). Delacour's (1945) description of the Maned Goose's (*Chenonetta jubata*) displays indicate affinities with *Aix,* and the post-copulatory behaviour consists of an exaggerated and prolonged raising of the male's hindquarters as it swims away from the female, an action only slightly indicated in *Aix* (D. F. McKinney, pers. comm).

The behaviour of the Wood Duck (*Aix sponsa*) has been thoroughly discussed by Heinroth (1910) and Lorenz (1951-1953); these authors have also provided the most complete account of the Mandarin Duck's (*Aix galericulata*) behaviour. The males of these species possess the most elaborate plumage patterns to be found in the Anatidae, and a knowledge of their behaviour contributes to the understanding of this remarkable plumage specialization. Additional comments on the relations between the plumage and behaviour of these species are presented by Dilger and Johnsgard (1959).

The behaviour of the Brazilian Teal (*Amazonetta brasiliensis*) provides a fascinating mixture of components found in species of several different tribes.

The male's wheezy whistle is reminiscent of *Aix*, but the female's inciting is rather like some species of *Anas* or *Aythya*. Female pre-copulatory behaviour is an *Anas*-like head-pumping rather than the soliciting posture of female *Aix*, and following copulation the male swims away in a rigid posture astonishingly like the post-copulatory display of *Netta* and *Aythya* (D. F. McKinney, pers. comm.) and *Anas angustirostris*.

The Ringed Teal (*"Anas" leucophrys* of Delacour and Mayr, 1945) seems to belong to the perching duck tribe rather than the Anatini (von Boetticher, 1952), as indicated by its hole-nesting habits, hybridization with *Amazonetta brasiliensis*, and other evidence. Furthermore, the behaviour and voice of the female Ringed Teal is extremely like that of *Aix*, and the copulatory behaviour of the species is also very similar to that of *Aix*, but is totally unlike *Anas*. I therefore believe that the Ringed Teal should be placed in a separate genus *Callonetta* (as originally proposed by Delacour, 1936) and be included in the perching duck tribe adjacent to *Aix*.

Tribe Anatini

This large tribe of typical surface-feeding ducks is comprised of one large genus *Anas* (about 35 species) and several aberrant monotypic genera of dubious relationships. Although males of most species of *Anas* differ greatly in appearance the females tend to be more similar. Display patterns are also similar, and the remarkable degree of interspecific hybrid fertility indicates a closely knit evolutionary group that justifies a broad generic concept. This tribe also typifies the mating situation outlined for ducks earlier, namely a short pair bond, strong sexual selection resulting from male competition for mates, and a high capacity for rapid evolutionary changes by means of a short life cycle and high fecundity.

The displays of two of the monotypic genera, *Hymenolaimus* and *Malacorhynchus*, are so poorly known that they can be omitted here. According to Delacour and Mayr (1945) the major display of the now-extinct Pink-headed Duck (*Rhodonessa caryophyllacea*) was a wheezy neck-stretching, probably corresponding to the "Burp" of male *Anas*, or possibly to the courtship call of male *Aythya*, to which it may be more closely related, as is indicated by its tracheal structure. The highly specialized Torrent Duck (*Merganetta armata*) is also poorly known, but the descriptions of Phillips (1953) and Scott (1954) indicate that the species' behaviour is unique, and shows no distinct similarity to typical *Anas* behaviour.

The behaviour of 14 species in the genus *Anas* (*sensu* Delacour and Mayr) has been carefully investigated by Lorenz (1941; 1951-1953). He has pointed out numerous behavioural homologies among related species, and has thus determined the probable major evolutionary relationships within the group. This important work cannot be adequately summarized here, and should be read in its complete form for details. Most species studied by Lorenz are characterized by numerous display patterns, the number and form of which are usually shared by other species in direct proportion to their degree of evolutionary relationships as suggested by other characters. However, some species (such as *Anas georgica spinicauda*) lack individual displays that are found in closely related species, and it appears probable that this is the result of a secondary loss of such displays, possibly under

the impact of selection for isolating mechanisms under conditions of sympatry. Recent research (Lorenz, 1958) has indicated that the genetic factors governing such displays may be present in a latent condition in these species, and the displays may only appear in hybrid matings. It would be expected that such a secondary loss of an individual display pattern might occur in a region of sympatry with another closely related form in which this pattern forms an important part of its species-recognition system.

Certain behavioural patterns have been found in all the species of *Anas* thus far studied. For example, female inciting has been found in every species observed, and it appears to play a basic role in the pair-formation process of at least some species of *Anas* (Johnsgard, 1959, 1960b). Likewise in the case of males the orientation of the back of the head towards a " courted " female appears to be of primary significance in many species, and special head feather patterns are often exhibited during this display. Pre-copulatory display in all species studied involves a mutual head-bobbing. No special female post-copulatory displays have been recorded, but in males these vary from elaborate displays (as in the mallard group) to those species where such displays are rudimentary or lacking. Major male social displays in *Anas* include (in Lorenz's 1951-1953 terminology) " Burping," the " Grunt-whistle," " Head-up-tail-up," " Down-up," " Bridling," " Chin-lifting," and others. Generalized patterns typical of nearly all species include ritualized preening, drinking, and shaking movements. Correlated with these behavioural patterns, males of many species possess erectile crests or otherwise specialized head plumage, many have elaborate scapular feathering or tail feathers, and nearly all have metallic-coloured specula. Bright bill colouration is also typical of many species.

Behavioural evidence (such as the presence of a " Grunt-whistle ") indicates that the Andean Crested Duck (" *Lophonetta" specularioides*) should be regarded as a member of the genus *Anas*, probably most closely related to *specularis*, rather than an aberrant shelduck such as Delacour and Mayr (1945) considered it to be.

Tribe Aythyini

The diving duck tribe is much like the preceding one in that the pair bond is short, there are numerous sympatric and closely related species, and there is a one or two year period to maturity. All species exhibit sexual dimorphism, particularly in the head and iris colouration. Metallic-coloured specula are lacking in all species, but white specula are characteristic of most, and mock preening occurs in most if not all species.

Sexual displays in the group show remarkable uniformity, and justify the broad generic concept of Delacour and Mayr (1945). In fact, *Netta rufina* shows such great similarities to some of the Anatini and *Netta erythropthalma* shows so many characteristics of *Aythya* that any distinct generic separation is difficult. The sexual behaviour is outwardly rather different from that of *Anas*, but the fact that fertile *Anas* x *Aythya* hybrids have been reared on several occasions (Gray, 1958) indicates that the two groups must actually be fairly closely related. In at least one species (*Netta rufina*), pre-copulatory behaviour approaches *Anas*-like head-bobbing, but in most species of *Aythya* thus far studied the female assumes a receptive posture without previous

mutual head-bobbing display. Post-copulatory display in all species of *Netta* and *Aythya* thus far observed is essentially identical, but different from that of *Anas*. The male calls, then swims in a rigid posture with the head pointed downwards and the bill pressed against the breast. Females of most, and probably all, species have inciting displays which contain a strong chin-lifting component (as in the blue-winged ducks and shovelers), alternating with pointing movements.

Almost no comparative behavioural studies on the Aythyini have been published. Lind's (1958) study of the Red-crested Pochard (*Netta rufina*) provides almost the only information on that genus, and Hochbaum's (1944) account of Canvasback (*Aythya vallisneria*) displays is the most complete description of typical *Aythya* behaviour. A courtship call, emitted with a curved neck or head-throw is the major *Aythya* display, and is probably homologous with the " Sneeze " of *Netta rufina* and, possibly, the " Burp " of *Anas*. Neck-stretching occurs in both sexes of many species, and is apparently equivalent to the " Chin-lifting " of *Anas*. The posture Hochbaum termed the " Sneak " is also typical of many species.

Male head-throws have been recorded for all species of *Aythya* except *innotata* (the displays of which are undescribed), as well as for *Netta erythropthalma* and *N. peposaca*. Group chases over the water surface by several males after a female are typical of this group, and seem to represent a ritualized version of the rape chases that are found in many species of *Anas*.

The Eiders

The four species of eiders were placed by Delacour and Mayr (1945) in the Tribe Mergini, but Delacour later (1956) stated that they belong in a separate tribe, the Somateriini, adjacent to the Anatini. This decision was apparently based on Humphrey's (1958) studies on tracheal anatomy, in which aspect the eiders do resemble the *Anas* group. However apart from this detail of anatomy, and a superficial similarity in female plumages to *Anas* (which is probably the result of selection for concealing colouration in similar nesting habitats), there seems to be little reason to suspect any close relationships between these groups. Myres' recent (1959) comparative behavioural study of the group resulted in his conclusion that the eiders show no behavioural similarity with *Anas*, and also are fairly distinct from the other sea ducks. Females show the inciting behaviour found in the Anatini, Aythyini, and the goldeneyes (*Bucephala*) and mergansers (*Mergus*), and likewise solicit copulation in a prone posture as do the Aythyini and the Mergini. Male displays deviate from those of all other ducks, and thus shed no light on relationships. Male pre and post-copulatory behaviour greatly resembles that of the goldeneyes (*Bucephala*), with many ritualized comfort movements included in the displays (Hoogerheide, 1950).

Tribe Mergini

This tribe of sea ducks differs from the Aythyini mainly in that the species do not achieve sexual maturity until their second or, possibly, third year (in scoters), and they also tend to subsist to a greater degree on a diet

of animal matter. Most forms are Northern Hemisphere in distribution, and there is much sympatry of ranges. Some of the most elaborate displays and male plumage patterns in the entire family Anatidae are found in this tribe. Only two species (the isolated Southern Hemisphere mergansers *Mergus australis* and *M. octosetaceus*) lack sexual dimorphism. Specialized colour patterns tend to occur on the heads, bills, and wings. Erectile crests occur on some species, and sexual dimorphism is frequent in bill, foot, and eye colouration.

Displays in the group are often extremely complex, and it is difficult to generalize on them or to point out homologies. Detailed information is not available for many species, but Myres (1959a) has well summarized the published information and added many additional observations. It may be said that the scoters (*Melanitta*) are the most generalized of the group, and their displays tend to be derived from simple comfort movements. In this group, as in the eiders, bill shape and colouration probably plays an important role in species recognition. McKinney (1959) and Myres (1959b) have described copulatory behaviour of scoters, which is comprised primarily of ritualized comfort movements, such as drinking, preening, stretching and shaking.

The behaviour of the Old-squaw, or Long-tailed Duck (*Clangula hyemalis*) and Harlequin (*Histrionicus histrionicus*) is still inadequately known, but both species appear to have head-throw displays and other displays associated with loud and elaborate calls.

The goldeneyes and Bufflehead of the genus *Bucephala* show striking variations in their behavioural patterns, and Myres feels that the Bufflehead (*B. albeola*) probably deserves generic separation from the goldeneyes on this basis. The displays of the goldeneyes are exceedingly complex, and have been studied by several workers, including Myres (1957), B. Dane *et al* (1959) and others. Myres (1959b) has also described the copulatory behaviour of the Bufflehead, which is essentially like that of the goldeneyes and scoters.

Behaviourally, the goldeneyes seem to be linked to the mergansers through the Smew (*Mergus albellus*) (Lebret, 1958), which exhibits characteristics of both groups and has frequently hybridized in the wild with goldeneyes. The Hooded Merganser (*Mergus cucullatus*) appears to be similar to the Smew in its displays, but the Red-breasted Merganser (*M. serrator*) and Goosander (*M. merganser*) show surprising differences in their male display patterns. However, the mating behaviour of the females of these species is relatively uniform. Nothing is known concerning the displays of the Chinese Mergansers (*M. squamatus*), and very little is known concerning the Southern Hemisphere species. Copulatory behaviour of the mergansers is only very poorly understood. In all species where it has been described the female assumes a receptive posture after mutual drinking display (as in goldeneyes), and the males of at least some species perform ritualized preening and drinking movements, which in the Hooded Mergansers are linked into a sequence almost identical with that found in the goldeneyes.

Subspeciation is very evident in some species of sea-ducks such as the Common and Velvet Scoters (*Melanitta nigra* and *M. fusca*) and the Common Eider (*Somateria mollissima*). This is probably the result of the wide ranges of these forms and the numerous disjunct breeding and wintering areas.

It is interesting that in these cases the American races, which are subjected to the greatest amount of sympatry with other species, have the most elaborate male signal characters of bill form and colouration, whereas the Atlantic races tend to have these characters reduced. It appears likely that in these species the recognition characters have been reinforced in the areas where possibilities for incorrect mate selection are greatest.

Tribe Oxyurini

The stiff-tail group represents a unique section of the Anatidae that has deviated greatly from the remainder of the family in morphology, ecology, and behaviour. The tribe consists of a diverse group of genera which are of uncertain relationships to one another and to the rest of the family. In contrast to nearly all of the other Anatinae, males of all species lack a tracheal bulla, and correlated with this there has been the development of a sound-producing tracheal air sac system. Sexual behaviour has become modified for sound production by this means, and it is a significant fact that in this group, which inhabits weedy, overgrown ponds, auditory rather than visual displays appear to be of prime importance. Although males differ in appearance from females in most species, visual display characters mainly involve bill colour and, in some forms, head colouration. The relatively minor importance of plumage in species-recognition is shown by the fact that in South America two species (*Oxyura vittata* and *O. jamaicensis ferruginea*) occur sympatrically which have almost identical male plumage patterns. However, according to Dr. Martin Moynihan (*in litt.*) these species' displays (and associated vocalizations) are much more different than the degree of difference found in most species of *Anas*. In this group taxonomists must therefore rely on behavioural characteristics and the anatomical basis of display (the œsophagus and tracheal air sac) rather than upon external features. In this respect, the North American Ruddy Duck (*Oxyura j. jamaicensis*) and the Peruvian Ruddy Duck (*O. j. ferruginea*) have essentially identical displays (Moynihan, *in litt.*), but differ greatly from the Argentine Ruddy Duck (*O. vittata*). Correlated with this, the Argentine Ruddy Duck has an inflatable œsophagus and a weakly developed tracheal air sac (Wetmore, 1926), indicating a different means of sound production. By inflating the œsophagus and using jerky head and neck movements to produce sounds, the Argentine Ruddy Duck appears to be similar in its displays to the African Maccoa Duck (*O. maccoa*) and possibly the Australian Blue-billed Duck (*O. australis*). In the North American Ruddy Duck (*O. j. jamaicensis*) the sound produced during display is for the most part a mechanical one, caused by the bill striking the inflated air sac.

No comparative behavioural studies have been done on the tribe as a whole, and to date not even a single species' behaviour has been adequately described. The nearly completed studies of Miss Helen Hays on the North American Ruddy Duck will, however, provide an important contribution to our understanding of the group. Some behavioural information is available for *Oxyura australis* (Brown, 1949; Wheeler, 1953; Scott, 1958) and *Biziura lobata* (Serventy, 1946). In those species where display has been observed, the tail is cocked upwards and some kind of head jerking or bobbing is utilized to produce sound. A backward foot-kicking has also been observed in several

species. Wheeler (1953) has provided the only published account of copulatory behaviour for any species in the group, which in *Oxyura australis* involves an underwater chase, with the female being completely submerged during copulation. According to Miss Helen Hays (pers. comm.), this is entirely different from copulatory behaviour in *O. j. jamaicensis*, in which " Bill-flicking " is the primary male pre-copulatory display, and the usual head-bobbing, or " Bubble," display follows copulation.

Practically no behavioural information is available regarding the Black-headed Duck (*Heteronetta atricapilla*) and the White-backed Duck (*Thalassornis leuconotus*), both of which are only dubiously included in the stiff-tail group. A knowledge of the Black-headed Duck's behaviour would be of great interest, not only because of its uncertain affinities, but also because of its parasitic nesting behaviour, which must certainly have modified sexual behaviour and pair formation.

