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THE GLOW-WORM AND OTHER BEETLES

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Содержание

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TRANSLATOR'S NOTE

This is the second volume on Beetles in the complete English edition of Henri Fabre's entomological works. The first is entitled *The Sacred Beetle and Others;* the second and the third will be known as *The Life of the Weevil* and *More Beetles* respectively.

The Glow-worm, which gives its name to the present book, did not form part of the *Souvenirs entomologiques* as originally published. It is one of two essays written specially, at my request, for translation into English, towards the close of Henri Fabre's life; in fact, this and *The Ant-lion*, a short essay for children, were the last works that came from the veteran author's pen. *The Glow-worm* appeared first in the *Century Magazine*. Of the remaining chapters, several have appeared in various periodicals, notably the *English Review* and in *Land and Water*, the editor and proprietors of which admirable weekly have shown the most enlightened interest in Fabre's work.

A part of the chapter entitled *The Dung-beetles of the Pampas*

figures in Messrs. Adam & Charles Black's volume, *The Life and Love of the Insect* (New York: the Macmillan Co.), translated by myself; and the chapters on the Capricorn and Burying-beetles will be found in Mr. T. Fisher Unwin's volume, *The Wonders of Instinct* (New York: the Century Co.), translated by myself and Mr. Bernard Miall, which also contains *The Glow-worm*. These chapters are included in the present edition by consent of and arrangement with the publishers named.

Lastly, Mr. Bernard Miall has earned my gratitude by the valuable assistance which he has given me in preparing the translation of the greater part of this volume.

ALEXANDER TEIXEIRA DE MATTOS.

CHELSEA, *5 September,* 1919.

CHAPTER I
THE GLOW-WORM

Few insects in our climes vie in popular fame with the Glow-worm, that curious little animal which, to celebrate the little joys of life, kindles a beacon at its tail-end. Who does not know it, at least by name? Who has not seen it roam amid the grass, like a spark fallen from the moon at its full? The Greeks of old called it [Greek: lampouris], meaning, the bright-tailed. Science employs the same term: it calls the lantern-bearer, *Lampyris noctiluca*, LIN. In this case, the common name is inferior to the scientific phrase, which, when translated, becomes both expressive and accurate.

In fact, we might easily cavil at the word "worm." The Lampyris is not a worm at all, not even in general appearance. He has six short legs, which he well knows how to use; he is a gad-about, a trot-about. In the adult state, the male is correctly garbed in wing-cases, like the true Beetle that he is. The female is an ill-favoured thing who knows naught of the delights of flying: all her life long, she retains the larval shape, which, for the rest, is similar to that of the male, who himself is imperfect so long as he has not achieved the maturity that comes with pairing-time. Even in this initial stage, the word "worm" is out of place. We French have the expression "Naked as a worm," to point to the

lack of any defensive covering. Now the Lampyris is clothed, that is to say, he wears an epidermis of some consistency; moreover, he is rather richly coloured: his body is dark brown all over, set off with pale pink on the thorax, especially on the lower surface. Finally, each segment is decked at the hinder edge with two spots of a fairly bright red. A costume like this was never worn by a worm.

Let us leave this ill-chosen denomination and ask ourselves what the Lampyris feeds upon. That master of the art of gastronomy, Brillat-Savarin,[1] said:

"Show me what you eat and I will tell you what you are."

A similar question should be addressed, by way of a preliminary, to every insect whose habits we propose to study, for, from the least to the greatest in the zoological progression, the stomach sways the world; the data supplied by food are the chief of all the documents of life. Well, in spite of his innocent appearance, the Lampyris is an eater of flesh, a hunter of game; and he follows his calling with rare villainy. His regular prey is the Snail.

This detail has long been known to entomologists. What is not so well-known, what is not known at all yet, to judge by what I have read, is the curious method of attack, of which I have seen no other instance anywhere.

Before he begins to feast, the Glow-worm administers an

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[1] Anthelme Brillat-Savarin (1755-1826), author of *La Psychologie du goût*. —*Translator's Note*.

anæsthetic: he chloroforms his victim, rivalling in the process the wonders of our modern surgery, which renders the patient insensible before operating on him. The usual game is a small Snail hardly the size of a cherry, such as, for instance, *Helix variabilis*, DRAP., who, in the hot weather, collects in clusters on the stiff stubble and on other long, dry stalks, by the roadside, and there remains motionless, in profound meditation, throughout the scorching summer days. It is in some such resting-place as this that I have often been privileged to light upon the Lampyris banqueting on the prey which he had just paralyzed on its shaky support by his surgical artifices.

But he is familiar with other preserves. He frequents the edges of the irrigating-ditches, with their cool soil, their varied vegetation, a favourite haunt of the mollusc. Here, he treats the game on the ground; and, under these conditions, it is easy for me to rear him at home and to follow the operator's performance down to the smallest detail.

I will try to make the reader a witness of the strange sight. I place a little grass in a wide glass jar. In this I install a few Glow-worms and a provision of Snails of a suitable size, neither too large nor too small, chiefly *Helix variabilis*. We must be patient and wait. Above all, we must keep an assiduous watch, for the desired events come unexpectedly and do not last long.

Here we are at last. The Glow-worm for a moment investigates the prey, which, according to its habit, is wholly withdrawn in the shell, except the edge of the mantle, which projects slightly.

Then the hunter's weapon is drawn, a very simple weapon, but one that cannot be plainly perceived without the aid of a lens. It consists of two mandibles bent back powerfully into a hook, very sharp and as thin as a hair. The microscope reveals the presence of a slender groove running throughout the length. And that is all.

The insect repeatedly taps the Snail's mantle with its instrument. It all happens with such gentleness as to suggest kisses rather than bites. As children, teasing one another, we used to talk of "tweaksies" to express a slight squeeze of the finger-tips, something more like a tickling than a serious pinch. Let us use that word. In conversing with animals, language loses nothing by remaining juvenile. It is the right way for the simple to understand one another.

The Lampyris doles out his tweaks. He distributes them methodically, without hurrying, and takes a brief rest after each of them, as though he wished to ascertain the effect produced. Their number is not great: half-a-dozen, at most, to subdue the prey and deprive it of all power of movement. That other pinches are administered later, at the time of eating, seems very likely, but I cannot say anything for certain, because the sequel escapes me. The first few, however – there are never many – are enough to impart inertia and loss of all feeling to the mollusc, thanks to the prompt, I might almost say, lightning methods of the Lampyris, who, beyond a doubt, instils some poison or other by means of his grooved hooks.

Here is the proof of the sudden efficacity of those twitches,

so mild in appearance: I take the Snail from the Lampyris, who has operated on the edge of the mantle some four or five times. I prick him with a fine needle in the fore-part, which the animal, shrunk into its shell, still leaves exposed. There is no quiver of the wounded tissues, no reaction against the brutality of the needle. A corpse itself could not give fewer signs of life.

Here is something even more conclusive: chance occasionally gives me Snails attacked by the Lampyris while they are creeping along, the foot slowly crawling, the tentacles swollen to their full extent. A few disordered movements betray a brief excitement on the part of the mollusc and then everything ceases: the foot no longer slugs; the front-part loses its graceful swan-neck curve; the tentacles become limp and give way under their weight, dangling feebly like a broken stick. This conditions persists.

Is the Snail really dead? Not at all, for I am free to resuscitate the seeming corpse. After two or three days of that singular condition which is no longer life and yet not death, I isolate the patient and, although this is not really necessary to success, I give him a douche which will represent the shower so dear to the able-bodied mollusc. In about a couple of days, my prisoner, but lately injured by the Glow-worm's treachery, is restored to his normal state. He revives, in a manner; he recovers movement and sensibility. He is affected by the stimulus of a needle; he shifts his place, crawls, puts out his tentacles, as though nothing unusual had occurred. The general torpor, a sort of deep drunkenness, has vanished outright. The dead returns to life. What name shall

we give to that form of existence which, for a time, abolishes the power of movement and the sense of pain? I can see but one that is approximately suitable: anæsthesia. The exploits of a host of Wasps whose flesh-eating grubs are provided with meat that is motionless though not dead[2] have taught us the skilful art of the paralyzing insect, which numbs the locomotory nerve-centres with its venom. We have now a humble little animal that first produces complete anæsthesia in its patient. Human science did not in reality invent this art, which is one of the wonders of our latter-day surgery. Much earlier, far back in the centuries, the Lampyris and, apparently, others knew it as well. The animal's knowledge had a long start of ours; the method alone has changed. Our operators proceed by making us inhale the fumes of ether or chloroform; the insect proceeds by injecting a special virus that comes from the mandibular fangs in infinitesimal doses. Might we not one day be able to benefit by this hint? What glorious discoveries the future would have in store for us, if we understood the beastie's secrets better!

What does the Lampyris want with anæsthetical talent against a harmless and moreover eminently peaceful adversary, who would never begin the quarrel of his own accord? I think I see. We find in Algeria a Beetle known as *Drilus maroccanus*, who, though non-luminous, approaches our Glow-worm in his organization and especially in his habits. He too feeds on land

[2] Cf. *The Hunting Wasps*, by J. Henri Fabre, translated by Alexander Teixeira de Mattos: *passim*. —*Translator's Note*.

molluscs. His prey is a Cyclostome with a graceful spiral shell, tight-closed with a stony lid which is attached to the animal by a powerful muscle. The lid is a movable door which is quickly shut by the inmate's mere withdrawal into his house and as easily opened when the hermit goes forth. With this system of closing, the abode becomes inviolable; and the Drilus knows it.

Fixed to the surface of the shell by an adhesive apparatus whereof the Lampyris will presently show us the equivalent, he remains on the look-out, waiting, if necessary, for whole days at a time. At last, the need of air and food oblige the besieged noncombatant to show himself; at least, the door is set slightly ajar. That is enough. The Drilus is on the spot and strikes his blow. The door can no longer be closed and the assailant is henceforth master of the fortress. Our first impression is that the muscle moving the lid has been cut with a quick-acting pair of shears. This idea must be dismissed. The Drilus is not well enough equipped with jaws to gnaw through a fleshy mass so promptly. The operation has to succeed at once, at the first touch: if not, the animal attacked would retreat, still in full vigour, and the siege must be recommenced, as arduous as ever, exposing the insect to fasts indefinitely prolonged. Although I have never come across the Drilus, who is a stranger to my district, I conjecture a method of attack very similar to that of the Glow-worm. Like our own Snail-eater, the Algerian insect does not cut its victim into small pieces: it renders it inert, chloroforms it by means of a few tweaks which are easily distributed, if the lid but half-opens

for a second. That will do. The besieger thereupon enters and, in perfect quiet, consumes a prey incapable of the least muscular effort. That is how I see things by the unaided light of logic.

Let us now return to the Glow-worm. When the Snail is on the ground, creeping, or even shrunk into his shell, the attack never presents any difficulty. The shell possesses no lid and leaves the hermit's fore-part to a great extent exposed. Here, on the edges of the mantle contracted by the fear of danger, the mollusc is vulnerable and incapable of defence. But it also frequently happens that the Snail occupies a raised position, clinging to the tip of a grass-stalk or perhaps to the smooth surface of a stone. This support serves him as a temporary lid; it wards off the aggression of any churl who might try to molest the inhabitant of the cabin, always on the express condition that no slit show itself anywhere on the protecting circumference. If, on the other hand, in the frequent case when the shell does not fit its support quite closely, some point, however tiny, be left uncovered, this is enough for the subtle tools of the Lampyris, who just nibbles at the mollusc and at once plunges him into that profound immobility which favours the tranquil proceedings of the consumer.

These proceedings are marked by extreme prudence. The assailant has to handle his victim gingerly, without provoking contractions which would make the Snail let go his support and, at the very least, precipitate him from the tall stalk whereon he is blissfully slumbering. Now any game falling to the ground would

seem to be so much sheer loss, for the Glow-worm has no great zeal for hunting-expeditions: he profits by the discoveries which good luck sends him, without undertaking assiduous searches. It is essential, therefore, that the equilibrium of a prize perched on the top of a stalk and only just held in position by a touch of glue should be disturbed as little as possible during the onslaught; it is necessary that the assailant should go to work with infinite circumspection and without producing pain, lest any muscular reaction should provoke a fall and endanger the prize. As we see, sudden and profound anæsthesia is an excellent means of enabling the Lampyris to attain his object, which is to consume his prey in perfect quiet.

What is his manner of consuming it? Does he really eat, that is to say, does he divide his food piecemeal, does he carve it into minute particles, which are afterwards ground by a chewing-apparatus? I think not. I never see a trace of solid nourishment on my captives' mouths. The Glow-worm does not eat in the strict sense of the word: he drinks his fill; he feeds on a thin gruel into which he transforms his prey by a method recalling that of the maggot. Like the flesh-eating grub of the Fly, he too is able to digest before consuming; he liquefies his prey before feeding on it.

This is how things happen: a Snail has been rendered insensible by the Glow-worm. The operator is nearly always alone, even when the prize is a large one, like the Common Snail, *Helix aspersa*. Soon a number of guests hasten up – two, three

or more – and, without any quarrel with real proprietor, all alike fall to. Let us leave them to themselves for a couple of days and then turn the shell, with the opening downwards. The contents flow out as easily as would soup from an overturned saucepan. When the sated diners retire from this gruel, only insignificant leavings remain.

The matter is obvious: by repeated tiny bites, similar to the tweaks which we saw distributed at the outset, the flesh of the mollusc is converted into a gruel on which the various banqueters nourish themselves without distinction, each working at the broth by means of some special pepsine and each taking his own mouthfuls of it. In consequence of this method, which first converts the food into a liquid, the Glow-worm's mouth must be very feebly armed apart from the two fangs which sting the patient and inject the anæsthetic poison and, at the same time, no doubt, the serum capable of turning the solid flesh into fluid. These two tiny implements, which can just be examined through the lens, must, it seems, have some other object. They are hollow and in this resemble those of the Ant-lion, which sucks and drains its capture without having to divide it; but there is this great difference, that the Ant-lion leaves copious remnants, which are afterwards flung outside the funnel-shaped trap dug in the sand, whereas the Glow-worm, that expert liquefier, leaves nothing, or next to nothing. With similar tools, the one simply sucks the blood of its prey and the other turns every morsel of his to account, thanks to a preliminary liquefaction.

