

tent by the excited cries of the old male who was trying to drive off a persistent young one who had appeared on his premises and who had to be chased out of the tree again and again. Then two fresh-looking cup-shaped nests of the shallow Hooded type were discovered in the leafy sycamores opposite the ranch house, and the birds were seen flying busily around.

The mesquites which had now come into fresh green leaf were fragrant with yellow tassels. And here and there big cactus flowers were to be seen. The desert was putting on bridal garments.

*1834 Kalorama Round, Washington, D. C.*

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## REASON AND INSTINCT IN BIRD MIGRATION

BY N. F. LEOPOLD, JR.

IT is a well known fact that every species of animal, having had its origin in a very small section or territory, tends to spread farther and farther in all directions from its center of origin. This gradual spread continues until progress is checked by a barrier of some variety. This entire principle has been summed up under the zoological law of "barrier control dispersal from a geographic center of origin."

It is very easy to explain this tendency, and the resultant gradual extension of range of resident animals, but when we attempt to carry our explanation further, to the extension of migration ranges in birds for example, we are confronted with a more difficult problem.

In the case of resident animals it can easily be understood why this tendency must exist. A species springs up in a limited area; its numbers increase; the food supply in the original area proves inadequate to satisfy the needs of the increasing number of individuals and some of the more hardy members of the race go forth to seek new territory and a new food supply. Their selection of direction followed in this quest for food is a matter of chance, but those going in a direction where they find conditions favorable, survive, and settle there permanently; while those which are less fortunate in their choice of new quarters are either killed off, or

forced to move to still other territory. Such a tendency to dispersal seems logical enough—in fact is absolutely necessitated by food conditions, but now let us turn our attention to the problem of bird migration.

An explanation of the whole problem of bird migration was once attempted upon the same line of reasoning as pertains in the case of non-migratory animals. For example, a bird nesting perhaps in the extreme northern portion of the Temperate Zone of the Northern Hemisphere found conditions in this locality favorable during the summer months, but when winter set in, it was forced to seek new territory where climatic conditions were less rigorous, and the food supply more abundant. Here again the selection or choice of which course to follow, north or south, was a chance matter, but those who chose the former perished; those who chose the latter survived. This same problem, so ran the old theory, presented itself each year, and each generation was compelled to make its own choice or perish. This belief of course is controverted by the fact that most birds leave their breeding ground long before climatic conditions render it necessary, and besides this, that many birds traverse a much longer route in their semi-annual migrations than would be necessary to find suitable climatic conditions. A case in point is the Golden Plover (*Pluvialis dominicus*) which leaves its breeding ground in the Arctic circle in July, the most element part of the year, and in its migration south, passes over the Temperate and Semi-tropic Zones of the Northern Hemisphere, where favorable conditions exist in order to continue its long flight to Patagonia.

These two facts absolutely preclude the possibility of the suggestion that the question of bird migration is a matter decided by each generation of birds for itself, and nearly all zoologists today hold the belief that a tendency toward migration is inherited by each generation of birds from its forebears as an instinct. This accounts for the fact that birds leave their summer homes long before climatic conditions compel them, "instinctively" knowing that such conditions will come. The fact that birds ignore favorable localities in their migrations, in order to go farther where similar conditions exist, is explicable by the same line of reasoning. The instinct which causes birds to migrate, originated

at a time when the necessary conditions of food supply and climate could not be duplicated in any region nearer to the breeding grounds than that chosen by the species for its winter home. But conditions have changed. Today the Golden Plover could find in our own Southern States conditions identical with those in his winter retreat. Why then does he not shorten his migration route by 1,000 or 1,500 miles and take up his winter abode in the Northern Hemisphere? Will he ever change his habits in this way? This is the question which I wish to attack in this paper.

Before attempting to explain any mode of behavior on the basis of instinct, it is of course necessary for us to procure a definition of the term instinct. In most modern schools of psychology, instinct is defined as an inherited pattern of behavior; the inheritance of a habit once acquired by the ancestors of the animal in question. The definition would do very nicely were it not for the fact that evolutionists and students of heredity have proved to us, without question, that an acquired trait, and one which effects only the body or somatic cells without influencing the germ plasm is incapable of being transmitted to the offspring through heredity. Such an acquired trait a habit obviously is, and hence it becomes impossible to adhere to the definition of an instinct as an inherited habit. A small number of psychologists recognizing the absurdity of the old definition have substituted therefore the following: "An instinct is an inherited or native tendency toward a particular method of behavior." This, while ambiguous and not wholly satisfactory, would do very well as a working definition in the present problem. Now let us look into the matter. Is instinct the only factor in migration?

If instinct is the one and only factor governing bird migration then the Golden Plover which instinctively turns to Argentine and Brazil as its winter home, will never give up this locality in favor of equally favorable and nearer areas. Reason and learning cannot enter at all. The birds' habits are instinctive and will remain fixed until natural conditions require their change.

But is this the case? Let us take as an example the case of two birds and their status in the Chicago Area. This area is situated ideally for a study such as this. At the southwestern tip of Lake Michigan, east but not too far east of the Mississippi

Valley, Chicago offers a wonderful place for the study of accidental visitors and stragglers from the west. Its position on the Great Lakes makes it a logical place to which will be blown birds carried from their normal habitat by storms.

