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Mites (Family Trombiculidae) Parasitizing Birds Migrating from Africa to Europe

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The mechanisms of dissemination of arthropod-borne human and animal pathogens are of considerable interest to the epidemiologist, veterinarian and biologist. Birds which are hosts to such pathogens and their arthropod vectors could transport them over long distances during their spring and autumn migratory flights

In April 1961, birds migrating from Africa to Europe were collected in south-western Spain and examined for ectoparasites and antibodies to arboviruses. Fully engorged larvae of two species of trombiculid mites unknown in Europe (genera Neoschoengastia *and* Blankaartia*) but found in Africa were collected from two of the migrating birds (redstart and little bittern), suggesting that the birds were carrying the mites from Africa to Europe.*

Trombiculid mites are the proven vectors of scrub typhus ; they have also been implicated in the transmission of human haemorrhagic nephroso-nephritis. The finding of the mite larvae on migrating birds is therefore of some epidemiological interest and underlines the importance of obtaining more data on the dispersal of trombiculids by migrating birds.

In recent years, biologists and epidemiologists have shown considerable interest in the role of migrating birds as disseminators of human pathogens. During spring and autumn migratory flights, birds move over long distances and are therefore potentially capable of transporting pathogenic organisms from one region to another, either in their tissues or in the tissues of their ectoparasitic arthropods. Pavlovskij (1940) suggested that birds may play an important part in disseminating ticks infected with the virus of Russian spring-summer encephalitis. Hoogstraal et al. (1961), who found African species of *Hyalomma* on birds passing northwards through Egypt during their spring migration, suggested that many of these ticks are carried some distance into Europe and Asia. Similarly, in autumn, birds passing through Egypt on their southward migration from Europe were infested with tick species known to occur only in Europe and Asia (Hoogstraal et al., 1963).

Although a great deal of work has been done during the last five years or so on the transport of ticks by migratory birds, there have been few records of ectoparasitic mites on migrating birds. H. Hoogstraal (personal communication, 1963) collected unidentified mites on birds migrating through Egypt. H. E. McClure (personal communication, 1963) collected larvae of the trombiculid mite, *Leptotrombidium scutellaris*, which is not known to breed in Malaya, from a migrating grey-headed thrush, *Turdus obscurus*, netted in Pahang, Malaya.

The dissemination of trombiculid mites by migrating birds should receive more attention since the larvae of some of these mites infest birds and are the proven vectors of scrub typhus. Audy (1949) remarked that birds and large mammals may have been responsible for the spread of scrub typhus and its trombiculid vectors over large areas. More recently, trombiculid mites appear to have been implicated in the transmission of human haemorrhagic nephroso-nephritis in Europe (Daniel, to be published).

In April 1961, the World Health Organization sponsored an expedition to south-western Spain, under the direction of Dr C. E. Gordon Smith, then of the Arbovirus Unit, London School of Hygiene and Tropical Medicine, to collect ectoparasites (particularly ticks) and blood samples from birds migrating from Africa into Europe. The field team consisted of the author and Mr R. W. Sims,

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Mr P. R. Colston and Mr G. S. Cowles from the Bird Section of the British Museum (Natural History). Notes on the birds collected during the trip have been published by Colston & Cowles (1963).

The collections were made in and around the Pinar de la Algaida, a re-afforested pine wood on the east bank of the Guadalquivir river, near San Lucar de Barrameda, 8 km NNE of Bonanza and 11.5 km west of Trebujena in the Province of Cadiz. The study area may be divided into three main biotopes: (1) forests of stone pine (*Pinus pinea*); (2) a narrow fringe consisting mainly of *Halimium* scrub and patches of *Juncus* spp. with a few eucalyptus plantations, and (3) the extensive salt marshes, or *marismas*, leading down to the river. The *marismas*, which were wet and muddy during the earlier part of our visit due to tidal inundations, quickly dried as hard baked mud. The *marisma* vegetation was halophytic and consisted predominantly of species of *Salicornia* and *Salsola*.

MATERIALS AND METHODS

Birds were shot or mist-netted and blood samples were taken on filter-paper strips for testing for antibodies to arthropod-borne viruses. After examination for attached ticks, the birds were wrapped in lint and kept overnight in polyethylene bags. The following morning, ectoparasites which had detached from the body were removed from the lint and either held live for further studies or preserved in 70% spirit. The birds were identified by R. W. Sims, P. R. Colston and G. S. Cowles.

RESULTS

Among the total of 307 birds (214 migrants and 97 residents) examined, only two were infested with trombiculid mites.