PROSPECTS FOR FUTURE BEHAVIOURAL RESEARCH

As is all too evident from the above discussion, great gaps still remain in our knowledge of the general behavioural patterns of many species, to which any interested person could contribute much. In no case, even in the commonest species, is any waterfowl species so thoroughly understood that it would not be worthy of additional detailed study. Indeed, careful quantitative study of a single form or a few closely related forms is more likely to greatly increase our knowledge of the function and evolution of behavioural differences than simply pursuing broad-scale qualitative studies. Examples of situations which could be studied especially profitably are (1) geographic variations in the behaviour of well-marked subspecies and (2) variations in the behaviour of closely related, sympatric forms. In the former case, D. F. McKinney's uncompleted studies on the races of the Common Eider (*Somateria mollissima*) will be of great interest, and other promising examples include the races of Common Teal (*Anas crecca*), Velvet Scoter (*Melanitta fusca*) and Canada Goose (*Branta canadensis*), to mention only a few. Examples of studies where the effects of secondary contact in closely related, but rarely hybridizing, forms might be profitably investigated include Grey and Chestnut-breasted Teal (*Anas gibberifrons* and *A. castanea*), Greater and Lesser Scaup (*Aythya marila* and *A. affinis*), and the Goldeneyes (*Bucephala clangula* and *B. islandica*). Cases where secondary contact of incipient species is accompanied by frequent hybridization are especially instructive, as, for example, where the Mallard (*Anas platyrhynchos*) is in contact with the Black Duck (*A. rubripes*) and the Grey Duck (*A. superciliosa*). Finally, the comparison of mainland forms with island races that have lost most of their secondary sexual characteristics of plumage could provide an insight into a similar secondary loss of behavioural characteristics which might have occurred.

ACKNOWLEDGEMENTS

This paper was written while the author was being supported by a National Science Foundation Postdoctoral Fellowship. I would also like to state my appreciation to the following persons with whom I have exchanged ideas and observations on various species:

J. Delacour, H. Hays, P. Humphrey, H. Lind, K. Lorenz, D. F. McKinney, M. Moynihan, D. Ripley, P. Scott, C. G. Sibley and W. Von de Wall. W. C. Dilger kindly read and commented on an early version of the manuscript.

LITERATURE CITED

BALHAM, R. W. (1954). The behaviour of the Canada Goose (*Branta canadensis*) in Manitoba. Ph.D. Dissertation, Univ. of Missouri. 244 pp.

BLURTON JONES, N. G., and R. A. F. GILLMOR. (1954). Triumph display in geese. *Wildfowl Trust Sixth Annual Report*: 82.

BROWN, G. (1949). Display of Blue-billed Ducks. *Emu*, 48:315.

DANE, B., C. WALCOTT and W. H. DRURY. (1959). The form and duration of the display actions of the Goldeneye (*Bucephala clangula*). *Behaviour* 14:265-281.

DELACOUR, J. (1936). Note sur la classification des Anatidés. *Oiseau* 6:366-379.

DELACOUR, J. (1945). The display of the Maned Goose. *Wilson Bull.*, 57:129.

DELACOUR, J. (1954, 1956, 1959). *The Waterfowl of the World*. 3 vol. Country Life, London.

DELACOUR, J. and E. MAYR. (1945). The family Anatidae. *Wilson Bull*, 57:3-55.

DILGER, W. C. and P. A. JOHNSGARD. (1959). Comments on "species recognition" with special reference to the Wood Duck and the Mandarin Duck. *Wilson Bull.*, 71:46-53.

FINN, F. (1919). *Bird Behaviour*. London, 363 pp.

GRAY, A. P. (1958). *Bird Hybrids*. Commonwealth Agricultural Bureau of England. 390 pp.

HEINROTH, O. (1910). Beobachtungen bei einem Einbürgerungsversuch mit der Brautente (*Lampronessa sponsa* (*L.*)). *Journ. für Ornith.* 58:101-156.

HEINROTH, O. (1911). Beiträge zur Biologie, namentlich Ethologie und Psychologie der Anatiden. *Verh. V Int. orn. Kongr., Berlin.* 1910. pp. 598-702.

HOCHBAUM, H. A. (1944). *The Canvasback on a Prairie Marsh*. Amer. Wildl. Inst., Washington. 201 pp.

HOOGERHEIDE, C. (1950). De Eidereenden, *Somateria mollissima* L., of Vlieland. *Ardea*, 37:139-160.

HUMPHREY, P. S. (1958). Classification and systematic position of the eiders. *Condor*, 60:129-135.

JOHNSGARD, P. A. (1959). Evolutionary relationships of the North American mallards. Ph.D. Dissertation, Cornell University. 153 pp.

JOHNSGARD, P. A. (1960a). Hybridization in the Anatidae and its taxonomic implications. *Condor,* 62 : 25-33.

JOHNSGARD, P. A. (1960b). A quantitative behavioural study of the Mallard and the Black Duck. *Wilson Bull.,* (In Press).

LEBRET, T. (1958). Baltsbewegingen van het Nonnetje, *Mergus albellus* L. *Ardea,* 46 : 75-79.

LIND, H. (1958). Eine untersuchung über das Balzverhalten der Kolbenente (*Netta rufina* Pallas). *Zeitschrift für Tierpsychologie,* 15 : 99-111.

LORENZ, K. Z. (1941). Vergliechende Bewegungstudien an Anatinen. *Journ. für Ornith.,* 89 (Suppl.) : 194-294.

LORENZ, K. Z. (1951-1953). Comparative studies on the behaviour of the Anatinae. *Avic. Mag.,* 57 : 157-182; 58 : 8-17, 61-72, 86-94, 172-184; 59 : 24-34, 80-91.

LORENZ, K. Z. (1958). The evolution of behaviour. *Sci. Amer.,* 199(6) : 67-78.

MCKINNEY, D. F. (1953). Studies on the behaviour of the Anatidae. Ph.D. Dissertation, University of Bristol. 227 pp.

MCKINNEY, D. F. (1959). Waterfowl at Cold Bay, Alaska, with notes on the display of the Black Scoter. *Wildfowl Trust Tenth Annual Report*: 133-140.

MAYR, E. (1942). *Systematics and the Origin of Species.* Columbia Univ. Press New York. 334 pp.

MAYR, E. (1958). Behaviour and systematics. In : *Behaviour and Evolution.* Yale University Press, New Haven. 557 pp.

MEANLEY, B. and A. G. MEANLEY. (1958). Post-copulatory display in Fulvous and Black-bellied Tree Ducks. *Auk,* 75 : 96.

MOYNIHAN, M. (1958). Notes on the behaviour of the Flying Steamer Duck. *Auk,* 75 : 183-202.

MYRES, M. T. (1957). An introduction to the behaviour of the goldeneyes (*Bucephala islandica* and *B. clangula* (Class Aves, Family Anatidae)). M. A. Thesis, University of British Columbia, 254 pp.

MYRES, M. T. (1959a). The behaviour of the sea-ducks and its value in the systematics of the tribes Mergini and Somateriini, of the family Anatidae. Ph.D. Dissertation, University of British Columbia. 504 pp.

MYRES, M. T. (1959b). Display behaviour of Bufflehead, scoters and goldeneyes at copulation. *Wilson Bull.,* 71 : 159-168.

PHILLIPS, S. (1953). An incident concerning the Peruvian Torrent Duck. *Avic. Mag.,* 59 : 134.

POULSEN, H. (1949). Bidrag til Svanerne Ethologi. *Dansk. Ornith. Foren. Tidsskr.,* 42 : 173-201.

POULSEN, H. (1957). Notes on the mating behaviour of the Sheld-duck. (*Tadorna tadorna* (*L.*)). *Dansk. Ornith. Foren. Tidsskr.,* 51 : 115-118.

SCOTT, P. (1954). Behaviour of the Bolivian Torrent Duck. In : *Wildfowl Trust Sixth Annual Report*: 69-72.

SCOTT, P. (1958). Notes on Anatidae seen on world tour. *Wildfowl Trust Ninth Annual Report*: 86-112.

SERVENTY, V. N. (1946). Display in the Musk Duck. *Emu*, 45:318-321.

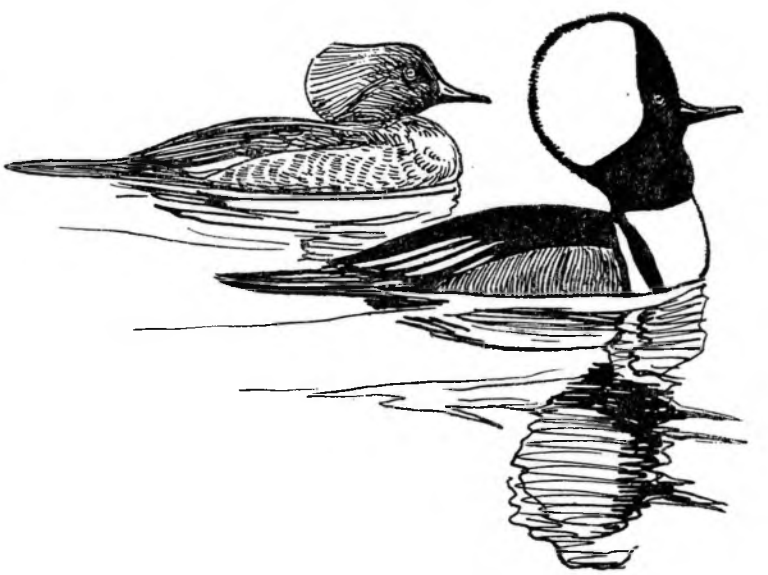
SIBLEY, C. G. (1957). The evolutionary and taxonomic significance of sexual dimorphism and hybridization in birds. *Condor*, 59:166-191.

VERHEYEN, R. (1953). Contribution à l'Ostéologie at à la Systématique des Ansériformes. *Gerfaut*, 43 (suppl.):373-497.

VON BOETTICHER, H. (1952). *Gänse und Entenvögel aus aller Welt*. Die Neue Brehm-Bücherei, Heft 73. 95 pp.

WETMORE, A. (1926). *Observations on the Birds of Argentina, Paraguay, Uruguay and Chile*. Bull. U.S. Nat. Mus., Washington. 448 pp.

WHEELER, J. R. (1953). Notes on the Blue-billed Ducks at Lake Wendouree, Ballarat. *Emu*, 53:280-282.



Hooded Merganser *Mergus cucullatus* displaying

EXPERIMENTS ON THE CAUSATION OF THE THREAT POSTURES OF CANADA GEESE

N. G. Blurton Jones

(Dept. of Zoology and Comparative Anatomy, Oxford)

Summary

A PAIR of Canada Geese hand-reared in 1953 were used between 1955 and 1958 to test experimentally the hypothesis that certain display postures of this species are caused by a conflict between tendencies to attack and to flee from an opponent. The geese would follow and stay peacefully with the author if he was wearing a red sweater, corduroy trousers and Wellington boots. If he carried a stick or brush they would flee. If he wore a jacket they would attack vigorously. Thus it was possible to administer attack-evoking and escape-evoking stimuli simultaneously. When this was done the postures previously interpreted as 'threatening' were elicited. When the attack-evoking stimulus was presented behind a fence which the geese had learned they could not get through, some but not all of the postures observed in the attack-flee conflict were seen. The experiments support the original hypothesis, which was based on non-experimental field observations.

Introduction

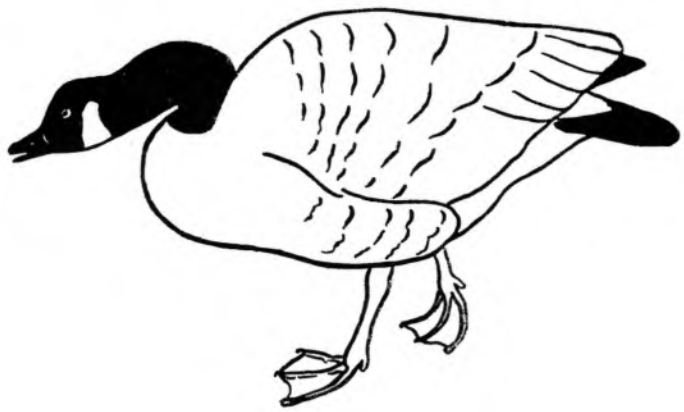
Most studies of the motivation of the displays of birds are based on observations of free wild birds. Tinbergen (1959) has recently reviewed the analysis of field observations and "natural experiments." Several non-experimental investigations have supported the hypothesis that in natural situations "threat displays" arise when the bird is in a state of conflict, tending at the same time to attack and to flee from an opponent. To verify this hypothesis and, at the same time, the interpretative methods that gave rise to it, it is necessary to be able to stimulate the tendencies to attack and to flee both separately and simultaneously. On the 'conflict' hypothesis, simultaneous presentation should evoke threat postures but the separate stimuli should not. Though such an experiment is extremely simple in principle, it is rarely practicable, so that it seems worth reporting some experiments of this kind with Canada Geese *Branta canadensis*.

Hostile behaviour in wild Canada Geese

Between 1950 and 1956 I had been watching free-living feral Canada Geese in the field, and had become familiar with their displays and other behaviour throughout the annual cycle.

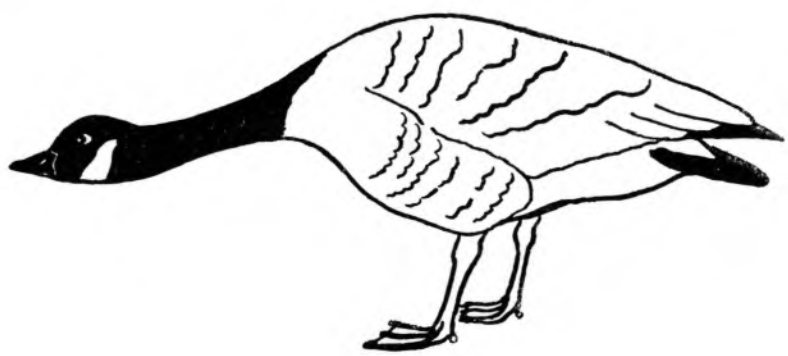
Hostility (attack and avoidance) is shown when territory holders meet, and in winter flocks when different pairs or family parties meet or come close together. Certain postures also occur in these situations. Those most commonly seen are named and described below. They are only a small part of the repertoire of the species but are by far the commonest both in natural quarrels of captive and wild birds and in the experiments.

1. **Bent-necked** posture. The head is lowered and held close to the breast, and the neck is doubled back on itself. The bill is usually pointed towards the opponent.



Bent-necked

2. **Forward** posture. The head is lowered and held far in front of the body with the neck more or less nearly straight. Intermediates between these two are seen, and the forward often develops out of the bent-necked posture by a forward thrust of the head. Although it is usually practicable to classify a posture as one or the other they are grouped together for the purposes of this paper. They are usually accompanied by a quiet grunting call (mostly with bent-necked) and loud, rapid honking (usually with forward), and sometimes there is a flicking movement of the closed wings with the forward posture.



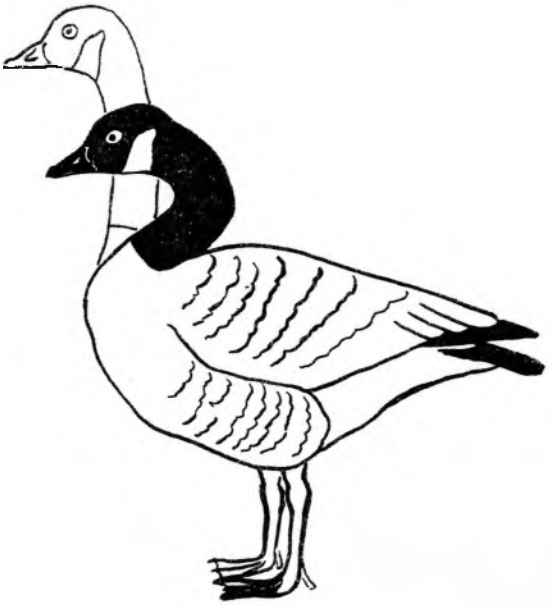
Forward

3. **Erect** posture. The head and neck are held erect and the body is also tilted into an erect position. Feathers on the body and neck are raised, often very strongly, and sometimes the bird hisses and makes trampling movements with its feet.

4. **Head-pumping.** The head and neck are held erect but the neck is repeatedly bent and straightened, lowering and raising the head each time in a vertical bobbing movement.

In their recent paper Collias and Jahn (1959) describe head-pumping, bent-necked and forward postures and interpret their motivation on the basis of their similarity to actual attack and alarm positions. My own interpretation, from general observation of free-living birds, without quanta-

tive analysis, is that all four postures occur when there is reason to believe that the bird is simultaneously motivated both to attack and to flee from its opponent, e.g. in situations where the bird often attacks or retreats from another goose. A goose in the erect posture (and at any time with erect feathers) is relatively more likely to flee and less likely to attack than one in the bent-necked or forward postures. Geese performing bent-necked and forward are more likely to attack than to flee. A goose doing the forward posture seems more strongly motivated than one doing bent-necked in that if it attacks it fights more vigorously. However, Klopman (pers. comm.) finds that bent-necked more often precedes actual attacks than does forward.



