MIGRATION-ROUTES OF THE ARCTIC TERN (*STERNA PARADISÆA* BRÜNNICH)

BY O. L. AUSTIN, JR.

For a long time the migration routes of the Arctic Tern have been a mystery to man. All we have known concerning the distribution of this species are the breeding-areas, and, to a much lesser extent, the winter range. Even in this knowledge there are evidences that point to the probable course followed by the birds in their journeys between the two localities, but for some unaccountable reason it has never been traced satisfactorily to date. However, data have been gathered this last year that seem to indicate clearly the route followed by at least our eastern North American birds in their travels. These are the recovery in France of an Arctic Tern banded in Labrador and the observations of Captain Iselin of the schooner "Atlantis," as recorded in this paper.

The breeding-range of the Arctic Tern has its center of greatest abundance in Scotland, the islands immediately north and west of there, and the more northerly coasts of the North Sea. Thence it branches out in all directions, becoming almost circumpolar in the Northern Hemisphere, extending in places to within 8° of the pole, but never coming south of the 40th parallel of latitude. To the westward it includes Iceland, Greenland, Baffin Land, Hudson Bay, Labrador, and our coast south to Massachusetts. Eastward it reaches through Lapland, Finland, Estland, northern Russia, the coasts and lower river-courses of Siberia, on through the Behring Sea, south to the Anadyr and Commander Islands, and thence across to Alaska and as far west as Melville Island.

Our knowledge of the winter range of the species is more hazy and indefinite as it lies for the most part in seas that are comparatively unfrequented by man. It is usually given as those waters lying between Brazil and Argentina and West Africa, and south to some undetermined point below the Antarctic Circle. The Pacific migrants seem to winter off the west of South America, and it is possible that the two flights may meet somewhere south of the Horn, but concerning this there are practically no data.

The singular fact that the only records for the species on our Atlantic coast between Massachusetts and Brazil are a half-dozen accidental ones scattered between Long Island and

Georgia, has caused almost no speculation or comment. It has been supposed commonly that the Arctic Terns fly several hundred miles off shore, as do the Golden Plover, migrating directly from here to the Bahamas—this in spite of the fact that there are no records whatsoever for the latter islands, or for any others of the West Indies! The theory has been substantiated somewhat by sight records of flocks flying southward in this supposed path, but I believe the records to be erroneous. It is logical to expect the Common Tern there, and in my experience it is impossible to differentiate between *hirundo* and *paradisæa* when the individuals are on the wing and over fifty feet away.

This route, somewhat paralleling our shores southward, has been postulated by men who believed the birds flew in a straight line, the shortest possible distance from their breeding-grounds here to the eastern coast of South America. They neglected to take into consideration that a straight line on Mercator's projection is not the shortest distance between any two points on the surface of the earth—a mistake made all too frequently by writers on pelagic migration. The shortest possible route from Labrador or Massachusetts to Brazil is along the great circle running between the two places. It would carry the birds away from our coast at almost a right angle, and take them nearer the Azores than Bermuda.

But there are other facts in their distribution pointing to the probability that our North American birds do not parallel our coast at all in their journeys southward. We can safely assume that the present focal-point of density of individuals during the breeding-season was probably the original locus from which the species radiated to occupy the territory it now covers at nesting-time. In other words, the breeding-range of the Arctic Tern has extended itself gradually in all directions from nuclear centers somewhere in northeastern Europe. It is contrary to all reasonable expectation to believe that in establishing the colonies of the Atlantic Coast of North America the birds flew directly from Scotland to Newfoundland. It is far more likely that they came in short stages, as did the Norsemen who followed in their path ages later—first to Iceland, then to Greenland, next to Labrador, and finally on south to their present southern limit at Muskeget Island. The present distribution of the birds along that path indicates this as the probable mode of dispersal, though it must have taken long ages to complete the process.

We know that birds as races have to learn their migration-routes. The Starling, since its introduction into this country,

has taken many years to evolve the short migration it now performs, and the bird has not yet acquired in this route, which is still in the process of development, the regularity and distance of the established old-world course. As a general rule birds do not travel as does the Homing Pigeon, guided solely by an instinct that leads them straight to their objective without previous knowledge of the country. It is assumed that the usual process in most species is to leave a region using the route by which their ancestors entered it, without any regard for short-cuts—witness the right-angle turn the Bobolinks still make between their route along the Mississippi Valley and the wheatfields of the Middle West. So it is not illogical to suppose that our Arctic Terns go back the way they came, and that the Massachusetts breeders go north and east, past Labrador, Greenland, and Iceland before starting south.

In view of the above, it is interesting to note that an American bird has been known to fly eastward across the ocean. The nestling Arctic Tern that I banded in Turnevik Bay, Labrador, on July 22, 1927, and which was picked up near La Rochelle, France, on October 1st, having flown 2500 miles at the tender age of three months, suggests that the Labrador birds follow some such route. This bird was one of five hundred I banded on the same islet that year, and its recovery may be only an accidental record, but with all the other evidence pointing towards such a route, I believe it was on its regular path in spite of there being no other records to substantiate it. There may be other recoveries in the near future, for I had the good fortune to be able to band six hundred of this year's hatch at the same place last July.

