SECTION VI

MIGRATION AND MOVEMENTS

AUTUMN MIGRATION IN EASTERN ETHIOPIA

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Observations were made on Palaearctic migrants in the Chercher Highlands and Ogaden areas of eastern Ethiopia in September. Large numbers of migrants of many species were seen in areas from which there has been no previous information. The data are compared with results from other parts of the country and the main conclusions are that:

arrival of the main bulk of migrants in the area is not until after the middle of September;

arrival coincides with a period when the vegetation is at its most lush at the end of the rains;

arrival is on an immense scale and on a broad front and extends southward just behind the southerly progression of the rain belt. (There is a month's interval between arrival dates in the north and south.)

There is evidence that immigration continues for at least six weeks, that there is a resting period for moult and that some species are segregated in certain parts of the country.

DIRECTIONS OF FLIGHT OF MIGRATING BIRDS OVER NORTHERN SWITZERLAND STUDIED BY TRACKING RADAR

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A Z-band tracking radar was used as described in previous papers (e.g. Int. orn. Congr. 1970). Sixty-four nights of spring migration and thirty-eight nights of autumn migration, each with two to three measurements of wind and an average of 150 tracked birds, were studied. The radar data, in connexion with known ringing results, provide evidence for the following points:

beside the birds of the large north-eastern landmasses there is always a small part of populations from the north and north-west migrating through Switzerland;

the percentage of northern and north-western populations seems to be larger in late spring when long-distance migrants are on their way;

the mountain ridges along the Swiss lowlands or the directions of wind induced by the mountain chains seem to have a strong directing influence on the main direction of migration; the principal direction of migration is 60° in spring and 240 to 250° in autumn;

deviations from the normal directions of flight, specially reversed migration, occur mainly at lower levels;

birds tend to fly on those nights when, and at those levels where, winds are most favourable for them; some birds fly downwind even if the direction of wind does not coincide with the direction of their goal;

birds can and do compensate for drifting by wind if necessary, e.g. when winds would lead them south-east in spring;

as has been reported earlier for autumn, in spring too, the mean tracks shift clockwise during undisturbed nights.

EXPERIMENTS ON DISCRIMINATION BY THE STARLING STURNUS VULGARIS BETWEEN GEOGRAPHICAL LOCALITIES

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For orientation towards a goal a bird first must be able to observe that two places differ geographically and secondly it must be able to find the direction to its goal. The present experiments do not deal with orientation towards a goal as a whole, but only with the first element: geographical discrimination. As experimental sites, two localities were chosen at a distance of 200 kilometres from each other in an east-west direction. Here, adult Starlings were trained to jump on two different perches in their cages to obtain food. During the training at one place the birds could obtain food only by jumping on one of the perches; at the other place only by jumping on the other perch. Geographical discrimination was tested by not rewarding their jumps.

The birds appeared to be able to distinguish between the two places under certain conditions. Suggestions were obtained that the landscape is used, although not necessarily a familiar one. Further, the sun seemed to be an essential factor.

SOME RELATIONS BETWEEN BREEDING SEASON, MOULT AND MIGRATORY RANGE

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The temporal distribution of passage periods, the breeding season and the period or periods of moult are examined for a variety of passerine species with respect to their contrasting migratory ranges. The techniques evolved for compressing these biological functions into a year determined by seasonal climatic changes clearly may differ between species resident in Britain and trans-Saharan or trans-equatorial migrants. Here are considered the duration of moult and whether it occurs on the breeding grounds or in winter quarters, the number and size of broods produced, together with the incubation and fledging periods needed, and various anatomical or physiological adaptations to long-range migration. Much of the information on which this review is based was extracted from data gathered by the extensive surveys organized by the British Trust for Ornithology. The potential of such broad-based enquiries is briefly examined.

DIURNAL MIGRATION OF WOOD WARBLERS PARULIDAE IN THE APPALACHIAN MOUNTAINS OF EASTERN UNITED STATES

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During the fall migration in the Appalachian Mountains there is a pronounced diurnal movement of normally nocturnally migrating Parulidae. In sixteen years over 16,000 parulids of thirty-three species have been netted and banded at the Allegheny Front Migration Observatory in West Virginia. Heavy flights come one or two days after the passage of a cold front to the north and usually last about three days, but they occur only on days of westerly winds, which force the birds to fly upwind in crossing the mountain.