And this is done with exquisite precision, though the equilibrium is sometimes anything but steady. My rearing-glasses supply me with magnificent examples. Crawling up the sides, the Snails imprisoned in my apparatus sometimes reach the top, which is closed with a glass pane, and fix themselves to it by means of a speck of glair. This is a mere temporary halt, in which the mollusc is miserly with its adhesive product, and the merest shake is enough to loosen the shell and send it to the bottom of the jar.

Now it is not unusual for the Glow-worm to hoist himself to the top, with the help of a certain climbing-organ that makes up for his weak legs. He selects his quarry, makes a minute inspection of it to find an entrance-slit, nibbles it a little, renders it insensible and, without delay, proceeds to prepare the gruel which he will consume for days on end.

When he leaves the table, the shell is found to be absolutely empty; and yet this shell, which was fixed to the glass by a very faint stickiness, has not come loose, has not even shifted its position in the smallest degree: without any protest from the hermit gradually converted into broth, it has been drained on the very spot at which the first attack was delivered. These small details tell us how promptly the anæsthetic bite takes effect; they teach us how dexterously the Glow-worm treats his Snail without causing him to fall from a very slippery vertical support and without even shaking him on his slight line of adhesion.

Under these conditions of equilibrium, the operator's short,

clumsy legs are obviously not enough; a special accessory apparatus is needed to defy the danger of slipping and to seize the unseizable. And this apparatus the Lampyris possesses. At the hinder end of the animal we see a white spot which the lens separates into some dozen short, fleshy appendages, sometimes gathered into a cluster, sometimes spread into a rosette. There is your organ of adhesion and locomotion. If he would fix himself somewhere, even on a very smooth surface, such as a grass-stalk, the Glow-worm opens his rosette and spreads it wide on the support, to which it adheres by its own stickiness. The same organ, rising and falling, opening and closing, does much to assist the act of progression. In short, the Glow-worm is a new sort of self-propelled cripple, who decks his hind-quarters with a dainty white rose, a kind of hand with twelve fingers, not jointed, but moving in every direction: tubular fingers which do not seize, but stick.

The same organ serves another purpose: that of a toilet-sponge and brush. At a moment of rest, after a meal, the Glow-worm passes and repasses the said brush over his head, back, sides and hinder-parts, a performance made possible by the flexibility of his spine. This is done point by point, from one end of the body to the other, with a scrupulous persistency that proves the great interest which he takes in the operation. What is his object in thus sponging himself, in dusting and polishing himself so carefully? It is a question, apparently, of removing a few atoms of dust or else some traces of viscidity that remain from the evil contact

with the snail. A wash and brush-up is not superfluous when one leaves the tub in which the mollusc has been treated.

If the Glow-worm possessed no other talent than that of chloroforming his prey by means of a few tweaks resembling kisses, he would be unknown to the vulgar herd; but he also knows how to light himself like a beacon; he shines, which is an excellent manner of achieving fame. Let us consider more particularly the female, who, while retaining her larval shape, becomes marriageable and glows at her best during the hottest part of summer. The lighting-apparatus occupies the last three segments of the abdomen. On each of the first two, it takes the form, on the ventral surface, of a wide belt covering almost the whole of the arch; on the third, the luminous part is much less and consists simply of two small crescent-shaped markings, or rather two spots which shine through to the back and are visible both above and below the animal. Belts and spots emit a glorious white light, delicately tinged with blue. The general lighting of the Glow-worm thus comprises two groups: first, the wide belts of the two segments preceding the last; secondly, the two spots of the final segments. The two belts, the exclusive attribute of the marriageable female, are the part richest in light: to glorify her wedding, the future mother dons her brightest gauds; she lights her two resplendent scarves. But, before that, from the time of the hatching, she had only the modest rush-light of the stern. This efflorescence of light is the equivalent of the final metamorphosis, which is usually represented by the gift of wings

and flight. Its brilliance heralds the pairing-time. Wings and flight there will be none: the female retains her humble larval form, but she kindles her blazing beacon.

The male, on his side, is fully transformed, changes his shape, acquires wings and wing-cases; nevertheless, like the female, he possesses, from the time when he is hatched, the pale lamp of the end segment. This luminous aspect of the stern is characteristic of the entire Glow-worm tribe, independently of sex and season. It appears upon the budding grub and continues throughout life unchanged. And we must not forget to add that it is visible on the dorsal as well as on the ventral surface, whereas the two large belts peculiar to the female shine only under the abdomen.

My hand is not so steady nor my sight so good as once they were, but, as far as they allow me, I consult anatomy for the structure of the luminous organs. I take a scrap of the epidermis and manage to separate pretty neatly half of one of the shining belts. I place my preparation under the microscope. On the skin, a sort of white-wash lies spread, formed of a very fine, granular substance. This is certainly the light-producing matter. To examine this white layer more closely is beyond the power of my weary eyes. Just beside it is a curious air-tube, whose short and remarkably wide stem branches suddenly into a sort of bushy tuft of very delicate ramifications. These creep over the luminous sheet, or even dip into it. That is all.

The luminescence, therefore, is controlled by the respiratory organs and the work produced is an oxidization. The white sheet

supplies the oxidizable matter and the thick air-tube spreading into a tufty bush distributes the flow of air over it. There remains the question of the substance whereof this sheet is formed. The first suggestion was phosphorus, in the chemist's sense of the word. The Glow-worm has been calcined and treated with the violent reagents that bring the simple substances to light; but no one, so far as I know, has obtained a satisfactory answer along these lines. Phosphorus seems to play no part here, in spite of the name of phosphorescence which is sometimes bestowed upon the Glow-worm's gleam. The answer lies elsewhere, no one knows where.

We are better informed as regards another question. Has the Glow-worm a free control of the light which he emits? Can he turn it on or down or put it out as he pleases? Has he an opaque screen which is drawn over the flame at will, or is that flame always left exposed? There is no need for any such mechanism: the insect has something better for its revolving light.

The thick tube supplying the light-producing sheet increases the flow of air and the light is intensified; the same air-tube, swayed by the animal's will, slackens or even suspends the passage of air and the light grows fainter or even goes out. It is, in short, the mechanism of a lamp which is regulated by the access of air to the wick.

Excitement can set the attendant air-duct in motion. We must here distinguish between two cases: that of the gorgeous scarves, the exclusive ornament of the female ripe for matrimony, and

that of the modest fairy-lamp on the last segment, which both sexes kindle at any age. In the second case, the extinction caused by a flurry is sudden and complete, or nearly so. In my nocturnal hunts for young Glow-worms, measuring about 5 millimetres long,[3] I can plainly see the glimmer on the blades of grass; but, should the least false step disturb a neighbouring twig, the light goes out at once and the coveted insect becomes invisible. Upon the full-grown females, lit up with their nuptial scarves, even a violent start has but a slight effect and often none at all.

I fire a gun beside a wire-gauze cage in which I am rearing my menagerie of females in the open air. The explosion produces no result. The illumination continues, as bright and placid as before. I take a spray and rain down a slight shower of cold water upon the flock. Not one of my animals puts out its light; at the very most, there is a brief pause in the radiance; and then only in some cases. I send a puff of smoke from my pipe into the cage. This time, the pause is more marked. There are even some extinctions, but these do not last long. Calm soon returns and the light is renewed as brightly as ever. I take some of the captives in my fingers, turn and return them, tease them a little. The illumination continues and is not much diminished, if I do not press too hard with my thumb. At this period, with the pairing close at hand, the insect is in all the fervour of its passionate splendour; and nothing short of very serious reasons would make it put out its signals altogether.

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[3] .195 inch. —*Translator's Note.*

All things considered, there is not a doubt but that the Glow-worm himself manages his lighting-apparatus, extinguishing and rekindling it at will; but there is one point at which the voluntary agency of the insect is without effect. I detach a strip of the epidermis showing one of the luminescent sheets and place it in a glass tube, which I close with a plug of damp wadding, to avoid too rapid an evaporation. Well, this scrap of carcass shines away merrily, although not quite as brilliantly as on the living body.

Life's aid is now superfluous. The oxidizable substance, the luminescent sheet, is in direct communication with the surrounding atmosphere; the flow of oxygen through an air-tube is not necessary; and the luminous emission continues to take place, in the same way as when it is produced by the contact of the air with the real phosphorus of the chemists. Let us add that, in aerated water, the luminousness continues as brilliant as in the free air, but that it is extinguished in water deprived of its air by boiling. No better proof could be found of what I have already propounded, namely, that the Glow-worm's light is the effect of a slow oxidization.

The light is white, calm and soft to the eyes and suggests a spark dropped by the full moon. Despite its splendour, it is a very feeble illuminant. If we move a Glow-worm along a line of print, in perfect darkness, we can easily make out the letters, one by one, and even words, when these are not too long; but nothing more is visible beyond a narrow zone. A lantern of this kind soon tires the reader's patience.

Suppose a group of Glow-worms placed almost touching one another. Each of them sheds its glimmer, which ought, one would think, to light up its neighbours by reflexion and give us a clear view of each individual specimen. But not at all: the luminous party is a chaos in which our eyes are unable to distinguish any definite form at a medium distance. The collective lights confuse the link-bearers into one vague whole.

Photography gives us a striking proof of this. I have a score of females, all at the height of their splendour, in a wire-gauze cage in the open air. A tuft of thyme forms a grove in the centre of their establishment. When night comes, my captives clamber to this pinnacle and strive to show off their luminous charms to the best advantage at every point of the horizon, thus forming along the twigs marvellous clusters from which I expected magnificent effects on the photographer's plates and paper. My hopes are disappointed. All that I obtain is white, shapeless patches, denser here and less dense there according to the numbers forming the group. There is no picture of the Glow-worms themselves; not a trace either of the tuft of thyme. For want of satisfactory light, the glorious firework is represented by a blurred splash of white on a black ground.

The beacons of the female Glow-worms are evidently nuptial signals, invitations to the pairing; but observe that they are lighted on the lower surface of the abdomen and face the ground, whereas the summoned males, whose flights are sudden and uncertain, travel overhead, in the air, sometimes a great way up.

In its normal position, therefore, the glittering lure is concealed from the eyes of those concerned; it is covered by the thick bulk of the bride. The lantern ought really to gleam on the back and not under the belly; otherwise the light is hidden under a bushel.

The anomaly is corrected in a very ingenious fashion, for every female has her little wiles of coquetry. At nightfall, every evening, my caged captives make for the tuft of thyme with which I have thoughtfully furnished the prison and climb to the top of the upper branches, those most in sight. Here, instead of keeping quiet, as they did at the foot of the bush just now, they indulge in violent exercises, twist the tip of their very flexible abdomen, turn it to one side, turn it to the other, jerk it in every direction. In this way, the search-light cannot fail to gleam, at one moment or another, before the eyes of every male who goes a-wooing in the neighbourhood, whether on the ground or in the air.

It is very like the working of the revolving mirror used in catching Larks. If stationary, the little contrivance would leave the bird indifferent; turning and breaking up its light in rapid flashes, it excites it.

While the female Glow-worm has her tricks for summoning her swains, the male, on his side, is provided with an optical apparatus suited to catch from afar the least reflection of the calling-signal. His corselet expands into a shield and overlaps his head considerably in the form of a peaked cap or eye-shade, the object of which appears to be to limit the field of vision and

concentrate the view upon the luminous speck to be discerned. Under this arch are the two eyes, which are relatively enormous, exceedingly convex, shaped like a skull-cap and contiguous to the extent of leaving only a narrow groove for the insertion of the antennæ. This double eye, occupying almost the whole face of the insect and contained in the cavern formed by the spreading peak of the corselet, is a regular Cyclop's eye.

At the moment of the pairing, the illumination becomes much fainter, is almost extinguished; all that remains alight is the humble fairy-lamp of the last segment. This discreet night-light is enough for the wedding, while, all around, the host of nocturnal insects, lingering over their respective affairs, murmur the universal marriage-hymn. The laying follows very soon. The round, white eggs are laid, or rather strewn at random, without the least care on the mother's part, either on the more or less cool earth or on a blade of grass. These brilliant ones know nothing at all of family-affection.

Here is a very singular thing: the Glow-worm's eggs are luminous even when still contained in the mother's womb. If I happen by accident to crush a female big with germs that have reached maturity, a shiny streak runs along my fingers, as though I had broken some vessel filled with a phosphorescent fluid. The lens shows me that I am wrong. The luminosity comes from the cluster of eggs forced out of the ovary. Besides, as laying-time approaches, the phosphorescence of the eggs is already made manifest without this clumsy midwifery. A soft opalescent light

shines through the skin of the belly.

The hatching follows soon after the laying. The young of either sex have two little rush-lights on the last segment. At the approach of the severe weather, they go down into the ground, but not very far. In my rearing-jars, which are supplied with fine and very loose earth, they descend to a depth of three or four inches at most. I dig up a few in mid-winter. I always find them carrying their faint stern-light. About the month of April, they come up again to the surface, there to continue and complete their evolution.

From start to finish, the Glow-worm's life is one great orgy of light. The eggs are luminous; the grubs likewise. The full-grown females are magnificent light-houses, the adult males retain the glimmer which the grubs already possessed. We can understand the object of the feminine beacon; but of what use is all the rest of the pyrotechnic display? To my great regret, I cannot tell. It is and will be, for many a day to come, perhaps for all time, the secret of animal physics, which is deeper than the physics of the books.

