Glimpses of Nature.

X.—BRITISH BLOODSUCKERS.

By Grant Allen.

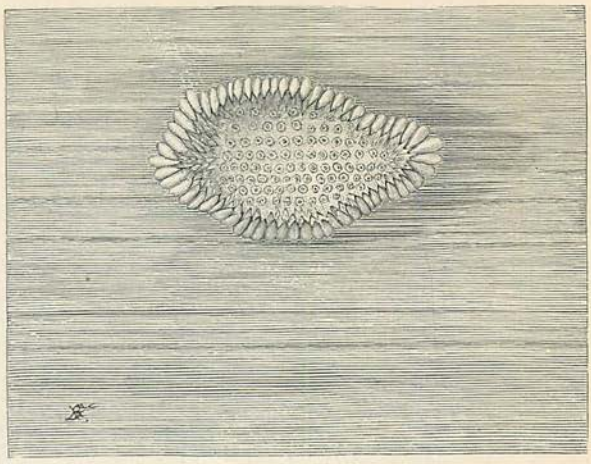
I WRITE this title with peculiar pleasure, because it is so nice to be able for once to apply it literally. With its figurative use I am already too familiar. In some of our tropical colonies the free-born Britons who are sent out in the Government employment to protect the natives or the coolies or the negroes, as the case may be, from our aggressive brethren, are commonly known to their planter neighbours as "British bloodsuckers"—apparently because, like most other members of Civil services elsewhere (except the Turkish), they get paid for their services. This use of the phrase is so well known to me, even as applied to myself, that I rejoice in being able to employ it here, without political prejudice of any sort, with reference to the habits of the mosquito and the horse-fly. Nobody, I suppose, is interested to deny that mosquitoes and horse-flies *do* suck blood; nobody feels the faintest sympathy for the misdeeds of those sanguinary and unpleasant creatures. Now, it is always delightful to find a lawful outlet for our evil passions: all the world turns out to hunt a mad dog. I love to flick the heads off tall thistles with my stick as I pass, and salve my scruples with the thought that they are the deadly enemies of the agricultural interest. If there were no thistles, there would be nothing in the shape of a large and conspicuous flower whose head one could knock off with a clear conscience.

But at the very outset, I foresee a destructive criticism. "The mosquito," you will say, "is not a *British* bloodsucker." Pardon me; there, you labour under a misapprehension. Everybody knows that we have gnats in England. Well, a gnat is a mosquito and a mosquito is a gnat. Like our old friend, Colonel Clay, they are the same gentleman under two different aliases. Or, rather, since it is only the female insect that bites, and only the bite that much concerns humanity, I ought perhaps to say the same lady. The difference of name is a mere question of nomenclature, and also (as with many other aliases) a question of where we happen to meet them. When we see a mosquito in England, we call him or her a gnat; when we see a gnat in Italy or Egypt, we call him or her a mosquito. But, as this is a fundamental point to our subject, I think we had better clear it up once for all before we go any farther. It is not much use talking about mosquitoes unless we really decide what particular creature it is that we are talking about.

There is not one kind of gnat, or one kind of mosquito, but several kinds of them; and both names are loosely applied in conversation to cover a large variety of related small flies, almost all of them members of the genus Culex. The one point of similarity between the whole lot lies in the fact that they all suck blood; whenever we light upon a blood-sucking culex in England we say it is a gnat; while whenever we light upon one in any other part of Europe, Asia, Africa, or America, we say it is a mosquito. That is just a piece of our well-known British arrogance; we will not admit that there are such venomous beasts as mosquitoes in England, and therefore, when we find them, we call them by another name, and fancy we have got rid of them. As a matter of fact, mosquitoes of one sort or another occur in most countries, if not in all the world; they are most numerous, it is true, in the tropics and in warm districts generally; but they also abound in Canada, Siberia, Russia, and Lapland. Even in the Arctic regions, they come out in swarms during the short summer; and wherever ponds or stagnant waters abound in Finland or Alaska, they bite quite as successfully and industriously while they last as in Ceylon or Jamaica. At least a hundred and fifty kinds are "known to science," and of these, no fewer than thirty-five occur in Europe. We have nine in Britain. Most of the European species bite quite hard enough to be popularly ranked as mosquitoes; the remainder are called by the general and indefinite name of flies—a vague term which covers as large an acreage of evil as charity.

