# PART I

## THE NATURAL HISTORY OF THE HOUSE-FLY

## CHAPTER I

### INTRODUCTION

NOT the least of the striking features of recent scientific progress has been the discovery of the vital relationship of insect life to humanity. Daily are we realising with increasing knowledge the power and majesty of Beelzebub[1]. Through all ages mosquitoes have inflicted greater destruction than all the armies of the world. Within the last few years we have witnessed the sacrifice of thousands of lives to the Tse-tse fly's taste for blood and the kindred of the irritating flea have been shown to play no mean *rôle*

[1] Beelzebub. *Baal*, meaning 'lord' or 'god' and *zebub*, usually identified with the Hebrew word of the same spelling, meaning 'flies.' It is interesting to note that the alternative spelling is Beelzebul; *zebul* is for *zebel* sometimes used for 'dung.' From what is now known of the breeding habits of flies these alternatives would appear to have a closer and more apparent relationship!

in the spread of one of our most deadly diseases. The power of transmitting disease germs however is not confined to insects of blood-sucking habits. Step by step evidence, both circumstantial and exact, has been accumulated until it has now been shown and is an undisputed fact that where the necessary conditions occur, our most common and widespread insect the house-fly is a prominent factor in the carriage of infection. Living with us in our homes, feeding off our tables, we have an insect whose befouled body and limbs may at any time be bearing micro-organisms of a dangerous nature. It does not seem so long ago since we were being taught to regard this insect as a very respectable member of our household. *Tempora mutantur.* No longer will children be taught that it is wrong to kill a fly but rather the first step to be taken by one who would seek to mould himself after the pattern of St George.

The discovery of the serious *rôle* which the house-fly may play under certain conditions, was hardly less astonishing than the revelation of our profound ignorance of its life-history, habits and bionomics generally. In this respect it afforded another example of a not infrequent occurrence in biology, namely, the passing over of the commonplace in the search for the unique and rare. Zoological literature is replete with minute descriptions of creatures which few have seen, or ever will see, and which have not

the remotest relationship to man. On the other hand here we have an insect, undoubtedly the commonest and most widely spread of all insects, which has accompanied man wherever he has travelled whether it be into the torrid heat of the tropics or into the icy regions of the north, which is his companion from the time he enters the world until he leaves it, which amuses the young and annoys the old, but notwithstanding all this, it has been too common a creature to be deemed worthy of serious study. With a single exception no attempt has been made until within the last few years to make a careful study of the house-fly. In 1790[1] Wilhelm von Gleichen published in Nürnberg an excellent account of the life-history and habits of this insect which was illustrated by some exceptionally interesting plates, and when the present writer commenced a detailed study of the house-fly in 1905 Gleichen's work was still the most exhaustive account available. The older naturalists from Reaumur (1738) onwards included short accounts of the house-fly in their general works and during the last century fragmentary observations were recorded. The last complete account of the life-history had been written by Packard in 1874, which together with some additional investigations of Howard in 1898 and 1902, constituted practically our entire knowledge of the

[1] This is the date of the edition in my possession but an earlier edition would appear to have been published in 1764 or 1766.

commonest insect. Never was the adage 'Familiarity breeds contempt' more forcibly illustrated. The placing of its human relationship on a different basis was responsible for a kindling of interest in and a desire for knowledge of the house-fly with the result that it was in danger of becoming almost a cult. Fortunately this did not happen, but instead a considerable number of investigations bearing on its bionomics and relations to disease were carried out and are still being prosecuted both in England and in the United States. Its relation to public health was deemed sufficiently serious to warrant an inquiry by the Local Government Board: this inquiry is now being carried on and already several valuable reports have been issued. In the United States a very active campaign is being waged on all sides against the house-fly as it is recognised to be a serious factor in the transmission of zymotic diseases and as being synonymous with insanitary conditions. No small credit for this activity is due to the primary and continued efforts of Dr L. O. Howard, the Entomologist of the United States Department of Agriculture. As illustrating the popular feeling with regard to fly campaign in the United States it may be mentioned that the Mayor of the capital of one of the States was elected almost solely on the strong stand which he had taken in advocating anti-fly measures. This sudden change of opinion, which has already affected