CHAPTER II
THE SITARES

The high banks of sandy clay in the country round about Carpentras are the favourite haunts of a host of Bees and Wasps, those lovers of a thoroughly sunny aspect and of soils that are easy to excavate. Here, in the month of May, two Anthophoræ[4] are especially abundant, gatherers of honey and, both of them, makers of subterranean cells. One, *A. parietina*, builds at the entrance of her dwelling an advanced fortification, an earthy cylinder, wrought in open work, like that of the Odynerus,[5] and curved like it, but of the width and length of a man's finger. When the community is a populous one, we stand amazed at the rustic ornamentation formed by all these stalactites of clay hanging from the façade. The other, *A. pilipes*, who is very much more frequent, leaves the opening of her corridor bare. The chinks between the stones in old walls and abandoned hovels, the surfaces of excavations in soft sandstone or marl, are found suitable for her labours; but the favourite spots, those to which the greatest number of swarms resort, are vertical stretches, exposed

[4] Cf. *The Mason-bees*, by J. Henri Fabre, translated by Alexander Teixeira de Mattos: chap. viii.; and *Bramble-bees and Others*, by J. Henri Fabre, translated by Alexander Teixeira de Mattos: *passim*. —*Translator's Note*.

[5] Cf. *The Mason-wasps*, by J. Henri Fabre, translated by Alexander Teixeira de Mattos: chaps. vi. and x. —*Translator's Note*.

to the south, such as are afforded by the cuttings of deeply sunken roads. Here, over areas many yards in width, the wall is drilled with a multitude of holes, which impart to the earthy mass the look of some enormous sponge. These round holes might be fashioned with an auger, so regular are they. Each is the entrance to a winding corridor, which runs to a depth of four to six inches. The cells are distributed at the far end. If we would witness the labours of the industrious Bee, we must repair to her workshop during the latter half of May. Then, but at a respectful distance, if, as novices, we are afraid of being stung, we may contemplate, in all its bewildering activity, the tumultuous, buzzing swarm, busied with the building and the provisioning of the cells.

It is most often during the months of August and September, those happy months of the summer holidays, that I have visited the banks inhabited by the Anthophora. At this period all is silent near the nests; the work has long been completed; and numbers of Spiders' webs line the crevices or plunge their silken tubes into the Bee's corridors. Let us not, however, hastily abandon the city once so populous, so full of life and bustle and now deserted. A few inches below the surface, thousands of larvæ and nymphs, imprisoned in their cells of clay, are resting until the coming spring. Might not such a succulent prey as these larvæ, paralysed and incapable of defence, tempt certain parasites who are industrious enough to attain them?

Here indeed are some Flies clad in a dismal livery, half-black,

half-white, a species of Anthrax (*A. sinuata*),[6] flying indolently from gallery to gallery, doubtless with the object of laying their eggs there; and here are others, more numerous, whose mission is fulfilled and who, having died in harness, are hanging dry and shrivelled in the Spiders' webs. Elsewhere the entire surface of a perpendicular bank is hung with the dried corpses of a Beetle (*Sitaris humeralis*), slung, like the Flies, in the silken meshes of the Spiders. Among these corpses some male Sitares circle, busy, amorous, heedless of death, mating with the first female that passes within reach, while the fertilized females thrust their bulky abdomens into the opening of a gallery and disappear into it backwards. It is impossible to mistake the situation: some grave interest attracts to this spot these two insects, which, within a few days, make their appearance, mate, lay their eggs and die at the very doors of the Anthophora's dwellings.

Let us now give a few blows of the pick to the surface beneath which the singular incidents already in our mind must be occurring, beneath which similar things occurred last year; perhaps we shall find some evidence of the parasitism which we suspected. If we search the dwellings of the Anthophoræ during the early days of August, this is what we see: the cells forming the superficial layer are not like those situated at a greater depth. This difference arises from the fact that the same establishment is exploited simultaneously by the Anthophora and by an Osmia (*O.*

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[6] Cf. *The Life of the Fly*, by J. Henri Fabre, translated by Alexander Teixeira de Mattos: chaps. ii. and iv. —*Translator's Note*.

tricornis)[7] as is proved by an observation made at the working-period, in May. The Anthophoræ are the actual pioneers, the work of boring the galleries is wholly theirs; and their cells are situated right at the end. The Osmia profits by the galleries which have been abandoned either because of their age, or because of the completion of the cells occupying the most distant part; she builds her cells by dividing these corridors into unequal and inartistic chambers by means of rude earthen partitions. The Osmia's sole achievement in the way of masonry is confined to these partitions. This, by the way, is the ordinary building-method adopted by the various Osmiæ, who content themselves with a chink between two stones, an empty Snail-shell, or the dry and hollow stem of some plant, wherein to build their stacks of cells, at small expense, by means of light partitions of mortar.

The cells of the Anthophora, with their faultless geometrical regularity and their perfect finish, are works of art, excavated, at a suitable depth, in the very substance of the loamy bank, without any manufactured part save the thick lid that closes the orifice. Thus protected by the prudent industry of their mother, well out of reach in their distant, solid retreats, the Anthophora's larvæ are devoid of the glandular apparatus designed for secreting silk. They therefore never spin a cocoon, but lie naked in their cells, whose inner surface has the polish of stucco.

In the Osmia's cells, on the other hand, means of defence are required, for these are situated in the surface layer of the bank;

[7] Cf. *Bramble-bees and Others: passim*. —*Translator's Note*.

they are irregular in form, rough inside and barely protected, by their thin earthen partitions, against external enemies. The Osmia's larvæ, in fact, contrive to enclose themselves in an egg-shaped cocoon, dark brown in colour and very strong, which preserves them both from the rough contact of their shapeless cells and from the mandibles of voracious parasites, Acari,[8] Cleri[9] and Anthreni,[10] those manifold enemies whom we find prowling in the galleries, seeking whom they may devour. It is by means of this equipoise between the mother's talents and the larva's that the Osmia and the Anthophora, in their early youth, escape some part of the dangers which threaten them. It is easy therefore, in the bank excavated by these two Bees, to recognize the property of either species by the situation and form of the cells and also by their contents, which consist, with the Anthophora, of a naked larva and, with the Osmia, of a larva enclosed in a cocoon.

On opening a certain number of these cocoons, we end by discovering some which, in place of the Osmia's larva, contain each a curiously shaped nymph. These nymphs, at the least shock received by their dwelling, indulge in extravagant movements, lashing the walls with their abdomen till the whole house shakes

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[8] Mites and Ticks. —*Translator's Note*.

[9] A genus of Beetles of which certain species (*Clerus apiarius* and *C. alvearius*) pass their preparatory state in the nests of Bees, where they feed on the grubs. —*Translator's Note*.

[10] Another genus of Beetles. The grub of *A. musæorum*, the Museum Beetle, is very destructive to insect-collections. —*Translator's Note*.

and dances. And, even if we leave the cocoon intact, we are informed of their presence by a dull rustle heard inside the silken dwelling the moment after we move it.

The fore-part of this nymph is fashioned like a sort of boar's-snout armed with six strong spikes, a multiple ploughshare, eminently adapted for burrowing in the soil. A double row of hooks surmounts the dorsal ring of the four front segments of the abdomen. These are so many grappling-irons, with whose assistance the creature is enabled to progress in the narrow gallery dug by the snout. Lastly, a sheaf of sharp points forms the armour of the hinder-part. If we examine attentively the surface of the vertical wall which contains the various nests, it will not be long before we discover nymphs like those which we have been describing, with one extremity held in a gallery of their own diameter, while the fore-part projects freely into the air. But these nymphs are reduced to their cast skins, along the back and head of which runs a long slit through which the perfect insect has escaped. The purpose of the nymph's powerful weapons is thus made manifest: it is the nymph that has to rend the tough cocoon which imprisons it, to excavate the tightly-packed soil in which it is buried, to dig a gallery with its six-pointed snout and thus to bring to the light the perfect insect, which apparently is incapable of performing these strenuous tasks for itself.

And in fact these nymphs, taken in their cocoons, have in a few days' time given me a feeble Fly (*Anthrax sinuata*) who is quite incapable of piercing the cocoon and still more of making her

exit through a soil which I cannot easily break up with my pick. Although similar facts abound in insect history, we always notice them with a lively interest. They tell us of an incomprehensible power which suddenly, at a given moment, irresistibly commands an obscure grub to abandon the retreat in which it enjoys security, in order to make its way through a thousand difficulties and to reach the light, which would be fatal to it on any other occasion, but which is necessary to the perfect insect, which could not reach it by its own efforts.

But the layer of Osmia-cells has been removed; and the pick now reaches the Anthophora's cells. Among these cells are some which contain larvæ and which result from the labours of last May; others, though of the same date, are already occupied by the perfect insect. The precocity of metamorphosis varies from one larva to another; however, a few days' difference of age is enough to explain these inequalities of development. Other cells, as numerous as the first, contain a parasitical Hymenopteron, a Melecta (*M. armata*), likewise in the perfect state. Lastly, there are some, indeed many, which contain a singular egg-shaped shell, divided into segments with projecting breathing-pores. This shell is extremely thin and fragile; it is amber-coloured and so transparent that one can distinguish quite plainly, through its sides, an adult Sitaris (*S. humeralis*), who occupies the interior and is struggling as though to set herself at liberty. This explains the presence here, the pairing and the egg-laying of the Sitares whom we but now saw roaming, in the company of the Anthrax-

flies, at the entrance to the galleries of the Anthophoræ. The Osmia and the Anthophora, the joint owners of the premises, have each their parasite: the Anthrax attacks the Osmia and the Sitaris the Anthophora.

But what is this curious shell in which the Sitaris is invariably enclosed, a shell unexampled in the Beetle order? Can this be a case of parasitism in the second degree, that is, can the Sitaris be living inside the chrysalis of a first parasite, which itself exists at the cost of the Anthophora's larva or of its provisions? And, even so, how can this parasite, or these parasites, obtain access to a cell which seems to be inviolable, because of the depth at which it lies, and which, moreover, does not reveal, to the most careful examination under the magnifying-glass, any violent inroad on the enemy's part? These are the questions that presented themselves to my mind when for the first time, in 1855, I observed the facts which I have just related. Three years of assiduous observation enabled me to add one of its most astonishing chapters to the story of the formation of insects.

After collecting a fairly large number of these enigmatical shells containing adult Sitares, I had the satisfaction of observing, at leisure, the emergence of the perfect insect from the shell, the act of pairing and the laying of the eggs. The shell is easily broken; a few strokes of the mandibles, distributed at random, a few kicks are enough to deliver the perfect insect from its fragile prison.

In the glass jars in which I kept my Sitares I saw the pairing

follow very closely upon the first moments of freedom. I even witnessed a fact which shows emphatically how imperious, in the perfect insect, is the need to perform, without delay, the act intended to ensure the preservation of its race. A female, with her head already cut out of the shell, is anxiously struggling to release herself entirely; a male, who has been free for a couple of hours, climbs on the shell and, tugging here and there, with his mandibles, at the fragile envelope, strives to deliver the female from her shackles. His efforts are soon crowned with success; and, though the female is still three parts swathed in her swaddling-bands, the coupling takes place immediately, lasting about a minute. During the act, the male remains motionless on the top of the shell, or on the top of the female when the latter is entirely free. I do not know whether, in ordinary circumstances, the male occasionally thus helps the female to gain her liberty; to do so he would have to penetrate into a cell containing a female, which, after all, is not beyond his powers, seeing that he has been able to escape from his own. Still, on the actual site of the cells, the coupling is generally performed at the entrance to the galleries of the Anthophoræ; and then neither of the sexes drags about with it the least shred of the shell from which it has emerged.

After mating, the two Sitares proceed to clean their legs and antennæ by drawing them between their mandibles; then each goes his own way. The male cowers in a crevice of the earthen bank, lingers for two or three days and perishes. The female also,

after getting rid of her eggs, which she does without delay, dies at the entrance to the corridor in which the eggs are laid. This is the origin of all those corpses swinging in the Spiders' web with which the neighbourhood of the Anthophora's dwellings is upholstered.

Thus the Sitares in the perfect state live long enough only to mate and to lay their eggs. I have never seen one save upon the scene of their loves, which is also that of their death; I have never surprised one browsing on the plants near at hand, so that, though they are provided with a normal digestive apparatus, I have grave reasons to doubt whether they actually take any nourishment whatever. What a life is theirs! A fortnight's feasting in a storehouse of honey; a year of slumber underground; a minute of love in the sunlight; then death!

Once fertilized, restlessly the female at once proceeds to seek a favourable spot wherein to lay her eggs. It was important to note where this exact spot is. Does the female go from cell to cell, confiding an egg to the succulent flanks of each larva, whether this larva belong to the Anthophora or to a parasite of hers, as the mysterious shell whence the Sitaris emerges would incline one to believe? This method of laying the eggs, one at a time in each cell, would appear to be essential, if we are to explain the facts already ascertained. But then why do the cells usurped by the Sitares retain not the slightest trace of the forcible entry which is indispensable? And how is it that, in spite of lengthy investigations during which my perseverance has been kept up

by the keenest desire to cast some light upon all these mysteries, how is it, I say, that I have never come across a single specimen of the supposed parasites to which the shell might be attributed, since this shell appears not to be a Beetle's? The reader would hardly suspect how my slight acquaintance with entomology was unsettled by this inextricable maze of contradictory facts. But patience! We may yet obtain some light.

Let us begin by observing precisely at what spot the eggs are laid. A female has just been fertilized before my eyes; she is forthwith placed in a large glass jar, into which I put, at the same time, some clods of earth containing Anthophora-cells. These cells are occupied partly by larvæ and partly by nymphs that are still quite white; some are slightly open and afford a glimpse of their contents. Lastly, in the inner surface of the cork which closes the jar I sink a cylindrical well, a blind alley, of the same diameter as the corridors of the Anthophora. In order that the insect, if it so desire, may enter this artificial corridor, I lay the bottle horizontally.

The female, painfully dragging her big abdomen, perambulates all the nooks and corners of her makeshift dwelling, exploring them with her palpi, which she passes everywhere. After half an hour of groping and careful investigation, she ends by selecting the horizontal gallery dug in the cork. She thrusts her abdomen into this cavity and, with her head hanging outside, begins her laying. Not until thirty-six hours later was the operation completed; and during this

incredible lapse of time the patient creature remained absolutely motionless.