Head-pumping

Experimental arrangements

The opportunity for experiments on the conflict between attacking and fleeing was provided by a pair of Canada Geese hand-reared in 1953. When adult these birds would uninhibitedly attack and fight with people whom they did not see often, and with familiar people dressed in an unfamiliar way. They were quite unafraid of the author and his parents when dressed in their habitual gardening clothes and would follow them or stay peacefully with them but if we carried a stick or brush we could chase the geese away and make them run in front of us. (The geese learned this response in their first year, probably as a result of being pushed out of the house with a brush, but ontogeny is irrelevent here). Otherwise it was only possible to make the geese move by walking away and calling, whereupon they would follow.

Thus a familiar person wearing strange clothes and carrying a brush moving towards the geese constituted a simultaneous stimulus to attack and to flee. To check whether the fleeing tendency played any greater part than just preventing attack, in one series of experiments the intruder advanced

towards the geese behind a wire-netting fence which the geese had learned they could not get through but which they never avoided or fled from.

The experiments made use of five situations: non-hostile (control), attack - evoking, flee - evoking, attack - and - flee, attack - prevented. The occurrence of attacking, fleeing, bent-necked and forward posturing or other behaviour was recorded, but usually with little reference to how frequently each was shown during the trial. Thus the quantitative records consist of comparisons between the numbers of trials in which an activity was seen and those in which it did not occur.

Results

1. **Non-hostile situation:** I would go to the geese wearing Wellington boots, corduroy trousers and a red sweater. Usually they would watch me come, greet me briefly (with postures that *superficially* resemble the 'threat' postures) then prepare to follow me or else resume their previous activities until I went, when they would attempt to follow. A complete record of the number of these encounters was not kept, as the behaviour was so consistent.

2. **Attack-evoking situation:** I would go to the geese wearing a jacket instead of the sweater. They would see me, raise their heads rapidly, then run towards me calling, with their heads held low in front of them. They would then peck and take hold of me with their bills and begin to beat me with the carpal joints of their wings. Beating would continue until I broke away and ran off too quickly to be caught. The geese would give chase but then stop and come no nearer. Line *b.* of Table I shows the frequency of attacks in this situation. Comparison with the control (line *a*) shows that the intruder plus jacket evokes significantly more attacks than intruder without jacket. Fighting does not give way to posturing (Table I, line *e*); so one can also say that the stimulus evokes fighting more readily than, or preferentially to, posturing.

TABLE I: Responses of Canada Geese to intruder in experimental situations, described in text.

Frequency of attacks	Attack and fight	Do not attack
a. intruder in familiar sweater (control situation)	2	54
b. intruder in jacket	24	5
c. intruder in jacket, and carrying brush	5	18
d. in jacket, and separated by fence ..	3	23
Frequency of posturing	Bent-necked or forward posture	No posturing
e. intruder in jacket	7	22
f. in jacket, and carrying brush ..	21	2
g. in jacket, and separated by fence ..	25	1
h. in familiar clothes, carrying brush ..	3	c.300

The comparisons between rows in the table which are referred to in the text have been tested using X^2 and all found to be significant beyond $P=0.01$.

3. **Flee-evoking situation:** I would go to the geese wearing familiar clothing but carrying a brush or stick. They would watch me. As I got near they would turn and walk or run away, depending on how quickly I approached and whether I waved the weapon at them or not. A complete

record of such visits was not kept. They were very numerous and their effects nearly constant.

4. **Situation combining stimuli to attack and to flee:** I would go to the geese wearing unfamiliar clothing (e.g. a jacket, or shoes instead of boots) and carrying a brush or large stick. They would see me, rapidly raise their heads, then run towards me calling and with heads lowered. Near me they would stop and stand, continuing to call and posture, changing from one posture to another very often and perhaps wing-shaking and preening. When I withdrew they might chase after me, still posturing. Lines *c* and *f* of Table I record the frequencies of attacks and of posturing and show that there were fewer attacks but more posturing to the intruder in a jacket when he carries a brush.

Postures adopted while the geese were running towards the intruder are excluded: so the comparison shows effect of the brush, not the remoteness of the intruder. If postures during approach are included the difference between responses to with-brush and brushless situations is less marked, showing that fear of the brush, though it determines whether posturing or attack occurs once the geese have reached the intruder, has little influence on whether or not they 'threaten' while running towards him.

5. **Situation in which attack is prevented by a fence:** the geese would be first shut in a fenced paddock. Later I would go to them wearing unfamiliar clothes and stand by the fence. They would approach rapidly, as in situations 2 and 4, then stop by the fence, continuing to call and posture. Sometimes they would walk up and down trying to find a way through the fence or just push against it, usually for only a short time. Lines *d* and *g* of Table I record the frequencies of attacks and of posturing in this situation. There was significantly less attack and more posturing to an intruder in a jacket when he was behind a fence.

The prevention of attack by the fence increases the occurrence of 'threatening' postures in just the same way as the brush, *i.e.* a physical barrier has the same effect as the conflicting tendency to flee. Though this seems to be true for the bent-necked and forward postures it is probably not true for some others (notably the erect) which seem to occur only when a tendency to attack and a strong tendency to flee co-exist.

6. **Comparison of effect of intruder with and without jacket, within the thwarting situation:** If threat postures are partly caused by a tendency to attack, stimuli which evoke attack should also increase the likelihood of threat postures occurring. Fighting and threatening do not occur simultaneously. It is therefore best in looking for the effects of attack-stimuli on posturing to consider a thwarting situation, in which fighting does not occur. Line *h*, derived mostly from occasions when the geese were being shut up for the night, contrasts greatly with line *f*: strange clothes enhance the likelihood of the intruder evoking threat. I have no records of the 'control' situation with normal clothes and the fence between me and the geese, though there were many such occasions. Posturing was certainly not at all common in this situation.

Discussion

The experiments show that the same stimulus evoked both attack and bent-necked and forward postures. Two questions arise from this. The first

is whether it is only stimuli which evoke attack that produce these postures. Since these two postures appeared markedly absent from situations where there was no attack evoking stimulus it was not thought important to pursue this question. But ideally it would be necessary to compare the attack-flee situation with another approach-avoidance situation (e.g. feeding or flocking against fleeing) to show that the postures were related to the attack tendency and not to the approach tendency which it involves. Casual observation of various blocked approach or locomotion situations revealed no bent-necked or forward postures or aggressive calls. In fact the Canada Goose seems to have other special calls given whenever locomotion (to whatever purpose) is blocked.

The second question is what factors determine whether the stimulated bird attacks or does not attack but postures instead? Observation shows that fighting and posturing have a negative relationship with each other in addition to the positive relationship of a shared stimulus. In the attack experiments it was seen that fighting did not give way to threat and that it occurred to the exclusion of posturing. Prevention of fighting by presenting a fleeing-evoking stimulus simultaneously with the attack-evoking stimulus, or by a physical barrier which the birds showed no tendency to flee from, allowed bent-necked and forward postures to appear. One can only conclude that in the causation of these two postures some factor which prevents attack is necessary. A known physical barrier and a conflicting tendency to flee will do this equally well. It is also conceivable that a weakly attack-motivated bird may be prevented from attacking by any conflicting tendency, even just the tendency to continue feeding or sleeping.

Comparison of the fence experiments and the brush (attack-flee) experiments enables one to see whether the fleeing tendency is necessary for the causation of a posture beyond being simply a factor preventing attack. It seems to have no effect in the causation of bent-necked and forward threat beyond preventing aggression. But this does not apply to the erect posture, which did not occur in the fence experiments and could only be evoked in the brush experiments, usually only by waving the brush or approaching very quickly (which were described as strengthening the fleeing behaviour in the control situation). In the causation of this posture the fleeing tendency plays a greater part than just as an inhibitor of fighting. Its effect on this posture cannot be mimicked by a physical barrier to attack, both attacking and fleeing tendencies are essential to it. Head-pumping, also sometimes seen in brush experiments and not in fence experiments, may require only a blocked fleeing tendency but no experiments on this were tried. Clearly experiments with blocking a fleeing tendency by a fence would be worthwhile but again casual observation suggests that only head-pumping might possibly appear in this situation.

It is important that, though the geese fled from the brush when I was in normal clothes and they never fled from me by the fence, they had learned that they could not get through the fence by pushing or walking up and down, and that if they tried to get through the fence they would only threaten on ceasing their attempts to get through. Prevention of attack relies on an "internal decision" within the attack-threat system, a choice between behaviour appetitive to attack (trying to get through the fence) and posturing. It seems that repeated failure to succeed in getting through the fence builds

up a block on attacking, and that a *relatively* weak fleeing tendency can have an identical effect. But fleeing differs from inability to get through the fence in that it can vary independently of the attack tendency, and so become relatively stronger than the attack tendency. This seems to be what leads to the occurrence of postures not seen in the fence experiments.

The experiments do not go very far in showing what determines which of the threat postures is performed. Moynihan (1955) has described the importance of various combinations of absolute and relative levels of attack- and flee-tendencies. The differences between the fence and brush experiments show not only that the erect posture and head-pumping require a stronger relative fleeing tendency than do bent-necked and forward but that different relative levels of fleeing tendency can have quite different effects on the attack-threat system: 1) merely preventing attack, which can also be done by other factors, 2) some more far reaching effect which can only be produced by a fleeing tendency.

A way in which experimental demonstration of the difference in causation between bent-necked and forward postures is possible is illustrated by a few observations of the following kind. My wearing slightly unusual clothes (e.g. shoes instead of Wellington boots) evoked weak attack on some occasions, and when behind a fence evoked bent-necked more than forward. This contrasts with the jacket (which gets strong attacks nearly every time) getting mostly forward postures when behind a fence. This suggests that within the thwarting situation, when attack is prevented, the choice between bent-necked and forward postures is determined only by the strength of the attack-evoking stimulus, the potential tendency to attack.

The experiments confirm that some inhibitory influence on attack, at the same time as the presence of a stimulus to attack, is necessary for the occurrence of threat postures. They also show that attack-flee conflict gives rise to threat postures, but that some of them occur whenever attack is blocked while others will occur only when a fleeing tendency conflicts with the attack tendency.

These results make it seem highly probable that the interpretative methods are correct in suggesting that attack-flee conflict is the situation in which threat postures usually occur in nature.

Acknowledgements

I wish to thank J. M. Cullen, K. E. L. Simmons and D. M. Vowles for valuable discussion while some of the experiments were in progress, G. H. Manley, Miss M. F. Hall and other members of the Department of Zoology and Comparative Anatomy, Oxford, for discussion during the preparation of this paper, R. B. Klopman for discussion and comparison with his own observations, and Dr. N. Tinbergen for reading and criticising the final draft of the paper.

References

COLLIAS, N. E. and JAHN, L. R. (1959). Social behaviour and breeding success in Canada Geese (*Branta canadensis*) confined under semi-natural conditions. *Auk* 76:479-509.

MOYNIHAN, M. (1955). Some aspects of reproductive behaviour in the Black-headed Gull (*Larus r. ridibundas L.*) and related species. *Behaviour*, Suppl. 4.

TINBERGEN, N. (1959). Comparative studies of the behaviour of gulls (*Laridae*) : a progress report. *Behaviour* 15:1-70.

INJURY-FEIGNING IN THE ANATIDAE

Frederick V. Hebard

" INJURY-FEIGNING " or some apparently allied form of distraction behaviour performed by parents caring for broods when confronted by a predator has been recorded in at least 58 species of the family Anatidae. But it seems not to occur in a few species and there are many others whose parental behaviour is undescribed. The purpose of this paper is to summarize what is now known in the hope of stimulating further observations and to draw attention to the possible taxonomic value of the presence or absence of such behaviour.

The writer has supplemented his own observations by an extensive search of the literature, including periodicals, and by personal communications. He gratefully acknowledges the help of Dr. James Bond, M. Brooks, jr., B. W. Cartwright, Dr. Clarence Cottam, A. D. Cruickshank, J. Delacour, O. Hawksley, A. W. Johnson, Dr. H. L. Mendall, Dr. A. H. Miller, Dr. A. A. Sanders and Dr. L. H. Walkinshaw.

The following table summarises the available data:

Tribe	Total no. of species	Species in which feigning is recorded	Species in which feigning seems not to occur	Insufficient information
Anseranatini	1	—	—	1
Dendrocygnini	8	6	—	2
Anserini	21	3	3	15
Tadornini	15	8	2	5
aberrant Tadornini	5	—	—	5
Anatini	38	19	2	17
aberrant Anatini	5	2	—	3
Somateriini	4	3	—	1
Aythyini	15	7	3	5
Cairinini	12	3	2	7
Mergini	16	7	4	5
Oxyurini	7	0	1+	6
aberrant Oxyurini	2	—	—	2
	149	58	17	74

(The sequence of tribes, and of species in the subsequent notes, is that of Scott, *Coloured Key to the Wildfowl of the World*, 1957)

DENDROCYGNINI. Published records for *Dendrocygna eytoni, javanica, viduata* and *autumnalis*. Unpublished records for *D. bicolor* and *arborea*. By both sexes, which share incubation and brood-care in whistling ducks.

ANSERINI. Published records for *Anser brachyrhynchus, A. canagicus* (?) and several races of *Branta canadensis*. Seems not to occur in swans. Both parents may take part.

TADORNINI. Published records for *Tadorna ferruginea, cana, tadornoides, variegata* and *tadorna, Chloephaga melanoptera, picta, hybrida*. Both sexes may display in *Tadorna*, but perhaps only female in *Chloephaga*. Seems not to occur in *Alopochen aegyptiacus* and *Neochen jubatus* and perhaps in the aberrant genera *Cereopsis, Tachyeres* and *Lophonetta*.

ANATINI. Published records for *Anas angustirostris, erythrorhyncha, bahamensis, georgica, acuta, crecca, gibberifrons, platyrhynchos, rubripes porcilorhyncha superciliosa, undulata, sparsa, strepera, americana, discors, cyanoptera, platalea, rhynchotis* and *clypeata.* Usually by female only, but has been recorded for both parents in *A. erythrorhyncha, crecca, acuta* and *platyrhynchos.* Not yet recorded for *A. penelope* and *querquedula,* amongst often-seen species.
Recorded also in *Malacorhynchus membranaceus* and *Rhodonessa caryophyllacea.*

SOMATERIINI. Recorded for females of *Somateria mollissima, spectabilis* and *fischeri.*

AYTHYINI. Published records for *Aythya vallisneria, americana, australis, novae-seelandiae, collaris, fuligula* and *affinis,* but not for *ferina* and *marila.* Females only (males take no part in brood-care). Seems not to occur in *Netta erythrophthalma brunnea* and no records for other species of *Netta.*

CAIRININI. Published records for *Chenonetta jubata, Aix galericulata* and *A. sponsa.* Seems not to occur in other species, but of these only *Cairina moschata* and *Plectropterus gambensis* are well-known.

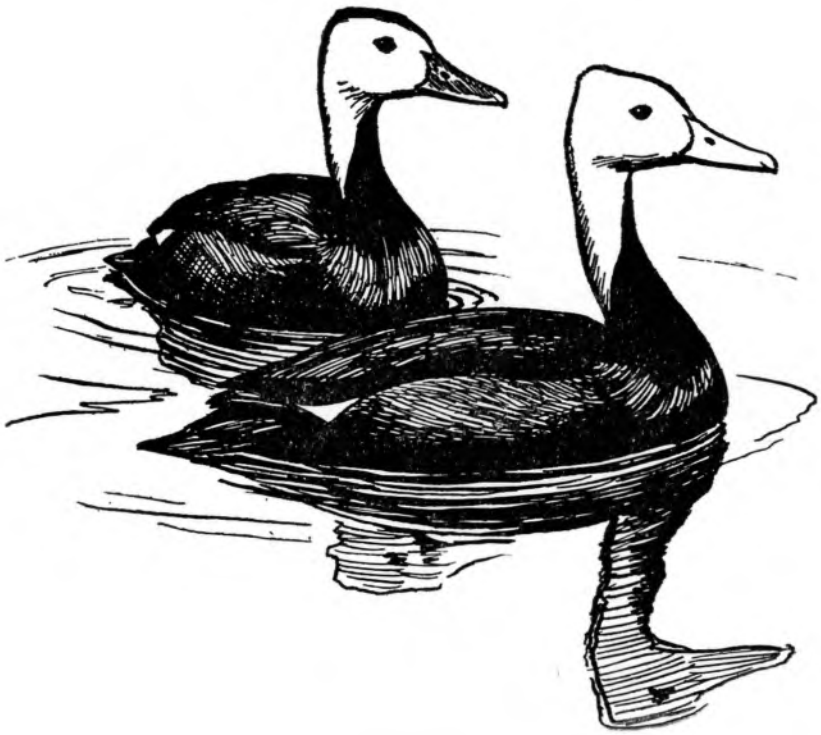
MERGINI. Records for *Melanitta fusca, Histrionicus histrionicus, Clangula hyemalis, Bucephala clangula, Mergus cucullatus, M. serrator, M. merganser.* Not recorded for *Melanitta migra* or *perspicillata, Bucephala albeola,* or *Mergus octosetaceus.*

OXYURINI. Seems never to have been recorded for any species, though only *Oxyura jamaicensis* has been much studied.