Four species, all common summer residents of boreal forests, constitute 55 per cent of parulids banded. They will leave the United States by at least three different routes; so, the mountain is probably an effective leading line causing the birds to fly south-west for a short distance at least. The most numerous species, *Dendroica striata*, is almost unknown south-west of the station in autumn. Birds of the year make up a smaller fraction of those caught than at coastal stations and in some species there is a marked difference in timing of the migration of birds of the year and older birds.

MOVEMENTS AND BIO-ECONOMICS OF MIGRANT RAPTORS IN SOUTH WEST AFRICA

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Migrant raptors play an important role during the summer in containing certain population-explosion plagues, especially of the ubiquitous termite *Hodotermes mossambicus*. Historical accounts suggest that their role in this was probably much greater in the past. An average large flock might be composed of about 500 *Milvus migrans* and twenty *Aquila nipalensis*. It would consume an estimated quarter to half a million termite alates a day (25–30 kg). Congregations of raptors tend to disperse gradually over a wide area following the first few days of a local termite explosion, but may remain in the district for weeks.

Milvus migrans in its two subspecies generally forms the greater part of raptor congregations, but in northern South West Africa *Falco vespertinus* is also a dominant nucleus species. *Aquila nipalensis* generally constitutes the next largest fraction of the flock. Several other migrant and resident raptors frequently constitute minor fractions. Non-raptors, particularly the migrant storks, are frequently found alongside the raptors.

During early and mid-summer the flocks of raptors probably feed almost exclusively on termites and move with the major first-rain fronts. Their movements from year to year may vary with the local combinations of a number of factors producing the explosions of prey. Later in the summer the flocks break up and probably switch to sources of less concentrated food as they retreat northwards.

BIRD MIGRATION IN EASTERN ASIA AND ITS RELATION TO THAT OF AUSTRALIA

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During the eight years, July 1963 to July 1971, a million and a quarter birds of 1,214 species were banded in ten countries of eastern and southern Asia. Nearly 7,000 recoveries and 50,000 repeats among these birds have spelled out patterns of migration at the various latitudes. These include overt migrants that move from the north temperate zone to the tropics, migrants that move within the zones, migrants or wanderers within the tropics and sedentary species. Many species have segments of their populations that progressively migrate further south as they nest further north.

Migration routes of the multiple species may be grouped into four massive flyways across the continent; Eastern Asian, Indo-Asian, Eastern Afro-European and Western Afro-European. Segments of populations of species that extend across Eurasia use the flyway nearest to their breeding ranges and move along migration routes that rarely intercept between flyways. Certain groups such as the emberizids perform east-west migrations before entering routes taking them south.

Migratory patterns of the present millenium probably reflect glacial patterns of the Pleistocene. Current theories of continental drift offer explanations for problems of movements round the Himalayas and for the absence of landbird migrants to Australia. There is an exchange of seabirds and shore-birds between Asia and Australia. The proximity of Africa for vast periods of time is reflected in the number of species that move south-west from northern Asia. The drift of India into the southern edge of Asia has brought about a shift in migrants from central Asia to it. Australia has moved into the Asian sphere too late to pick up the land migrants that have used the Eastern Asian flyway. Man's disturbance of habitats and populations at present is altering the flight paths and population densities of migrants.

DISPERSAL OF SOME SOUTHBOUND MIGRATING NORTH AMERICAN SHORE-BIRDS AWAY FROM THE GULF OF ST LAWRENCE (CANADA) TO THE LESSER ANTILLES AND NORTH-EASTERN SOUTH AMERICA

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During the autumns of 1969, 1970, 1971 and 1972, 15,081 transient shore-birds of twenty-one species (Charadriidae and Scolopacidae) were banded and colour-marked on the Magdalen Islands, Gulf of St Lawrence, and Sable Island, off Nova Scotia, Canada. Forty-four individuals of six species were recovered at the banding locations one year after banding and sixteen individuals returned two years later. Sightings or recoveries or both of 103 birds of eight species away from the banding localities indicate that individuals dispersed in two areas 3,200 kilometres apart. A northern area includes all the Canadian Atlantic Provinces and the New England States south to Virginia; a southern area includes the Lesser Antilles, Guyana and Surinam. One bird was sighted in Bermuda and another recaptured at the Azores.

The fall and spring migratory routes of these species are illustrated, compared and discussed in relation to fat contents or reserves of energy and to the relative abundance and arrival dates in autumn on the Canadian Atlantic seaboard. The effects of weather on the length of stay and the accumulation of reserves of fat are analysed according to sex and age-classes. The sightings or recoveries or both indicate that the migration of shore-birds is precisely timed; moreover, groups of migrants use the same resting or feeding areas or both year after year.