The first bird I shall quote as an example is Harris's Sparrow (*Zonotrichia querula*) a distinctly western species, common in migration west of the Mississippi River. Until very recently the bird, a rare, almost accidental visitant in the Chicago area, was included on our list on the strength of two positive records and two sight records. In the last three years however there have been at least twelve records, two of Mr. H. L. Stoddard at Miller, Indiana; three by Mr. Lyons at Waukegan, Illinois; one by Mr. Sanborn at Beach, Illinois, and six by Mr. G. P. Lewis and myself at Chicago, Illinois. But more than this, the vast majority if not all these records were made in the fall, all between September 20 and October 1 each year. Still further, the bird has not skipped a single one of the last three years, and lastly, several of the specimens, at least one of Mr. Lyons' and my last specimen (taken September 26, 1922) were immature birds. How shall we account for this phenomenon; a bird accidental at Chicago for the last sixty years, suddenly grows regular and commoner in its occurrence. I should like to suggest the following explanation.

The first individuals appearing here, appeared from accidental causes. Perhaps they were blown out of their course by a storm, and found shelter here. Upon finding themselves in new territory, they learned that here, in a place foreign to their normal migration route, conditions were favorable to them. The next year instead of following the traditional path, far to the west, they again chose the short cut upon which they had stumbled the year before, —and they brought their brood with them. This is not instinct, it is *reason*. An objection may be urged against this theory on the ground of coincidence. This would hardly explain how three successive years, the birds have chosen almost exactly the same date, and have chosen exactly the same field in which to put in in their appearance as is the case with the records of Mr. Lewis and myself. The birds chose for the first two years a small field in a rather well populated district of the city, just south of the Jackson Shore Apartments and north of Jackson Park. Apparently

a certain weed upon which the bird feeds was available here. This last year however, the field has been cleared of vegetation, and the bird has sought a new habitat, alighting upon similar fields at the northern extremity of Lincoln Park, a distance of about eleven miles from its former haunts. Another case in point is the Franklin's Gull (*Larus franklinii*). Once before reported from our area, and only twice from the State of Illinois, this bird was noticed on October 15, 1921 on a small sand-bar at the North end of Lincoln Park by Messrs. Lewis and Watson. At the time of discovery there were about ten birds in the flock and hence it would be necessary to assume either that the whole flock was blown in by a storm, or that the discovery marked a rather advanced stage in the Gull's extension of migration route, and that previously straggling individuals had found their way here but had not been noticed. This would be an easy and natural explanation in view of the similarity of this bird to the common *Larus philadelphia*, and the consequent difficulty of distinction. Furthermore the birds were again noticed on the identical sand-bar and on almost identically the same date (October 23, 1922) and the birds acted in a precisely similar manner to last year;—gradually decreasing in numbers until about a week after their first discovery they had all left. In this case also a large proportion of the birds were immatures, the brood perhaps, of those pioneer birds which the year before had either accidentally or purposely selected a migration route equally favorable with the old one; definitely controverted their old "instincts;" and by reason repeated their trip of last year.

There are numerous other examples of birds extending their range into our area, although the two cited constitute most striking examples. The Western Meadowlark (*Sturnella neglecta*), and the Bachman's Sparrow (*Peuceea aestivalis bachmanii*) are examples of summer residents where this extension of range has occurred. The former, a distinctly trans-Mississippian form was unknown in the Chicago area until recently when it has established itself firmly in several nesting colonies, one in Chicago Heights, and one near Rockford, Illinois. The latter, a southern form has only recently been found to nest at River Forest, near Chicago where its numbers increase each year.

As permanent residents the Cardinal (*Cardinalis cardinalis*) and the Tufted Titmouse (*Baeolophus bicolor*) may be cited. Both southern forms common in the southern portion of the State, have persistently pushed the boundaries of their range northward, until today the once rare Cardinal is very common if not abundant, and the formerly accidental Tufted Titmouse is a not uncommon permanent resident in restricted parts of the area. These cases however are not examples of changes in migration route, and hence are not so important to our subject as the first mentioned.

Now then to sum up. If we believe that instinct is the only factor influencing bird migration, how can we account for such instances as the above? Shall we not rather say that instinct without doubt is the motivating impulse in the idea of migration in general, but that the change of specific migration route, though brought about by chance, is in many cases preserved and continued by reason of learning, until it again appears in later generations as instinct.

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## ARRIVAL OF BIRDS IN RELATION TO SUNSPOTS.

BY RALPH E. DE LURY.

THE time of arrival of a migrating bird at a given place will differ from its normal time of arrival there by an amount which depends on the numbers of birds, their physiological condition, their food, their enemies and many other factors which vary with the weather. Local weather conditions affect birds with results often too terribly obvious, but the influence of long general pulses and periodic changes in the weather become apparent only from long series of observations of their migrations and numbers. In this connection the records of the weather and of the arrivals of birds kept by Victor Chandon and his family at Montdidier, France, from 1784 to 1869, are extremely interesting. (*Annales du Bureau Central Météorologique de France*, 1899.) These records are discussed herewith in relation to the 11.5 year