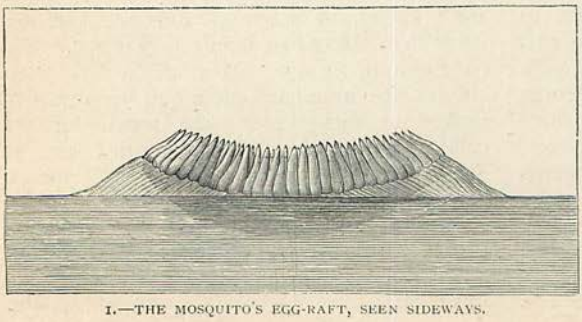
In hot summers, you will often read in the papers a loud complaint that "mosquitoes have made their appearance in England," most often in the neighbourhood of the

London docks; and this supposed importation of venomous foreign insects is usually set down to the arrival of some steamer from Bombay or New Orleans. The papers might almost as well chronicle the "arrival" of the cockroach or of the common house-fly. There are always mosquitoes in England; and they bite worse in very hot weather. Occasionally, no doubt, some stray Mediterranean or American gnat, rather hungrier than our own, does come over in water in the larval form and effect a lodgment in London for a week or two; but only a skilled entomologist could distinguish him from one of our own breeds, after careful examination. Let it be granted then, as Euclid says, that there is no essential difference between a gnat and a mosquito, and let us admit that the same name is applied in both cases to a large variety of distinct but closely related species. After which preliminary clearing of the ground, we will proceed quietly to the detailed description of one such typical bloodsucker.



2.—THE MOSQUITO'S EGG-RAFT SEEN FROM ABOVE

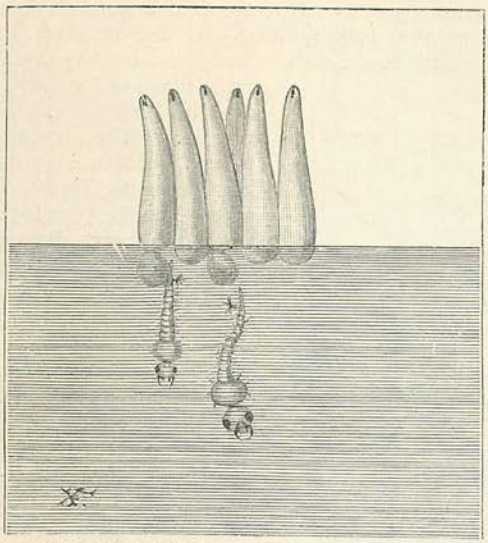
The mosquito is in a certain sense an amphibious animal; that is to say, during the course of its life, it has tried both land and water. It begins existence as an aquatic creature, and only steps ashore at last to fly in the open air when it has arrived at its adult form and days of discretion. The mother mosquito, flitting in a cloud-like swarm of her kind, haunts for the most part moist and watery spots in thick woods or marshes, and lays her tiny eggs on the surface of some pool or stagnant water. They are deposited one by one, and then glued together with a glutinous secretion into a little raft or boat, shown in No. 1, which floats about freely on the pond or puddle. It looks just like the conventional representations of the "ark of bulrushes" provided for the infant Moses. An industrious mother will lay some two or three hundred such eggs in a season, so that we need not wonder at the great columns of mosquitoes that often appear in damp places in summer. No. 2 shows the same raft seen from above, and excellently illustrates its admirable boat-shaped or saucer-shaped construction.



1.—THE MOSQUITO'S EGG-RAFT, SEEN SIDEWAYS.