RECORDING MIGRATION IN THE FAR EAST BY MEANS OF RADAR

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During 1972 and 1973 the 10-cm 650 kW Plessey 43S weather radar of the Royal Observatory, Hong Kong, was used to study migration across the southern coast of mainland China and over the South China Sea. It is expected that by the beginning of 1974 movements will have been looked for in most months of the year. A preliminary note has appeared in *Nature* 241 (5391): 552. Northward spring and southward autumn migrations have been recorded of charadriiform and passerine-type species, but mid-year movements are also expected. Some evidence of a 1,100–1,900-km movement across the south-north axis of the South China Sea was detected in late April 1972. Attempts are being made by other ornithologists to make similar radar studies in peninsular West Malaysia and in Japan, thus providing information for three points on the migration route from south-eastern Asia to eastern Siberia. The purpose of showing films from Hong Kong at Canberra is to encourage additional studies in Indonesia, the Philippines, Taiwan and American Micronesia.

THE ACTIVITIES OF THE MIGRATORY KAMCHATKAN RUSTIC BUNTINGS IN CAGES EXPOSED TO DIFFERENT ARTIFICIAL PHOTOPERIODS

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This research is concerned with the correlation of photoperiod and the activities of migratory birds. The experiment was first conducted by exposing migratory Kamchatkan Rustic Buntings *Emberiza rustica* to two different artificial photoperiods: 15L-9D, 9L-15D. Each room was lighted by a 40-watt fluorescent lamp and the temperature was fixed at 20 °C. The activities of the subjects were measured during light and dark periods by a counter and an electropolyrecorder. The results are: the amount of activity

at night of the 15L-9D group increased from late April to early May, then gradually decreased until October, when it slightly increased again; in contrast, the amount of activity at night of the 9L-15D group increased a little later than that of the 15L-9D group, but surpassed it in autumn. Next, the subjects were exposed to three different photoperiods under the same conditions: 16L-8D, 12L-12D and 8L-16D. The results are: the activity at night of the 16L-8D group reached its highest point in spring and a relatively high point in autumn; the amount of activity at night of the 12L-12D group reached a moderately high point in spring and a very high point in autumn; and the activity at night of the 8L-16D group showed no noticeable increase either in spring or autumn.

Thus the groups exposed to the increased light (16L and 15L) increased their activity at night mainly in spring, whereas the 12L and the 9L groups did so mainly in autumn and the 8L group showed no noticeable seasonal variation. The results will be compared with experiments with a few other passerine species.

ALTITUDINAL MIGRATION IN SOUTH-EASTERN AFRICA

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Altitudinal migration is defined as the seasonal movement of birds from high-level breeding haunts to lower levels during the winter. The phenomenon occurs in the southern and eastern parts of Africa where there are abrupt transitions from sea-level to interior plateaux, rift-valley systems and isolated massifs.

The climatic regimes involve wet summer-breeding seasons and dry winters. Examples are given of non-forest and forest bird movements; the former are seldom as extended as those undertaken by forest species, which include members of five families. Data are given on the movements of selected species and it is shown that some migrants maintain a territory in their winter quarters. Evidence from ringed birds shows that species undertaking altitudinal migration do so year after year proving that the phenomenon is not merely a dispersal by young birds. There are no known forests where the whole population moves to lower levels.

The significance of the migration is discussed and it is concluded that its evolution was related to vicissitudes of the Pleistocene climate. At the present time it is probably important in maintaining gene-flow between populations in montane forest, a highly fragmented and, in many areas, a vanishing habitat.

BIRD MOVEMENTS IN AUSTRALIA

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Of the 713 species of birds recorded from Australia more than half probably undertake some movement. Irregular nomadic movements are undertaken by many species that live permanently in Australia. These movements are probably conditioned by changes in supply of food resulting from erratic rainfall and drought. Such movements may involve only a small section of the population, which is otherwise sedentary.

Seasonal south-north migrations are undertaken by few species of landbirds that breed in Australia. None of these migrate beyond the equator and most winter in northern Australia or in islands near the north of the continent. Some individuals remain in southern Australia during the winter. Undoubtedly this reflects the fact that very cold conditions in winter occur only in parts of the south-east.

Regular migration beyond the equator of birds breeding in Australia only occurs in four species of seabirds. Other seabirds breeding in Australia probably disperse into the surrounding seas when they are not breeding. Although little is known concerning these movements they may be considerable and some individuals of one species, *Puffinus pacificus*, are known to move north of the equator.