Sowls (*Prairie Ducks* pp. 147-149. 1955) has distinguished "feigning behaviour" from "tolling": "A hen is said to *toll* when she diverts an intruder's attention from her brood by moving deliberately and conspicuously from it... [for" "] A hen is said to feign when she exhibits a spectacular flapping movement across water or land similar to the escape behaviour of flightless moulting birds. This behaviour seems to attract attention away from a hen's brood as in tolling, but the hen uses a flapping movement across land or water whereas in tolling she swims or flies."

Only accounts which appear to refer to feigning have been used in compiling the foregoing notes. It would be helpful if observers seeking to fill the gaps in our knowledge would describe the actions seen in some detail and also note whether the intruder eliciting the behaviour was a man, another mammal or a bird.

A bibliography of the published records is filed at the Trust headquarters.



Pink-headed Duck

THE PINK-HEADED DUCK *Rhodonessa caryophyllacea* (Latham)

Sálim Ali

FOR the last ten years or so there has been continuing effort on the part of the Bombay Natural History Society through its widespread membership in India and sportsmen in general to re-discover the Pink-headed Duck, or at least to obtain some dependable clues concerning its present status. To obviate the possibility of this duck being confused in the field with the much commoner Red-crested Pochard (*Netta rufina*) by casual duck shooters, as had often proved to be the case, coloured illustrations of both species side by side were prepared and widely distributed two years ago to forest and district officials, private hunting organisations, individual sportsmen, and other likely informers, particularly in its known range of distribution. It is significant that since these illustrations went out, the sporadic claims made from time to time of the duck being seen have ceased. The conclusion to be drawn is either that the Pink-headed Duck has indeed become extinct as was feared, or that if perchance there are any lingering survivors they keep strictly confined to the seclusion of some remote and inaccessible areas and do not overflow outside at any season as they apparently not infrequently did in former years when the species was less rare. All things considered, the

former assumption seems the more plausible. Otherwise it is difficult to conceive that from the hundreds of sportsmen who regularly shoot ducks in north-eastern India, in the known habitat of the species, the tens of thousands of ducks shot every winter there should not turn up a single specimen bagged or seen, or even in the Calcutta bird market where up to half a dozen or so live birds could be seen in most winters in the 1890's and up to the first decade of the present century.

The recorded history of the Pink-headed Duck, such as it is, is well known and no new information has emerged within recent years. Since it was first described in 1790[1] the species has at no time been recorded as common anywhere. In fact it was always considered rare enough to be taken notice of, even by such sportsmen as seldom bother to vet their bags and to whom the significance of a duck is merely how it tastes!

An anonymous writer[2] in the defunct *Asian Sporting Newspaper* (Calcutta) of 17th August, 1880, describes the bird as a permanent resident of Bengal, which he considered to be its headquarters. Bengal 'Presidency' in those days included Bihar, Orissa, and western Assam—all localities whence most of the existing museum specimens are derived. He also mentions east Bhagalpur immediately north of Ganges River, and the southwest portions of Malda district. In the cold weather, November to March, he observed the birds in flocks of 6 to 30 or even 40 in lagoons adjoining large rivers. They were paired off during April, nesting in May, and he found eggs in June and July. He describes the nests as circular, well built, of dry grass and a few feathers, about 9 inches in diameter and 4-5 inches deep, with walls 3-4 inches thick, without any special lining. They were hidden in the middle of tufts of tall grass, difficult to find, generally not more than 500 yards from water. The eggs, unlike those of other ducks, were round, close textured, glossless white. Clutches consisted of 5-10 eggs. The average measurements of 8 eggs from two different nests are given as 1.75″ x 1.62″ (= *ca.* 44 x 41 mm.), while two very round ones measured 1.71″ x 1.66″ (= *ca.* 43 x 42 mm.). Both birds were flushed near the nest, but he was unable to ascertain if both sexes, or which, incubated. When the young are fledged in September, he writes, the birds return with the receding waters to the jungly lagoons. In July 1880 nests were reported from the northern extremity of Patraha Katal (or jheel) in grass jungle on the banks. A breeding female, though unhurt by shot, fluttered about and dragged herself when approached, flew totteringly with loud quacking 6 feet above the water, and flopped on the grassy land as if badly wounded. This manoeuvre was repeated when again approached; finally the bird rose in the air and flew off perfectly. Weights of 5 males shot between 13th February and 28th June are given as 2 lb. 3 oz. (13th Feb.); 1 lb. 14 oz., 2 lb., 1 lb. 13 oz., 1 lb. 12 oz. (28th June). Other details available in the scanty literature on the Pinkhead are that it is a surface-feeding duck like the Spotbill (*Anas poecilorhyncha*) but can dive with celerity like a pochard, and that it sometimes perches on trees, though Finn calls it a 'non-

[1]Latham, *Index Ornithologicus* 2:866. Later Latham described it as common in Oudh, living in pairs, often kept tame, and becoming "tolerably familiar."

[2]Evidently F. A. Shillingford, a correspondent of A. O. Hume, responsible for most of the basic information we possess about the Pink-headed Duck in the wild state.

percher.' Tickell[1] in comparing this species with the Mallard says: "The neck is longer and thinner; the high position of the eye and the very gradual slope of the forehead give it a widely different look from *Anas* proper, more allied to *Dendrocygna* (Whistling Teal) . . . "

The above accounts are the principal 'source material' for practically all that has been written about the biology of the species, and the same information, in one form or another, has passed on from author to author.

Although a few live specimens have reached Europe from time to time, the Pink-headed Duck has never bred in captivity. The nuptial display of the male, said to resemble that of the Mallard, is imperfectly known, and the down plumage of the young not at all.

Probably some of the very last living examples of this duck were the eleven birds I was fortunate enough to see in the aviaries of the late Mr. Alfred Ezra in Foxwarren Park, near London, in December 1929. These birds had been shipped to him from Calcutta by his brother, Sir David Ezra, and were believed to come from the Goalpara district of western Assam, though their exact provenance was never disclosed. In spite of highly tempting monetary rewards offered during the last 30 years or so, it is ominous that not a single specimen has been produced by professional trappers. As a precautionary measure the capture or killing of the Pink-headed Duck, and the taking of its eggs has, since 1956, been totally prohibited by law, but it is clear that unfortunately protection has come too late. The last reliable sight record of the duck is of June 1935, by the late Mr. C. M. Inglis, in the Darbhanga district of Bihar.

The extinction of the Pink-headed Duck cannot be ascribed wholly to human vandalism though in the later stages killing doubtless helped to accelerate the pace. As a species it appears to have already reached a low threshold of numbers during the 19th century. The phenomenal growth and spread of human population in India in the bird's erstwhile habitats, and the consequent reclamation for cultivation of more and more of the swampy grass jungles it loved, have contributed to seal its doom. That small numbers may still linger in some remote refuge is perhaps wishful thinking but not an impossibility, although recent failures in the search make it seem highly improbable.

From the scrappy literature alone it seems difficult to form any adequate estimate of the comparative abundance enjoyed by this duck during the 170 years since first recognised by science. One reads statements like this of Jerdon (1863): "This very lovely duck is most common in parts of Bengal, but is found at times throughout northern India, is rare in the N.W. provinces, and still more so in Central and Southern India." Or this of W. T. Blanford (1898), "Fairly common and resident in Upper Bengal, in the districts of Purneah, Maldah, and Bhagalpur, and in Tirhoot . . . " And lastly this of Stuart Baker (1929), "In former days they were not rare in parts of Eastern Bengal and sometimes half a dozen could be picked up when returning from a tiger shoot . . . " (with a line of elephants beating through thick grass or forest with overgrown ponds and swamps). What are we to understand by

[1]MS. of 'Indian Ornithology', written in the 1860's (?), never published. Now in the library of the Zoological Society of London.

"most common", "fairly common", "not rare" and "rare" in this context (Jerdon, 1863, Birds of India: 80, Fauna of British India, ed. 1, 4:426, Fauna of British India, ed. 2, 6:391)?

In an attempt to get some more concrete idea concerning the former numerical status of this unique duck, and perhaps build up a more complete picture of its overall distribution from specimens preserved in the major ornithological collections of the world, I recently addressed a large number of likely museums asking for data about any skins of the Pink-headed Duck that may be in their charge. The positive information received is summarised below. It makes a revealing documentation and should prove useful to future research workers, particularly since it is unlikely that any fresh acquisitions of the Pink-headed Duck will be possible in the future. The total number of skins preserved in museums, excluding the two in Japan (ex Ezra aviaries, Calcutta) that were destroyed during the recent wartime bombing (Yamashina, personal communication) is now 71. Allowing an extra 10% for any specimens unaccounted for in other public or private collections, one may take it that there are probably not more than 80 skins all told in existence to-day. Considering how zealous museums must have been all along to acquire specimens of this unique and beautiful duck, the meagreness of the number represented in world collections is symptomatic of its rarity. The oldest skins (mounted) are in Paris (Museum Nationale d'Hist. Naturelle) dated 1825; the youngest "wild" skin is probably the one in Yale Peabody Museum collected by C. M. Inglis in Darbhanga district, N. Bihar in 1923. I am doubtful about the two 1924 Kheri (U.P.) skins in the U.S. National Museum, Washington, and in the American Museum of Natural History, New York, as to whether they were killed in that year or merely presented then to the visiting Vernay-Faunthorpe Expedition by their host Mr. L. W. Hearsey, being actually collected earlier. If shot in 1924 this would seem to be the very last record of the procuring of a wild specimen. Museum skins with dates later than 1923 (latest 1936) are all of captive birds that died in aviaries, principally of the brothers Ezra, either in Calcutta or in London.

Since 1936 there is no reliable record known to me of a living Pink-headed Duck either in the wild state or in captivity. In a recent letter, however, Mr. H. G. Deignan says: "I seem to recall that Sir David Ezra showed me a living male in his aviaries in Calcutta in 1945." If there was such a bird it is not known where its skin rests at present. It must certainly be considered the very last example to be seen alive.

SPECIMENS OF THE PINK-HEADED DUCK (*Rhodonessa caryophyllacea*) PRESERVED IN WORLD MUSEUMS

UNITED KINGDOM

British Museum (Natural History)

No. of skins	Sex	Locality	Date	Remarks
8	♂	"India". "N. India", Purneah	Many without. Earliest 7th Mar.,	Total 21 specimens in 57 years.
10	♀	dist.. "Bootan", Calcutta, Nepal,	1879 ("Calcutta") latest 8th May.	7 of above ex-captivity Ezra
3	o?	"Baghownie. Tirhut, Bihar",	1936 (ex-captivity, Ezra).	between 1929 and 1936.
		"Madras". "ex-captivity".		

Royal Scottish Museum, Edinburgh

1	♂	Nil.	Nil.	Mounted. From collection of Sir Wiliam Jardine.

The Wildfowl Trust, Slimbridge

1	♀	Nil.	"from before war" = the 1930s.	ex-Alfred Ezra's aviaries.

UNITED STATES OF AMERICA

American Museum of Natural History, New York

2	♂	"India". "Mandalay Bazaar",	Earliest date 1898; latest 1936.	Includes 3 skins ex-Ezra aviaries.
4	(♂)	Calcutta market, "ex-Alfred Ezra's		
1	♀	aviaries", "N. Kheri dist., S. border of Nepal".		

Smithsonian Institution, U.S. National Museum

1	(♀)	"N. Kheri dist., near S. border of	1934 (*sic*) = 1924	Vernay-Faunthorpe Exped.
1	♀	Nepal"		
1	♂	ex-captivity A. Ezra		

Academy of Natural Sciences of Philadelphia

1	♂	Nil.	Nil.	Part of Rivoli Massena Collection. Received by Academy in 1840

Museum of Comparative Zoology, Harvard College

1	o?	Nil.	Nil.	From Baron Lafresnaye's Collection

Peabody Museum of Natural History, New Haven

No. of skins	Sex	Locality	Date	Remarks
2	♂	1 ex-captivity Ezra, Calcutta (said		
1	♀	to come from Dhubri)	*ca.* 1930	
		"Bhagownie. Darbhanga dist., N. Bihar"	7th April, 1923	ex-coll. C. M. Inglis

INDIA

Bombay Natural History Society

1	o?	"Kheri dist., U.P.", Calcutta Mar-	Earliest 1897: latest 1921	
3	♂	ket, Alipore Zoo, "Darbhanga, N.		
1	♀	Bihar", "Singu, Koolag, Upper Burma"		

Zoological Survey of India

8	♂	"Burma", Calcutta Market, Alipore	Earliest pre-1843; latest 1926	
8	♀	Zoo, ex-Ezra aviaries		

GERMANY

University Zoological Museum, Berlin

1	♀	"Assam"	?	Ex-coll. J. McClelland. Acquired from Calcutta 1843
1	♂			Died in Zoo. Berlin. 1908

Senckenburg Museum, Frankfurt

1	♂	"Calcutta"	Nil	

FRANCE

Museum Nationale d'histoire Naturelle, Paris

2	♀ (or imm.)	"Calcutta,,' "Bengal", "Calcutta	Earliest 1825 (Duvaucel); latest	4 mounted and 2 cabinet skins
2	♂(ad.)	Bazar", "Jessore"	1881	
2	♀(ad.)			

("Delacour had a number in his aviary (1930-35) same time as Ezra. Received from Calcutta"—Berlioz)

NETHERLANDS

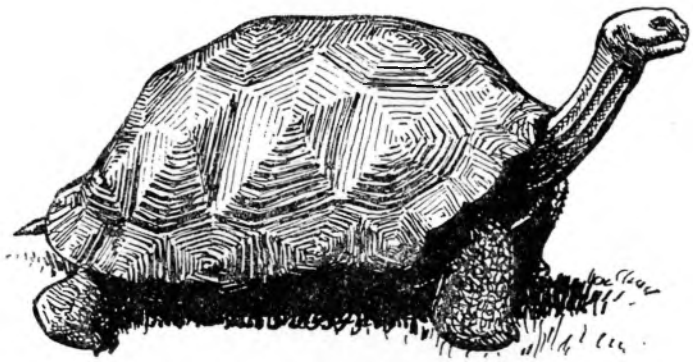
Rijksmuseum van Natuurlijke Historie, Leiden

1	♂	"India"	Nil	Old mounted specimen

SWEDEN

State Museum of Natural History, Stockholm

2	♂(ad.)	One obtained Bhagownie, Bihar	25th July, 1910	Received through Col. F. M. Bailey
		One, probably from his aviary. from A. Ezra	October, 1927	



Giant Tortoise

BBC/IUCN DARWIN CENTENARY EXPEDITION

to the British Virgin Islands, Trinidad, Panama, Ecuador and the Galapagos Islands. January—March 1959

Peter Scott

THAT pretentious title was given, almost in jest, to our latest filming excursion. My wife and I were accompanied by Tony Soper as cameraman. We left England on 5th January, 1959, spent ten days in the British Virgin Islands, as the guest of H.H. the Administrator, Mr. Geoffrey Allsebrook, a week with Dr. William Beebe, the veteran American explorer and zoologist at Simla, his remarkable tropical research station in Trinidad, a week at the equally famous research station on the island of Barro Colorado in the Panama Canal Zone, a few days in Ecuador and five weeks in Galapagos. All our major journeys were by air.

Of the Anatidae only three species were seen—the Masked Duck *Oxyura dominica* (L.) in Panama, the Colombian Torrent Duck *Merganetta armata colombiana* Des Murs in Ecuador and the Galapagos Pintail *Anas bahamensis galapagensis* Ridgway.