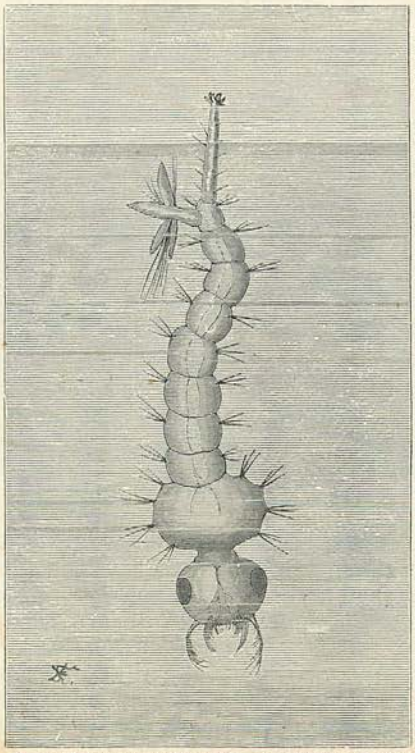
After about three days' time, the eggs begin to hatch, and the active little larvæ escape, wriggling, into the water. No. 3, which is enlarged forty diameters, exhibits the stages of the hatching process. A sort of lid or door at the lower end of the floating egg opens downward into the water, and the young mosquito slides off with a jerk of the tail into its native marshes. Almost everybody who has travelled in Asia, Africa, or America must be familiar with these little brown darting larvæ, which occur abundantly in the soft water in jugs and wash-hand basins. Brown, I say roughly, because they look so at a casual glance; but if you examine them more closely you will see that they are rather delicately green, and often mottled. It is not easy to catch them, however, so quickly do they wriggle; you try to put your hand on them, and they slip through your fingers; you have caught one now, and, hi presto! before you know it, he is twirling off to the other side and disporting himself gaily in aquatic gambols.

Nevertheless, he is a creature well worth observing, this larva. Get him still under the microscope (which is no easy matter — to



3.—THE EGGS HATCHING, AND YOUNG MOSQUITOES ESCAPING.

insure it, you must supply him with only the tiniest possible drop of water) and you will then perceive that he has a distinct head, with two large dark eyes, and that behind it comes a globular body, and then a tail of several quickly-moving segments. No. 4 is a portrait of the larva in his full-grown stage, near the surface of the water. He is about half an inch long, and nimble as a squirrel. You will observe on his head a sort of big moustache, set with several smaller bristles. This moustache (which consists for science of a pair of mandibles) is kept always in constant and rapid motion; its use is to create an eddy or continuous current of water; which brings very tiny animals and other objects of food within reach of the voracious larva's mouth; for young or old, your mosquito is invariably a hungry subject. In point of fact, you may say that these hairy organs are the equivalents of hands with which the larva feeds himself. They vibrate ceaselessly.

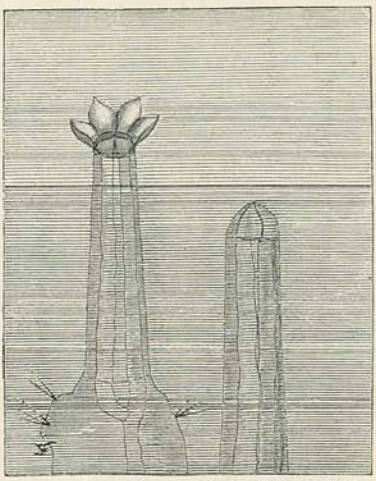


4.—THE MOSQUITO-LARVA IN HIS FAVOURITE ACT OF STANDING ON HIS HEAD AND BREATHING.

At the opposite end of the body, you will observe, there are two other organs, both equally interesting. One of them, which goes straight up to the surface of the water, and protrudes above it, is the larva's breathing-tube; for the mosquito breathes, at this stage, not with his head but with his tail; this ingenious mechanism I will explain further presently. The other organ, which in the illustration (No. 4) goes off to the left, and has four loose ends visible, serves its owner as a fin and rudder. It is the chief organ of locomotion—the oar or screw by whose means the larva darts with lightning speed through the water, and alters his direction with such startling rapidity. You will note that it is not unlike the screw of a steamer, and it answers for the animal the same general purpose. How effectual it is as a locomotive device everybody knows who has once tried chivvying a few healthy mosquito larvæ round the brimming sea of his bedroom basin.

The breathing-tube deserves a little longer notice. By its means air is conveyed direct into the internal air-channels of the insect, which do not form lungs, but ramify like arteries all over the body. We carry our blood to the lungs to be aerated; the insects carry the oxygen to the blood. To take in air, the larva frequently rises to near the surface, as you see him doing in No. 4; then he stands on his head, cocks up his tail, and pushes out his air-tube. Indeed, when at rest this is his usual attitude. No. 5, which, of course, is very highly magnified, shows his tail in the act of taking in a good gulp of oxygen. The little valves, or doors, which cover the air-tube are here opened radially, and the larva is breathing. To the right you see the

position of the tube after he has taken in a long draught of air (just like a whale or a porpoise) and is darting to the depths again. The tiny valves or doors are now closed, so that no water can get in; the larva will go on upon the air thus stored till all of it is exhausted; he will then rise once more to the surface, let out the breath loaded with carbonic acid, and draw in a fresh stock again for future use.