and is reflected in the bye-laws relating to public health matters, is of more than ordinary interest and is fully in keeping with the spirit of the age. One is reminded of the description of the fly which Ruskin gives us. When Menelaus the King of Sparta invokes the goddess Athena for strength to withstand Hector, she gives him the courage of the most fearless and audacious of creatures, namely, the fly. 'The common house-fly,' Ruskin says, 'is the most perfectly free and republican of creatures. There is no courtesy in him; he does not care whether it is a king or clown whom he teases and in every step of his swift, mechanical march and in every pause of his resolute observation, there is one and the same perfect expression of perfect egotism, perfect independence and self-confidence and conviction of the world having been made for flies. Your fly free in the air, free in the chamber, a black incarnation of caprice, wandering, investigating, fleeting, flitting, feasting at his will with rich variety of feast, from the heaped sweets in the grocer's window to those of the butcher's back-yard and from the galled place on your horse's neck to the brown spot on the road from which, as the hoof disturbs him, he rises with angry republican buzz; what freedom is like his?'

In contemplating the change of public opinion towards the fly and our present attitude towards it which our investigations have brought about we are

made increasingly conscious of the truth of Gilbert White's sage words written in 1777, that:

'The most insignificant insects and reptiles are of much more consequence and have much more influence in the economy of nature than the incurious are aware of.'

## CHAPTER II

### THE STRUCTURE OF THE FLY

In order to understand how a fly lives, moves and has its being it is necessary to know something of the manner in which its body is built up, in other words to understand its structure. This is no dry aggregation of unexplicable details but a story of how a creature has been perfected in accordance with the requirements of its life and habits.

The typical insect has two pairs of wings such as we find in the butterfly, the grasshopper, or the beetle. The house-fly, however, has a single pair only and on this account it is included with all other flies in a large family known as the *Diptera* or two-winged flies. The hind pair of wings which are the undeveloped ones, are represented by a small pair of drumstick-shaped appendages known as 'balancers' owing to the fact that they are considered by some to

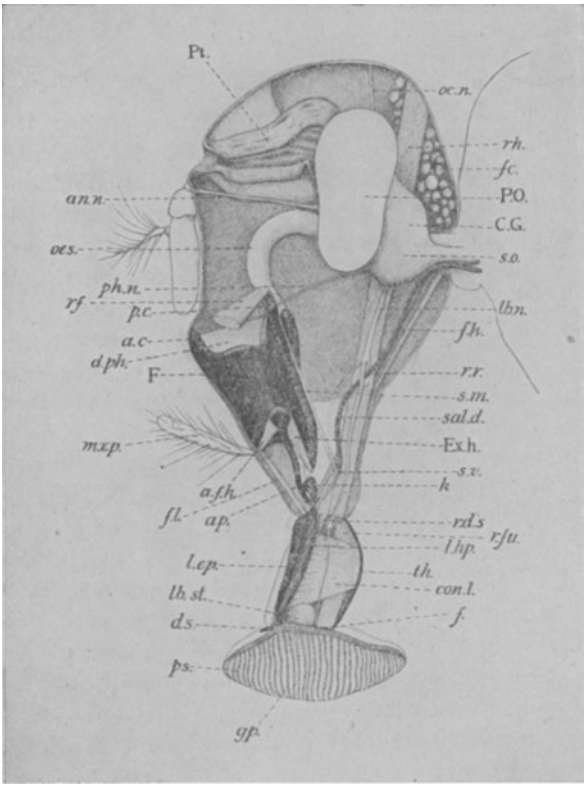


Fig. 1. Interior of the head of house-fly. Left side of head and air-sacs removed. Of the various parts the following may be noted: *Pt.*, eversible frontal sac; *oes.*, oesophagus; *F.*, pharyngeal suction pump; *d.ph.*, muscles working same; *P.O.*, *C.G.*, *s.o.*, brain; *sal.d.*, salivary duct with its valve *s.v.*; *lb.st.*, salivary gland of oral lobe; *p.s.*, channel or pseudotrachea of oral lobe; *l.ep.*, upper lip; *l.hp.*, lower lip or floor of mouth; *oc.n.*, *an.n.*, *ph.n.*, *lb.n.*, nerves. The rest of the structures are chiefly muscles for the retraction and movements of the proboscis, etc.

have some relation to the maintenance of equilibrium. The characteristic divisions of the body are well marked.