The British Virgin Islands

Our stay in the British Virgin Islands was perhaps chiefly memorable to us for the fishes on the coral reefs. We distinguished something over a hundred species, most of which we have since been able to identify. I made drawings of them underwater using wax pencils on plastic sheets and the sketches were transferred to a notebook in watercolour. We also filmed underwater using aqualungs. The water was not as clear as it sometimes is in those parts, because of a storm immediately before our arrival, but in spite of that the reefs were full of interest, and as ever, fantastically beautiful.

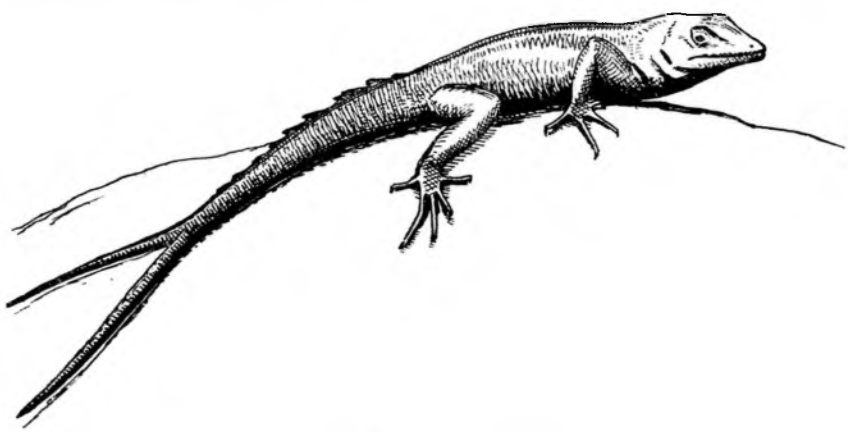
In the garden of Government House at Road Town, Tortola we learned the entertaining and exciting game of fishing for large ground spiders in their holes with the fluffy flower head of a grass which the spider grips and by which it may be jerked out into the open. This technique enabled us to catch

and film spiders which were more than four inches across. We filmed Brown Pelicans diving for their food, plunging in spectacularly from thirty or forty feet up, and went on horseback to a Nature Reserve on the top of Sage

Peripatus

Mountain in the centre of Tortola where to my delight we found a Peripatus; it was the first time that I had ever seen this strange caterpillar-like animal which bridges the gap between the worms and the arthropods, and catches its prey by squirting a sticky viscous jet at it. On our return to sea level my horse, Blackie, ran away with me for a mile along the wrong side of the road, narrowly missing a head-on collision with a Land Rover; but fortunately I managed to stay on until he got home.

On the bole of a tree on Bellamy's Key—a tiny island in Trellis Bay—we discovered a male Anolis Lizard with two tails, the second evidently regenerated from a crack rather than a clean break in the original tail. The result was a symmetrical Y shaped tail. This lizard became the emblem of a beautiful holiday hotel on the island.



Anolis cristatellus Male with double tail

Trinidad

The Tropical Research Station of the New York Zoological Society is in the Arima Valley in northern Trinidad. Simla is its name and Dr. William Beebe is its Director. At 82 Dr. Beebe (one of the original explorers of the deep-sea in his bathysphere) is still very much the driving force of the station. Dr. Jocelyn Crane, his second-in-command, welcomed us in a most friendly fashion, and we stayed there a week. Dr. Crane is working on the evolution

of the behaviour patterns of certain invertebrates, especially fiddler crabs, butterflies of the family Heliconiidae and praying mantises.

Dr. David Snow, the ornithologist of the Research Station, took us to see the Guacharos or Oil Birds *Steatornis caripensis* which live in caves through which the Arima River runs and emerge only at night to feed principally on the fruit of the oil palm. They are about $2\frac{1}{2}$ ft. across the wings and are distantly related to the Nightjars. The name Guacharo seems to come from their loud and eerie cry, but more interesting is their high pitched clicking noise whose echo provides a system by which they can safely fly in caves which are completely without light. They also have interesting bristly whiskers which no doubt help them in feeling the whereabouts of eggs and young.

Dr. Snow also showed us the nests of three species of hummingbirds and the striking display of the Black and White Manakin *Manacus manacus* which he has been studying. We filmed and recorded a display ground, where in the half light of the deep forest about 25 males each have a 'court' in which they bob up and down and dash about like little squibs, making a noise like a whip-crack with their wings.

Panama

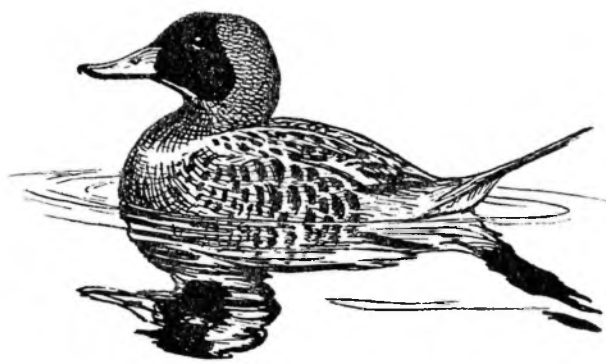
At the U.S. Air Force Jungle Survival School in Balboa the Director, Mr. Morgan Smith, showed us a number of animals brought in by his students from their jungle exercises. These included some interesting snakes including two very large Boa Constrictors, an interesting and rare lizard subsequently identified as *Mornnasaurus annularis,* and a Three-toed Sloth, green with the algae which live in its grooved hairs and plentifully supplied with the parasitic moth (about twice the size of a clothes moth) which I had never seen before. Later Mr. Smith took us to a place where I hoped to get underwater film of tropical fish. It was a feeder to the canal, thickly overhung with forest. I was about to enter the water with mask and flippers when we made the discovery that we were standing on a recently hatched cayman's (crocodile's) nest. Mr. Smith assured me that these caymen were " quite docile " (in American pronunciation the word rhymes with fossil) and so I took to the water. Almost at the same time there was a rustle and a splash a short distance up the bank. The water was not very clear, and there were practically no fish, so after an excursion fifty yards down stream and back I returned rather thankfully to shore. I could not see how in the muddy water even the most docile crocodile could be expected to distinguish me from its legitimate prey. As we withdrew along the bank we found the tracks of the basking cayman we had disturbed. Mr. Smith estimated it was 7-8 feet long.

The Smithsonian Institution's Research Station at Barre Colorado, an island in Lake Gatun in the Panama Canal Zone, is remarkable for the number of native mammal species. Staying at the Headquarters on the island we were awoken before dawn on the first morning by the echoing cries of a band of Howler monkeys in the trees immediately round the station. Coatis were common in the island and a band of them lived round the buildings as scavengers, becoming quite tame. Also semi-tame were a couple of young Collared Peccaries or Wild Pigs and a young Tapir.

At night ultra-violet and white lights were burning outside the main buildings and great numbers of moths and other insects were attracted, including several beautifully adapted leaf-mimicking Bush Crickets and an equally perfect leaf-mimicking Mantis.

Swimming in Lake Gatun from the island's jetty we identified several species of tropical fresh water fish including a *Molienesia,* two species of Tetras and a fine blue Cichlid.

But perhaps the most important day in the Canal Zone we spent going up the Chagres River in an air-thrust boat to look for the Masked Duck, one of the six remaining species of the 147 species of Anatidae which I had never previously seen alive.



Masked Duck *Nomonyx dominica*

Dr. Martin Moynihan, the Director of the Station, who is studying behaviour in monkeys, but had also previously studied the Stiff-tailed Ducks, took us to a place above Gamboa in order to find them. My diary records the day as follows:

'On Friday, 30th January, set off in the dark by boat to the Railway Station at Frijolles. Freight train to Gamboa, where dawn was breaking as we embarked in an aluminium boat with air-thrust propeller. Mosquitoes were bad at first light, but as the dawn broke they departed and we buzzed up the Chagres River with the boatman Chi-chi at the helm. Many little black Jacanas with yellow-tipped red bills and yellow primaries and secondaries were along the floating weeds at the edge of a wide expanse of shallow river. Frogs were singing loudly in one spot although we could never manage to see the animals themselves. Close behind a small log I saw the head of a Cayman (local crocodile) with eyes just above water. He must have been about three feet long. There was a very tame young Blue Heron *Florida coerulea* (the juvenile plumage is pure white) catching insects and fish quite unconcernedly within about four yards of us. We saw Purple Gallinules, a Moorhen, American Coots, a tiny rail, three kinds of grebes, an Osprey and some Hangnests. I swam in spite of the crocodile risk and saw Mollies and Tetras, and Cichlids and a Gudgeon-type fish (probably an Eleotrid). The Cichlids were a foot long and chunky with a blue pattern and I met what appeared to be an albino.

There were big Terrapins which were exceptionally wild. They went off the log on which they were basking at fifty yards.

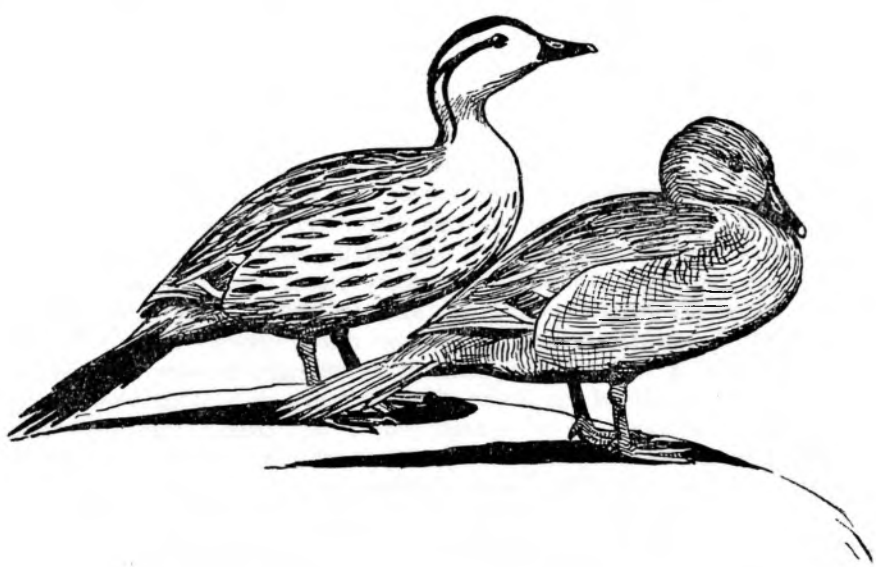
After my swim we crossed to a new area of pools and white water lilies and water hyacinths and there, as the air-thrust engine stopped, we looked at five little reddish-brown ducks swimming slowly away from us through the thick weed. We saw at once that they were Masked Ducks—the object of our day's excursion—two males and three females. They were not unlike what I had expected them to look like. Two of the five carried their tails up, the other three down on the water. They soon went to sleep again and we sat and watched them. Their heads were flat topped and seemed very large—about half the length of the body; the tail was long, otherwise in shape they looked rather like *Thalassornis*, the African White-backed Duck. The female's heads were most strikingly marked so that I thought of young Great Crested Grebes or of the Labrid Fish *Scarus croicencis*, the Mud Belly. We watched them for perhaps twenty minutes during which they did practically nothing. Then we tried rather ineptly to get closer and they flew up when we appeared at thirty yards. There were striking white patches in the wings which showed only when they flew. We never saw them again though we hunted the marsh in the direction they took. We found a flock of fifty Lesser Scaups and had lunch on a forest point which offered a dry shod landing where I sat down in an ant's nest and was badly bitten . . . '

Ecuador

Most of our time in Ecuador was spent preparing and making arrangements for our trip to Galapagos but we had time to make a short excursion to look for Torrent Ducks. Mr. Robin Copping of the British Embassy, who is an excellent amateur naturalist, took us to the San Pedro River on 5th February, 1959.

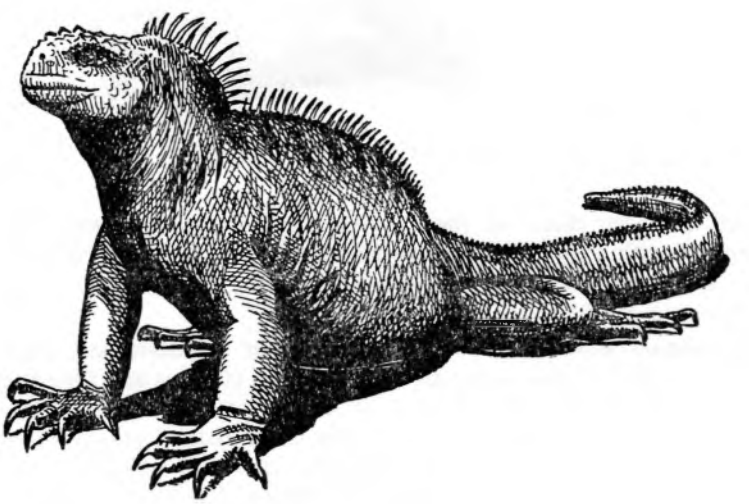
' We stopped the cars where the road and railway cross a large fast flowing river by a natural bridge. The river was far below and on stones beside it there was a pair of slate grey flycatchers behaving exactly like wagtails. Sr. Ponce, a local ornithologist who came with us as guide, said that the Torrent Ducks were to be seen on this stretch in the early morning. We began to work our way down the left bank of the river; there were frequent sets of rapids and fine vertical cliffs in many places with a marvellous red flowered Bromeliid growing on them attended by a large dull-coloured hummingbird. A sandpiper, many doves, an oriole—yellow and black and white—and three or four other species of hummingbirds were all that we saw. There was no sign of the ducks. We had lunch on a slope overlooking the river and Sr. Ponce said he thought that at this time of day the ducks were resting on some rocky ledge under the banks and the time of day to see them was seven a.m. We finally decided to strike on towards a river junction some way further down stream. At the next corner we were taking a short rest when two young Ecuadorians appeared with muzzle-loading guns and offered some beans called Guava, the pod is olive brown and furry and

inside the beans are surrounded by a soft cotton-woolly substance which tastes as Robin Copping said of flowers. You suck it off the bean, which you spit out. The two young hunters moved off and presently we heard them shout and saw them waving on the hillside a quarter of a mile away, from which point they could see down the next reach of the river. Sr. Ponce went off at the double then came back at the double for Tony's camera which he had been carrying, and was off again. We followed trying to keep in touch along tortuous tracks through the thick underbrush, tracks evidently made by cattle, which became in places low tunnels through the dense cover; often we had to bend double to get through. Eventually scratched and breathless we reached the group overlooking the river and they pointed excitedly down stream. There sure enough was a female Torrent Duck fishing at the edge of the rapids. She kept jumping up on to a stone then into the torrent again to dive at once. She stayed down for about ten seconds and then emerged and hopped up on to the next stone, all the time working upstream. Then I saw another female nearer to us; she fished up towards us until out of sight under the cliff below. Suddenly Sr. Ponce spotted another upstream near to where we had eaten our Guava beans and where Robin and the little Ecuadorian boy were still sitting. This turned out to be one of a pair and we had a fleeting glimpse of the male at fairly long range. We planned to creep into position by the river and then get Sr. Ponce to move the birds gently past us. This Phil and Tony explained to him in impeccable Spanish and we set off. As we reached the river we saw a pair of the ducks on some rocks opposite and quite close to us, but they did not stay long enough for us to film them. They dived at once and were away down stream. We hoped that the upper pair was still undisturbed but we found that Robin had been trying to drive them down to us so that in fact the ones we'd seen were the same birds, which established that only four Torrent Ducks were present, one male and three females. They seemed to be just as elusive here as we had found them in Bolivia in 1953. As all four had now disappeared we started back. We were



Pair of Colombian Torrent Ducks *Merganetta armata colombiana*

only a few hundred yards from the road and the cars when I spotted a single drake fishing in a set of rapids. We watched him preening on a stone for ten minutes or more, then stalked down through a field of maize emerging about thirty yards from the rock where he was sleeping. Eventually he moved downstream after which, although only 60 yards away, he was unwilling to move any further but remained on a ledge of the cliff two or three feet above the water apparently asleep with his head to one side but not under his wing. During the preening and in walking up the side of the rock he had frequently used his tail as a support almost like a woodpecker. We had had a very good look at his plumage. There was no suggestion of a dark neck ring as in the southern races and this was as far as I could tell from both male and female a typical Colombian Torrent Duck. We left him sitting on his ledge, and so back to Quito.'