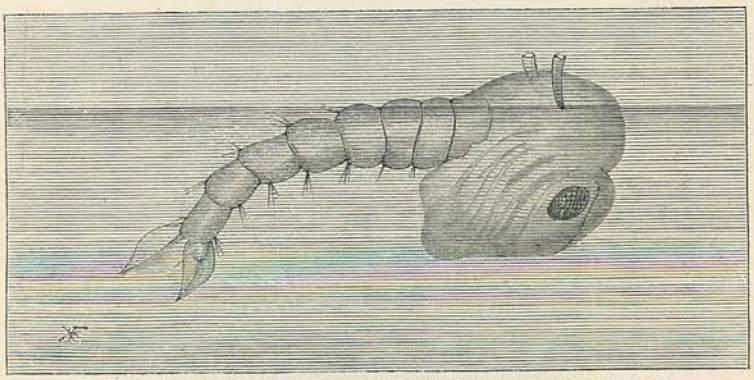


5.—THE LARVA'S BREATHING-TUBE, CLOSED AND OPEN.

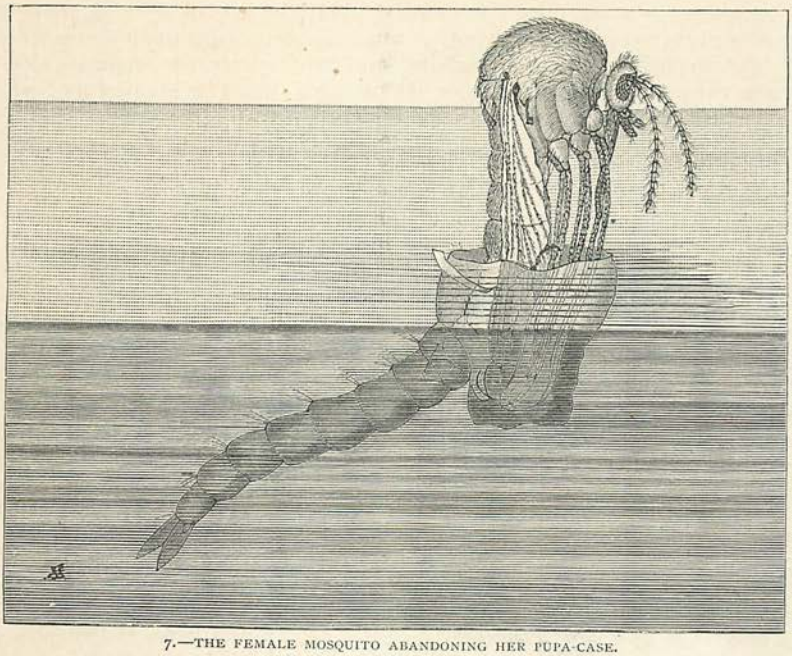
The young mosquito remains in the larval form for about a fortnight or three weeks, during the course of which time he moults thrice. As soon as he is full grown, he becomes a pupa or chrysalis—lies by, so to speak, while he is changing into the winged condition. No. 6 is a faithful portrait of the mosquito in this age of transition. (I borrow the last phrase from the journalists of my country.)

Within the pupa-case, which is smaller than the larva, the insect is bent double; in this apparently uncomfortable position, it begins to develop the wings, the legs, and the blood-sucking apparatus of the perfect mosquito. Nevertheless, ill-adapted as such a shape might seem for locomotion—with one's head tucked under, and one's eyes looking downward—the mosquito in the pupa continues to move about freely, instead of taking life meanwhile in the spirit of a mummy in the mummy-case. By way of change, however, he now eats nothing—having, in fact, no mouth to eat with. But the most wonderful thing of all is the alteration in his method of breathing. The pupa no longer breathes with its tail, but with the front part of its body, where two little horn-shaped tubes are developed for the purpose. You can see them in the illustration (No. 6), which is taken at the moment when the active and locomotive pupa has just come to the surface to breathe, and is floating, back up, and head doubled under downward, in a most constrained position. The attitude reminds one of nothing so much as that of a bull, with his head between his legs, rushing forward to attack one. You can see through the pupa-case the great dark eyes and the rudiments of the legs as they form below it.