The eggs are white, oval and very small. They measure barely two-thirds of a millimetre[11] in length. They stick together slightly and are piled in a shapeless heap which might be likened to a good-sized pinch of the unripe seeds of some orchid. As for their number, I will admit that it tried my patience to no purpose. I do not, however, believe that I am exaggerating when I estimate it as at least two thousand. Here are the data on which I base this figure: the laying, as I have said, lasts thirty-six hours; and my frequent visits to the female working in the cavity in the cork convinced me that there was no perceptible interruption in the successive emission of the eggs. Now less than a minute elapses between the arrival of one egg and that of the next; and the number of these eggs cannot therefore be lower than the number of minutes contained in thirty-six hours, or 2160. But the exact number is of no importance: we need only note that it is very large, which implies, for the young larvæ issuing from the eggs, very numerous chances of destruction, since so lavish a supply of germs is necessary to maintain the species in the requisite proportions.

Enlightened by these observations and informed of the shape, the number and the arrangement of the eggs, I searched the galleries of the Anthophoræ for those which the Sitares had laid there and invariably found them gathered in a heap inside the

[11] .026 inch. —*Translator's Note.*

galleries, at a distance of an inch or two from the orifice, which is always open to the outer world. Thus, contrary to what one was to some extent entitled to suppose, the eggs are not laid in the cells of the pioneer Bee; they are simply dumped in a heap inside the entrance to her dwelling. Nay more, the mother does not make any protective structure for them; she takes no pains to shield them from the rigours of winter; she does not even attempt, by stopping for a short distance, as best she can, the entrance-lobby in which she has laid them, to protect them from the thousand enemies that threaten them; for, as long as the frosts of winter have not arrived, these open galleries are trodden by Spiders, by Acari, by Anthrenus-grubs and other plunderers, to whom these eggs, or the young larvæ about to emerge from them, must be a dainty feast. In consequence of the mother's heedlessness, the number of those who escape all these voracious hunters and the inclemencies of the weather must be curiously small. This perhaps explains why she is compelled to make up by her fecundity for her deficient industry.

The hatching occurs a month later, about the end of September or the beginning of October. The season being still propitious, I was led to suppose that the young larvæ must at once make a start and disperse, in order that each might seek to gain access, through some imperceptible fissure, to an Anthophora-cell. This presumption turned out to be entirely at fault. In the boxes in which I had placed the eggs laid by my captives, the young larvæ, little black creatures at most a twenty-fifth of an

inch long, did not move away, provided though they were with vigorous legs; they remained higgledy-piggledy with the white skins of the eggs whence they had emerged.

In vain I placed within their reach lumps of earth containing nests of the Anthophora, open cells, larvæ and nymphs of the Bee: nothing was able to tempt them; they persisted in forming, with the egg-skins, a powdery heap of speckled black and white. It was only by drawing the point of a needle through this pinch of living dust that I was able to provoke an active wriggling. Apart from this, all was still. If I forcibly removed a few larvæ from the common heap, they at once hurried back to it, in order to hide themselves among the rest. Perhaps they had less reason to fear the cold when thus collected and sheltered beneath the egg-skins. Whatever may be the motive that impels them to remain thus gathered in a heap, I recognized that none of the means suggested by my imagination succeeded in forcing them to abandon the little spongy mass formed by the skins of the eggs, which were slightly glued together. Lastly, to assure myself that the larvæ, in the free state, do not disperse after they are hatched, I went during the winter to Carpentras and inspected the banks inhabited by the Anthophoræ. There, as in my boxes, I found the larvæ piled into heaps, all mixed up with the skins of the eggs.

CHAPTER III
THE PRIMARY LARVA OF THE SITARES

Nothing new happens before the end of the following April. I shall profit by this long period of repose to tell you more about the young larva, of which I will begin by giving a description. Its length is a twenty-fifth of an inch, or a little less. It is hard as leather, a glossy greenish black, convex above and flat below, long and slender, with a diameter increasing gradually from the head to the hinder extremity of the metathorax, after which it rapidly diminishes. Its head is a trifle longer than it is wide and is slightly dilated at the base; it is pale-red near the mouth and darker about the ocelli.

The labrum forms a segment of a circle; it is reddish, edged with a small number of very short, stiff hairs. The mandibles are powerful, red-brown, curved and sharp; when at rest they meet without crossing. The maxillary palpi are rather long, consisting of two cylindrical sections of equal length, the outer ending in a very short bristle. The jaws and the lower lip are not sufficiently visible to lend themselves to accurate description.

The antennæ consist of two cylindrical segments, equal in length, not very definitely divided; these segments are nearly as long as those of the palpi; the outer is surmounted by a cirrus

whose length is as much as thrice that of the head and tapers off until it becomes invisible under a powerful pocket-lens. Behind the base of either antennæ are two ocelli, unequal in size and almost touching.

The thoracic segments are of equal length and increase gradually in width from front to back. The prothorax is wider than the head, but is narrower in front than at the base and is slightly rounded at the sides. The legs are of medium length and fairly robust, ending in a long, powerful, sharp and very mobile claw. On the haunch and thigh of each leg is a long cirrus, like that of the antennæ, almost as long as the whole limb and standing at right angles to the plane of locomotion when the creature moves. There are a few stiff bristles on the legs.

The abdomen has nine segments, of practically equal length, but shorter than those of the thorax and diminishing very rapidly in width toward the last. Fixed below the eighth segment, or rather below the strip of membrane separating this segment and the last, we see two spikes, slightly curved, short, but with strong, sharp, hard points, and placed one to the right and the other to the left of the median line. These two appendages are able, by means of a mechanism recalling, on a smaller scale, that of the Snail's horns, to withdraw into themselves, as a result of the membranous character of their base. They can also retreat under the eighth segment, borne, as they are, by the anal segment, when this last, as it contracts, withdraws into the eighth. Lastly, the ninth or anal segment bears on its hinder edge two long cirri,

like those of the legs and the antennæ, curving backwards from tip to base. At the rear of this segment a fleshy nipple appears, more or less prominent; this is the anus. I do not know where the stigmata are placed; they have evaded my investigations, though these were undertaken with the aid of the microscope.

When the larva is at rest, the various segments overlap evenly; and the membranous intervals, corresponding with the articulations, do not show. But, when the larva walks, all the articulations, especially those of the abdominal segments, are distended and end by occupying almost as much space as the horny arches. At the same time the anal segment emerges from the sheath formed by the eighth; the anus, in turn, is stretched into a nipple; and the two points of the penultimate ring rise, at first slowly, and then suddenly stand up with an abrupt motion similar to that of a spring when released. In the end, these two points diverge like the horns of a crescent. Once this complex apparatus is unfolded, the tiny creature is ready to crawl upon the most slippery surface.

The last segment and its anal button are curved at right angles to the axis of the body; and the anus comes and presses upon the surface of locomotion, where it ejects a tiny drop of transparent, treacly fluid, which glues and holds the little creature firmly in position, supported on a sort of tripod formed by the anal button and the two cirri of the last segment. If we are observing the animal's manner of locomotion on a strip of glass, we can hold the strip in a vertical position, or even turn it upside down, or

shake it lightly, without causing the larva to become detached and fall, held fast as it is by the glutinous secretion of the anal button.

If it has to proceed along a surface where there is no danger of a fall, the microscopic creature employs another method. It crooks its belly and, when the two spikes of the eighth segment, now fully outspread, have found a firm support by ploughing, so to speak, the surface of locomotion, it bears upon that base and pushes forward by expanding the various abdominal articulations. This forward movement is also assisted by the action of the legs, which are far from remaining inactive. This done, it casts anchor with the powerful claws of its feet; the abdomen contracts; the various segments draw together; and the anus, pulled forward, obtains a fresh purchase, with the aid of the two spikes, before beginning the second of these curious strides.

During these manoeuvres, the cirri of the flanks and thighs drag along the supporting surface and by their length and elasticity appear fitted only to impede progress. But let us not be in a hurry to conclude that we have discovered an inconsistency: the least of creatures is adapted to the conditions amid which it has to live; there is reason to believe that these filaments, far from hampering the pigmy's progress, must, in normal circumstances, be of some assistance to it.

Even the little that we have just learnt shows us that the young Sitaris-larva is not called upon to move on an ordinary surface. The spot, whatever it may be like, where this larva is to live later exposes it to the risk of many dangerous falls,

since, in order to prevent them, it is not only equipped with strong and extremely mobile talons and a steel-shod crescent, a sort of ploughshare capable of biting into the most highly polished substance, but is further provided with a viscous liquid, sufficiently tenacious and adhesive to hold it in position without the help of other appliances. In vain I racked my brains to guess what the substance might be, so shifting, so uncertain and so perilous, which the young Sitares are destined to inhabit; and I discovered nothing to explain the necessity for the structure which I have described. Convinced beforehand, by an attentive examination of this structure, that I should witness some peculiar habits, I waited with eager impatience for the return of the warm weather, never doubting that by dint of persevering observation the mystery would be disclosed to me next spring. At last this spring, so fervently desired, arrived; I brought to bear all the patience, all the imagination, all the insight and discernment that I may possess; but, to my utter shame and still greater regret, the secret escaped me. Oh, how painful are those tortures of indecision, when one has to postpone till the following year an investigation which has led to no result!

My observations made during the spring of 1856, although purely negative, nevertheless have an interest of their own, because they prove the inaccuracy of certain suppositions to which the undeniable parasitism of the Sitares naturally inclines us. I will therefore relate them in a few words. At the end of April, the young larvæ, hitherto motionless and concealed in the

spongy heap of the egg-skins, emerge from their immobility, scatter and run about in all directions through the boxes and jars in which they have passed the winter. By their hurried gait and their indefatigable evolutions we readily guess that they are seeking something which they lack. What can this something be, unless it be food? For remember that these larvæ were hatched at the end of September and that since then, that is to say, for seven long months, they have taken no nourishment, though they have spent this period in the full enjoyment of their vitality, as I was able to assure myself all through the winter by irritating them, and not in a state of torpor similar to that of the hibernating animals. From the moment of their hatching they are doomed, although full of life, to an absolute abstinence of seven months' duration; and it is natural to suppose, when we see their present excitement, that an imperious hunger sets them bustling in this fashion.

The desired nourishment could only be the contents of the cells of the Anthophora, since we afterwards find the Sitares in these cells. Now these contents are limited to honey or larvæ. It just happens that I have kept some Anthophora-cells occupied by larvæ or nymphs. I place a few of these, some open, some closed, within reach of the young Sitares, as I had already done directly after the hatching. I even slip the Sitares into the cells: I place them on the sides of the larva, a succulent morsel to all appearances; I do all sorts of things to tempt their appetite; and, after exhausting my ingenuity, which continues fruitless, I remain

convinced that my famished grubs are seeking neither the larvæ nor nymphs of the Anthophora.

Let us now try honey. We must obviously employ honey prepared by the same species of Anthophora as that at whose cost the Sitares live. But this Bee is not very common in the neighbourhood of Avignon; and my engagements at the college[12] do not allow me to absent myself for the purpose of repairing to Carpentras, where she is so abundant. In hunting for cells provisioned with honey I thus lose a good part of the month of May; however, I end by finding some which are newly sealed and which belong to the right Anthophora. I open these cells with the feverish impatience of a sorely-tried longing. All goes well: they are half-full of fluid, dark, nauseating honey, with the Bee's lately-hatched larva floating on the surface. This larva is removed; and taking a thousand precautions, I lay one or more Sitares on the surface of the honey. In other cells I leave the Bee's larva and insert Sitares, placing them sometimes on the honey and sometimes on the inner wall of the cell or simply at the entrance. Lastly, all the cells thus prepared are put in glass tubes, which enable me to observe them readily, without fear of disturbing my famished guests at their meal.

But what am I saying? Their meal? There is no meal! The Sitares, placed at the entrance to a cell, far from seeking to make their way in, leave it and go roaming about the glass tube;

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[12] Fabre, as a young man, was a master at Avignon College. Cf. *The Life of the Fly:* chaps. xii., xiii., xix. and xx. —*Translator's Note.*

those which have been placed on the inner surface of the cells, near the honey, emerge precipitately, half-caught in the glue and tripping at every step; lastly, those which I thought I had favoured the most, by placing them on the honey itself, struggle, become entangled in the sticky mass and perish in it, suffocated. Never did experiment break down so completely! Larvæ, nymphs, cells, honey: I have offered you them all! Then what do you want, you fiendish little creatures?

Tired of all these fruitless attempts, I ended where I ought to have begun: I went to Carpentras. But it was too late: the Anthophora had finished her work; and I did not succeed in seeing anything new. During the course of the year I learnt from Léon Dufour,[13] to whom I had spoken of the Sitares, that the tiny creature which he had found on the Andrenæ[14] and described under the generic name of Triungulinus, was recognized later by Newport[15] as the larva of a Meloe, or Oil-beetle. Now it so happened that I had found a few Oil-beetles in the cells of the

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[13] Jean Marie Léon Dufour (1780-1865), an army surgeon who served with distinction in several campaigns, and subsequently practised as a doctor in the Landes, where he attained great eminence as a naturalist. Fabre often refers to him as the Wizard of the Landes. Cf. *The Life of the Spider*, by J. Henri Fabre, translated by Alexander Teixeira de Mattos: chap. i.; and *The Life of the Fly:* chap. i. —*Translator's Note*.

[14] A genus of Burrowing Bee, the most numerous in species among the British Bees. —*Translator's Note*.

[15] George Newport (1803-1854), an English surgeon and naturalist, president of the Entomological Society from 1844 to 1845 and an expert in insect anatomy. —*Translator's Note*.

same Anthophora that nourishes the Sitares. Could there be a similarity of habits between the two kinds of insects? This idea threw a sudden light for me upon the subject; but I had plenty of time in which to mature my plans: I had another year to wait.

