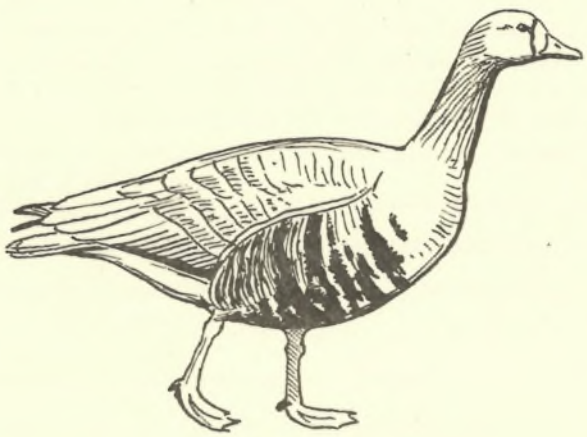
of January 1953. The proportion in December 1950 agrees very closely.

Conclusive proof that pairing takes place during the winter has yet to be provided. Though two second-winter geese were members of three-adult families, this does not indicate that they were parents. Nor can it be shown beyond doubt that any third-winter geese were parents. Table III indicates that it is quite possible for all the successful parents to have been older birds (in their fourth or subsequent winters).

SHORT NOTES ON GEESE

NOTES ON THE BELLY-MARKINGS OF WHITE-FRONTED GEESE

The occurrence of more or less extensive patches of black or blackish-brown feathers on the abdomens of adult White-fronted Geese (*A. albifrons*) and Lesser White-fronted Geese (*A. erythropus*) is one of the most obvious aids to identification of these species. Similar patches are found also in the Greylag Goose (*A. anser*), but are typically much less extensive than in *albifrons* and *erythropus*. From casual observation it is clear that the extent of these patches varies widely between different individuals and more critical examination of skins has shown that birds of the Greenland race (*A. a. flavirostris*) tend to have heavier markings than do other forms of *albifrons* (Dalgety and Scott, *Bull. B.O.C.* **68**(6) : 109–121 1948). Tucker (in Witherby *et al.*, *The Handbook of British Birds*, **3** : 1939) writes that the variability of these markings ' is not directly dependent on age or sex,' but Alpheraky (*The Geese of Europe and Asia*, 1905), although not claiming any correlation between marking and sex, has asserted with some force that in the Greylag and both species of Whitefront the black markings increase in number and size with the age of the bird, being few and small in two-year-olds and continuing to extend in fully adult birds until they ' may at last occupy almost the whole belly.' Since the vehemence of Alpheraky's pronouncements is inversely related to their truth and since his belief conflicts directly with that of Tucker it seemed desirable to re-examine the problem. Presumably both writers' opinions were based on the study of museum skins. Though it is possible when determining the sex of a goose by dissection to discover whether the bird has attained sexual maturity, no criteria are known



by which the age of sexually mature birds can be established, so that it is not clear on what evidence the conflicting opinions are founded.

The obvious method of studying the relation between age and extent of black marking is by recording the appearance of marked individuals over a period of years. This has been done by taking photographs of the Whitefronts in the Trust collection in November 1950, November 1951 and January 1953. All the geese used were adult when first caught up : unfortunately no precise information on their age at that time is available. While being photographed each goose was held vertically with its ventral surface squarely towards the camera. Complete standardisation of position was not achieved and some disarrangement of the plumage while the birds were being handled must have occurred, but these difficulties should not have introduced large errors. Sixteen *albifrons*, of four subspecies, and five *erythropus* were photographed, but for various reasons (e.g., deaths, loss of rings, unsatisfactory positioning for photograph) comparisons for all the birds for all three years could not be made. The results of the available comparisons are tabulated below.

CHANGES IN AREA OF BLACK BELLY-MARKINGS

Season	Marked Increase	Marked Decrease	Little Change	No. of Geese in Sample
1950—51	0	2	5	7
1950—53	0	4	4	8
1951—53	2	0	14	16
	2	6	23	31

There seems to be no evidence of a tendency for the area of the black patches to increase with age, but some suggestion that in any one individual it tends to remain about the same.

An attempt was then made to see how closely the patterns in successive years resembled each other. No objective method of comparison could be devised, but a single subjective classification into ' closely similar ' and ' dissimilar ' showed that 13 pairs of comparisons were similar and 18 dissimilar. This indicates that although the appearance of the markings on one bird in successive years tends to remain constant the resemblance is not likely to be constant enough to serve as a reliable means of identification (i.e. there is no close analogy with the constancy of ' finger-prints ' in human beings).