No. 7 exhibits very prettily the next stage in this short eventful history—the emergence of a female mosquito from her dressing-gown or pupa-case. She looks like a lady coming out of her ball-dress. As the pupa grows older, the skin or case stands off of itself from the animal within, by a sort of strange internal shrinkage, and a layer of air is thus formed between case and occupant. This causes the whole apparatus to float to the surface, and enables the winged



6.—THE PUPA OR CHRYSALIS, BREATHING THROUGH TWO HORN-LIKE TUBES.



7.—THE FEMALE MOSQUITO ABANDONING HER PUPA-CASE.

fly to make an effective exit. The new mosquito, looking still very hump-backed, and distinctly crouching, breaks through the top of the pupa-case (which opens by a slit), raises herself feebly and awkwardly on her spindle shanks, and withdraws her tail from its swathing bandage. She has grown meanwhile into a very different creature from the aquatic larva: observe her long plumed antennæ, her curious mouth-organs, her six hairy legs, and her delicate gauze-like wings, all of them wholly distinct from her former self, and utterly unrepresented by anything in the swimming insect. It is a marvellous transformation this, from a darting aquatic with rudder and tail, to a flying terrestrial and aerial animal, with legs and wings and manifold adapted appendages. At first, one would say, the new-fledged mosquito can hardly know herself.

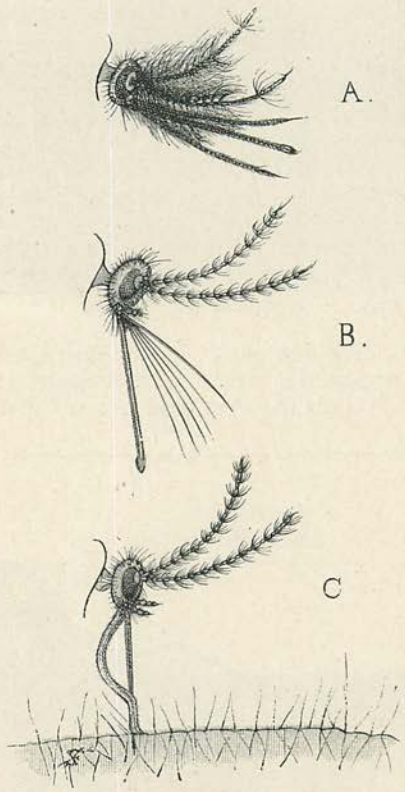
In nature, however, nothing is ever wasted. The pupa-case, you would suppose, is now quite useless. Not a bit of it. Our lady utilizes it at once as a boat to float upon. She plants her long legs upon it gingerly, as you see in No. 8, where you can still make out the shape of the tail

8.—THE FEMALE MOSQUITO MAKING A BOAT OF HER CAST-OFF SKIN.

and the horn-like breathing-tubes of the pupa. Thus does she rise on stepping-stones of her dead self to higher things, in a more literal sense than the poet contemplated. You observe her above, in her natural size, and below much magnified. Notice her beautiful gauzy wings, marked with hairy veins, her pretty plume-like antennæ, her spider-like jointed legs, and her hump of a body. She stands now, irresolute, meditating flight and wondering whether she dare unfold her light pinions to the breeze. Soon, confidence and strength will come to her; she will plim them on the summer air, and float away carelessly, seeking whom she may devour.

All this is what happens to a successful insect. But often, the boat fails; the young wings get wetted; the mosquito cannot spread them; and so she is drowned in the very element which till now was the only place where she could support existence.

And here I must say a word in favour of the male as against the female mosquito. In most species, and certainly in our own commonest British gnat, the male fly never sucks blood at all, but passes an idyllic vegetarian existence, which might excite the warmest praise from Mr. Bernard Shaw, in sipping the harmless nectar of flowers. He has, in point of fact, no weapon to attack us with. He is an unarmed honey-sucker.



9. — HEADS OF MOSQUITOES; A, THE WHISKERED MALE; B, THE BLOOD-SUCKING FEMALE, WITH LANCETS EXPOSED; C, THE FEMALE, BITING A HUMAN HAND.