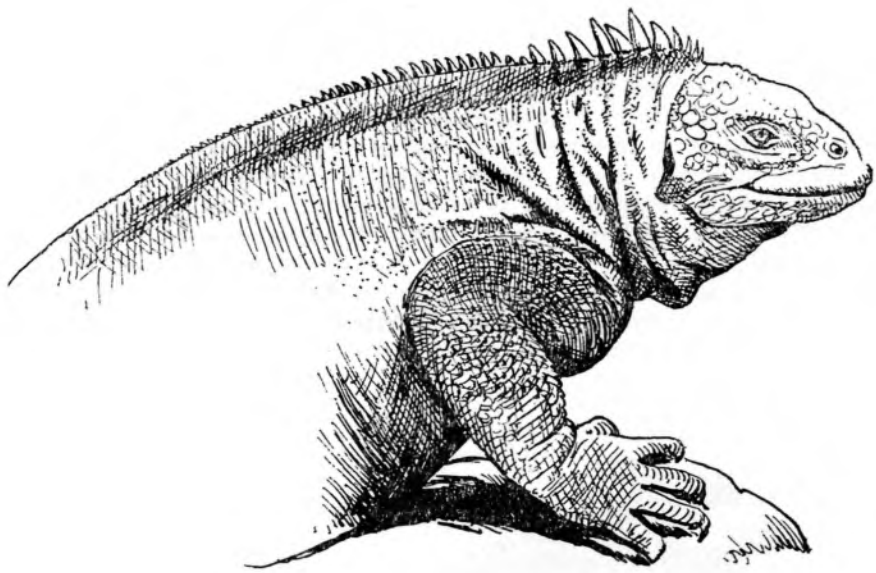
Marine Iguana *Amblyrhynchus cristatus*

Galapagos

We flew the six hundred miles from Guayaquil to the Galapagos Islands in a Curtis freighter of the Ecuadorian Airline, L.I.A. The islands are volcanic and lie astride the Equator, but for most of the year they are cooled by the Humboldt Current sweeping up the coast of Chile and Peru from the south. We were there however in the rainy season when it was often very hot.

The name Galapagos means Tortoise, and the Giant Tortoises are called Galapagos by the Ecuadorians. All the islands have two names—the modern Ecuadorian name and an old English name dating from the days of the pirates and buccaneers. Thus the seat of government is at Wreck Bay on the island of San Cristobal or Chatham.

The largest island, Isabela or Albemarle, is seventy miles long, and nine of the archipelago are more than five miles long. Only four of them are



Land Iguana *Conolophus subcristatus*

inhabited and on three of these there are colonies of several hundred Ecuadorians with a sprinkling of European settlers. The craters of some of the islands rise to five thousand feet and a volcanic eruption took place in late 1959 (after our visit).

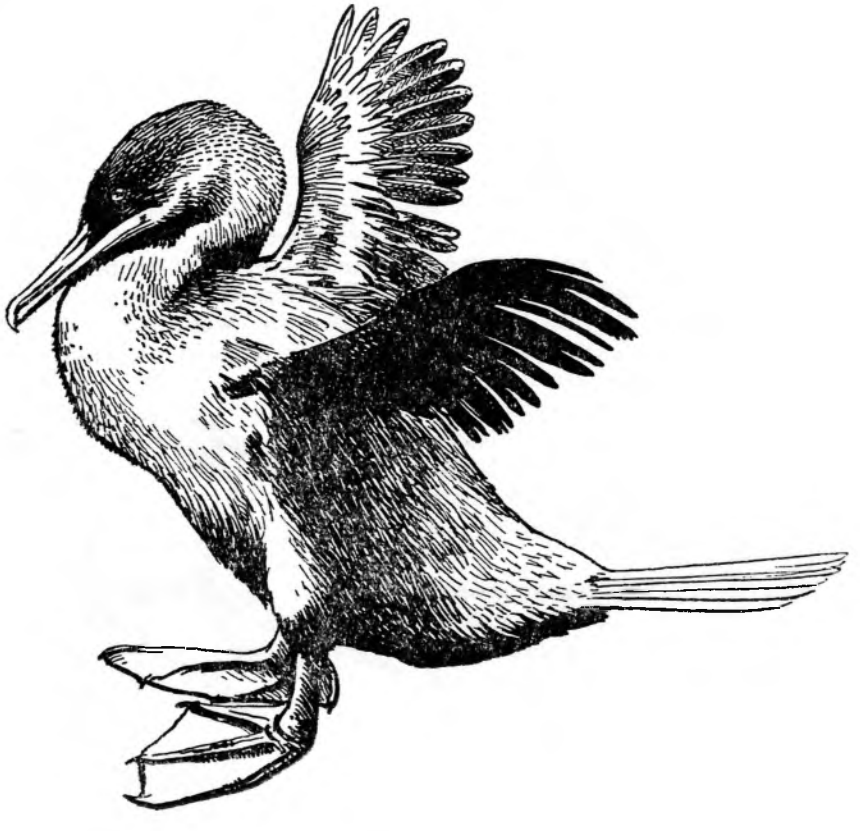
The islands show astonishing contrasts: for the most part they consist of dry lava rocks with extensive growth of Cactus (*Cereus* and *Opuntia*) which in some places become thirty-foot-high trees. But the higher central parts of the islands are much damper due to the cloud (called *garua*) which hangs over the peaks for much of the year. In some cases the highlands consist of a green moorland but the lower slopes are thickly forested with rich tropical 'moss forest.'

The Galapagos Islands played an important part in Darwin's conception of the theory of Evolution. During the voyage of the Beagle he noticed that not only were the Galapagos species different from those of the mainland, but that on each island they were slightly different from those of neighbouring islands. This could not be reconciled with the current belief that species were created and immutable. His observations of the finches and mockingbirds and the land reptiles, perhaps more than any other single influence, convinced Darwin of the fact of evolution.

The Galapagos are oceanic islands which have never been connected to the South American Continent. Presumably the terrestrial species such as the Giant Tortoises *Testudo,* the Land Iguanas *Conolophus,* the Lava Lizard *Tropidurus,* the Snake *Dromicus,* the Gecko *Phyllodactylus* and the native Rat *Nesoryzomys,* originally reached the islands by very rare accidents, riding perhaps on rafts of dead timber and weed which come drifting down the mainland rivers. One such accident might bring more than one species at a time but it seems certain that there have been several separate 'arrivals' of

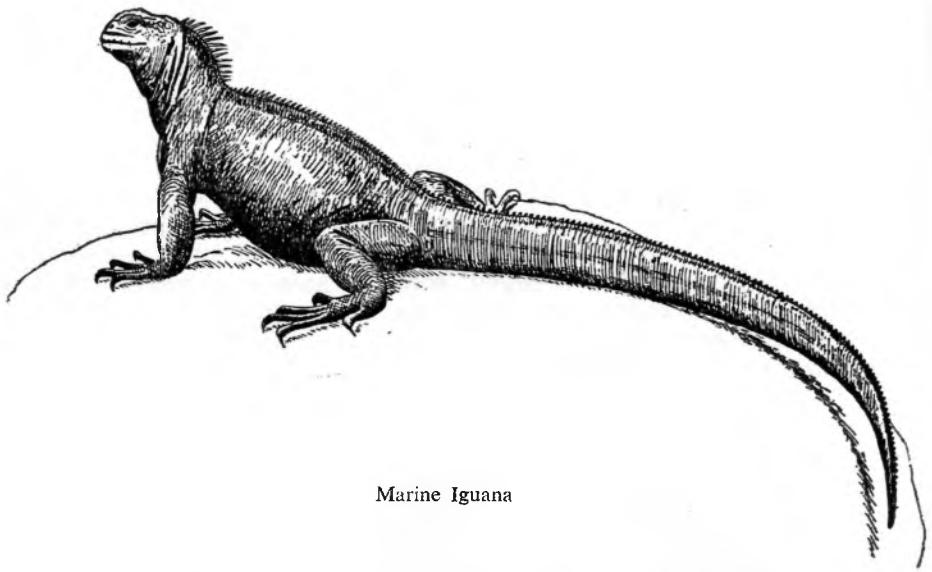
this kind. At one time the main part of the archipelago was probably a single much larger island upon which the initial colonisations took place. Subsequent subsidences left only the tops of the mountains as separate islands, on which the various species developed racial and even specific characters. A number of sea level changes of this nature in both directions may have played an important part in the startling adaptive radiation shown by Darwin's Finches. On the island of Isabela there are five volcanic peaks and five different races of Giant Tortoises have been reported from this one island (all are believed to be either extinct or on the edge of extinction). On this island the marks of marine molluscs (*Chiton*) and echinoderms have been found at more than 300 feet above present sea level. Clearly there have been many changes in sea level since these islands first appeared.

Darwin described the fauna of Galapagos as eminently curious and this it most certainly is. The native animals are almost all unique to the islands even if only as in some cases a Galapagos subspecies. A number of them are still probably as numerous as they have ever been but others are seriously threatened by the direct and indirect effects of human colonisation. A good example of the difficulties which they face is given by the Tortoises already extinct on several of the islands and clinging on by the narrowest margin on others. On the island of Santa Cruz or Indefatigable we were lucky enough



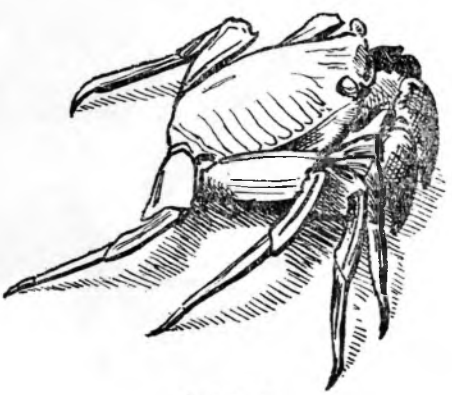
Flightless Cormorant *Nannopterum harrissi*

to see seven of these magnificent reptiles, the largest about 4 feet 6 inches long. They are hunted for their flesh and for their oil by the Ecuadorians; their eggs are dug up by the hordes of feral pigs which have run wild on most of the islands; their young, while their shells are still soft, are eaten by the feral dogs; and their green food is eaten (in some places bare) by feral goats, donkeys and cattle.



Marine Iguana

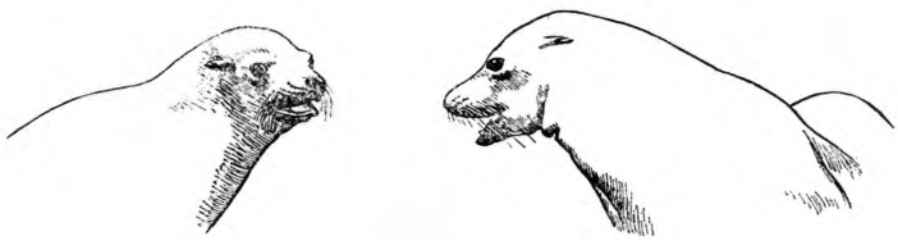
Other species whose numbers are dangerously small are the Flightless Cormorant *Nannopterum harrisi*—the largest cormorant in the world—and the little Galapagos Penguin *Spheniscus mendiculus;* it is doubtful whether more than a few hundreds of either exist. Two more very rare species are the Flamingo, which may be no different from the West Indian Flamingo *Phoenicopterus ruber* (though it may prove to be distinct), and the Fur Seal *Arctocephalus galapagoensis* which is confined to a very small number of colonies. The Land Iguana *Conolophus,* a splendid nearly three-foot-long brown lizard with yellow head and legs, is now to be found only on four islands.



Red Crab

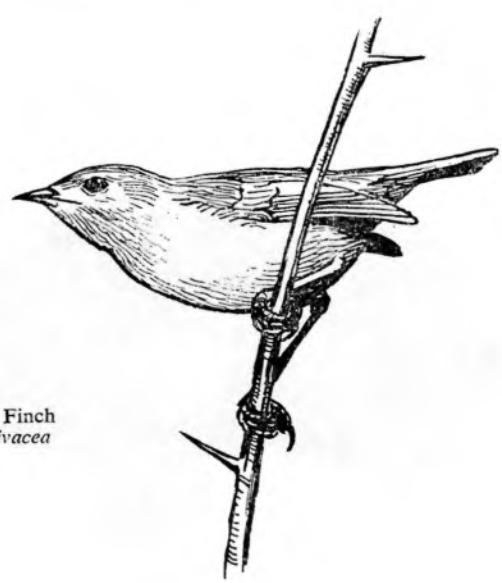
Happily the Sea Iguanas *Amblyrhynchus cristatus,* the most striking of all, are still common on most of the islands. Although the races have not yet all been described, the populations are clearly distinguishable on each island. The Iguanas of Tower Island in the north are small and pitch black for example, while those of Hood and Floreana are rose-pink with black spots, a green crest and green front legs. The race which lives on Fernandina or

Narborough is brownish black and has the habit of collecting together in very large colonies; we found nine hundred of them in a solid mass on the top of a rock about twenty yards long at Punta Espinosa at high water, with the scarlet and blue shore crabs climbing all round and over them. At low tide these Iguanas go out to forage on seaweed up to ten and possibly twenty feet down on the outer reefs. We found that they normally lay only two eggs, buried in the sand at the tops of the beaches. We filmed the females digging their burrows and actually laying the eggs—with an eight minute pause between first and second. The hole is then filled in and covered over by the female with great care. The Galapagos Sea Lion *Zalophus wollebaeckii* is



Galapagos Sea Lions *Zalophus wollebaeckii*

still quite common; we swam with them and filmed them underwater, and were twice chased out by the very aggressive bulls. The Galapagos Dove *Nesopelia* a beautiful little bird which is rather disastrously tame, is numerous only on some of the uninhabited islands, having been greatly reduced on the inhabited ones. The Hawk *Buteo* and the herons of three species seem to be holding their own as indeed are the finches and mockingbirds. Unfortunately we did not see the famous Woodpecker Finch *Camarhynchus pallidus*, which



The Warbler Finch
Certhidea olivacea

uses a cactus spine to pry insects out of cracks in bark just as a woodpecker uses its bill.

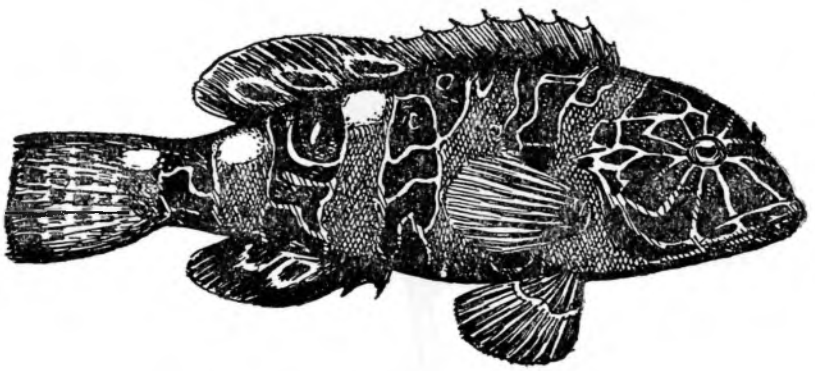
The Lava Lizard and the small non-poisonous Snake, both of which seem to vary from island to island, do not appear to be in any danger of extermination though the snake is less common than the lizards; but the interesting native Rats are unable to compete with the introduced Black and Brown Rats and may well be on the way out. Breeding stocks should if possible be established in captivity.

The status of the small dusky Galapagos Albatross *Diomedia irrorata* which breeds on Hood Island and nowhere else in the world is rather obscure. None were present during the period of our visit though it is understood that many had returned only a month later. Hood is rarely visited but the entire species appears to be represented by one or two hundred individuals.

Santa Cruz Mockingbird
Nesomimus

Our base of operations in Galapagos was at Academy Bay on the island of Santa Cruz or Indefatigable. From here we made two ten day voyages to the other islands in the Patrol Boat kindly put at our disposal by the Ecuadorian Navy. Altogether we landed on eleven of the islands in the group.