In order to discover whether the extent of marking is related to sex it is necessary to use some measure of $\frac{\text{area of black patches}}{\text{total area liable to include black patches}}$. For a first approximation estimates of the black areas in tenths of the total abdominal surface were used ($\frac{0}{10}$ = no black markings, $\frac{10}{10}$ = surface all black). Eleven males and twelve females (of all forms) were available. For each group a mean value of $\frac{5}{10}$ was obtained. A second source of data on possible sex differences in the European Whitefront (*A. a. albifrons*) was available, consisting

of drawings of the belly-markings of ringed wild geese seen at the New Grounds in the winters of 1951–52 and 1952–53. Their markings were sketched on standard outlines (made with a rubber stamp). The use of such sketches as a method of comparing areas is obviously even less accurate than the comparison of photographs, but since the drawings were made without consideration of their use for this purpose there seems no reason to suppose that a bias with respect to sex is present. Drawings of twenty-six pairs of birds were available. The sex of the individuals in these pairs had been determined by differences in relative size, especially of the head and bill, and confirmed by their behaviour during sustained observation. The area of the black patches in the sketches was determined for the left and right sides of the birds separately, and then summed. When the black areas were expressed as percentages of the lateral surface area of the breast and belly the mean value for males was 27% and for females 23%, a difference without significance. Comparison of the members of each pair showed that in sixteen of the twenty-six pairs the male was more heavily marked than the female, in two the extent of the marking was closely similar and in eight the female was the more heavily marked. It seems unlikely that any separation of the sexes by the extent of the belly-markings can be achieved.

This study confirms the view of Tucker (*loc. cit.*) that the variability of the belly-markings is not directly dependent on age or sex.

HOSTILE ENCOUNTERS BETWEEN WILD WHITE-FRONTED GEESE IN WINTER FLOCKS

During observations on the behaviour of the wild geese in years 1949–53 particular attention was paid to hostile encounters. A detailed report based on some 2200 encounters was published in March 1953 (Boyd, *Behaviour*: V, pt. 2, pp. 85–129). This note summarises that account, and does not make use of further data obtained in the winter of 1952–53.

Families (parents with young of the year) and pairs of adults form the great majority of the persistent groups within large flocks of geese. Hostile encounters result from at least three types of conflict between individuals or groups. Sexual rivalry is responsible for many of the conflicts between adults without families (pair formation occurs during the winter). Interference with freedom of movement and preservation of family coherence are the main factors leading to encounters between families.

A large majority of attacks are successful and most of them are uncontested. About half the encounters seen affected only two birds. Very few involved more than two families. There seem to be two ranking systems from which an observer can predict which geese in a conflict situation will show aggressive behaviour and what the outcome of an attack will be. First-winter birds not in families are inferior to all other classes. Paired adults are superior to single adults and also to first-winter birds still with their parents. These young birds in families, though subordinate to members of pairs, tend to be superior to single adults. Parents are superior to all other classes. Family-size provides the second criterion of rank, for large families are superior to smaller ones and the success of members of a family is affected by its size even when some of its members take no active part in an encounter.

Observations on the patterns of aggressive and submissive behaviour have shown that the postures used by adults and young are similar, but adults are more vigorous than young and parents are more vigorous than adults without families. Males attack more and are more successful than females though there is no clear difference between the sexes in vigour. There is a direct relation between intensity of threat and response, and response is also affected by the status of the attacker but apparently not by that of the victim. There is very little fighting within families. Geese of other species are tolerated within flocks.

The frequency of attacks within a flock is affected by its composition and density, by the general level of activity, by disturbance, and by the accessibility of drinking places. Conflicts for food are rare.

TRIUMPH DISPLAY IN GEESE

The following note has been received from N. G. Blurton Jones and Robert A. F. Gillmor who spent a week at Slimbridge under a special grant from Leighton Park School.

During the first week in January 1953, we carried out a comparative study of the triumph displays of the ' true geese ' (*Anser and Branta*) with especial reference to the movements involved and their relation to the colours and markings of each species. Notes, sketches, photographs and a film showing the aggressive and triumph displays of most of the geese in the Trust's collection were made. The film's main use was to help in further analysis and study. Some observations were also made of a particularly aggressive individual Andean Goose, although it does not belong to the two genera of ' true geese.'

The aggressive displays are basically the same in both *Anser* and *Branta*. They appear to be ritualised stages in a direct attack, e.g. ' high head waving,' as if the bird is swimming or walking towards its opponent, and the ' bent-necked aggressive posture,' as if the bird is about to peck its opponent.

It was found that certain species ' specialised ' in various postures, the high head aggressive posture being typical of the Bar-headed Goose, for example. The triumph display consists of an extreme aggressive posture disguised by the following movements : (1) a horizontal waving, with the head held low and outstretched ; (2) an up and down vertical waving ; and (3) a thrusting forward of the bent neck. In black geese the Red-breasted Goose has only the horizontal waving, but the Canada Goose has all three components very marked which combine to produce a snaking movement, which is characteristic of the species.