But the female is very differently minded—a Messalina or a Brinvilliers, incongruously wedded to a vegetarian innocent. Even the very forms of the head and its appendages are quite different in the two sexes in adaptation to these marked differences of habit. No. 9 shows us the varieties of form in the male and female at a glance. Above (in Fig. A) we have the harmless vegetarian male. Observe his innocent sucking mouth, his bushy beard, his lack of sting, his obvious air of general respectability. He might pass for a pure and blameless ratepayer. But I must be more definitely scientific, perhaps, and add in clearer language that what I call his beard is really the antennæ. These consist of fourteen joints each, fitted with delicate circlets of hair; and the hairs in the male are so long and tufted as to give him in this matter a feathery and military appearance, wholly alien to his real mildness of nature. Look close at his head and you will find it is provided with three sets of organs—first, the tufted antennæ; second, a single sucking proboscis, adapted for quiet flower-hunting and nectar-eating; third, a pair of long palps, one on each side of the proboscis.

Now, beneath him, marked B, we get the head of his faithful spouse, the abandoned, blood-sucking mosquito, which looks at first sight, I confess, much more simple and harmless. Its antennæ have shorter and less bristling hairs; its proboscis seems quiet enough; and its palps are reduced to two mere horns or knobs, not a quarter the length of the bristly husband's, on each side of the proboscis. But notice in front of all that she has five long lancets, guarded by an upper lip, which do not answer to anything at all in her husband's economy. Those five lancets, with their serrated points, are the awls or piercers with which she penetrates the skin of men or cattle. They correspond to the mandibles, maxillæ, and tongue which I shall explain hereafter in the mouth of the gadfly. How they work you can observe in the lowest figure, C. Here you have a bit of the hand of a human subject—not to put too fine a point upon it (which is the besetting sin of mosquitoes), the artist's. He has delivered himself up to be experimented on in the interests of science. The sharp lancets have been driven through the skin into the soft tissue beneath, and the

bent proboscis is now engaged in sucking up the blood that oozes from it. If that were all, it would be bad enough ; but not content with that, the mosquito for some mysterious reason also injects a drop of some irritant fluid. I have never been able to see that this proceeding does her any good ; but it is irritating to us ; and that perhaps is quite sufficient for the ill-tempered mosquito.

Owing to the habits of the larva, mosquitoes are of course exceptionally abundant in marshy places. They were formerly common in the Fen district of England, but the draining of the fens has now almost got rid of them, as it has also of the fever-and-ague microbe.

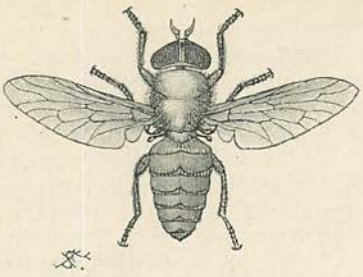
As a rule, mosquitoes are nocturnal animals, though in dark woods, and also in very swampy districts, they often bite quite as badly through the day-time as at night. But when evening falls, and all else is still, then wander forth these sons (or daughters) of Belial, flown with insolence and blood. "What time the grey fly winds her sultry horn," says Milton ; and that sultry horn is almost more annoying than the bite which it precedes. You lie coiled within your mosquito-curtains, wooing sweet sleep with appropriate reflections, when suddenly, by your ear, comes that still small voice, so vastly more pungent and more irritating than the voice of conscience. You light a candle, and proceed to hunt for the unwelcome intruder. As if by magic, as you strike your match, that mosquito disappears, and you look in vain through every fold and cranny of the thin gauze curtains. At last you give it up, and lie down again, when straightway, "z-z-z-z," the humming at your ear commences once more, and you begin the unequal contest all over again. It is a war of extermination on either side : you thirst for her life, and she thirsts for your blood. No peace is possible till one or other combatant is finally satisfied.

You can best observe the mosquito in action, however, by letting one settle undisturbed on the back of your hand, and waiting while she fills herself with your blood ; you can easily watch her doing so with a pocket lens. Like the old lady in "Pickwick," she is soon "swelling wisibly." She gorges herself with blood, indeed, which she straightway digests, assimilates, and converts into the 300 eggs aforesaid. But if, while she is sucking, you gently and unobtrusively tighten the skin of your hand by clenching your fist hard, you will find that she cannot any longer withdraw her mandibles ; they are caught fast in your flesh by their own harpoon-like teeth, and there she must stop accordingly till you choose to release her. If you then kill her in the usual manner, by a smart slap of the hand, you will see that she is literally full of blood, having sucked a good drop of it.