Of more importance are the observations of Captain Columbus Iselin. On a voyage of oceanographic exploration for Harvard University in the schooner "Atlantis," he sailed across the Atlantic and back last summer. On his way eastward in July not a single Tern of any description was seen. But on his return he suddenly sailed into an area of sea covered with Arctic Terns on August 26th, on the 51st parallel of latitude and about three hundred seventy-five miles west of Ireland. He shot some to make sure of his observations, and brought a specimen back to prove his identification. He continued seeing the birds for the next four days, always in small bunches, while the schooner traveled five hundred miles further westward along the same parallel. Here, seven hundred fifty miles east of Newfoundland, the birds ceased as suddenly as they began. His field notes for August 29th read:—"Shot Jaeger and Tern. For the past three days both

species have been numerous, especially the latter. The Terns fly high, and are usually in groups or pairs. They seem bound in no particular direction, and are not in much of a hurry."

The "Atlantis" evidently sailed across the migration-route of the Arctic Terns, and at a time when the first of the North American, Greenland, and Iceland birds were on their way south. The Captain's last sentence typifies their lackadaisical method of traveling. They never seem to be covering as much ground as they really are, for they must needs stop and feed *en route*. It is evident from the dates of their arrivals and departures that some of them must reach the winter quarters before the tardy ones even leave the breeding-grounds. They must spread at one time over an area some ten thousand miles long and from fifty to seven hundred miles in breadth. We know that at one point this thoroughfare is five hundred miles wide, lying four hundred miles off the Irish coast and straight north of the Azores.

The birds from northern Europe, Spitzbergen, Jan Mayen Land, Franz Josef Land, and the western part of Siberia must swing westward first and then southward, joining the American birds somewhere southwest of Ireland. It is unlikely that either prevailing winds or ocean currents affect the course of the flight directly, though violent storms undoubtedly are responsible for accidental records in out-of-the way places.

The origin of the migration that goes yearly along the eastern side of the Pacific past California and the west coast of South America is a very puzzling question. I judge the birds comprising this flight to be the ones that breed in the areas from the Taimyr Peninsula in Siberia eastward to Melville Island in North America. It is significant that this artery sticks to the eastern side of the ocean, in which it parallels that of the Atlantic. There are but two accidental records for Hawaii, and no records at all for the Pacific west of that, Australia, New Zealand, or the Indian Ocean.

In the collections of the Museum of Comparative Zoölogy there are excellent series of the Arctic Tern from both oceans. I have compared these very carefully, but I can find no appreciable difference of even subspecific value between the birds, no matter whence they come, in color, structure, or size. They are undoubtably one and the same race.

Our knowledge of the winter range of the species is still too vague and indefinite. It is highly probable that when more is understood of the doings of the birds in the Southern Hemisphere, we may gain some clue to the nature of the Pacific migrants and their relation to those of the Atlantic. But

there is comparatively little research being carried on to-day in either the Antarctic or the Arctic. Undoubtedly banding will be a very large factor in helping decide the matter.

NOTES ON BANDING TERNS AT CHATHAM, MASSACHUSETTS, FOR 1928

BY CHARLES B. FLOYD

THE fifth consecutive summer's work with the Common and Roseate Terns (*Sterna hirundo* and *dougalli*) on Tern Island, Chatham, Massachusetts, was begun on June 30, 1928. The purposes of this season's activities were:

1. To band a minimum of five thousand immature birds.
2. To determine by trapping whether or not any Terns banded during previous years return to the island to nest.
3. To secure as many parasites as possible from adults, young, and nests.
4. To make a series of blood smears for the Department of Tropical Medicine, Harvard University Medical School, from adult and young of both species.

The Terns arrived in Chatham, as in former years, early in May, and mating and incubating went along in due time despite the fact that the rainfall during June was nearly twice the normal amount. Warden Patterson tramped over the island on June 11th and estimated that the birds were present in their usual numbers and found nests with eggs everywhere in the grass and open sand. He noted that the birds were flying long distances for food, which was, apparently, difficult to obtain at that time. Upon visiting the island July 1st we found many young in all stages of growth, and literally hundreds were ready for banding. The Common Terns appeared more advanced than the Roseates. It was necessary to work fast in order to band the quota set, and we developed a most efficient method of procedure. All bands were opened the day previous to the one on which they were to be used, and the numbers recorded. They were then carried loose in side pockets. The young Tern was lifted from the ground with the left hand, head toward the body, and turned feet up as it was raised. The thumb was then pressed behind the left leg at the joint, holding it upright and firm. This permitted the bander to place the band around the tarsus with the right