

CHAPTER I

INTRODUCTORY

FLEAS form a group of insects that have, until recently, been little studied by zoologists. We call them insects because they are jointed animals, or Arthropods, with three pairs of legs in the adult condition. The reader will best understand the position which fleas occupy in the general classification of animals by remembering that the arthropods, or jointed animals, are one of a dozen subkingdoms, or phyla, to which the various members of the great animal kingdom have been assigned. There is good ground for believing that all the animals included in each phylum trace their ancestry back to a common primitive form which lived in more or less remote ages. Besides (1) *Insects*, the arthropods, or jointed animals, include (2) *Crustaceans*, such as crabs, lobsters, shrimps, wood-lice, water-fleas and barnacles; (3) *Myriapods*, such as centipedes and millipedes; and (4) *Arachnids*, such as spiders, scorpions, mites and ticks. To all these varied forms of animal life fleas, and other insects, are therefore more or less nearly related.

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The animals belonging to this large and important collection, which compose the arthropod phylum, have certain common characteristic features. We find a body made up of a series of more or less completely similar segments placed one behind the other. In this they resemble certain worms which are far less highly organised. The body is elongated, symmetrical on either side, and the mouth and anus are at opposite ends. There is, however, an important advance on the segmented worms. Each typical segment carries a pair of appendages which are very different from the foot-stumps that are found on certain worms. These appendages of arthropods are divisible into distinct limb-segments, separated from one another by moveable joints, and acted upon by special muscles.

The common ancestor of all the various arthropods which are found living on the earth to-day, was probably composed of a series of segments each very similar to the last and each bearing a pair of very similar appendages. In the course of ages, these appendages have been astoundingly modified in form and in function. So it happens that we find in the arthropods of the present day pairs of antennæ, of mandibles and other mouth-parts, of pincers, of legs, of swimming-feet and of tail pieces which on close examination can all be traced back to a common structure. The body-segments, also, have been

strangely fused together and modified. All that has been so far said applies equally to fleas and to other insects.

It is of great interest, when one comes to make a minute study of the form and external structure of a flea, to try and trace the modifications that must have taken place in the course of descent from the ancestral arthropod; but the relationship of fleas to other insects living at the present day is of more immediate concern. Insects are highly specialized arthropods and fleas are highly specialized insects. This means that they have become vastly modified from the primitive ancestral type and fitted thereby for a life among certain defined and peculiar surroundings.

It will be unnecessary to remind the reader who knows anything of zoology or of botany that all classification is now based on descent. Since naturalists have abandoned a belief in the special creation of the various species of animals now living on the earth and have conclusively shown that they have arisen by descent and modification from other forms, the problem is to reconstruct a vast genealogical tree. What then were the ancestors of the fleas and to what other insects, in consequence, do they appear to be related?

It is probable that the ancestors of the fleas were winged insects, and that the organs of flight were

gradually lost, as they became useless, when a partially parasitic life was adopted. At one time entomologists regarded fleas as wingless flies and placed them in the order Diptera. Certain supposed scaly plates on their bodies were regarded as the atrophied relics of wings. It is, however, more than doubtful whether this view is correct ; and all modern entomologists who have given any special study to fleas are agreed that they are sufficiently unlike any other living insects to deserve a place in an order by themselves. To this order the name *Siphonaptera* has been given: which means that the insects comprised in it are provided with sucking mouths and are destitute of wings. Another name for the order is Aphaniptera, but this is gradually falling into disuse. Linnæus (1758) only mentions two species of flea: the human flea which he appropriately named *Pulex irritans*, and the chigoe of hot countries which he called *Pulex penetrans*, from the habit which the female has of burrowing under the skin of her victims. At the time of writing, about 460 species of flea have been described and named; but some of the names are doubtless synonymous, and the actual number of separable species that have been discovered is somewhere about four hundred. The vast majority of these have been described within the last few years, which shows what can be done when attention is turned to any neglected group of animals. There

can be no doubt that many undiscovered species still remain, and will now, in due course, be collected, described and named.

The position which should be assigned to the order Siphonaptera in the general scheme of insect classification is a question on which the most learned modern entomologists have disputed with considerable vigour. Some see the nearest relatives among the beetles, others among the flies. The majority, as we shall see later on, would place them near the Diptera: but since no convincing arguments have been produced on either side it may be wisest to regard the question as still at present unsolved.

Fleas belong to one of the groups of insects which go through a complete metamorphosis. Their life-history consequently falls into four divisions: egg, larva, pupa and imago. If the climate permits, the female flea lays her eggs all the year round, and from one to five are dropped at a time. Unlike those of many other parasites they are never attached to the hairs of the hosts, but appear to be deposited indiscriminately on the floors of houses or in the nests and sleeping places of their hosts. The eggs generally hatch in a few days, and a minute, white, wormlike larva emerges (Fig.1). The larvæ of some, and possibly of all, fleas are provided with a wonderful adaptation in the shape of an egg-breaker or hatching-spine. This is a thin plate, like the edge of a knife, where