The humming sound itself by which the mosquito announces her approaching visit is produced in two distinct manners. The deeper notes which go to make up her droning song are due to the rapid vibration of the female insect's wings as she flies ; and these vibrations are found by means of a siren (an instrument which measures the frequency of the waves in notes) to amount to about 3,000 in a minute. The mosquito's wings must therefore move with this extraordinary rapidity, which sufficiently accounts for the difficulty we have in catching one. But the higher and shriller notes of the complex melody are due to special stridulating organs situated like little drums on the openings of the air-tubes ; for the adult mosquito breathes no longer by one or two air-entrances on the tail or back, like the larva, but by a number of spiracles, as they are called, arranged in rows along the sides of the body, and communicating with the network of internal air-chambers. The curious mosquito music thus generated by the little drums serves almost beyond a doubt as a means of attracting male mosquitoes, for it is known that the long hairs on the antennæ of the males, shown in No. 9, Fig. A, vibrate sympathetically in unison with the notes of a tuning-fork, within the range of the sounds emitted by the female. In other words, hairs and drums just answer to one another. We may, therefore, reasonably conclude that the female sings in order to please and attract her wandering mate, and that the antennæ of the male are organs of hearing which catch and respond to the buzzing music she pours forth for her lover's ears. A whole swarm of gnats can be brought down, indeed, by uttering the appropriate note of the race : you can call them somewhat as you can call male glow-worms by showing a light which they mistake for the female.

A much larger and more powerful British bloodsucker than the mosquito, again, is the gadfly or horse-fly, whose life-size portrait Mr. Enock has drawn for us in No. 10. Most people know this fearsome beast well in the fields in summer ; he has a trick of settling on the back of one's neck, and making a hole in one's skin with his sharp mandibles ; after which he quietly sucks

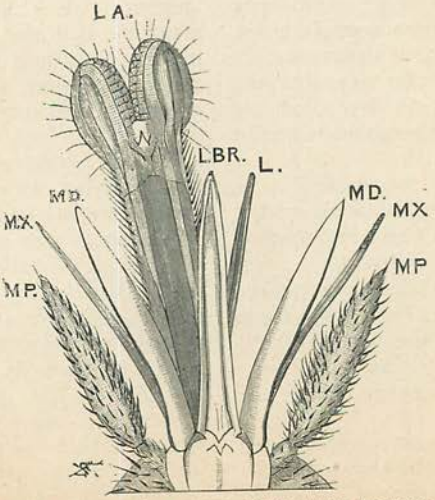
one's blood almost without one's perceiving him. Horses in pastures are often terribly troubled by these persistent creatures, which make no noise, but creep silently up and settle on the most exposed parts of the legs and flanks. They are very voracious, and manage to devour an amount of blood which is truly surprising.



10.—THE GADFLY, NATURAL SIZE.

A little examination of the gadfly will show you, too, one important point in which it and all other true flies differ from the bees, wasps, butterflies, and the vast mass of ordinary insects. All the other races have four wings, and I showed you in the case of the wasp the beautiful mechanism of hooks and grooves by which the fore and hind wings are often locked together in one great group so as to insure uniformity and fixity in flying. Among the true flies, however, including not only the house-fly and the meat-fly, but also the gadflies and the mosquitoes, only one pair of wings, the front pair, is ever developed. The second or hind pair is feebly represented by a couple of tiny rudimentary wings, known as poisers or balancers, which you can just make out in the sketch, like a couple of stalked knobs, in the space between the true wings and the tail or abdomen. It is pretty clear that the common ancestor of all these two-winged flies must have had four wings, like the rest of the great class to which he belonged; but he found it in some way more convenient for his purpose to get rid of one pair, and he has handed down that singular modification of structure to all his descendants. Yet, whenever an organ or set of organs is suppressed in this way, it almost always happens that rudiments or relics of the suppressed part remain to the latest generations; and thus the true flies still retain, in most cases, the two tiny poisers or balancers just to remind us of their descent from four-winged ancestors. Nature has no habit more interesting than this retention of parts long since disused or almost disused; by their aid we are able to trace the genealogy of plants and animals.

