SOME EXPERIMENTAL WORK ON, AND TECHNIQUES USED IN A STUDY OF AVIAN MALLOPHAGA.

BY

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An attempt to access the value of the small amount of earlier work done on Mallophaga leads to some new theories and the questioning of earlier ones. The main experiments are concerned with the orientation of the lice, their migration to the bird's head, and their reactions to temperature and light. A pure red light was used successfully for the first time, and this may have an important application in other studies.

Intrigued by A.E. Shipley's statement, "Birds are not only birds but aviating zoological gardens", I was surprised to find that the life histories, relationships, and importance of bird parasites are poorly understood. There is much synonomy of species and often the populations from closely related birds are not taxonomically separable. Nonetheless one species of birds may have from two to nine kinds of host-specific lice, and there are probably from 500-1,000 species of bird lice altogether in Great Britain.

Mallophaga are commonly known as bird lice, biting lice or chewing lice. They have chewing mandibles, in contrast with the Anoplura which have sucking mouthparts, and have been found on the majority of birds and some mammals, but not man. Since they are not known to be carriers of disease they have not attracted medical or economic attention. The Mallophagan of the dog, however, is an intermediate host of a tape-worm, and there is one record of a bird louse acting as the intermediate host of the roundworm Filaria which infects swifts. It is possible that Ornithosis viruses may be spread by Mallophaga and may cause the rare epidemics of psittacosis transmitted by parrots, sea-birds, pigeons and budgerigars (Miles, 1950).

Most evidence suggests that Mallophaga evolved from a primitive hemimetabolous insect of the same stock as Psocoptera (book-lice), in the late Triassic period. Since their evolution has been determined by that of the bird host, Mallophaga of related hosts are themselves related. Evolution has been slow because of the stability of the environment, and so may be a guide to the evolution of the host.

Experiments conducted on Mallophaga using Kunn's classification (Fraenkel and Gunn, 1940), were done mainly to recheck the work of Stenram (1956) on Columbicola columba (pigeon wing louse), see figs 1.a and 1b.

1. Reactions to temperature.

The alternative chamber apparatus, fig.2, similar to Stenram's, was used in these experiments. This apparatus consists of two perspex tanks which are thermostatically controlled; the approximate measurements being 16 ins. long, 6 ins. wide and 7 ins. high. A smaller central compartment is made up from the two tanks, and is divided by a piece of asbestos which keeps the temperatures separate. The lice can move freely along a feather which rests in a slot in the asbestos and are able to select the temperature which they prefer. Stenram used extremes of 18°C and 35°C and concluded " the specimens are not at all influenced by temperature". I used temperatures of 36.5°C - 45°C and a definite migration occurred from the higher to the lower temperature overnight. Experiments are not viable with temperatures much below 35°C as chill coma sets in. Martin (1934 p.7) at 42°C says "Oviposition occurred infrequently... and the resulting nymphs died within a few days after hatching". Conci (1952) determined the auto-selected temperatures to be 36° - 37°C.

2. Reactions to light.

All living species examined were negatively photo-taxic: only Barber (1921) found no reaction. The following results were obtained using a 'Wratten' 25 red filter:-

(i) with a spot lamp - no reaction,

(ii) with microscope sub-stage light - no reaction,

(iii) with the temperature chamber, both chambers set at 36.5°C - the lice passed from the illuminated part to the 'Wratten' filter-shaded part.

The use of this red filter may be important because, (i) any detailed study of the living insect under the microscope has been made most difficult due to irritation from light, (ii) many roosting birds appear to be unaffected by red light and this makes it possible to determine whether the distribution of lice at night differs from that during the day, and (iii) microphotography of living specimens can be carried out without disturbing them.

3. Orientation.

The lice react in a heghly specialised and very restricted way, their movements being dependent upon the structure of the feather. I agree with Stenram's division of their orientation into three reactions: (i) almost without exception they keep their bodies parallel to the rami, (ii) they direct their heads toward the shaft, and (iii) if they are irritated they will migrate to the basal part of the feather, running sideways and keeping their bodies parallel to the rami. In fact most of the lice are found in this basal area.

Stenram (1956 p. 181) says "Feathers have a polarity morphologically orchemically". A simpler explanation might be that lice prefer the thicker, more rigid part of the feather which is near the shaft.

When a feather is plunged into alcohol, apex downwards, the lice turn facing the apex, their heads towards the shaft (figs 3a, 3b.) The result is the same when the feather is put in base downwards, when other fixatives and anaesthetics are used and when mult:-parasitism with mites occurs. At first I thought the vanes contracted on immersion into the alcohol, squeezing the lice and making them turn. But this did not explain why they always turned in the same direction.

Stenram (p.187) refers to the "reaction to airstreams... the specimens force themselves down between the barbs so that only one lateral margin is visible in the vane... evidently more protected against hard conditions during flight... no risk of their falling off. It is more likely that they will be damaged by desication". I recently observed that if a bright light is suddenly shone on the feather, the lice turn in the same direction. This occurs in natural conditions when a bird is preening or stretching out before flight.

When the feathers are raffled upwards in preening or in the wind, the lice would be dislodged if they attempted to move to the base of the feather or to turn with the dorsal side facing the apex. This dorsal side cannot be bent upwards: only in facing the other way can the lice bend with the barbs and so not become dislodged.

4. Migration to the head.

Various theories have been proposed to explain this well-known phenomenon. Eichler (1937 and 1952) suggests that the lice, in the same way as several other insects, climb upwards when irritated and the practice of holding a shot bird by the head encourages this movement. According to another, the lice may need liquid which is found around the eye. Stenram (p. 187) says that since all the quills are directed towards the head, falling together when the muscle tonus ceased, the lice's reaction to move to the base of the feather will have them eventually arrive at the head.

Stenram may be partially right but I found that the lice reacted irrespective of the host's position. A freshly-killed pigeon was skinned and the whole skin was put on a surgical tray and placed inside an incubator at a temperature of 36.5°C and a humidity of 95% (Previously, lice had been kept under similar conditions on individual feathers without any migration being observed). After 24 hours all of the lice i.e. Coloceras damicorne (Nitzsch, large pigeon head louse, figs 4a, 4b, 8), Campanulotes bidentatus (Scopoli, small pegeon head louse, figs 5, 6, 7), and Columbicola columbae (Linn, pigeon wing louse, figs 1a, 1b,) had migrated from the birds head to the other end of the tray.

Then lice were placed on several feathers taken from the skin and these were placed near the skin at one end of the tray. After 24 hours the lice had moved off the feathers to the other end of the tray. It would seem that early putrefaction or enzyme changes cause the movement of the lice and suggest a phobotaxis rather than a thermotaxis.

Referring to white pigeons, Stenram (p. 171) states that they are "more heavily infested with Mallophaga than others. Thus... seem to be less resistant to infestation, probably owing to a weaker constitution... they are also more difficult to rear". In Nottinghamshire my own findings differ from the above. I made estimates of lice populations using the code system of Harshbarger and Raffenberger (1961) on two separate occasions at different local pigeon lofts.

At each time three white and three coloured birds were examined, making a total of twelve birds on which counts were made. Several pigeon breeders were questioned as to whether white pigeons were more difficult to rear than coloured, in no case has any difference been noted.

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