

# BIRD-LICE AND EVOLUTION

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**B**IRDS, like other animals, are preyed upon by parasites. These are very varied and include viruses, protozoa, worms, insects, ticks and other birds. The most characteristic parasites of birds are, however, the feather-lice or Mallophaga. These lice eat feathers, scales of skin and, exceptionally, blood resulting from their chewing activities. The mouth-parts of the feather-lice are suited to chewing and are not at all like those of the lice of mammals (Anoplura) which suck blood.

When biologists began to study Mallophaga, some very remarkable facts soon became apparent—facts which can only be explained on an evolutionary basis. Firstly it was found that the lice found on any given species of bird are usually not found on any other species or, if they are, they are found only on very closely related species; this phenomenon is called "host-specificity". The second fact was that birds of a given family, wherever they occur throughout the world, carry lice which are very closely related. For instance, the lice of coots and rails of Europe resemble closely the lice from the flightless rail of Tristan da Cunha and the rails of America and Australasia. Finally it was found that the lice from distantly related hosts usually resemble each other much more closely than do their hosts.

Let us consider very briefly the evolution of host and parasite in order to explain these facts.

Evolution, from one point of view, has been the invasion of new and unoccupied nutritive zones. For example, life arose in the sea. At this stage in the world's history, life on land would have been impossible and it only became a possible nutritive zone after the first plants had invaded it. The first land animals were herbivores and their advent created a new nutritive zone for another group of animals—the carnivores.

The archaic bird possessed two unique characters which, together, constituted a new nutritive zone with many advantages. The two characters were its feathers and the fact that it was "warm-blooded"—in other words, its body temperature did not vary markedly with change in surrounding temperature. This zone, the bird's body, was soon invaded by small insects which probably resembled the lowly "book-lice" of today. These insects lived by chewing feathers and skin as do the Mallophaga; they lived in a protected niche with a highly congenial environment, ample food (provided their numbers were limited), reasonably easy and certain methods of dispersal (from parents to offspring and from adult to adult during copulation) and only one serious adversary—the bird. It is certain that the bird was the prime "selective agent" which shaped the course of Mallophaga evolution. The original invaders of birds' feathers were not particularly well adapted to a life among feathers and must have suffered rather heavy casualties, although, it should be remembered, the archaic bird was not as expert at delousing as is the modern bird since most of the habits which enable the bird to kill many lice evolved later in response to the presence of the lice. Now it is general that, in response to strong adversity, an organism evolves rapidly. The feather-lice evolved towards a body-form and habits which assisted them in invading the bird. At the same time they acquired the closest physiological adaptation to the conditions prevailing on the particular host—the development of host-specificity.

On the bird's body there are three main "niches" to be invaded. The head, because it cannot be effectively deloused, is the obvious first choice. Head-lice are slow movers with large mandibles and large heads to house them; their body-form is rounded. They have evolved habits which confine them to the feathers of the head. The other niches on the bird's body are the wings and the general body feathers. The lice that have evolved in the wing niche are long and slender, with small heads and jaws; they are adept at shuffling rapidly sideways under the primaries. The main trend of evolution in the few lice that have invaded the general body niche has been towards speed of movement for they are the fastest movers of all the lice. These adaptations reduced the adversities of the lice considerably and evolution slowed down proportionately.

During the course of the evolution of bird lice, their hosts were evolving even more rapidly in response to an environment which was a good deal less congenial than that of the lice. Birds had to deal with varied weather and climatic conditions, with increasing numbers of predators, and with the problem of competing effectively with their own and other kinds for food. Because of the variety of the problems, there is great diversity in the numerous patterns of structure and behaviour by which they were met. The great increase in competition for food encourages the exploitation of new nutritive zones. This, in turn, may lead to specialization and, consequently, to the evolution of adaptations which may be so extreme as to obscure the original structural pattern of the group (e.g. the flamingoes).

The explanation of the facts which impressed the early workers is now clear. The archaic birds carried lice which were closely related. The birds, in exploiting different nutritive zones, diverged along various lines, often attaining highly specialised forms bearing little resemblance to their ancestors or to related groups. The lice were not subject to such adversity as were their hosts and therefore evolved more slowly, thus retaining a greater resemblance to their ancestral forms and to related groups than did their hosts to theirs.

The evolution of host-specificity by the lice has prevented the colonization of strange hosts in most cases. Cases are, however, fairly commonly found where this has happened. Another phenomenon which is sometimes found is convergence (i.e. the attainment of a common form by two distantly related lice). Bearing these two difficulties in mind, we should be able to use the fact that they carry related lice as evidence of relationship between groups of birds which have little in common structurally. If one applies the rule proposed by G. H. E. Hopkins, difficulties due to secondary infestations and convergence are reduced to insignificance. The rule is: If two groups of birds have one genus of louse in common they are possibly related; if two, they are probably related and if three, they are certainly related.

As examples of the method, the relationships of the flamingoes and the relationship between the Ostrich and Rhea may be considered.

The flamingoes have been classified in the order Ciconiformes (storks, herons, cranes) and also in the order Anseriformes (ducks, geese, swans) but never on the grounds of any certain evidence. A study of the Mallophaga of the three groups revealed that the flamingoes are host to species belonging to three genera which are found nowhere else but on members of the order Anseriformes. This is very strong evidence for classifying the flamingoes in this order.

The Ostrich and Rhea are usually classified in two different orders since they are considered by the bird systematists to be only distantly related. Yet these birds both carry a genus of Mallophaga which occurs on no other bird. They also share two species of mite and each carried a subspecies of one species of tapeworm. We cannot explain these facts adequately except by assuming that these birds evolved from a common stock.

It should be stressed that our knowledge of the Mallophaga and other bird parasites is still very incomplete. Less than half the African birds have been examined for parasites. This gap limits the information the Mallophaga-specialist can give to the bird systematists.

A final example will be given which demonstrates another way in which a study of the parasites of birds can illuminate an obscure point connected with the host.

The fleas are primarily mammalian parasites but some have colonized birds. In the nests of the Jackass Penguin on our coasts occur species of flea belonging to the genus *Parapsyllus*. Other species of this genus of flea are found only on other penguins and on certain South American rodents. This fact points to a South American origin of our penguins.

Birds are host to many other parasites; certain flies deposit their eggs in the nests of birds and the maggots which hatch out suck the blood of the nestlings and often cause their death; mites and ticks, intestinal and blood worms, Protozoa, Bacteria and viruses all prey on birds. Ornithologists can greatly increase our knowledge of these animals and their often strange relationships with the bird host by collecting parasites from bird and nest. Full details of procedure will gladly be supplied to anyone writing to Dr. Botha de Meillon, South African Institute for Medical Research, P.O. Box 1038, Johannesburg.