When April came, my Sitaris-larvæ began, as usual, to bestir themselves. The first Bee to appear, an Osmia, is dropped alive into a glass jar containing a few of these larvæ; and after a lapse of some fifteen minutes I inspect them through the pocket-lens. Five Sitares are embedded in the fleece of the thorax. It is done, the problem's solved! The larvæ of the Sitares, like those of the Oil-beetles, cling like grim death to the fleece of their generous host and make him carry them into the cell. Ten times over I repeat the experiment with the various Bees that come to plunder the lilac flowering outside my window and in particular with male Anthophoræ; the result is still the same: the larvæ embed themselves in the hair of the Bees' thorax. But after so many disappointments one becomes distrustful and it is better to go and observe the facts upon the spot; besides, the Easter holidays fall very conveniently and afford me the leisure for my observations.

I will admit that my heart was beating a little faster than usual when I found myself once again standing in front of the perpendicular bank in which the Anthophora nests. What will be the result of the experiment? Will it once more cover me with confusion? The weather is cold and rainy; not a Bee shows herself on the few spring flowers that have come out. Numbers of Anthophoræ cower, numbed and motionless, at the entrance

to the galleries. With the tweezers, I extract them one by one from their lurking-places, to examine them under the lens. The first has Sitaris-larvæ on her thorax; so has the second; the third and fourth likewise; and so on, as far as I care to pursue the examination. I change galleries ten times, twenty times; the result is invariable. Then, for me, occurred one of the moments which come to those who, after considering and reconsidering an idea for years and years from every point of view, are at last able to cry: "Eureka!"

On the days that followed, a serene and balmy sky enabled the Anthophoræ to leave their retreats and scatter over the countryside and despoil the flowers. I renewed my examination on those Anthophoræ flying incessantly from one flower to another, whether in the neighbourhood of the places where they were born or at great distances from these places. Some were without Sitaris-larvæ; others, more numerous, had two, three, four, five or more among the hairs of their thorax. At Avignon, where I have not yet seen *Sitaris humeralis*, the same species of Anthophora, observed at almost the same season, while pillaging the lilac-blossom, was always free of young Sitaris-grubs; at Carpentras, on the contrary, where there is not a single Anthophora-colony without Sitares, nearly three-quarters of the specimens which I examined carried a few of these larvæ in their fleece.

But, on the other hand, if we look for these larvæ in the entrance-lobbies where we found them, a few days ago, piled

up in heaps, we no longer see them. Consequently, when the Anthophoræ, having opened their cells, enter the galleries to reach the exit and fly away, or else when the bad weather and the darkness bring them back there for a time, the young Sitaris-larvæ, kept on the alert in these same galleries by the stimulus of instinct, attach themselves to the Bees, wriggling into their fur and clutching it so firmly that they need not fear a fall during the long journeys of the insect which carries them. By thus attaching themselves to the Anthophoræ the young Sitares evidently intend to get themselves carried, at the opportune moment, into the victualled cells.

One might even at first sight believe that they live for some time on the Anthophora's body, just as the ordinary parasites, the various species of Lice, live on the body of the animal that feeds them. But not at all. The young Sitares, embedded in the fleece, at right angles to the Anthophora's body, head inwards, rump outwards, do not stir from the point which they have selected, a point near the Bee's shoulders. We do not see them wandering from spot to spot, exploring the Anthophora's body, seeking the part where the skin is more delicate, as they would certainly do if they were really deriving some nourishment from the juices of the Bee. On the contrary, they are nearly always established on the toughest and hardest part of the Bee's body, on the thorax, a little below the insertion of the wings, or, more rarely, on the head; and they remain absolutely motionless, fixed to the same hair, by means of the mandibles, the feet, the closed crescent of

the eighth segment and, lastly, the glue of the anal button. If they chance to be disturbed in this position, they reluctantly repair to another point of the thorax, pushing their way through the insect's fur and in the end fastening on to another hair, as before.

To confirm my conviction that the young Sitaris-grubs do not feed on the Anthophora's body, I have sometimes placed within their reach, in a glass jar, some Bees that have long been dead and are completely dried up. On these dry corpses, fit at most for gnawing, but certainly containing nothing to suck, the Sitaris-larvæ took up their customary position and there remained motionless as on the living insect. They obtain nothing, therefore, from the Anthophora's body; but perhaps they nibble her fleece, even as the Bird-lice nibble the birds' feathers?

To do this, they would require mouth-parts endowed with a certain strength and, in particular, horny and sturdy jaws, whereas their jaws are so fine that a microscopic examination failed to show them to me. The larvæ, it is true, are provided with powerful mandibles; but these finely-pointed mandibles, with their backward curve, though excellent for tugging at food and tearing it to pieces, are useless for grinding it or gnawing it. Lastly, we have a final proof of the passive condition of the Sitaris-larvæ on the body of the Anthophoræ in the fact that the Bees do not appear to be in any way incommoded by their presence, since we do not see them trying to rid themselves of the grubs. Some Anthophoræ which were free from these grubs and some others which were carrying five or six upon their bodies

were placed separately in glass jars. When the first disturbance resulting from their captivity was appeased, I could see nothing peculiar about those occupied by the young Sitares. And, if all these arguments were not sufficient, I might add that a creature which has already been able to spend seven months without food and which in a few days' time will proceed to drink a highly-flavoured fluid would be guilty of a singular inconsistency if it were to start nibbling the dry fleece of a Bee. It therefore seems to me undeniable that the young Sitares settle on the Anthophora's body merely to make her carry them into the cells which she will soon be building.

But until then the future parasites must hold tight to the fleece of their hostess, despite her rapid evolutions among the flowers, despite her rubbing against the walls of the galleries when she enters to take shelter and, above all, despite the brushing which she must often give herself with her feet to dust herself and keep spick and span. Hence no doubt the need for that curious apparatus which no standing or moving upon ordinary surfaces could explain, as was said above, when we were wondering what the shifting, swaying, dangerous body might be on which the larva would have to establish itself later. This body is a hair of a Bee who makes a thousand rapid journeys, now diving into her narrow galleries, now forcing her way down the tight throat of a corolla, and who never rests except to brush herself with her feet and remove the specks of dust collected by the down which covers her.

We can now easily understand the use of the projecting crescent whose two horns, by closing together, are able to take hold of a hair more easily than the most delicate tweezers; we perceive the full value of the tenacious adhesive provided by the anus to save the tiny creature, at the least sign of danger, from an imminent fall; we realize lastly the useful function that may be fulfilled by the elastic cirri of the flanks and legs, which are an absolute and most embarrassing superfluity when walking upon a smooth surface, but which, in the present case, penetrate like so many probes into the thickness of the Anthophora's down and serve as it were to anchor the Sitaris-larva in position. The more we consider this arrangement, which seems modelled by a blind caprice so long as the grub drags itself laboriously over a smooth surface, the more do we marvel at the means, as effective as they are varied, which are lavished upon this fragile creature to help it to preserve its unstable equilibrium.

Before I describe what becomes of the Sitaris-grubs on leaving the body of the Anthophoræ, I must not omit to mention one very remarkable peculiarity. All the Bees invaded by these grubs that have hitherto been observed have, without one exception, been male Anthophoræ. Those whom I drew from their lurking-places were males; those whom I caught upon the flowers were males; and, in spite of the most active search, I failed to find a single female at liberty. The cause of this total absence of females is easy to understand.

If we remove a few clods from the area occupied by the

nests, we see that, though all the males have already opened and abandoned their cells, the females, on the contrary, are still enclosed in theirs, but on the point of soon taking flight. This appearance of the males almost a month before the emergence of the females is not peculiar to the Anthophoræ; I have observed it in many other Bees and particularly in the Three-horned Osmia (*O. tricornis*), who inhabits the same site as the Hairy-footed Anthophora (*A. pilipes*). The males of the Osmia make their appearance even before those of the Anthophora and at so early a season that the young Sitaris-larvæ are perhaps not yet aroused by the instinctive impulse which urges them to activity. It is no doubt to their precocious awakening that the males of the Osmia owe their ability to traverse with impunity the corridors in which the young Sitaris-grubs are heaped together, without having the latter fasten to their fleece; at least, I cannot otherwise explain the absence of these larvæ from the backs of the male Osmiæ, since, when we place them artificially in the presence of these Bees, they fasten on them as readily as on the Anthophoræ.

The emergence from the common site begun by the male Osmiæ is continued by the male Anthophoræ and ends with the almost simultaneous emergence of the female Osmiæ and Anthophoræ. I was easily able to verify this sequence by observing at my own place, in the early spring, the dates at which the cells, collected during the previous autumn, were broken.

At the moment of their emergence, the male Anthophoræ, passing through the galleries in which the Sitaris-larvæ are

waiting on the alert, must pick up a certain number of them; and those among them who, by entering empty corridors, escape the enemy on this first occasion will not evade him for long, for the rain, the chilly air and the darkness bring them back to their former homes, where they take shelter now in one gallery, now in another, during a great part of April. This constant traffic of the males in the entrance-lobbies of their houses and the prolonged stay which the bad weather often compels them to make provide the Sitares with the most favourable opportunity for slipping into the Bees' fur and taking up their position. Moreover, when this state of affairs has lasted a month or so, there can be only very few if any larvæ left wandering about without having attained their end. At that period I was unable to find them anywhere save on the body of the male Anthophora.

It is therefore extremely probable that, on their emergence, which takes place as May draws near, the female Anthophoræ do not pick up Sitaris-larvæ in the corridors, or pick up only a number which will not compare with that carried by the males. In fact, the first females that I was able to observe in April, in the actual neighbourhood of the nests, were free from these larvæ. Nevertheless it is upon the females that the Sitaris-larvæ must finally establish themselves, for the males upon whom they now are cannot introduce them into the cells, since they take no part in the building or provisioning. There is therefore, at a given moment, a transfer of Sitaris-larvæ from the male Anthophoræ to the females; and this transfer is, beyond a doubt, effected during

the union of the sexes. The female finds in the male's embraces both life and death for her offspring; at the moment when she surrenders herself to the male for the preservation of her race, the vigilant parasites pass from the male to the female, with the extermination of that same race in view.

In support of these deductions, here is a fairly conclusive experiment, though it reproduces the natural circumstances but roughly. On a female taken in her cell and therefore free from Sitares, I place a male who is infested with them; and I keep the two sexes in contact, suppressing their unruly movements as far as I am able. After fifteen or twenty minutes of this enforced proximity, the female is invaded by one or more of the larvæ which at first were on the male. True, experiment does not always succeed under these imperfect conditions.

By watching at Avignon the few Anthophoræ that I succeeded in discovering, I was able to detect the precise moment of their work; and on the following Thursday,[16] the 21st of May, I repaired in all haste to Carpentras, to witness, if possible, the entrance of the Sitares into the Bee's cells. I was not mistaken: the works were in full swing.

In front of a high expanse of earth, a swarm stimulated by the sun, which floods it with light and heat, is dancing a crazy ballet. It is a hover of Anthophoræ, a few feet thick and covering an area which matches the sort of house-front formed by the perpendicular soil. From the tumultuous heart of the cloud rises

[16] Thursday is the weekly holiday in French schools. —*Translator's Note.*

a monotonous, threatening murmur, while the bewildered eye strays through the inextricable evolutions of the eager throng. With the rapidity of a lightning-flash thousands of Anthophoræ are incessantly flying off and scattering over the country-side in search of booty; thousands of others also are incessantly arriving, laden with honey or mortar, and keeping up the formidable proportions of the swarm.

I was at that time something of a novice as regards the nature of these insects:

"Woe," said I to myself, "woe to the reckless wight bold enough to enter the heart of this swarm and, above all, to lay a rash hand upon the dwellings under construction! Forthwith surrounded by the furious host, he would expiate his rash attempt, stabbed by a thousand stings!"

At this thought, rendered still more alarming by the recollection of certain misadventures of which I had been the victim when seeking to observe too closely the combs of the Hornet (*Vespa crabro*), I felt a shiver of apprehension pass through my body.

Yet, to obtain light upon the question which brings me hither, I must needs penetrate the fearsome swarm; I must stand for whole hours, perhaps all day, watching the works which I intend to upset; lens in hand, I must scrutinize, unmoved amid the whirl, the things that are happening in the cells. The use moreover of a mask, of gloves, of a covering of any kind is impracticable, for utter dexterity of the fingers and complete liberty of sight

are essential to the investigations which I have to make. No matter: even though I leave this wasps'-nest with a face swollen beyond recognition, I must to-day obtain a decisive solution of the problem which has preoccupied me too long.

A few strokes of the net, aimed, beyond the limits of the swarm, at the Anthophoræ on their way to the harvest or returning, soon informed me that the Sitaris-larvæ are perched on the thorax, as I expected, occupying the same position as on the males. The circumstances therefore could not be more favourable. We will inspect the cells without further delay.

My preparations are made at once: I button my clothes tightly, so as to afford the Bees the least possible opportunity, and I enter the heart of the swarm. A few blows of the mattock, which arouse a far from reassuring crescendo in the humming of the Anthophoræ, soon place me in possession of a lump of earth; and I beat a hasty retreat, greatly astonished to find myself still safe and sound and unpursued. But the lump of earth which I have removed is from a part too near the surface; it contains nothing but Osmia-cells, which do not interest me for the moment. A second expedition is made, lasting longer than the first; and, though my retreat is effected without great precipitation, not an Anthophora has touched me with her sting, nor even shown herself disposed to fall upon the aggressor.

This success emboldens me. I remain permanently in front of the work in progress, continually removing lumps of earth filled with cells, spilling the liquid honey on the ground, eviscerating

larvæ and crushing the Bees busily occupied in their nests. All this devastation results merely in arousing a louder hum in the swarm and is not followed by any hostile demonstration. The Anthophoræ whose cells are not hurt go about their labours as if nothing unusual were happening round about them; those whose dwellings are overturned try to repair them, or hover distractedly in front of the ruins; but none of them seems inclined to swoop down upon the author of the damage. At most, a few, more irritated than the rest, come at intervals and hover before my face, confronting me at a distance of a couple of inches, and then fly away, after a few moments of this curious inspection.