The whole structure of the fly is admirably adapted to a flitting, aerial life. A pair of large compound eyes occupies almost the whole of the hemispherical head and provides the insect with a wide field of vision. The greater portion of the interior of the middle-body or thorax is occupied with muscles used in flying. In the abdomen a pair of large air-sacs gives great buoyancy to the body of the insect, which buoyancy is increased further by air-sacs situated in the thorax and head (fig. 3). The provision of these air-sacs together with a well developed tracheal system, as the system of silvery air-tubes permeating all the organs and tissues of the body is called, has an important relation to the remarkable degree of activity evinced by these insects. In insects these air-tubes or tracheae take the place of the blood-vessels and capillaries found in higher animals, and as in birds a rich blood supply is associated with an active life so likewise in an active insect as the house-fly we find a rich tracheal supply.

The greater portion of the hemispherical head of the fly is occupied by a pair of large compound eyes; each being composed of about four thousand faceted individual eyes which together apparently produce a single somewhat blurred image and not thousands of

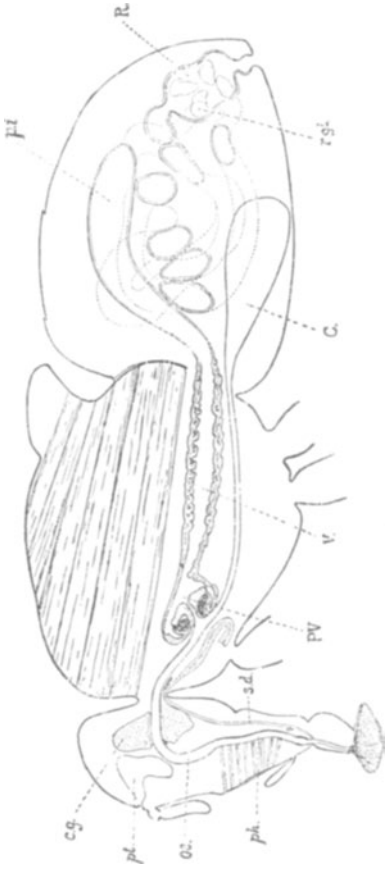


Fig. 2. Longitudinal section of alimentary canal of house-fly. *ph.*, pharyngeal suction pump; *oe.*, oesophagus; *pt.*, frontal sac; *c.g.*, brain; *s.d.*, salivary duct; *P.V.*, proventriculus; *V.*, chyle stomach or ventriculus; *C.*, crop or sucking stomach; *p.i.*, proximal intestine; *R.*, rectum; *r.g.*, rectal glands.

separate images. On the top of the head in the space between the eyes are three simple eyes arranged in a triangle. The width of this space on the top of the head between the eyes serves as a means of distinguishing the male from the female which is otherwise impossible without a more careful examination. In the male the eyes are separated by about one-fifth the breadth of the head, but in the female this space is wider, being about one-third the breadth of the head.

The proboscis or, as it is sometimes inaccurately called, 'tongue' of the fly, represents the enormously modified mouth parts or jaws of other insects such as beetles and grasshoppers which chew their food. The mouth parts of the house-fly have been adapted to a sucking function not combined with or involving a previous piercing function, as in the case of the mosquito and flea which pierce before sucking. The house-fly cannot pierce the softest skin, as the parts which are used to pierce the skin in the case of the stable-fly (*Stomoxys calcitrans*) are reduced to harmless proportions in the house-fly, and the proboscis is terminated by a pair of soft cushion-like lobes or lips, called the oral lobes, which form together a heart-shaped structure having the aperture leading into the mouth situated in the middle. The popular idea that the house-fly 'bites' at certain times is incorrect, as it cannot bite; the idea is due to a confusion of