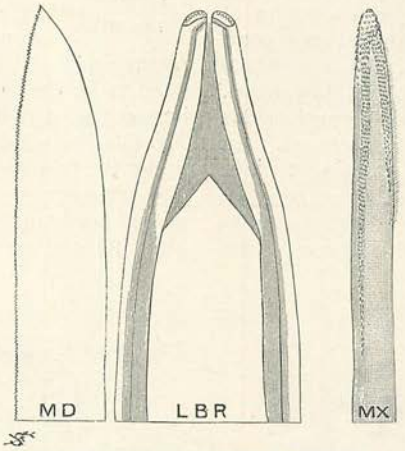
In No. 11 we have a dissected view of the mouth-organs and blood-sucking apparatus of the gadfly, immensely enlarged, so as to show in detail the minute structure. In life, all these separate parts are combined together into a compound sucker (commonly called the proboscis), which forms practically a single tube or sheath; they are dissected out here for facility of comprehension. The longest part, marked LA in the sketch, is the *labium* or lower lip, which makes up the mass of the tube; it ends in two soft finger-like pads, which are fleshy in texture, and which enable it to fix itself firmly (like a camel's foot) on the skin of the victim. The grooved and dagger-shaped organ, marked LBR, is the *labrum*, or upper lip; and the tube or sheath formed by the shutting together of these two parts incloses all the other organs. Combined, they form a trunk or proboscis, not unlike that of the elephant. But the elephant is not a blood-sucker; his trunk encircles no dangerous cutting weapon. It is otherwise with the gadfly, which has a pair of sharp knives within, for lancing the thick skin of its unhappy victims. These knives are known as *mandibles*, and are marked MD in the sketch, one on either side of the labrum. They first pierce the skin; the *maxillæ*, marked MX, of which there are also a pair, then lap up the blood from the internal tissues. Finally, there is the true tongue or



11.—THE GADFLY'S LANCETS, WITH OTHER PARTS OF THE PROBOSCIS.

lingua, marked L, which is the organ for tasting it. As to the *maxillary palps*, marked MP, they do not form part of the tube at all, but stand outside it, and assist like hands in the work of manipulation.

This is how the mouth looks when fully opened out for microscopic examination. But as the fly uses it, it forms a closed tube, of which the labium and the labrum are the two walls, enfolding the lances or mandibles, and the lickers or maxillæ, as well as the tongue. Pack them all away mentally, from MX to MX, within the two covers, and you will then understand the nature of the mechanism. Look back at Fig. B in No. 9, and you will there observe that all the parts in the mosquito answer to those in the gadfly. The long upper sheath is the upper lip: then come the lancets, the lappers, and the tongue, and last of all, the lower lip.



12.—THE CUTTING EDGES OF THE LANCETS.

In No. 12, which is still more highly magnified, we have the essential parts of the blood-sucking apparatus made quite clear for us. Here LBR is the tip of the labrum, or upper lip, forming the front of the groove or sheath in which the lances work. Its end is blunt, so as to enable it to be pressed close against the minute hole formed by the lances. MD is the sharp tip of one of the two lances, with its serrated or saw-like cutting edge; this is the organ that does the serious work of imperceptibly piercing the skin and the tissues beneath it. MX is the tip of one of the maxillæ, or blood-lappers, which suck or lap up the blood from the wound after the lances have opened it. I need hardly call your attention to the extraordinary delicacy and minuteness of these hard, sharp weapons, strong enough to pierce the tough hide of a horse, yet so small that if represented on the same scale as the insect itself, you would fail to perceive them.

Is it not marvellous, too, that the same set of organs about the mouth, which we saw employed by the wasp for cutting paper from wood, and by the ant for the varied functions of civilized ant-life, should be capable of modification in the butterfly into a sucker for honey, and in the gadfly into a cunning mechanism for piercing thick hides and feeding on the life-blood of superior animals? Nature, it seems, is sparing of ground-plan, but strangely lavish of minor modifications. She will take a single set of organs, inherited from some early common ancestor, and keep them true in the main through infinite varieties; but as habits alter in one species or another, she will adapt one of these sets to one piece of work and another to a second wholly unlike it. While she preserves throughout the similarity due to a common origin, she will vary infinitely the details and the minor structures so as to make them apply to the most diverse functions. Nothing shows this truth more beautifully, and more variously, than the mouths of insects; and though the names by which we call the different parts are, I will admit, somewhat harsh and technical, I feel sure that anybody who once masters their meaning cannot fail to be delighted by the endless modifications by which a few small instruments are made to fit an ever-increasing and infinite diversity of circumstances.