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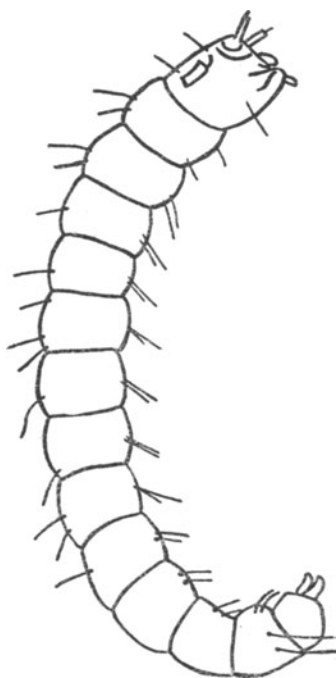


Fig. 1. The larva of a flea. The body consists of thirteen segments and is legless. On the fore part of the head are the antennæ and on the upper part of the head is shown the knife-like edge of the egg-breaker. The mouth-parts are adapted for biting. On the last segment of the body are the two caudal stylets.

the point of the head comes in contact with the shell. The movements of the prisoner make a slight split in the egg-shell, which then bursts asunder. This organ has vanished in later larval life, and it is probably lost after the first moult. The larva is legless and has thirteen segments. It grows rapidly, and, as it grows, moults its skin several times. It is provided with mouth-parts adapted for biting, and eats any decaying organic refuse. The larvæ may be reared on the sweepings of an ordinary room or the dirty scurf which collects at the bottom of old birds' nests. It is hardly necessary to add that the mother takes no interest whatever in the larvæ and that the belief that she feeds them on dried blood is not based on any sound foundations.

The larval stage lasts some days, and the animal spins a small cocoon before pupating. In the course of a few more days, the time probably depending on the weather, the perfect flea emerges. The larvæ generally live in places where the perfect insects will have an opportunity of finding a host as soon as they leave the pupal envelope. The nests of their hosts where the young are being reared are always favourite places. It seems possible that the comparative immunity from fleas which hoofed mammals or Ungulates enjoy may be due to the fact that the young beast follows its mother from the time of birth instead of passing its early life helpless in a nest.

Observations made on the development of the dog-flea (*Ctenocephalus canis*) in India show that eggs laid on October 17 hatched on October 19. The larva spun its cocoon on October 25 and the mature flea emerged on November 2. In Northern Europe the human flea takes about four weeks in summer and six weeks in winter to pass through its metamorphosis.

Unlike many parasitic insects, fleas do not constantly pass their time upon the bodies of their victims. The greater part of their life is probably spent on the ground, in the house, or nest, of the mammal or bird which serves them with blood. In this respect there is considerable difference in the habits of different species of flea. Some attach themselves to an animal and actually burrow into the skin. These are the most parasitic species. Some only come to feed and leave to lay their eggs. Many probably do not suck blood more than once in their lives.

An animal which harbours fleas and which nourishes the adult insect with blood is called a *host*. No fleas are more than what is called temporary parasites; which means that they pass but a portion of their lives on their hosts and frequently take occasion to hop on and off. All fleas, apparently, go from host to host. The labours of diligent collectors have proved that the great

majority of mammals and birds have fleas. As a general rule, it is true to say that certain species of flea are associated with certain species of host. Thus man is the true host of *Pulex irritans*; the cat family are the true hosts of the cat-flea (*Ctenocephalus felis*); and the dog family are the true hosts of the dog-flea (*Ctenocephalus canis*). But the human flea is sometimes found on cats and dogs, and cat and dog-fleas occasionally bite human beings; and cat-fleas are found on dogs and dog-fleas are found on cats. All fleas, so far as we know, may occasionally pass from one species of host to another; but they do not, for the most part, seem to flourish in unaccustomed quarters. Some fleas are more catholic in their tastes than others. Some seem to be very strictly confined to one host, and even when starving only suck strange blood under protest. There is a species of flea that has only (except by accident) been found on the long-tailed field-mouse and another that has only been found on the hedgehog. Other fleas are commonly found on two absolutely distinct animals; a good instance of this is the human flea which, at all events in certain parts of England, is a regular parasite of the badger.

As distinguished from true or natural hosts one must separate what may be termed casual or accidental hosts. All animals which come in contact with one another, or which live in close proximity,

may exchange fleas. So even bird-fleas may be collected from mammals and typically mammalian fleas from birds. In this fashion puzzles may arise which tax the ingenuity of the collector to solve. Bird-fleas are sometimes found on bats, and this may be obviously attributed to the bats having inhabited a hole which was tenanted by starlings or an old loft infested with the fleas of pigeons. All beasts of prey are sometimes found to harbour the fleas of animals they have devoured. Rabbits' fleas are found on wild-cats; hedgehogs' fleas on foxes; mice fleas on weasels; and fleas characteristic of small birds on stoats. So also in the case of mice, rats and voles with holes and runs in the same hedgerow, the parasites usually peculiar to one are not uncommonly found on the others. It is sometimes difficult to determine the true host of a flea.

Much more puzzling to explain are the reasons which confine a flea to a certain host and which cause closely allied hosts to have different fleas. The fleas from the house-martin and the sand-martin are quite different; those from the domestic fowl and the domestic pigeon are distinct species. The causes which have affected the evolution of the various forms of flea are too obscure to enable anyone at the present day to offer any satisfactory explanation.

Speaking generally, the fleas found on birds have points in common, and they probably form a natural