Despite the selection of a common site for their nests, which might suggest an attempt at communistic interests among the Anthophoræ, these Bees, therefore, obey the egotistical law of each one for himself and do not know how to band themselves together to repel an enemy who threatens one and all. Taken singly, the Anthophora does not even know how to dash at the enemy who is ravaging her cells and drive him away with her stings; the pacific creature hastily leaves its dwelling when disturbed by undermining and escapes in a crippled state, sometimes even mortally wounded, without thinking of making use of its venomous sting, except when it is seized and handled. Many other Hymenoptera, honey-gatherers or hunters, are quite as spiritless; and I can assert to-day, after a long experience, that only the Social Hymenoptera, the Hive-bees, the Common Wasps and the Bumble-bees, know how to devise a common

defence; and only they dare fall singly upon the aggressor, to wreak an individual vengeance.

Thanks to this unexpected lack of spirit in the Mason-bee, I was able for hours to pursue my investigations at my leisure, seated on a stone in the midst of the murmuring and distracted swarm, without receiving a single sting, though I took no precautions whatever. Country-folk, happening to pass and beholding me seated, unperturbed, in the midst of the whirl of Bees, stopped aghast to ask me whether I had bewitched them, whether I charmed them, since I appeared to have nothing to fear from them:

"Mé, moun bel ami, li-z-avé doun escounjurado què vous pougnioun pas, canèu de sort!"

My miscellaneous impedimenta spread over the ground, boxes, glass jars and tubes, tweezers and magnifying-glasses, were certainly regarded by these good people as the implements of my wizardry.

We will now proceed to examine the cells. Some are still open and contain only a more or less complete store of honey. Others are hermetically sealed with an earthen lid. The contents of these latter vary greatly. Sometimes we find the larva of a Bee which has finished its mess or is on the point of finishing it; sometimes a larva, white like the first, but more corpulent and of a different shape; at other times honey with an egg floating on the surface. The honey is liquid and sticky, with a brownish colour and a very strong, repulsive smell. The egg is of a beautiful white, cylindrical

in shape, slightly curved into an arc, a fifth or a sixth of an inch in length and not quite a twenty-fifth of an inch in thickness; it is the egg of the Anthophora.

In a few cells this egg is floating all alone on the surface of the honey; in others, very numerous these, we see, lying on the egg of the Anthophora, as on a sort of raft, a young Sitaris-grub with the shape and the dimensions which I have described above, that is to say, with the shape and the dimensions which the creature possesses on leaving the egg. This is the enemy within the gates.

When and how did it get in? In none of the cells where I have observed it was I able to distinguish a fissure which could have allowed it to enter; they are all sealed in a quite irreproachable manner. The parasite therefore established itself in the honey-warehouse before the warehouse was closed; on the other hand, the open cells, full of honey, but as yet without the egg of the Anthophora, are always free from parasites. It is therefore during the laying, or afterwards, when the Anthophora is occupied in plastering the door of the cell, that the young larva gains admittance. It is impossible to decide by experiment to which of these two periods we must ascribe the introduction of the Sitares into the cell; for, however peaceable the Anthophora may be, it is evident that we cannot hope to witness what happens in the cell at the moment when she is laying an egg or at the moment when she is making the lid. But a few attempts will soon convince us that the only second which would allow the Sitaris to establish itself in the home of the Bee is the very second when the egg is

laid on the surface of the honey.

Let us take an Anthophora-cell full of honey and furnished with an egg and, after removing the lid, place it in a glass tube with a few Sitaris-grubs. The grubs do not appear at all eager for this wealth of nectar placed within their reach; they wander at random about the tube, run about the outside of the cell, sometimes happen upon the edge of the orifice and very rarely venture inside. When they do, they do not go far in and they come out again at once. If one happens to reach the honey, which only half fills the cell, it tries to escape as soon as it has perceived the shifting nature of the sticky soil upon which it was about to enter; but, tottering at every step, because of the viscous matter clinging to its feet, it often ends by falling back into the honey, where it dies of suffocation.

Again, we may experiment as follows: having prepared a cell as before, we place a larva most carefully on its inner wall, or else on the surface of the food itself. In the first case, the larva hastens to leave the cell; in the second case, it struggles awhile on the surface of the honey and ends by getting so completely caught that, after a thousand efforts to gain the shore, it is swallowed up in the viscous lake.

In short, all attempts to establish the Sitaris-grub in an Anthophora-cell provisioned with honey and furnished with an egg are no more successful than those which I made with cells whose store of food had already been broached by the larva of the Bee, as described above. It is therefore certain that the Sitaris-

grub does not leave the fleece of the Mason-bee when the Bee is in her cell or at the entrance to it, in order itself to make a rush for the coveted honey; for this honey would inevitably cause its death, if it happened by accident to touch the perilous surface merely with the tip of its tarsi.

Since we cannot admit that the Sitaris-grub leaves the furry corselet of its hostess to slip unseen into the cell, whose orifice is not yet wholly walled up, at the moment when the Anthophora is building her door, all that remains to investigate is the second at which the egg is being laid. Remember in the first place that the young Sitaris which we find in a closed cell is always placed on the egg of the Bee. We shall see in a minute that this egg not merely serves as a raft for the tiny creature floating on a very treacherous lake, but also constitutes the first and indispensable part of its diet. To get at this egg, situated in the centre of the lake of honey, to reach, at all costs, this raft, which is also its first ration, the young larva evidently possesses some means of avoiding the fatal contact of the honey; and this means can be provided only by the actions of the Bee herself.

In the second place, observations repeated *ad nauseam* have shown me that at no period do we find in each invaded cell more than a single Sitaris, in one or other of the forms which it successively assumes. Yet there are several young larvæ established in the silky tangle of the Bee's thorax, all eagerly watching for the propitious moment at which to enter the dwelling in which they are to continue their development. How

then does it happen that these larvæ, goaded by such an appetite as one would expect after seven or eight months' complete abstinence, instead of all rushing together into the first cell within reach, on the contrary enter the various cells which the Bee is provisioning one at a time and in perfect order? Some action must take place here independent of the Sitares.

To satisfy those two indispensable conditions, the arrival of the larva upon the egg without crossing the honey and the introduction of a single larva among all those waiting in the fleece of the Bee, there can be only one explanation, which is to suppose that, at the moment when the Anthophora's egg is half out of the oviduct, one of the Sitares which have hastened from the thorax to the tip of the abdomen, one more highly favoured by its position, instantly settles upon the egg, a bridge too narrow for two, and with it reaches the surface of the honey. The impossibility of otherwise fulfilling the two conditions which I have stated gives to the explanation which I am offering a degree of certainty almost equivalent to that which would be furnished by direct observation, which is here, unfortunately, impracticable. This presupposes, it is true, in the microscopic little creature destined to live in a place where so many dangers threaten it from the first, an astonishingly rational inspiration, which adapts the means to the end with amazing logic. But is not this the invariable conclusion to which the study of instinct always leads us?

When dropping her egg upon the honey, therefore, the

Anthophora at the same time deposits in her cell the mortal enemy of her race; she carefully plasters the lid which closes the entrance to the cell; and all is done. A second cell is built beside it, probably to suffer the same fatal doom; and so on until the more or less numerous parasites sheltered by her down are all accommodated. Let us leave the unhappy mother to continue her fruitless task and turn our attention to the young larva which has so adroitly secured itself board and lodging.

In opening cells whose lid is still moist, we end by discovering one in which the egg, recently laid, supports a young Sitaris. This egg is intact and in irreproachable condition. But now the work of devastation begins: the larva, a tiny black speck which we see running over the white surface of the egg, at last stops and balances itself firmly on its six legs; then, seizing the delicate skin of the egg with the sharp hooks of its mandibles, it tugs at it violently until it breaks, spilling its contents, which the larva eagerly drinks up. Thus the first stroke of the mandibles which the parasite delivers in the usurped cell is aimed at the destruction of the Bee's egg. A highly logical precaution! The Sitaris-larva, as we shall see, has to feed upon the honey in the cell; the Anthophora-larva which would proceed from that egg would require the same food; but the portion is too small for two; so, quick, a bite at the egg and the difficulty will be removed. The story of these facts calls for no comment. This destruction of the cumbersome egg is all the more inevitable inasmuch as special tastes compel the young Sitaris-grub to make its first meals of

it. Indeed we see the tiny creature begin by greedily drinking the juices which the torn wrapper of the egg allows to escape; and for several days it may be observed, at one time motionless on this envelope, in which it rummages at intervals with its head, at others running over it from end to end to rip it open still wider and to cause a little of the juices, which become daily less abundant, to trickle from it; but we never catch it imbibing the honey which surrounds it on every side.

For that matter, it is easy to convince ourselves that the egg combines with the function of a life-buoy that of the first ration. I have laid on the surface of the honey in a cell a tiny strip of paper, of the same dimensions as the egg; and on this raft I have placed a Sitaris-larva. Despite every care, my attempts, many times repeated, always failed. The larva, placed in a paper boat in the centre of the mass of honey, behaves as in the earlier experiments. Not finding what suits it, it tries to escape and perishes in the sticky toils as soon as it leaves the strip of paper, which it soon does.

On the other hand, we can easily rear Sitaris-grubs by taking Anthophora-cells not invaded by the parasites, cells in which the egg is not yet hatched. All that we have to do is to pick up one of these grubs with the moistened tip of a needle and to lay it delicately on the egg. There is then no longer the least attempt to escape. After exploring the egg to find its way about, the larva rips it open and for several days does not stir from the spot. Henceforth its development takes place unhindered,

provided that the cell be protected from too rapid evaporation, which would dry up the honey and render it unfit for the grub's food. The Anthophora's egg therefore is absolutely necessary to the Sitaris-larva, not merely as a boat, but also as its first nourishment. This is the whole secret, for lack of knowing which I had hitherto failed in my attempts to rear the larvæ hatched in my glass jars.

At the end of a week, the egg, drained by the parasite, is nothing but a dry skin. The first meal is finished. The Sitaris-larva, whose dimensions have almost doubled, now splits open along the back; and through a slit which comprises the head and the three thoracic segments a white corpusculum, the second form of this singular organism, escapes to fall on the surface of the honey, while the abandoned slough remains clinging to the raft which has hitherto safeguarded and fed the larva. Presently both sloughs, those of the Sitaris and the egg, will disappear, submerged under the waves of honey which the new larva is about to raise. Here ends the history of the first form adopted by the Sitaris.

In summing up the above, we see that the strange little creature awaits, without food, for seven months, the appearance of the Anthophoræ and at last fastens on to the hairs on the corselet of the males, who are the first to emerge and who inevitably pass within its reach in going through their corridors. From the fleece of the male the larva moves, three or four weeks later, to that of the female, at the moment of coupling; and then from the female

to the egg leaving the oviduct. It is by this concatenation of complex manoeuvres that the larva in the end finds itself perched upon an egg in the middle of a closed cell filled with honey. These perilous gymnastics on the hair of a Bee in movement all the day, this passing from one sex to the other, this arrival in the middle of the cell by way of the egg, a dangerous bridge thrown across the sticky abyss, all this necessitates the balancing-appliances with which it is provided and which I have described above. Lastly, the destruction of the egg calls, in its turn, for a sharp pair of scissors; and such is the object of the keen, curved mandibles. Thus the primary form of the Sitares has as its function to get itself carried by the Anthophora into the cell and to rip up her egg. This done, the organism becomes transformed to such a degree that repeated observations are required to make us believe the evidence of our eyes.

CHAPTER IV
THE PRIMARY LARVA OF THE OIL-BEETLES

I interrupt the history of the Sitares to speak of the Meloes, those uncouth Beetles, with their clumsy belly and their limp wing-cases yawning over their back like the tails of a fat man's coat that is far too tight for its wearer. The insect is ugly in colouring, which is black, with an occasional blue gleam, and uglier still in shape and gait; and its disgusting method of defence increases the repugnance with which it inspires us. If it judges itself to be in danger, the Meloe resorts to spontaneous bleeding. From its joints a yellowish, oily fluid oozes, which stains your fingers and makes them stink. This is the creature's blood. The English, because of its trick of discharging oily blood when on the defensive, call this insect the Oil-beetle. It would not be a particularly interesting Beetle save for its metamorphoses and the peregrinations of its larva, which are similar in every respect to those of the larva of the Sitares. In their first form, the Oil-beetles are parasites of the Anthophoræ; their tiny grub, when it leaves the egg, has itself carried into the cell by the Bee whose victuals are to form its food.

Observed in the down of various Bees, the queer little creature for a long time baffled the sagacity of the naturalists,

who, mistaking its true origin, made it a species of a special family of wingless insects. It was the Bee-louse (*Pediculus apis*) of Linnæus;[17] the Triungulin of the Andrenæ (*Triungulinus andrenetarum*) of Léon Dufour. They saw in it a parasite, a sort of Louse, living in the fleece of the honey-gatherers. It was reserved for the distinguished English naturalist Newport to show that this supposed Louse was the first state of the Oil-beetles. Some observations of my own will fill a few lacunæ in the English scientist's monograph. I will therefore sketch the evolution of the Oil-beetles, using Newport's work where my own observations are defective. In this way the Sitares and the Meloes, alike in habits and transformations, will be compared; and the comparison will throw a certain light upon the strange metamorphoses of these insects.

The same Mason-bee (*Anthophora pilipes*) upon whom the Sitares live also feeds a few scarce Meloes (*M. cicatricosus*) in its cells. A second Anthophora of my district (*A. parietina*) is more subject to this parasite's invasions. It was also in the nests of an Anthophora, but of a different species (*A. retusa*), that Newport observed the same Oil-beetle. These three lodgings adopted by *Meloe cicatricosus* may be of some slight interest, as leading us to suspect that each species of Meloe is apparently the parasite of diverse Bees, a suspicion which will be confirmed when we examine the manner in which the larvæ reach the cell full of

[17] Carolus Linnæus (Karl von Linné, 1707-1778), the celebrated Swedish botanist and naturalist, founder of the Linnæan system of classification. —*Translator's Note.*

honey. The Sitares, though less given to change of lodging, are likewise able to inhabit nests of different species. They are very common in the cells of *Anthophora pilipes;* but I have found them also, in very small numbers, it is true, in the cells of *A. personata*.