Although living conditions during our trip never descended to the level of hardship, there were many times when they could have been described as

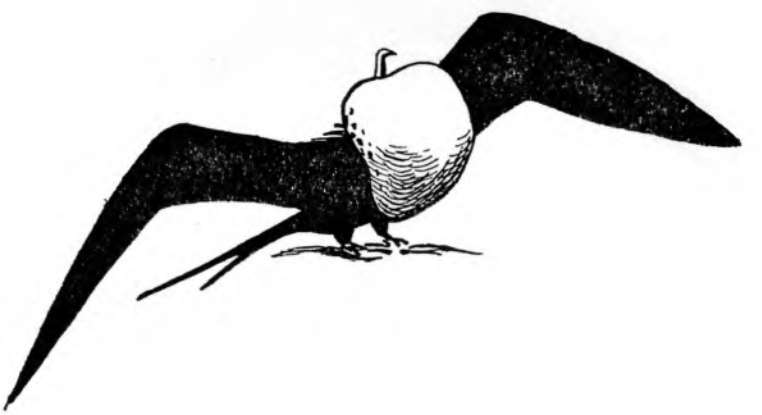


Hieroglyphic Grouper of Galapagos *Cirrhitus rivulatus*

'rugged.' Fresh water and food are both scarce and many nights we slept out in spite of a minor mosquito nuisance.

We swam frequently among magnificent fish shoals, marine iguanas, sea lions and penguins, and were not unduly troubled by sharks—which are quite numerous. The sea lion bulls were reputed to be the most dangerous animals we were likely to meet, but although they looked aggressive they never actually attacked in the water, and one which did so on land came to within a few feet as I filmed him and then stopped. It was only when the film shot was ended and I looked up from the view finder of the camera that I realised he had been charging me.

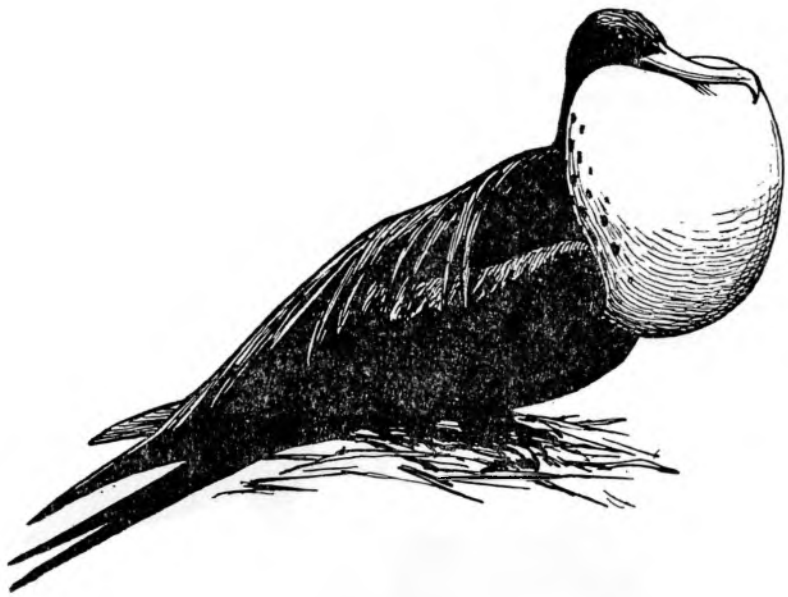
Some of our best film was made of the ecstatic courtship of the seven foot wing-span Frigate Birds on Tower and Hood.



Ecstatic display of male Frigate Bird

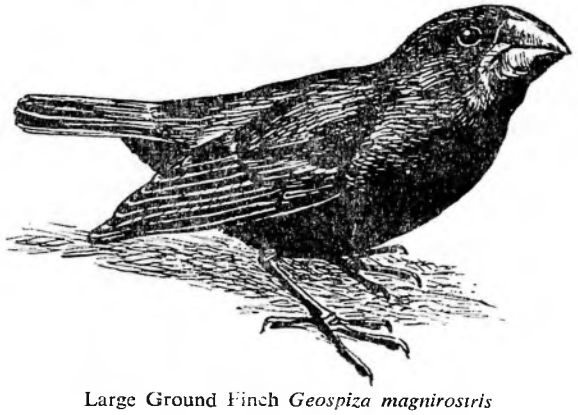
On Wednesday, 11th February we landed in a small cove at the back of Darwin Bay, Tower Island. Darwin Bay is a remarkable natural anchorage—a crater which is tipped sideways so that ships may enter over one lip into a circular harbour a mile in diameter. The cliffs overlooking the cove in which we landed were painted with the names of visiting yachts and the years of their visits. Rough white lettering was daubed across all the accessible vertical rock faces, which at first sight seemed to us to be inexcusable vandalism; but later when we thought about it more carefully we came to a more tolerant conclusion. The Galapagos Islands are remote and for any but a naturalist uninhabited Tower must be a forbidding and desolate place. The loneliness was lessened by the untidy white names which peopled the anchorage in imagination.

There was also, as we landed, a stink of fish on the beach from decaying fish-heads left by a fisherman's gutting party some months before. The shallow cove was full of large sharks, and walking on the white coralline beach were a few rather small, quite black Marine Iguanas. The rocks on one side were red with shore-crabs and in the small bushes above the high tide mark there were nesting Frigate Birds, the males with their huge red throat sacks inflated, already courting while the young of the previous year with



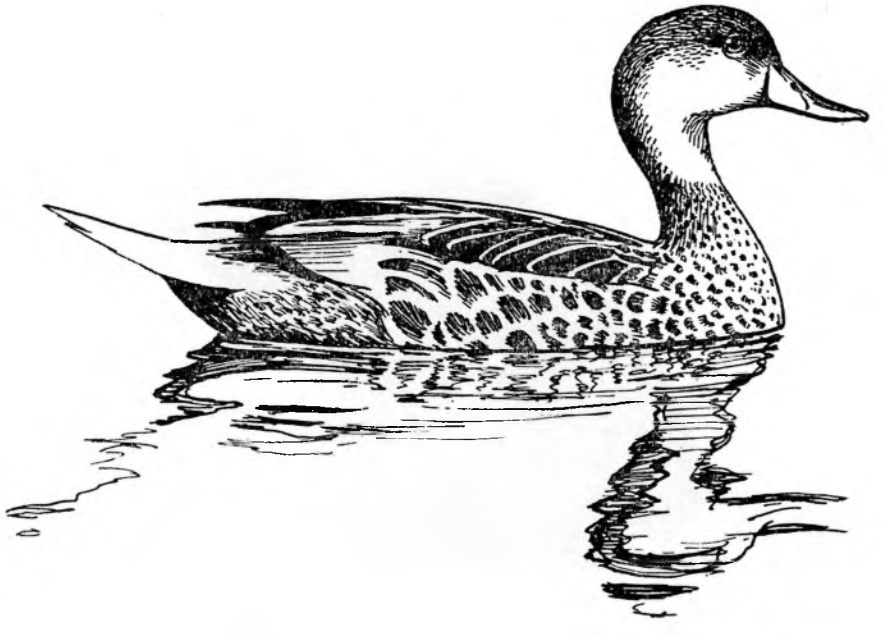
Male Frigate Bird *Fregata minor ridgewayi*

whitish heads still hung about near their old nests. Dimorphic Red-footed Boobies *Sula sula* some white some brown, but always with blue bills and red feet sat about in the stunted shrubs; Blue-faced Boobies *Sula dactylatra* with large young looked almost exactly like our northern Gannet *Sula bassana.* But the most graceful of the sea birds there, with a beautiful sad evocative cry, was the Galapagos Fork-tailed Gull *Creagrus furcatus* with a sooty black head, a sharp white spot behind the bill, almost like a drake Goldeneye, scarlet eyelids and an orange red gape—altogether a strikingly handsome gull. The quite common dusky Lava Gull was also on the beach at Tower. Although much less beautiful it is of a particular interest because its nest has not so far been found. It may breed high on the mountain tops. But in the pool behind the beach was the most exciting thing, our first pair of Galapagos Pintails. They are much as I had expected except that the female is duller; there was no red on the bill of this one and very little white on the cheek. In fact she was more like a Grey Teal *Anas gibberifrons* than a Bahama Pintail. They were quite tame and we finally filmed the pair at 25 feet in the clear water of the tidal pool which had filled by filtering through the coralline beach. Also on this pool were a family of Yellow-crowned Night Herons *Nyctanassa violacea* and a small blue Reef Heron *Butoides sundevalli.* The Tower Island Mockingbirds hopped round our feet and on to the camera tripod and among the Opuntia trees were two species of Black Finches (*Geospiza magnirostris* and *G. difficilis*), one with a very large bill and the other with a much smaller one. On the following morning there were thirty Pintails on this pool and I established that yesterdays female was duller than most. Several females had quite prominent red spots. Later when we climbed to the Crater Lake we saw a lot more, so that there might have been fifty or sixty altogether on Tower.



Large Ground Finch *Geospiza magnirostris*

On a lagoon behind the beach at James Bay on the island of James or Santiago there was a little group of twenty Galapagos Pintails near a flock of 21 surprisingly wild Flamingos, and we saw some display which to me was indistinguishable from that of the Bahama Pintail. We met a pair later up in the tortoise country in the interior of Santa Cruz, where they were sitting on a little pool among the rain sodden woods; a few yards away a Giant Tortoise was feeding. I saw one more pair on Hood, in a puddle on the path on the way up to the old war time radar station now deserted and in ruins in the centre of the island. The Galapagos Pintail is perhaps a little smaller and more slender, and if anything more graceful, than the Bahama but it is less smartly coloured; the bills of the females seem usually to show less red and the sharp line dividing the white cheek and the brown crown in the



Galapagos Pintail *Anas bahamensis galapagensis*

Bahama Pintail is much softened and blurred in the Galapagos race. In overall colour the bird may be a little reddish brown though in the field there does not seem to be very much difference.

The Charles Darwin Foundation for the Galapagos with Sir Julian Huxley as President of Honour, Dr. V. Van Straelen as President and Dr. J. Dorst as Secretary has been in existence for only a few months. Its first objective is to set up a Research Station in the islands—a project originally suggested by the International Union for the Conservation of Nature, and a well-found research vessel will be needed to extend the work. Monsieur Raymond Lévècque, a young Swiss scientist, arrived in the Galapagos in March 1960 to make plans for its establishment. This is clearly the first and most important step which can be taken to improve the chances of survival of the Galapagos fauna and will, it is hoped, ultimately enable science to make a proper use of this 'living laboratory of evolution.' The Ecuadorian Government has established a number of Protection Laws and once the Darwin Station is established there will be a much greater chance of enforcing them. The Government has also declared two large Nature Reserves but without some control they are Reserves in name only. Scarcely less important however than steps to protect the endemic species is a campaign to destroy the introduced mammals. It is clearly not realistic to imagine that all of them can ever be removed from all the Islands, but reductions would be helpful and it might be possible to exterminate them completely on certain islands to the great benefit of the native fauna.

At present the law prohibits the killing of any animals, including those introduced; and when, a few months after the declaration of the Nature Reserve in the western half of Santa Cruz last year, new settlers were allowed to occupy part of the Reserve, firearms were not permitted. As a result Tortoises, which can be killed without firearms, provide the only readily available meat. It is to be hoped that these anomalies will soon be corrected.

Galapagos Fur Seal *Arctocephalus galapagensis*

GOOSE-NETTING IN THE NETHERLANDS

J. A. Eygenraam

Institute for Biological Field Research, Arnhem, Holland

WHEN the need was felt of ringing geese for scientific game research it was obvious that the best way would be to co-operate with professional goose-netters. They have the equipment, decoy-geese, ability and time. The number of these men is not great: twenty-seven in all. Some of them work alone, others two to four together, so that the number of nets now in use is only seventeen. The intention of the government is to end goose-netting in conformity with the Paris Convention, because it is considered to be a form of mass-catching. Therefore licences are only given to persons who netted geese in some year between 1946 and 1951. So rejuvenation of the group is not possible and after one generation the race of goose-netters will be exterminated. Just in time we made contact with these hardened fellows who like goose-netting more than anything else.

The aim of catching and ringing geese for scientific purposes is to trace the flyways, the breeding- and wintering-areas, to study the composition of the population,—sex and age-ratios—mortality-rates, etc.

A beginning was made in February, 1954. A goose-netter was willing to yield the geese he captured for a premium about equal to the price the poulterer paid. This system proved to be satisfying for him as well as for us. So in the following years the number of netters working for our Institute was increased to six in the 1958-59 season. Nowadays sixteen nets, worked by twenty-six netters, are partly at our disposal. Five of the nets are in the province of Friesland (in the north of the country), six to the south of the Ijsselmeer (in the middle of the country) and five to the south of the large rivers (in the south of the country). Up to 31st March, 1959, nearly 1500 geese of four species had been ringed (Table I).

Among the species ringed the White-fronted Goose takes the first place with 63% of the total; the Bean Goose follows with nearly 29%. Those two species are captured all over the country. Barnacle Goose and Pink-footed Goose make up over 7% and less than 1% respectively. They are caught only in the North and the middle of the country. The netters down in the South do not even know these species. It is evident that they have not occurred there in living memory. Pinkfeet pass through and winter in the Netherlands in greater numbers than the small quantities of ringed individuals would suggest. During the last three years a total of 154 Pinkfeet were captured by all the netters together. The Barnacle Goose is protected in our country and may only be caught for ringing.

Though the Whitefront is captured throughout the country, from the figures it is obvious that they pass over the southern part of the country in smaller numbers than over the northern and central provinces. On the other hand the Bean Goose is captured mainly in the South (Table 2).

These differences cannot be explained by the distribution of the netters nor by a different method of netting, for in the past years we had two netters in the North, one in the middle and three in the South. They use the

same kind of nets, and all of them have Bean Geese as well as Whitefronts as decoy-birds. In the present state of our knowledge we can only suppose that the two species have different flyways.

Perhaps it is useful to say something here on the method of the Dutch goose-netters. In November they occupy their netting-territory—the same one as last year and often even the same as their father used—in a wet grassland. It takes a whole day before they have established themselves, laying out the two nets, one opposite the other on either side of a ditch. The nets are hidden in a slit in the ground and covered with grass so that the geese cannot see them. The nets are stretched by means of cords and steel springs and can be fetched over by pulling a cord. Which net will be used, the right one or the left, depends on the direction of the wind: the net is always pulled *with* the wind. Near the net a tame goose is tethered (the " stander "): and food is scattered. In the hide in which the netter is watching at a distance of 200-400 metres other tame geese are kept in cages (the " flyers "). As soon as wild geese are sighted the flyers are thrown into the air one by one. They fly, calling, to the stander and to the food. This induces the wild geese to come down and to walk to the net. The only difference between the catchers in Friesland and in the other provinces is that the Frisians tether more than one goose near the net, sometimes as many as seven Whitefronts and Bean Geese, whereas in the other provinces only one " stander " is used. Both groups are convinced of the rightness of their own method.

Except in the North the netted geese are ringed by our own personnel. Sex and age are determined and other particulars are noted before the geese are released.

In the 1958-59 season the age ratio of Whitefronted Geese differed very much from that in two preceding years. In 1955-56 137 birds were ringed, 69 of which were adult and 68 young—ratio 1 : 1.00. The 1956-57 catch was too small to provide an age-ratio. In 1957-58 in 295 specimens the age ratio was 1 ad. : 1.16 young; but in 1958-59 for every eight adult Whitefronts only one " chicken " was captured—ratio 1 : 0.12. So there is strong evidence that 1958 was a poor breeding-season for Whitefronts. For Bean Geese the following figures were noted: 1955-56 1 ad. : 0.64 young; 1957-58 1 : 1.12; 1958-59 1 : 0.42. They show similar variations to the Whitefronts.

Up to 31st October, 1959, 114 recoveries have been received, 80 Whitefronts, 29 Beans and 5 Barnacles. At the end of the present season the data will be worked out for a preliminary report.

In an account of goose-netting in the Netherlands the total numbers of netted geese cannot be omitted. It must be stated that there are only few data at our disposal, because figures are only known for the last three years.

In 1956-57 831 geese were captured in all, 41 of which were ringed; in 1957-58 1,282 were captured, 535 of which were ringed; in 1958-59 1,047 were captured, 550 of which were ringed. The present season 1959-60 seems to be a good season and it is expected that again over 50% of the total catch—maybe even 1000 geese—will be ringed and released.

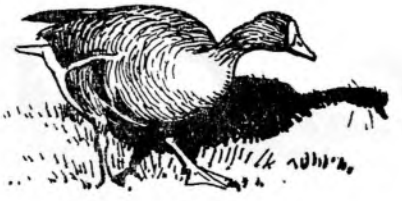
More and more the goose-netters like ringing geese rather than selling them to the poulterer or to some private collector, who keeps a couple in captivity.