On 20 April 1961, a redstart, *Phoenicurus phoenicurus phoenicurus*, was shot in the pine forest and 21 fully engorged trombiculid mite larvae were collected from it. These were examined by Dr P. H. Vercammen-Grandjean of the George Williams Hooper Foundation, University of California Medical Center, and confirmed to be close to, if not identical with, *Neoschoengastia streptopelia* collected by him from a dove, *Streptopelia semitorquata*, in Bukavu, Kivu Province, Congo.

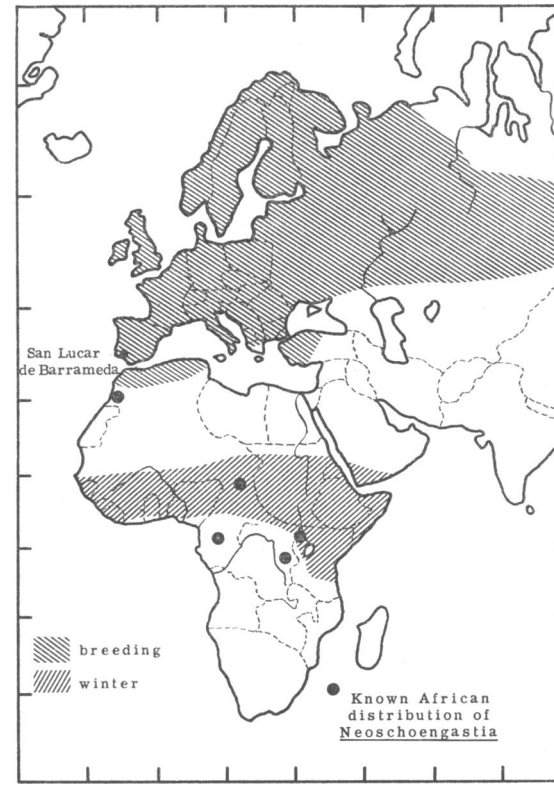
On 27 April, a little bittern, *Ixobrychus minutus minutus* (the only specimen of this bird collected during the expedition), was shot in a marshy copse in the pine forest fringe. From this bird, 23 fully engorged larvae belonging to the genus and subgenus *Blankaartia (Blankaartia)* were collected.

The bird hosts

Redstart, Phoenicurus phoenicurus phoenicurus *(Linnaeus) (Family Turdidae)*. The redstart (Fig. 1) breeds throughout almost the whole of the Palaearctic Faunal Region as far east as Lake Baikal, although the main part of the breeding range does not reach south of the Pyrenees (Buxton, 1950). In general, European populations migrate on a broad north-east/south-west front across the Mediterranean to winter along the southern edge of the Sahara to about 9°N and in East Africa south

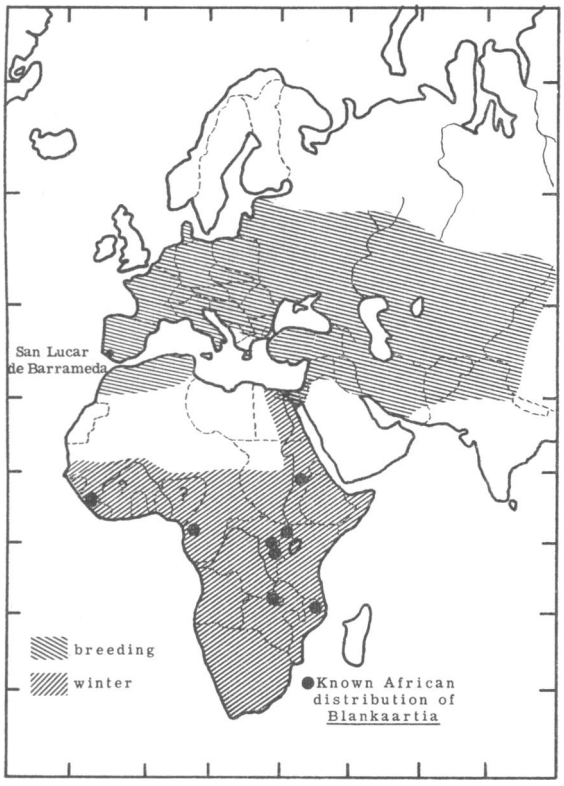
FIG. 1

WINTER AND SUMMER RANGE OF REDSTART (*PHOENICURUS P. PHOENICURUS*) [a] AND KNOWN AFRICAN DISTRIBUTION OF *NEOSCHOENGASTIA*



[a] After Hoogstraal et al. (1961).

FIG. 2
WINTER AND SUMMER RANGE OF LITTLE BITTERN (*IXOBRYCHUS M. MINUTUS*) AND KNOWN AFRICAN DISTRIBUTION OF *BLANKAARTIA*



to Lake Victoria. Chapin (1932) listed this subspecies among those that may reach the savannas just north of the Congo forests without actually penetrating the forests. The birds passing through Spain probably winter from Senegal to Chad (M. A. Traylor—personal communication, 1963), and according to Buxton (1950) redstarts have been seen in Nigeria during the winter.