Despite the presence of *Meloe cicatricosus* in the dwellings of the Mason-bee, which I so often ransacked in compiling the history of the Sitares, I never saw this insect, at any season of the year, wandering on the perpendicular soil, at the entrance of the corridors, for the purpose of laying its eggs there, as the Sitares do; and I should know nothing of the details of the egg-laying if Godart,[18] de Geer[19] and, above all, Newport had not informed us that the Oil-beetles lay their eggs in the earth. According to the last-named author, the various Oil-beetles whom he had the opportunity of observing dig, among the roots of a clump of grass, in a dry soil exposed to the sun, a hole a couple of inches deep which they carefully fill up after laying their eggs there in a heap. This laying is repeated three or four times over, at intervals of a few days during the same season. For each batch of eggs the female digs a special hole, which she does not fail to fill up afterwards. This takes place in April and May.

The number of eggs laid in a single batch is really prodigious. In the first batch, which, it is true, is the most prolific of

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[18] Jean Baptiste Godart (1775-1823), the principal editor of *L'Histoire naturelle des lépidoptères de France*. —*Translator's Note*.

[19] Baron Karl de Geer (1720-1778), the Swedish entomologist, author of *Mémoires pour servir à l'histoire des insectes* (1752-1778). —*Translator's Note*.

all, *Meloe proscarabæus*, according to Newport's calculations, produces the astonishing number of 4,218 eggs, which is double the number of eggs laid by a Sitaris. And what must the number be, when we allow for the two or three batches that follow the first! The Sitares, entrusting their eggs to the very corridors through which the Anthophora is bound to pass, spare their larvæ a host of dangers which the larvæ of the Meloe have to run, for these, born far from the dwellings of the Bees, are obliged to make their own way to their hymenopterous foster-parents. The Oil-beetles, therefore, lacking the instinct of the Sitares, are endowed with incomparably greater fecundity. The richness of their ovaries atones for the insufficiency of instinct by proportioning the number of germs in accordance with the risks of destruction. What transcendent harmony is this, which thus holds the scales between the fecundity of the ovaries and the perfection of instinct!

The hatching of the eggs takes place at the end of May or in June, about a month after they are laid. The eggs of the Sitares also are hatched after the same lapse of time. But the Meloe-larvæ, more greatly favoured, are able to set off immediately in search of the Bees that are to feed them; while those of the Sitares, hatched in September, have to wait motionless and in complete abstinence for the emergence of the Anthophoræ the entrance to whose cells they guard. I will not describe the young Meloe-larva, which is sufficiently well known, in particular by the description and the diagram furnished by Newport. To enable

the reader to understand what follows, I will confine myself to stating that this primary larva is a sort of little yellow louse, long and slender, found in the spring in the down of different Bees.

How has this tiny creature made its way from the underground lodging where the eggs are hatched to the fleece of a Bee? Newport suspects that the young Oil-beetles, on emerging from their natal burrow, climb upon the neighbouring plants, especially upon the Cichoriceæ, and wait, concealed among the petals, until a few Bees chance to plunder the flower, when they promptly fasten on to their fur and allow themselves to be borne away by them. I have more than Newport's suspicions upon this curious point; my personal observations and experiments are absolutely convincing. I will relate them as the first phase of the history of the Bee-louse. They date back to the 23rd of May, 1858.

A vertical bank on the road from Carpentras to Bédoin is this time the scene of my observations. This bank, baked by the sun, is exploited by numerous swarms of Anthophoræ, who, more industrious than their congeners, are in the habit of building, at the entrance to their corridors, with serpentine fillets of earth, a vestibule, a defensive bastion in the form of an arched cylinder. In a word, they are swarms of *A. parietina*. A sparse carpet of turf extends from the edge of the road to the foot of the bank. The more comfortably to follow the work of the Bees, in the hope of wresting some secret from them, I had been lying for a few moments upon this turf, in the very heart of the inoffensive

swarm, when my clothes were invaded by legions of little yellow lice, running with desperate eagerness through the hairy thickets of the nap of the cloth. In these tiny creatures, with which I was powdered here and there as with yellow dust, I soon recognized an old acquaintance, the young Oil-beetles, whom I now saw for the first time elsewhere than in the Bees' fur or the interior of their cells. I could not lose so excellent an opportunity of learning how these larvæ manage to establish themselves upon the bodies of their foster-parents.

In the grass where, after lying down for a moment, I had caught these lice were a few plants in blossom, of which the most abundant were three composites: *Hedypnois polymorpha*, *Senecio gallicus* and *Anthemis arvensis*. Now it was on a composite, a dandelion, that Newport seemed to remember seeing some young Oil-beetles; and my attention therefore was first of all directed to the plants which I have named. To my great satisfaction, nearly all the flowers of these three plants, especially those of the camomile (*Anthemis*) were occupied by young Oil-beetles in greater or lesser numbers. On one head of camomile I counted forty of these tiny insects, cowering motionless in the centre of the florets. On the other hand, I could not discover any on the flowers of the poppy or of a wild rocket (*Diplotaxis muralis*) which grew promiscuously among the plants aforesaid. It seems to me, therefore, that it is only on the composite flowers that the Meloe-larvæ await the Bees' arrival.

In addition to this population encamped upon the heads of the

composites and remaining motionless, as though it had achieved its object for the moment, I soon discovered yet another, far more numerous, whose anxious activity betrayed a fruitless search. On the ground, in the grass, numberless little larvæ were running in a great flutter, recalling in some respects the tumultuous disorder of an overturned Ant-hill; others were hurriedly climbing to the tip of a blade of grass and descending with the same haste; others again were plunging into the downy fluff of the withered everlastings, remaining there a moment and quickly reappearing to continue their search. Lastly, with a little attention, I was able to convince myself that within an area of a dozen square yards there was perhaps not a single blade of grass which was not explored by several of these larvæ.

I was evidently witnessing the recent emergence of the young Oil-beetles from their maternal lairs. Part of them had already settled on the groundsel- and camomile-flowers to await the arrival of the Bees; but the majority were still wandering in search of this provisional refuge. It was by this wandering population that I had been invaded when I lay down at the foot of the bank. It was impossible that all these larvæ, the tale of whose alarming thousands I would not venture to define, should form one family and recognize a common mother; despite what Newport has told us of the Oil-beetles' astonishing fecundity, I could not believe this, so great was their multitude.

Though the green carpet was continued for a considerable distance along the side of the road, I could not detect a single

Meloe-larva elsewhere than in the few square yards lying in front of the bank inhabited by the Mason-bee. These larvæ therefore could not have come far; to find themselves near the Anthophoræ they had had no long pilgrimage to make, for there was not a sign of the inevitable stragglers and laggards that follow in the wake of a travelling caravan. The burrows in which the eggs were hatched were therefore in that turf opposite the Bees' abode. Thus the Oil-beetles, far from laying their eggs at random, as their wandering life might lead one to suppose, and leaving their young to the task of approaching their future home, are able to recognize the spots haunted by the Anthophoræ and lay their eggs in the near neighbourhood of those spots.

With such a multitude of parasites occupying the composite flowers in close proximity to the Anthophora's nests, it is impossible that the majority of the swarm should not become infested sooner or later. At the time of my observations, a comparatively tiny proportion of the starving legion was waiting on the flowers; the others were still wandering on the ground, where the Anthophoræ very rarely alight; and yet I detected the presence of several Meloe-larvæ in the thoracic down of nearly all the Anthophoræ which I caught and examined.

I have also found them on the bodies of the Melecta- and Coelioxys-bees,[20] who are parasitic on the Anthophoræ. Suspending their audacious patrolling before the galleries under construction, these spoilers of the victualled cells alight for an

[20] Cf. *The Mason-bees:* chaps. viii. and ix. —*Translator's Note.*

instant on a camomile-flower and lo, the thief is robbed! A tiny, imperceptible louse has slipped into the thick of the downy fur and, at the moment when the parasite, after destroying the Anthophora's egg, is laying her own upon the stolen honey, will creep upon this egg, destroy it in its turn and remain sole mistress of the provisions. The mess of honey amassed by the Anthophora will thus pass through the hands of three owners and remain finally the property of the weakest of the three.

And who shall say whether the Meloe, in its turn, will not be dispossessed by a fresh thief; or even whether it will not, in the state of a drowsy, fat and flabby larva, fall a prey to some marauder who will munch its live entrails? As we meditate upon this deadly, implacable struggle which nature imposes, for their preservation, on these different creatures, which are by turns possessors and dispossessed, devourers and devoured, a painful impression mingles with the wonder aroused by the means employed by each parasite to attain its end; and, forgetting for a moment the tiny world in which these things happen, we are seized with terror at this concatenation of larceny, cunning and brigandage which forms part, alas, of the designs of *alma parens rerum!*

The young Meloe-larvæ established in the down of the Anthophoræ or in that of the Melecta- and the Coelioxys-bees, their parasites, had adopted an infallible means of sooner or later reaching the desired cell. Was it, so far as they were concerned, a choice dictated by the foresight of instinct, or just simply

the result of a lucky chance? The question was soon decided. Various Flies – Drone-flies and Bluebottles (*Eristalis tenax* and *Calliphora vomitoria*) – would settle from time to time on the groundsel- or camomile-flowers occupied by the young Meloes and stop for a moment to suck the sweet secretions. On all these Flies, with very few exceptions, I found Meloe-larvæ, motionless in the silky down of the thorax. I may also mention, as infested by these larvæ, an Ammophila (*A. hirsuta*),[21] who victuals her burrows with a caterpillar in early spring, while her kinswomen build their nests in autumn. This Wasp merely grazes, so to speak, the surface of a flower; I catch her; there are Meloes moving about her body. It is clear that neither the Drone-flies nor the Bluebottles, whose larvæ live in putrefying matter, nor yet the Ammophilæ who victual theirs with caterpillars, could ever have carried the larvæ which invaded them into cells filled with honey. These larvæ therefore had gone astray; and instinct, as does not often happen, was here at fault.

Let us now turn our attention to the young Meloes waiting expectant upon the camomile-flowers. There they are, ten, fifteen or more, lodged half-way down the florets of a single blossom or in their interstices; it therefore needs a certain degree of scrutiny to perceive them, their hiding-place being the more effectual in that the amber colour of their bodies merges in the

[21] For the Wasp known as the Hairy Ammophila, who feeds her young on the Grey Worm, the caterpillar of the Turnip Moth, cf. *The Hunting Wasps*, chaps. xviii. to xx. —*Translator's Note*.

yellow hue of the florets. So long as nothing unusual happens upon the flower, so long as no sudden shock announces the arrival of a strange visitor, the Meloes remain absolutely motionless and give no sign of life. To see them dipping vertically, head downwards, into the florets, one might suppose that they were seeking some sweet liquid, their food; but in that case they ought to pass more frequently from one floret to another, which they do not, except when, after a false alarm, they regain their hiding-places and choose the spot which seems to them the most favourable. This immobility means that the florets of the camomile serve them only as a place of ambush, even as later the Anthophora's body will serve them solely as a vehicle to convey them to the Bee's cell. They take no nourishment, either on the flowers or on the Bees; and, as with the Sitares, their first meal will consist of the Anthophora's egg, which the hooks of their mandibles are intended to rip open.

Their immobility is, as we have said, complete; but nothing is easier than to arouse their suspended activity. Shake a camomile-blossom lightly with a bit of straw: instantly the Meloes leave their hiding-places, come up and scatter in all directions on the white petals of the circumference, running over them from one end to the other with all the speed which the smallness of their size permits. On reaching the extreme end of the petals, they fasten to it either with their caudal appendages, or perhaps with a sticky substance similar to that furnished by the anal button of the Sitares; and, with their bodies hanging outside and their six

legs free, they bend about in every direction and stretch as far out as they can, as though striving to touch an object out of their reach. If nothing offers for them to seize upon, after a few vain attempts they regain the centre of the flower and soon resume their immobility.

But, if we place near them any object whatever, they do not fail to catch on to it with surprising agility. A blade of grass, a bit of straw, the handle of my tweezers which I hold out to them: they accept anything in their eagerness to quit the provisional shelter of the flower. It is true that, after finding themselves on these inanimate objects, they soon recognize that they have gone astray, as we see by their bustling movements to and fro and their tendency to go back to the flower if there still be time. Those which have thus giddily flung themselves upon a bit of straw and are allowed to return to their flower do not readily fall a second time into the same trap. There is therefore, in these animated specks, a memory, an experience of things.

After these experiments I tried others with hairy materials imitating more or less closely the down of the Bees, with little pieces of cloth or velvet cut from my clothes, with plugs of cotton wool, with pellets of flock gathered from the everlastings. Upon all these objects, offered with the tweezers, the Meloes flung themselves without any difficulty; but, instead of keeping quiet, as they do on the bodies of the Bees, they soon convinced me, by their restless behaviour, that they found themselves as much out of their element on these furry materials as on the smooth surface

of a bit of straw. I ought to have expected this: had I not just seen them wandering without pause upon the everlastings enveloped with cottony flock? If reaching the shelter of a downy surface were enough to make them believe themselves safe in harbour, nearly all would perish, without further attempts, in the down of the plants.

Let us now offer them live insects and, first of all, Anthophoræ. If the Bee, after we have rid her of the parasites which she may be carrying, be taken by the wings and held for a moment in contact with the flower, we invariably find her, after this rapid contact, overrun by Meloes clinging to her hairs. The larvæ nimbly take up their position on the thorax, usually on the shoulders or sides, and once there they remain motionless: the second stage of their strange journey is compassed.

After the Anthophoræ, I tried the first live insects that I was able to procure at once: Drone-flies, Bluebottles, Hive-bees, small Butterflies. All were alike overrun by the Meloes, without hesitation. What is more, there was no attempt made to return to the flowers. As I could not find any Beetles at the moment, I was unable to experiment with them. Newport, experimenting, it is true, under conditions very different from mine, since his observations related to young Meloes held captive in a glass jar, while mine were made in the normal circumstances, Newport, I was saying, saw Meloes fasten to the body of a Malachius and stay there without moving, which inclines me to believe that with Beetles I should have obtained the same results as, for instance,

with a Drone-fly. And I did, in fact, at a later date, find some Meloe-larvæ on the body of a big Beetle, the Golden Rose-chafer (*Cetonia aurata*), an assiduous visitor of the flowers.