Of the 130 species that visit Australia but breed elsewhere most are sea-birds that breed in the southern hemisphere and waders that breed in the northern hemisphere. Only ten species of insectivorous landbirds visit Australia. Of these, only two, swifts from the northern hemisphere, appear to be regular migrants in large numbers.

THE EFFECT OF SUPPLY OF FOOD ON THE BREEDING OF RESIDENT SPECIES AND THE MOVEMENT OF PALAEARCTIC MIGRANTS IN A TROPICAL AFRICAN SAVANNA

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In the Serengeti region of Tanzania (1°–3°S) insects are most abundant in the early rains of November and remain numerous throughout the wet season until May. They are less numerous in the dry season. The initial peak is produced by migrating birds arriving at local rainstorms because of convergences of winds associated with the Intertropical Front.

Peak of breeding by insectivorous nidicolous birds occurred two to three months after the peak of insects. Ground-nesters bred more constantly throughout the wet season with a peak in April. But Ostrich laid and hatched only during the dry season. Larger species of ground-nesters laid later in the season than smaller. The delay in breeding of insectivores, therefore, was related to the need to build up physiological condition after the dry season and store the reserves required before laying. This may also account for the laying period of Ostrich. Thus, supply of food could ultimately determine the timing of laying as it does in other regions.

Palaearctic migrants arrived in September two months before the peak of insects, when they were found only where local rainstorms occurred. Such storms concentrated migrating insects in large numbers. Hence migrating birds overcame shortage of food by following the migrating insects. After widespread rain in November, the migrant species dispersed and intermixed with residents. The method of finding local storms may be by attention to wind patterns. Such a method allows the start of spring migration to coincide with the movement of migrant insects north and also allows fattening.

GAPS IN KNOWLEDGE OF EUROPEAN PASSERINE MIGRATION TO AND FROM AFRICA

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Breeding distribution and winter quarters of most of the European passerines are fairly well known. Of the fifty-two European species wintering regularly south of the Sahara the winter quarters of three only are insufficiently documented (*Acrocephalus paludicola, Locustella naevia, Hirundo daurica*). In parts of Africa, specially in West Africa between Gambia and Nigeria but also in other parts of the continent, the winter distribution of other species also is poorly known.

Even less information is available if we ask for more details concerning the distribution of different breeding populations within the wintering area or for exact routes to and from the winter quarters. In this respect ringing has provided extensive material for two species only, *Hirundo rustica* and *Motacilla flava*. In both, ringing on the wintering grounds in tropical Africa has contributed considerably to our present knowledge. In twenty-nine other species recoveries south of 30°N in Africa of birds ringed in Europe are known. The five best have between twenty and fifty recoveries, most (16 species) less than five. This is not enough to give reliable answers to the above questions. Examples are given for *Motacilla flava, Oriolus oriolus, Hippolais icterina* and *Sylvia curruca*. Ringing in eastern Europe and in tropical Africa and efforts to secure more recoveries in the tropical winter quarters by informing the indigenous peoples of the significance of bird ringing would contribute considerably to

our present knowledge. This is summarized in Moreau's *The Palaearctic-African Bird Migration System* and in the new *Atlas of Passerine Migration* edited by Vogelwarte Radolfzell.

European passerines ringed or recovered in Africa south of 30°N (column A: ringed in Europe, recovered in Africa; column B: ringed in Africa, recovered in Europe or Asia; column C: total of A and B).

	A	B	C		A	B	C
Hirundo rustica	600	520	1120	*Delichon urbica*	10	1	11
Motacilla flava	48	97	145	*Sylvia communis*	9	2	11
Riparia riparia	41	8	49	*Motacilla alba*	8	3	11
Muscicapa striata	45	—	45	*Phoenicurus phoenicurus*	8	1	9
Lanius collurio	20	2	22	*Ficedula hypoleuca*	7	1	8
Sylvia borin	19	3	22	*Phylloscopus collybita*	6	2	8
Acrocephalus scirpaceus	19	1	20	*Sylvia atricapilla*	4	2	6
Phylloscopus trochilus	14	—	14				

For 16 species the totals only are given.

4 recoveries: *Oriolus oriolus, Acrocephalus arundinaceus, A. schoenobaenus, Anthus trivialis.* 3 recoveries: *Oenanthe oenanthe, Saxicola rubetra, Phylloscopus sibilatrix.* 2 recoveries: *Luscinia luscinia, Ficedula albicollis, Sylvia nisoria.* 1 recovery: *Luscinia megarhynchos, L. svecica, Acrocephalus palustris, Hippolais icterina, Lanius senator, L. nubicus.*