Mountfort & Ferguson-Lees (1961) listed the redstart among " passage migrants and vagrants " in the Guadalquivir valley of Spain. During our expedition, redstarts were seen regularly on passage in small numbers from 7 April to 3 May (Colston & Cowles, 1963).

Little bittern, Ixobrychus minutus minutus *(Linnaeus) (Family Ardeidae)*. The species breeds in Europe north to the Baltic States, east to Central Asia and south to north-west Africa, Egypt, Iran and northern India. It winters in Egypt and almost the whole of tropical Africa as far as South Africa (Fig. 2). One banded in Switzerland was captured in the Congo (F. Roux—personal communication, 1963). According to Traylor (personal communication, 1963), there are very few records from West Africa, but on its wintering grounds it is easily confused with the African race, *payesii*.

Mountfort & Ferguson-Lees (1961) listed the little bittern among " species breeding or regularly observed " in the Coto Doñana of Spain, although during our expedition we saw only one in the Pinar de la Algaida.

Distribution of the mites

Neoschoengastia Ewing. This genus is well represented in the Australasian and Neotropical Regions. Wharton & Fuller (1952) did not include it in their list of trombiculid mites from Europe. In Africa, the genus is represented by five species (Fig. 1), one each from Morocco, Cameroun, Chad, Congo (Léopoldville) and Uganda. The specimens taken by us from the redstart in southwestern Spain are close to, if not identical with, *N. streptopelia* Vercammen-Grandjean from the Congo.

Blankaartia Oudemans. The recorded distribution of this genus is rather patchy. Species have been collected from Burma, India, Malaya, Ceylon, Maldive islands, Sumatra, Guam, Philippines, Panama, Peru and Colombia. According to Wharton & Fuller (1952), there is one doubtful record from Europe, but apart from this the genus appears to be totally unrepresented in Europe. The known African distribution of the genus is given in Fig. 2. The subgenus *Blankaartia*, to which the species collected by us from the little bittern belongs, is known in Africa from Sierra Leone, Cameroun, Sudan, Congo (Léopoldville) and Mozambique. According to Vercammen-Grandjean (personal communication, 1963), the mites from the little bittern in south-western Spain and the species known from the Congo and Mozambique are very close to each other and to *Blankaartia (B). acuscutellaris* of Asia and probably represent only forms or variations of the same species. Perhaps the most significant fact in this connexion was the finding of *B. (B.) acuscutellaris* on a little bittern in Cameroun by Taufflieb & Mouchet (1959). The larvae were collected in April, presumably at a time when the bird was about to start on its northward spring

migration. Although Vercammen-Grandjean (1961) remarked that the Cameroun record needed very careful confirmation, the Spanish collection from the same bird host suggests that the Cameroun record is probably a valid one. In Malaya, Audy (1956) collected *Blankaartia (B.) acuscutellaris* from Schrenck's bittern, *Ixobrychus eurythmus*.

DISCUSSION AND CONCLUSIONS

From Fig. 1 and 2 it may be seen that *Neoschoengastia* and *Blankaartia* have previously been collected from the wintering grounds of the bird hosts in Africa, but not from their breeding areas. Possibly the mites are transported from Africa to Europe during their hosts' spring migration. Two other factors to be considered in this connexion are the speed of migration of the birds and the time required by the mites to engorge and drop off.

Time required by redstart and little bittern to reach south-western Spain from African wintering grounds

There are no direct records of migration speeds of these species in Africa. In Europe, migration speeds are generally higher in autumn than in spring and the same is probably true in Africa. Recovery of ringed redstarts in Europe would indicate speeds of up to 109 miles (175 km) per day in spring and up to 255 miles (410 km) per day in autumn (Buxton, 1950). During the spring flight across the Sahara, the speed of migration is lessened by strong headwinds unless the birds are travelling diagonally NE at altitudes of over 2000 m or directly below 500 m (Moreau, 1961). However, the birds must cross the inhospitable Sahara as quickly as possible and, from Moreau's (1961) estimates of flying times across the Sahara, it would appear that birds such as the redstarts probably reach the southern Mediterranean coast from Mali in two or three days. No data on migration speeds of the little bittern are available but the arrival of the redstart and the little bittern in southern Spain from tropical Africa in a week or ten days would not be surprising (Traylor—personal communication, 1963).