After exhausting the insect class, I put within their reach my last resource, a large black Spider. Without hesitation they passed from the flower to the arachnid, made for places near the joints of the legs and settled there without moving. Everything therefore seems to suit their plans for leaving the provisional abode where they are waiting; without distinction of species, genus, or class, they fasten to the first living creature that chance brings within their reach. We now understand how it is that these young larvæ have been observed upon a host of different insects and especially upon the early Flies and Bees pillaging the flowers; we can also understand the need for that prodigious number of eggs laid by a single Oil-beetle, since the vast majority of the larvæ which come out of them will infallibly go astray and will not succeed in reaching the cells of the Anthophoræ. Instinct is at fault here; and fecundity makes up for it.

But instinct recovers its infallibility in another case. The Meloes, as we have seen, pass without difficulty from the flower to the objects within their reach, whatever these may be, smooth or hairy, living or inanimate. This done, they behave very differently, according as they have chanced to invade the body of an insect or some other object. In the first case, on a downy Fly or Butterfly, on a smooth-skinned Spider or Beetle, the larvæ remain motionless after reaching the point which suits them.

Their instinctive desire is therefore satisfied. In the second case, in the midst of the nap of cloth or velvet, or the filaments of cotton, or the flock of the everlasting, or, lastly, on the smooth surface of a leaf or a straw, they betray the knowledge of their mistake by their continual coming and going, by their efforts to return to the flower imprudently abandoned.

How then do they recognize the nature of the object to which they have just moved? How is it that this object, whatever the quality of its surface, will sometimes suit them and sometimes not? Do they judge their new lodging by sight? But then no mistake would be possible; the sense of sight would tell them at the outset whether the object within reach was suitable or not; and emigration would or would not take place according to its decision. And then how can we suppose that, buried in the dense thicket of a pellet of cotton-wool or in the fleece of an Anthophora, the imperceptible larva can recognize, by sight, the enormous mass which it is perambulating?

Is it by touch, by some sensation due to the inner vibrations of living flesh? Not so, for the Meloes remain motionless on insect corpses that have dried up completely, on dead Anthophoræ taken from cells at least a year old. I have seen them keep absolutely quiet on fragments of an Anthophora on a thorax long since nibbled and emptied by the Mites. By what sense then can they distinguish the thorax of an Anthophora from a velvety pellet, when sight and touch are out of the question? The sense of smell remains. But in that case what exquisite subtlety must

we not take for granted? Moreover, what similarity of smell can we admit between all the insects which, dead or alive, whole or in pieces, fresh or dried, suit the Meloes, while anything else does not suit them? A wretched louse, a living speck, leaves us mightily perplexed as to the sensibility which directs it. Here is yet one more riddle added to all the others.

After the observations which I have described, it remained for me to search the earthen surface inhabited by the Anthophoræ: I should then have followed the Meloe-larva in its transformations. It was certainly *cicatricosus* whose larvæ I had been studying; it was certainly this insect which ravaged the cells of the Mason-bee, for I found it dead in the old galleries which it had been unable to leave. This opportunity, which did not occur again, promised me an ample harvest. I had to give it all up. My Thursday was drawing to a close; I had to return to Avignon, to resume my lessons on the electrophorus and the Toricellian tube. O happy Thursdays! What glorious opportunities I lost because you were too short!

We will go back a year to continue this history. I collected, under far less favourable conditions, it is true, enough notes to map out the biography of the tiny creature which we have just seen migrating from the camomile-flowers to the Anthophora's back. From what I have said of the Sitaris-larvæ, it is plain that the Meloe-larvæ perched, like the former, on the back of a Bee, have but one aim: to get themselves conveyed by this Bee to the victualled cells. Their object is not to live for a time on the body

that carries them.

Were it necessary to prove this, it would be enough to say that we never see these larvæ attempt to pierce the skin of the Bee, or else to nibble at a hair or two, nor do we see them increase in size so long as they are on the Bee's body. To the Meloes, as to the Sitares, the Anthophora serves merely as a vehicle which conveys them to their goal, the victualled cell.

It remains for us to learn how the Meloe leaves the down of the Bee which has carried it, in order to enter the cell. With larvæ collected from the bodies of different Bees, before I was fully acquainted with the tactics of the Sitares, I undertook, as Newport had done before me, certain investigations intended to throw light on this leading point in the Oil-beetle's history. My attempts, based upon those which I had made with the Sitares, resulted in the same failure. The tiny creatures, when brought into contact with Anthophora-larvæ or – nymphs, paid no attention whatever to their prey; others, placed near cells which were open and full of honey, did not enter them, or at most ventured to the edge of the orifice; others, lastly, put inside the cell, on the dry wall or on the surface of the honey, came out again immediately or else got stuck and died. The touch of the honey is as fatal to them as to the young Sitares.

Searches made at various periods in the nests of the Hairy-footed Anthophora had taught me some years earlier that *Meloe cicatricosus*, like the Sitares, is a parasite of that Bee; indeed I had at different times discovered adult Meloes, dead and shrivelled,

in the Bee's cells. On the other hand, I knew from Léon Dufour that the little yellow animal, the Louse found in the Bee's down, had been recognized, thanks to Newport's investigations, as the larva of the Oil-beetle. With these data, rendered still more striking by what I was learning daily on the subject of the Sitares, I went to Carpentras, on the 21st of May, to inspect the nests of the Anthophoræ, then building, as I have described. Though I was almost certain of succeeding, sooner or later, with the Sitares, who were excessively abundant, I had very little hope of the Meloes, which on the contrary are very scarce in the same nests. Circumstances, however, favoured me more than I dared hope and, after six hours' labour, in which the pick played a great part, I became the possessor, by the sweat of my brow, of a considerable number of cells occupied by Sitares and two other cells appropriated by Meloes.

While my enthusiasm had not had time to cool at the sight, momentarily repeated, of a young Sitaris perched upon an Anthophora's egg floating in the centre of the little pool of honey, it might well have burst all restraints on beholding the contents of one of these cells. On the black, liquid honey a wrinkled pellicle is floating; and on this pellicle, motionless, is a yellow louse. The pellicle is the empty envelope of the Anthophora's egg; the louse is a Meloe-larva.

The story of this larva becomes self-evident. The young Meloe leaves the down of the Bee at the moment when the egg is laid; and, since contact with the honey would be fatal to the

grub, it must, in order to save itself, adopt the tactics followed by the Sitaris, that is to say, it must allow itself to drop on the surface of the honey with the egg which is in the act of being laid. There, its first task is to devour the egg which serves it for a raft, as is attested by the empty envelope on which it still remains; and it is after this meal, the only one that it takes so long as it retains its present form, that it must commence its long series of transformations and feed upon the honey amassed by the Anthophora. This was the reason of the complete failure both of my attempts and of Newport's to rear the young Meloe-larvæ. Instead of offering them honey, or larvæ, or nymphs, we should have placed them on the eggs recently laid by the Anthophora.

On my return from Carpentras, I meant to try this method, together with that of the Sitares, with which I had been so successful; but, as I had no Meloe-larvæ at my disposal and could not obtain any save by searching for them in the Bees' fleece, the Anthophora-eggs were all discovered to have hatched in the cells which I brought back from my expedition, when I was at last able to find some. This lost experiment is little to be regretted, for, since the Meloes and the Sitares exhibiting the completest similarity not only in habits but also in their method of evolution, there is no doubt whatever that I should have succeeded. I even believe that this method may be attempted with the cells of various Bees, provided that the eggs and the honey do not differ too greatly from the Anthophora's. I should not, for example, count on being successful with the cells of the three-horned

Osmia, who shares the Anthophora's quarters: her egg is short and thick; and her honey is yellow, odourless, solid, almost a powder and very faintly flavoured.

CHAPTER V
HYPERMETAMORPHOSIS

By a Machiavellian stratagem the primary larva of the Oil-beetle or the Sitaris has penetrated the Anthophora's cell; it has settled on the egg, which is its first food and its life-raft in one. What becomes of it once the egg is exhausted?

Let us, to begin with, go back to the larva of the Sitaris. By the end of a week the Anthophora's egg has been drained dry by the parasite and is reduced to the envelope, a shallow skiff which preserves the tiny creature from the deadly contact of the honey. It is on this skiff that the first transformation takes place, whereafter the larva, which is now organized to live in a glutinous environment, drops off the raft into the pool of honey and leaves its empty skin, split along the back, clinging to the pellicle of the egg. At this stage we see floating motionless on the honey a milk-white atom, oval, flat and a twelfth of an inch long. This is the larva of the Sitaris in its new form. With the aid of a lens we can distinguish the fluctuations of the digestive canal, which is gorging itself with honey; and along the circumference of the flat, elliptical back we perceive a double row of breathing-pores which, thanks to their position, cannot be choked by the viscous liquid. Before describing the larva in detail we will wait for it to attain its full development, which cannot take long, for the

provisions are rapidly diminishing.

The rapidity however is not to be compared with that with which the gluttonous larvæ of the Anthophora consume their food. Thus, on visiting the dwellings of the Anthophoræ for the last time, on the 25th of June, I found that the Bee's larvæ had all finished their rations and attained their full development, whereas those of the Sitares, still immersed in the honey, were, for the most part, only half the size which they must finally attain. This is yet another reason why the Sitares should destroy an egg which, were it to develop, would produce a voracious larva, capable of starving them in a very short time. When rearing the larvæ myself in test-tubes, I have found that the Sitares take thirty-five to forty days to finish their mess of honey and that the larvæ of the Anthophora spend less than a fortnight over the same meal.

It is in the first half of July that the Sitaris-grubs reach their full dimensions. At this period the cell usurped by the parasite contains nothing beyond a full-fed larva and, in a corner, a heap of reddish droppings. This larva is soft and white, about half an inch in length and a quarter of an inch wide at its broadest part. Seen from above as it floats on the honey, it is elliptical in form, tapering gradually towards the front and more suddenly towards the rear. Its ventral surface is highly convex; its dorsal surface, on the contrary, is almost flat. When the larva is floating on the liquid honey, it is as it were steadied by the excessive development of the ventral surface immersed in the honey,

which enables it to acquire an equilibrium that is of the greatest importance to its welfare. In fact, the breathing-holes, arranged without means of protection on either edge of the almost flat back, are level with the viscous liquid and would be choked by that sticky glue at the least false movement, if a suitably ballasted hold did not prevent the larva from heeling over. Never was corpulent abdomen of greater use: thanks to this plumpness of the belly the larva is protected from asphyxia.

Its segments number thirteen, including the head. This head is pale, soft, like the rest of the body, and very small compared with the rest of the creature. The antennæ are excessively short and consist of two cylindrical joints. I have vainly looked for the eyes with a powerful magnifying-glass. In its former state, the larva, subject to strange migrations, obviously needs the sense of sight and is provided with four ocelli. In its present state, of what use would eyes be to it at the bottom of a clay cell, where the most absolute darkness prevails?

The labrum is prominent, is not distinctly divided from the head, is curved in front and edged with pale and very fine bristles. The mandibles are small, reddish toward the tips, blunt and hollowed out spoonwise on the inner side. Below the mandibles is a fleshy part crowned with two very tiny nipples. This is the lower lip with its two palpi. It is flanked right and left by two other parts, likewise fleshy, adhering closely to the lip and bearing at the tip a rudimentary palp consisting of two or three very tiny joints. These two parts are the future jaws. All this apparatus

of lips and jaws is completely immobile and in a rudimentary condition which is difficult to describe. They are budding organs, still faint and embryonic. The labrum and the complicated lamina formed by the lip and the jaws leave between them a narrow slit in which the mandibles work.

The legs are merely vestiges, for, though they consist of three tiny cylindrical joints, they are barely a fiftieth of an inch in length. The creature is unable to make use of them, not only in the liquid honey upon which it lives, but even on a solid surface. If we take the larva from the cell and place it on a hard substance, to observe it more readily, we see that the inordinate protuberance of the abdomen, by lifting the thorax from the ground, prevents the legs from finding a support. Lying on its side, the only possible position because of its conformation, the larva remains motionless or only makes a few lazy, wriggling movements of the abdomen, without ever stirring its feeble limbs, which for that matter could not assist it in any way. In short, the tiny creature of the first stage, so active and alert, is succeeded by a ventripotent grub, deprived of movement by its very obesity. Who would recognize in this clumsy, flabby, blind, hideously pot-bellied creature, with nothing but a sort of stumps for legs, the elegant pigmy of but a little while back, armour-clad, slender and provided with highly perfected organs for performing its perilous journeys?

Lastly, we count nine pairs of stigmata: one pair on the mesothorax and the rest on the first eight segments of the

abdomen. The last pair, that on the eighth abdominal segment, consists of stigmata so small that to detect them we have to gather their position by that in the succeeding states of the larva and to pass a very patient magnifying-glass along the direction of the other pairs. These are as yet but vestigial stigmata. The others are fairly large, with pale, round, flat edges.

If in its first form the Sitaris-larva is organized for action, to obtain possession of the coveted cell, in its second form it is organized solely to digest the provisions acquired. Let us take a glance at its internal structure and in particular at its digestive apparatus. Here is a strange thing: this apparatus, in which the hoard of honey amassed by the Anthophora is to be engulfed, is similar in every respect to that of the adult Sitaris, who possibly never takes food. We find in both the same very short oesophagus, the same chylific ventricle, empty in the perfect insect, distended in the larva with an abundant orange-coloured pulp; in both the same gall-bladders, four in number, connected with the rectum by one of their extremities. Like the perfect insect, the larva is devoid of salivary glands or any other similar apparatus. Its nervous system comprises eleven ganglia, not counting the oesophageal collar, whereas in the perfect insect there are only seven: three for the thorax, of which the last two are contiguous, and four for the abdomen.

Конец ознакомительного фрагмента.