TABLE 1. Numbers of geese ringed in the Netherlands

Season	Anser a. albifrons	Anser f. fabalis	Anser brachy-rhynchus	Branta leucopsis	Total	Number of nets
1953-54 ..	16	—	—	—	16	1
1954-55 ..	112	12	—	—	124	2
1955-56 ..	137	93	2	—	232	2
1956-57 ..	15	16	—	10	41	2
1957-58 ..	295	153	2	85	535	4
1958-59 ..	369	155	7	19	550	6
Total ..	944	429	11	114	1498	—
Percentages ..	63.0	28.7	0.7	7.6	100	—

TABLE 2. Regional distribution of geese caught for ringing: in percentages

Region	Anser a. albifrons %	Anser f. fabalis %	Anser brachy-rhynchus %	Branta leucopsis %	Total	Actual number caught
North ..	85.5	7.0	2.5	5.0	100	365
Centre ..	82.0	11.0	—	17.0	100	570
South ..	39.0	61.0	—	—	100	563
Total ..						1498



THE BRENT GOOSE (*Branta bernicla L.*) IN THE SOVIET UNION[1]

S. M. Uspenski

(*Ornithological Laboratory of Moscow State University*)

OWING to the rapid decline in the numbers of Brent Geese over large areas of Europe, Asia and North America, ever increasing attention has been paid to this goose in recent years. It has been recorded that during the past 40-50 years the numbers both of Eurasian (*B.b. bernicla*) and American (*B.b. nigricans*) Brent Geese have sharply declined. The Atlantic Brents (*B.b. hrota*) are little better off, although they are protected at the places where they nest and at those where they moult and also at their main wintering sites (Salomonsen, 1955). Information is lacking regarding the status of the population of the Eastern Siberian Brents (*B.b. orientalis*), but such observations as have been made give evidence of a considerable decline of these birds also. The International Committee for Bird Protection stated in 1954 that the Brent Goose is threatened with extinction and approached the governments of all interested states with an invitation to participate in full and universal protection of this species.

Interest in the Brent is also to be explained by its economic importance, particularly in the regions of the extreme north. Many aspects of the biology of the Brent, particularly their migration routes, had not been studied until recently.

All this caused the Commission for the Protection of Nature of the Academy of Sciences of the U.S.S.R. to carry out in 1957 a special inquiry by means of questionnaires in the northern and eastern regions of the U.S.S.R. (The investigation covered mainly the wide-spread network of stations of Glavsevmorput and Gidrometsluzhba*). The data obtained by this inquiry together with existing literary sources, information from inquiries and our own observations, paint the following picture of the present distribution, migration routes and, in some cases, of the numbers of Brent Geese in the Soviet Union.

Brent Geese *Branta bernicla* illustrating the taxonomy used in this paper
From left to right (from mid-North America eastwards):-
B.b. hrota, B.b. bernicla, B.b. orientalis. B.b. nigricans

[1]Reprinted, in a translation by D. D. Harber, from The Migration of Animals, No. 1, published by Academy of Science of the U.S.S.R. 1959.

*The bodies controlling the Northern Sea Routes and the Hydro-meteorological service respectively.

The Atlantic Brent Goose (*Branta bernicla hrota Müll.*) in the Soviet Union, nests (and moults) in very small numbers only on Franz Josef Land, on Aljer, Elizabether and Jackson Islands (Gorbunov, 1932). It has been encountered as a vagrant in Taimyr (Middendorff, 1853) and on Kolguev (Trevor Battye, 1895). Tugarinov's (1941) surmise of nesting on the north island of Novaya Zemlia has not been confirmed. According to Gorbunov (1932) it arrives in Franz Josef Land from June 3rd to 12th; departure taking place in September, some birds remaining on the islands until the end of this month.

The migration routes of the Atlantic Brents pass mainly through the western parts of the Barentz Sea, as it is encountered on passage on Bear Island. The main wintering grounds of *B.b. hrota* are situated on the Atlantic coast of North America; in lesser numbers they also winter on the Pacific coast of North America and together with *B.b. bernicla* on the shores of Western Europe (Delacour, 1954).

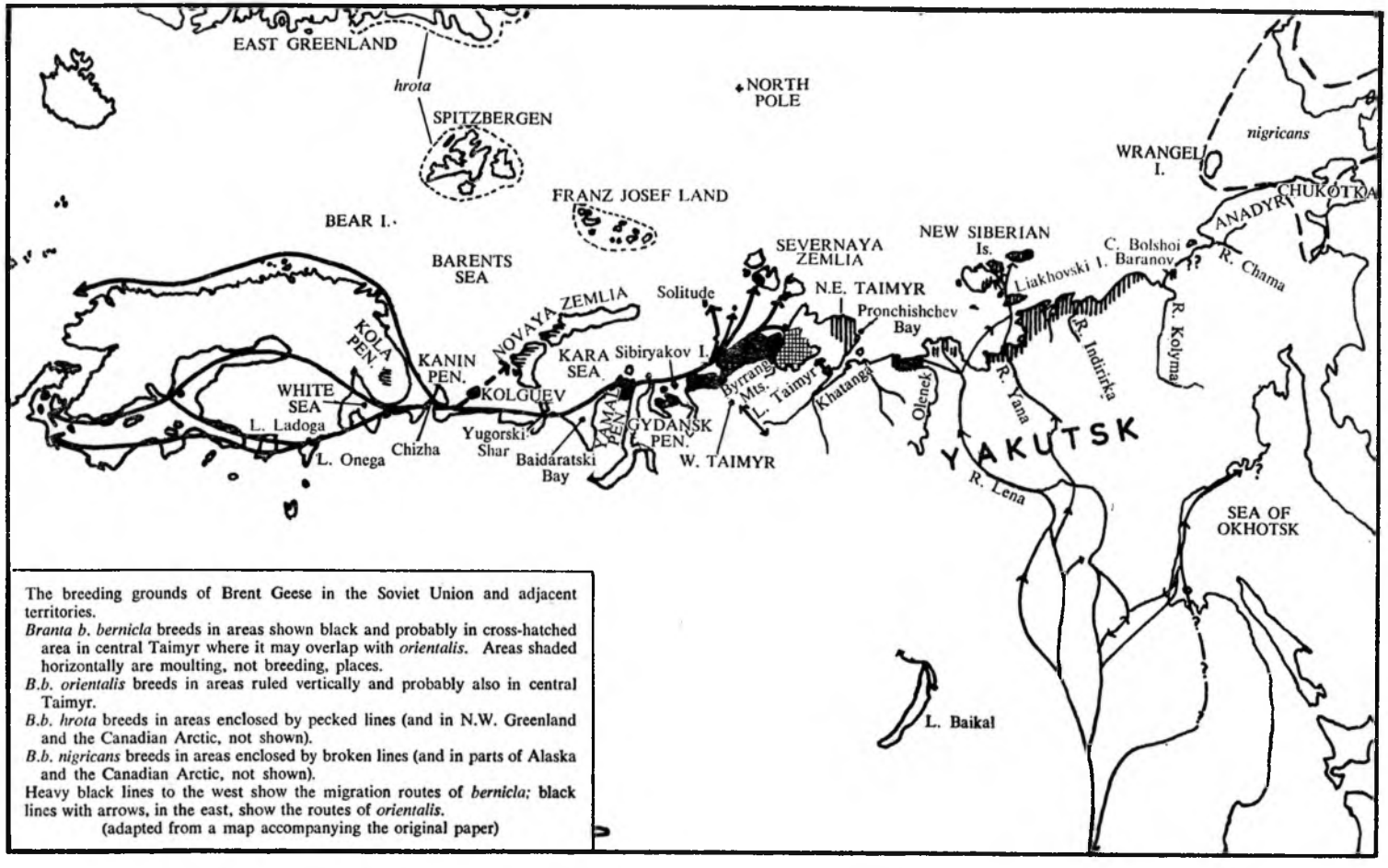
During the last 25 to 30 years the total numbers of *B.b. hrota,* according to observations at the Eastern American wintering grounds, have decreased by approximately 90%. This was due mainly to disease and to the disappearance of the main food of the birds, *Zostera marina*†, from coastal waters. To some extent the Brents changed to other foods; they began to eat other aquatic plants, *Ulva* and others, and to feed on pastures, which had not been observed before, but this did not compensate for the lost *Zostera* (Cottam, Lynch, Nelson, 1944).

Since the 1940's *B.b. hrota* has been protected on its American wintering grounds and from 1951 it has been protected also at its nesting and moulting sites in Greenland (Salomonsen, 1955).

The Eurasian Brent Goose (*Branta bernicla bernicla* L.) has its main nesting and moulting region on the north-east of Western Taimyr. Nesting and moulting of *B.b. bernicla* have also been reliably established (by Tugarinov, 1941, Ptushenko, 1952 and the data of polar stations) to occur on Kolguev, on Northern Yamal (north of 70°N, though it is absent from White Island), on the extreme north-east of the Gydansk Peninsula, in the south and south-west of Severnaya Zemlia, and on the small islands of the Kara Sea, including Uiedinenie (Solitude) Island.

Tugarinov considers it certain and Ptushenko as probable that Novaya Zemlia is a regular nesting and moulting area of *B.b. bernicla.* Brents have been observed there by many observers (on the south island by Baer, 1838, Theel, 1876, Markham, 1881, Gorbunov, 1929, Portenko, 1931, *et al.*; on the north island by Gillet, 1870, Markham, Portenko, Antipin, 1938). But all these encounters relate to unmated birds, usually in moult, sometimes on passage. No one has found a nest there and for this reason Pleske (1928) included the Brent in his list of the birds of Novaya Zemlia only as a passage migrant. This last author is obviously nearest to the truth. From our observations Brents are met with on Novaya Zemlia in small numbers and only unmated birds occur, usually in flocks of moulting Bean Geese

†The cause of the *Zostera* disease, *Labyrinthula,* is a species of single-celled, slimy fungus (Zenkevich, 1951).



The breeding grounds of Brent Geese in the Soviet Union and adjacent territories.

Branta b. bernicla breeds in areas shown black and probably in cross-hatched area in central Taimyr where it may overlap with *orientalis*. Areas shaded horizontally are moulting, not breeding, places.

B.b. orientalis breeds in areas ruled vertically and probably also in central Taimyr.

B.b. hrota breeds in areas enclosed by pecked lines (and in N.W. Greenland and the Canadian Arctic, not shown).

B.b. nigricans breeds in areas enclosed by broken lines (and in parts of Alaska and the Canadian Arctic, not shown).

Heavy black lines to the west show the migration routes of *bernicla;* black lines with arrows, in the east, show the routes of *orientalis.*

(adapted from a map accompanying the original paper)

and White-fronted Geese, this being the case both on the south island and in the southern part of the north island. We encounter here a phenomenon typical of Brent, the settling down of individuals (mainly not fully mature) and their moulting in an area crossed by the usual migration routes but far from breeding sites.

Some birds, perhaps regularly, also settle down and moult on the Kanin Peninsula (in the Chizha region, according to a personal communication from E. P. Spangenberg) and, according to information from inquiries, on the Kola Peninsula (in 1949 and 1950 in July and August a few dozen moulting Brent Geese were observed in the area of the middle course of the River Ponaya). Single birds are encountered during the summer months in the region of Lake Ladoga and, a fact which merits special attention, in exceptional cases they nest there. In particular a brood of Brent Geese was observed during the summer of 1956 by the Nizhniaia Nazia River (a communication from I. Riznich).

Brent fly to their Eurasian nesting sites mainly by the White Sea—Baltic route*, most following the shores of the Gulf of Finland, crossing Lake Ladoga and to some extent Lake Onega and Onega Bay on the White Sea. Some birds while on passage keep to the shores of the Gulf of Bothnia and, passing overland over the lakes of Finland and Karelia, reach the Karelian shore of the White Sea. Passage routes of minor importance cross the Gulf of Riga and Lakes Chudskoie and Ilmen (Menzbir, 1893; Tugarinov, 1941; Kumari, 1957). The passage of Brent over the Gulfs of Finland, Bothnia and Riga takes place from the end of April to the end of May, the most intensive passage occurring in the middle of May.

Besides the White Sea—Baltic route, Eurasian Brent also travel along the northern coasts of Scandinavia when migration from winter quarters to their nesting sites. Birds flying by this route reach Eastern Murman in the second half of May.

On the Western shores of the Kanin Peninsula the migration routes given above merge into one, the Brent flying only along the continental coasts of the Barentz and Kara Seas. The Kanin Peninsula, according to an oral communication from E.P. Spangenberg, is crossed by the birds along the valleys of the rivers Chizha and Shoina, mainly in the period from June 5th to 15th. It is characteristic that Brent Geese do not appear on passage in the Archangel region nor in the Dvinsk Bay of the White Sea in general (Manzbir, 1893), nor in the Mezen region, nor on the northern shores of the Kanin Peninsula.

Brent Geese reach Kolguev between June 10th and 20th and Novaya Zemlia at about the same time and according to our observations they arrive here in spring from the south-west.

The birds penetrate into the Kara Sea apparently only through Yugorski Shar, as passage has not been recorded either on northern Vaigach nor at the extreme south of Novaya Zemlia; nor do the birds fly along the western coast of Vaigach. According to our observations and material obtained from inquiries, Brent pass over Yugorski Shar in the period from

*Ringing of Brent has only been carried out to an insignificant extent and therefore their migration routes are described only on the basis of visual observations.

June 1st to 15th, the most intensive passage taking place between June 8th and 15th. In passing over Yugorski Shar the main mass of the birds keeps to the southern coast of Vaigach, where some flocks come down for rest and food.

The birds cross over Baidaratski Bay at its mouth; they are not observed in the regions of the Amderma, Ust-Kara, Mare-Sale and Cape Khorosovoi polar stations. They also do not appear in the Gulf of Obsk, in the region of the Cape Kamennyi polar station. The geese reach Northern Yamal, June 10th to 15th and about this time they appear on Western Taimyr. Latest of all, June 18th to 22nd, the birds reach Severnaya Zemlia* and the region of Lake Taimyrskoe.

Despite the presence of well defined passage routes along sea coasts and over large lakes, Brent not uncommonly occur far inland. For example, birds, apparently only or mainly of this subspecies, have been repeatedly encountered in White Russia, in the Ukraine, in the central districts of the European part of the RSFSR, in Bashkiria and even in the southern part of Western Siberia (Tugarinov, 1941).

The total number of *B.b. bernicla* at the present time is less than 20,000 (this figure is based on a calculation of the number of birds wintering in Western Europe and includes also a certain number of *B.b. hrota* which winter there) (Salomonsen, 1955).†

The overwhelming majority of Eurasian Brent Geese nest and moult in a relatively limited territory in the north-east of Western Taimyr. According to data obtained from inquiries, only here in the valley of the River Lenivaya and on the upper courses of the streams Granatovaya, Kamenaya, Sludyanaya, Toll and some others have there been recorded in recent years assemblies of nesting and moulting birds running into thousands of individuals.

In the region of Lake Taimyr *B.b. bernicla* is not numerous (data of the polar station communicated by V. M. Sdobnikov), and it is possible that in this area birds of the subspecies *B.b. orientalis* (see below) are much more common.

According to the data of the commercial hunting station Omulevaya 200-300 pairs nest at each of the following sites: Sibiryakov Island, the River Sosnovaya (left bank of the Gulf of Yeniseisk, where assemblies of moulting Brents are also observed; and the skerries of Minin. Brent are very few in number on Severnaya Zemlia; for example, in 1957 only isolated pairs were seen in the region of the polar station Bukhta Solenechnaya, and in the neighbourhood of the Krasnoflotskaya station 20-30 birds were counted. The number nesting on the small islands of the south-east Kara Sea is small; on Uiedinenie Island only a few pairs nest and that not every year.

The autumn departure of *B.b. bernicla* from its nesting and moulting sites begins in the middle of August and finishes during the first few days of September. At the end of August birds are already flying over Yugorski Shar and the Kanin Peninsula; in the first half of September they are over the Baltic. The routes of the spring and autumn migrations are basically

*Although in 1957 the first birds on the south-west of Severnaya Zemlia (Krasnoflotski Islands) were observed as early as the first ten days of June.

†According to a communication from E.P. Spangenberg the total number of Brent Geese flying over the Kanin Peninsula in 1957 came to about 10.000.