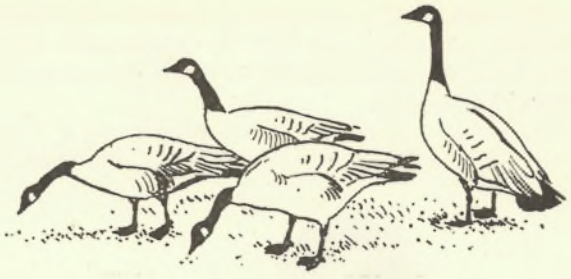
ROUNDING UP CANADA GEESE

1. Leicestershire

In the winter of 1952 Lord Gretton, of Stapleford Park, Leicestershire, asked the Trust for advice on methods of capturing Canada Geese, because the flock at Stapleford had grown inconveniently large. Since the geese were full-winged and not very tame, the simplest way of catching them promised to be by rounding-up at the time when the adults were flightless (having moulted their flight-feathers) and the goslings were not yet full-grown. It was agreed that the Trust should undertake the task.

On 25 June 1953 three members of the Trust staff went to Stapleford.[1] The

[1] H. Boyd, R. Philpott, Miss Peggy Cameron.



geese were found on the shores of the lake in the park and retired to the water when approached. After a brief inspection of the ground a ' corral ' was built at one end of the lake, in the hope that the geese could be driven into it. This consisted of a rough circle of wire-netting twenty yards across, open on the side near the water. Two ' wings ' made from rabbit-nets formed a funnel leading from the lake to the cage.

A disconcertingly large number of assistants had been obtained locally and the Press was well represented. The reputation of the Trust did not permit of failure. Fortunately a most impressive-looking boat with paddles at the stern was available. This was in itself almost enough for the geese and, with only a little encouragement from the shore party, the whole flock, except two old birds that flew off, was secured at the first attempt. The catch was ninety-two.

Thirty-four of the adult geese were ringed and returned to the lake. Some adults and some of the largest goslings were taken by local farmers. A large white domestic goose, which had been living with the Canadas, went with them too. But seventeen adults and twenty-four goslings were put in crates and taken to the New Grounds. These were later released on a lake on the estate of Major P. Clifford at Frampton-on-Severn. They have shown little inclination to wander and should soon become established.

HUGH BOYD.

2. BERKSHIRE

A twelve-hour operation on 28 June 1953 at Englefield Park, near Reading, resulted in the capture and marking of forty adult and gosling Canada Geese. As the geese were moulting and unable to fly, it was possible to round them up and drive them into a cage of netting where they were ringed and individually colour-ringed, measured, weighed, had the numbers of feathers in their tails counted and had their tail coverts dyed blue.

Some of the birds that had been ringed by the same party two years before were recovered. From the number of recaptures made it was estimated that nearly two hundred Canada Geese are in Berkshire.

The party consisted of Jones, national organiser of the B.T.O. enquiry into the population of Canada Geese in Britain ; Gillmor, who filmed the catch in detail ; G. H. Kay, C. J. R. Thorne, Q. O. N. Kay and K. E. L. Simmons.

M. H. Pitt, C. C. Hutchinson and O. J. C. Wellbelove assisted in 1950 when sixteen were caught without nets and 1951 when, with nets, a catch of eighty was made.

The Severn Wildfowl Trust provided blue anodised rings and dye for use in 1953.

There have been some interesting recoveries of birds ringed at Reading in 1951. One was found dead on Ascot racecourse in October of the same year. A bird ringed as a gosling was seen paired with an unringed female, also at

Ascot, in April 1952 and another was shot in Autumn 1952 twenty miles south-east at Dogmersfield. Another pair bred at Queensmere, twelve miles away, in 1952 and 1953 when we went specially to catch the five goslings, which were again ringed and colour-ringed.

ROBERT A. F. GILLMOR.
N. G. BLURTON JONES.

EXPERIMENTS ON THE FOLLOWING-REACTION OF DUCKLINGS

By Eric Fabricius and Hugh Boyd

THE useful study of animal behaviour, like any other kind of scientific enquiry, requires a point of view. Because of the complexity which characterises the activities of all living organisms and the comparative novelty of persistent investigation of these activities students of behaviour approach their tasks from many different standpoints. In recent years the most important, because most fruitful, basis of investigations by European workers has been that of *ethology*, the study of the causes of innate behaviour. The principal exponents of this method of approach, Lorenz and Tinbergen, have both published in recent years accounts in English of their aims and methods. In addition to a rather austere paper on ' The comparative method in studying innate behaviour patterns ' (1950), Lorenz has, in *King Solomon's Ring* (1952) provided a wealth of anecdote about what animals do, and why, in a language without technicalities but informed by his exceptional insight. Tinbergen, in *The Study of Instinct* (1951), has provided a more formal ' programme ' and in his very recent *Social Behaviour in Animals* (1953), a survey of some of the results of applying their ' objective ' method. Since these expositions are readily available, it is not necessary here to do more than state the fundamental tenets of the method to which the writers have attempted to adhere in studying some aspects of the behaviour of very young ducklings.

The ethological approach is characterised by especial attention to *innate* behaviour and to the problem of *causation*. ' Innate behaviour is behaviour that has not been changed by learning processes ' (Tinbergen, 1951). The ethologist's account of causation is essentially similar to that of the physiologist, but whereas the latter usually concern themselves with the functions of particular organs the ethologist is concerned with the functions of the animal as a whole. This equation of the problem of causation with the study of function may be