The feeding time of trombiculid mites

The transport of trombiculid species by migrating birds depends on the presence of the mite larvae on the birds, since only this developmental stage is parasitic; nymphs and adults live a non-parasitic life in or on the soil. If the larval feeding time is longer than that required by the migrating bird host to move from, say, point A in Africa to point B in Europe, then there is a reasonably good chance that mites picked up at A will be dropped off at some point beyond B, certainly not before. Harrison (1953, 1957) estimated the feeding times for several species of trombiculid mites and listed 16 species for which reasonably complete data are available. The mean feeding time for these species varied from 2.1 days for *Trombicula muridia* to 20 days for some species of *Euschoengastia*, and the maximum ranged from 6 to 60 days. *Blankaartia (Blankaartia) acuscutellaris* had a mean feeding time of 4 days and a maximum feeding time of 10 days. There are no data on feeding times of *Neoschoengastia* spp.

All mites collected by us from the little bittern and the redstart were fully engorged and ready to detach. It therefore seems reasonable to suppose that they were acquired by the birds from their wintering grounds or at some point on their migratory route through Africa and had attached and continued to feed during the host's flight into Europe.

Conclusion

At this point, one may well ask why trombiculid larvae have not previously been collected from birds migrating into Europe from Africa, since bird migrations have been studied by ornithologists for many years. Presumably, no one examined captive birds for trombiculid mites, or elected to collect them if they were noticed. Moreover, unless it was realized that, for example, *Blankaartia* and *Neoschoengastia* were mites which might not be indigenous to Europe, the essential interest of their presence on the northbound migrant birds could be missed; there are no published records to our knowledge to support the idea that the above mites are part of the normal European fauna. Their occurrence on the migrants not only raises the question of their dispersal by birds but indeed that of their zoogeographical distribution. We can only presume, meanwhile, that the mites at present under discussion were being dispersed by the birds northwards of their known areas of distribution.

The presence of these mite larvae on the migrating birds in south-western Spain would suggest that, as in the case of ticks, migrating birds may well be one of the mechanisms of dissemination of some trombiculid mites throughout the world.

Introduction of the mites into south-western Spain probably does not occur regularly, since

Nisbet, Evans & Feeney (1961) point out that the main migration routes in spring lie over and to the east of Cape Trafalgar. Birds reach areas to the west of this only as a result of drift due to easterly winds. Since the mites were in a fully engorged condition and ready to detach, one would not expect to find the species much further north than southern Europe.

Apart from distributional data on mites, wintering areas of the birds, migration routes and speeds of migration of the birds, and feeding times of trombiculid larvae, a number of other factors should be considered before one can say that the mites could be transported from Africa into Europe by the migrating birds. Hoogstraal et al. (1963) pointed out that tick infestation of migrant birds depends on the coincidence in any given area of their presence with the feeding activity of the tick species available to parasitize them. The same would also apply to the trombiculid mites, and in this case the period of activity of the parasitic trombiculid larvae should coincide with the time the birds are about to start on their migratory flight.

The successful introduction and establishment of non-European trombiculid species in Europe must depend further on whether the larval mites detach and fall in a suitable biotope at a favourable season for completing their development and whether suitable hosts are available for providing a meal for larvae of the next generation. If larvae drop into an inadequate " sterile " biotope, then they would fail to establish permanent populations of their species no matter how many larvae might be introduced annually by the migrating hosts.

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RÉSUMÉ

La dissémination et le transport à longue distance, par les oiseaux migrateurs, d'arthropodes vecteurs de virus pathogènes retient depuis quelques années l'attention des épidémiologistes.

L'auteur apporte une nouvelle contribution à cette question, en signalant la découverte, dans le sud-ouest de l'Espagne, de larves de thrombididés gorgées, appartenant aux genres *Neoschoengastia* et *Blankaartia*, parasitant un rouge-queue (*Phoenicurus phoenicurus phoenicurus*) et un héron blongios (*Ixobrychus minutus minutus*), capturés à leur retour d'Afrique. Ces thrombididés qui se rencontrent en Afrique tropicale, où ces oiseaux passent l'hiver, sont inconnus en Europe. Les thrombididés présentent un intérêt particulier, du fait que les larves de certains d'entre eux sont les vecteurs reconnus du typhus de brousse. Récemment on a suspecté ces acariens de transmettre l'agent d'une néphrose-néphrite hémorrhagique humaine.

L'importation de ces arthropodes paraît cependant exceptionnelle, car la route du sud-ouest de l'Espagne n'est pas celle que suivent habituellement ces oiseaux au printemps; il se peut qu'ils aient été détournés par les vents. En outre, pour qu'une population de thrombididés s'implante, il faut que les larves quittant l'oiseau rencontrent un biotope favorable à leur développement, et que les larves de la génération suivante trouvent l'hôte qui assurera leur nourriture pendant le stade parasitaire. Malgré ces facteurs aléatoires, la présence de thrombididés sur des oiseaux venant d'Afrique confirme l'intérêt des recherches, auxquelles participe l'OMS, sur les arthropodes vecteurs et les anticorps anti-arbovirus des oiseaux migrateurs.

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