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Insect life: Souvenirs of a naturalist

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PREFACE

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This little volume introduces the work of a great French naturalist to the reader of English. Réaumur, another Frenchman, is the greatest naturalist devoting himself to the observation of insects the world has yet seen. His six quarto volumes—*Mémoires pour servir à l'histoire des insectes*—were published between 1734 and 1742. J.-H. Fabre, who happily is still with us, is second only to Réaumur in this part of the great field of Natural History.

Though compatriots the two men are remarkably different in the nature of their genius. Réaumur, stately and slow, both discursive and diffuse. Fabre,—styled by Charles Darwin the immortal Fabre,—a most patient, indefatigable observer, ready to sacrifice everything to the carrying on of his work, but making deductions too rapidly from his observations, and taking a philosophical position from which he refuses to budge, even though he stand alone among the naturalists of this generation.

Fabre's great merit is his graphic portraiture of the living insect as it really is. This proves to be [vi]very different from insect life as it is usually supposed to be by the uninstructed, and as it is only too frequently represented to be in books. In the volume now offered to the reader he is almost entirely concerned with the instinct of Hymenoptera, the highest of the insect world in this respect. His studies of this subject have been continued in several other volumes, and he has also included in the series the results of many years of observation of the habits of other and very different insects.

His philosophical position may be briefly stated to be a determined refusal to recognise evolution as a legitimate idea. In this we may think him wrong; but it must be admitted that his views form a valuable antithesis to those of the many evolutionists who take the position that all that remains for the naturalist to do is to repeat the words Natural Selection and variation, and declare that thereby we understand the Cosmos.

Fabre is a difficult writer to translate. Probably no one has ever written on this subject with equal brilliancy and vivacity. But he is the most Gallic of Frenchmen. If his words are literally translated, they scarcely make English; if freely translated, the charm of his diction is too easily missed.

We hope that this volume may induce the student to read Fabre's subsequent volumes.1 Taken [7]altogether they are, if not superior, at least not inferior to this one—preferred simply because it is the first of the series.

In his works there is a good deal of delightful autobiography. Starting as a child amidst the direst poverty, he has become a highly accomplished man, a great naturalist, a brilliant writer; and he has done this with a complete

contempt for money, and a great indifference to the other rewards that Society is ready to bestow for such work.

D. SHARP.

Cambridge, *20th August 1901*. [ix]

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1 *Souvenirs Entomologiques* (Ch. Delagrave, 15 Rue Soufflot, Paris), of which there are now seven series, this volume being a translation of the first. ↑

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I

THE SACRED BEETLE

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This was how it came about. We were five or six, I the oldest and their professor, still more their comrade and friend; they, young fellows with warm hearts and lively imaginations, overflowing with that youthful vitality which makes one so open to impressions and so eager for knowledge.

Talking of one thing and another we followed a path bordered with elder and hawthorn, where already the Rose Beetle was revelling in the overwhelming scent of the clustering blossoms. We were going to see if the Sacred Scarabæus had yet appeared on the sandy plateau of Les Angles, rolling the ball of dung which ancient Egypt looked on as emblematic of the world; we wanted to discover whether the running stream at the bottom of the hill might not hide young newts under the net of water weeds—newts whose branchiæ look like tiny sprays of coral; to see if that elegant little fish of the rivulet, the stickleback, had donned his wedding cravat of azure and purple; if the new-come swallows were [2]dipping on pointed wings over the meadows chasing the midges which scatter their eggs in their

airy dance; to see if the Eyed Lizard was sunning his blue-spotted body at the mouth of a hole made in the sandstone; or if the flocks of Laughing Gulls, come up from the sea after the legions of fish which ascend the Rhône to spawn, were hovering over the river, and now and again uttering their cry like the laugh of a maniac. But enough; suffice it to say that, like simple folk who find much pleasure in living with the brute creation, we were intending to spend a morning in enjoying the ineffable awakening of life in springtime.

We were not disappointed. The stickleback was in full dress, his scales would have made silver look dim; his throat was of the brightest vermilion. On the approach of a great horse-leech with no good intentions, up rose the spines on back and side as if moved by a spring. Thus bravely encountered, the bandit beat an ignominious retreat down among the water-plants. The dull race of molluscs, Planorbinæ, and water-snails were sucking in air on the surface of the water, and the great Water Beetle, with its hideous larva, went by wringing the neck now of one, now of another, without the stupid band seeming to notice it. But let us leave the waters of the plain and climb the steep cliff dividing us from the tableland where sheep are feeding and horses are being exercised for the approaching races, one and all bestowing largesse on the rejoicing dung beetles.

For here at work are the scavenger beetles to whom is entrusted the high office of clearing the

[3]ground of impurities. It is impossible to admire sufficiently the variety of tools with which they are furnished, both to stir the dung with, to divide and shape it, and to hollow the deep retreats into which they shut themselves with their booty. These tools form a kind of technological museum, where there is a specimen of every kind of digging instrument. Some might be copied from those devised by human industry, others are of an original type, and might serve as models for new tools for man. Copris hispanica wears a strong horn on its head, forked and bent back, like the long spike of a pickaxe. To a similar horn C. lunaris adds two strong points, shaped liked a ploughshare, projecting from the thorax, and between them a sharp-edged protuberance, serving as a wide rake. Bubas bubalus and B. bison, both exclusively Mediterranean species, have foreheads armed with two stout, diverging horns, between which projects a horizontal share from the corslet. Geotrupes typhæus carries three points on the front of its thorax, parallel and standing straight out, the middle one shorter than the others. Onthophagus taurus owns as implements two long curving appendages like the horns of a bull, while the furcate Onthophagus has a two-pronged fork on its flat head. Even those least well off have on one part or other hard tubercules—tools blunt indeed, but which the patient insect knows very well how to utilise. All are furnished with a shovel, *i.e.* a large, flat, sharp-edged head; all use a rake—in other

words, they collect materials with their toothed front legs.

As compensation for their unpleasant work, [4]more than one gives out a strong scent of musk, and its ventral parts gleam like polished metal. Geotrupes hypocrita has the under part of its body bright with metallic lights of copper and gold, and G. stercorarius with amethystine violet. But the usual colour is black. It is in tropical regions that we find dung beetles in gorgeous array—absolutely living jewels. Under camel droppings in Upper Egypt is found a beetle rivalling the dazzling green of an emerald; Guiana, Brazil, Senegal, can show Copridæ of a metallic red, rich as the red of copper, bright as that of a ruby. If such a jewelled race be wanting to our country, still its dung beetles are not less remarkable for their habits.

What eagerness is displayed around a dropping! Never did adventurers from the four corners of the world show such eagerness in working a Californian claim! Before the sun grows too hot there they are by hundreds, large and small, pell-mell, of every kind and form and shape, hastening to secure a slice of the cake! Some work in the open air and rake the surface, some open galleries in the thickest part, seeking choice morsels, others toil in the under part and bury their treasure as soon as possible in the adjacent ground, and the smallest crumble some scrap fallen from the excavations of their strong fellow-workers. Some again—newcomers, and

doubtless the hungriest—eat then and there, but the aim of the greater number is to lay up a store which will allow them to pass long days of plenty down in some sure retreat. A fresh dropping is not to be found just when wanted in a plain where no thyme grows; such a gift is [5]indeed a piece of good fortune, and only comes to the lucky. So when found, the wealth is prudently stored. The smell has carried the good news a couple of miles round, and all have rushed to gather up provender. Some laggards are still coming in on the wing or on foot.

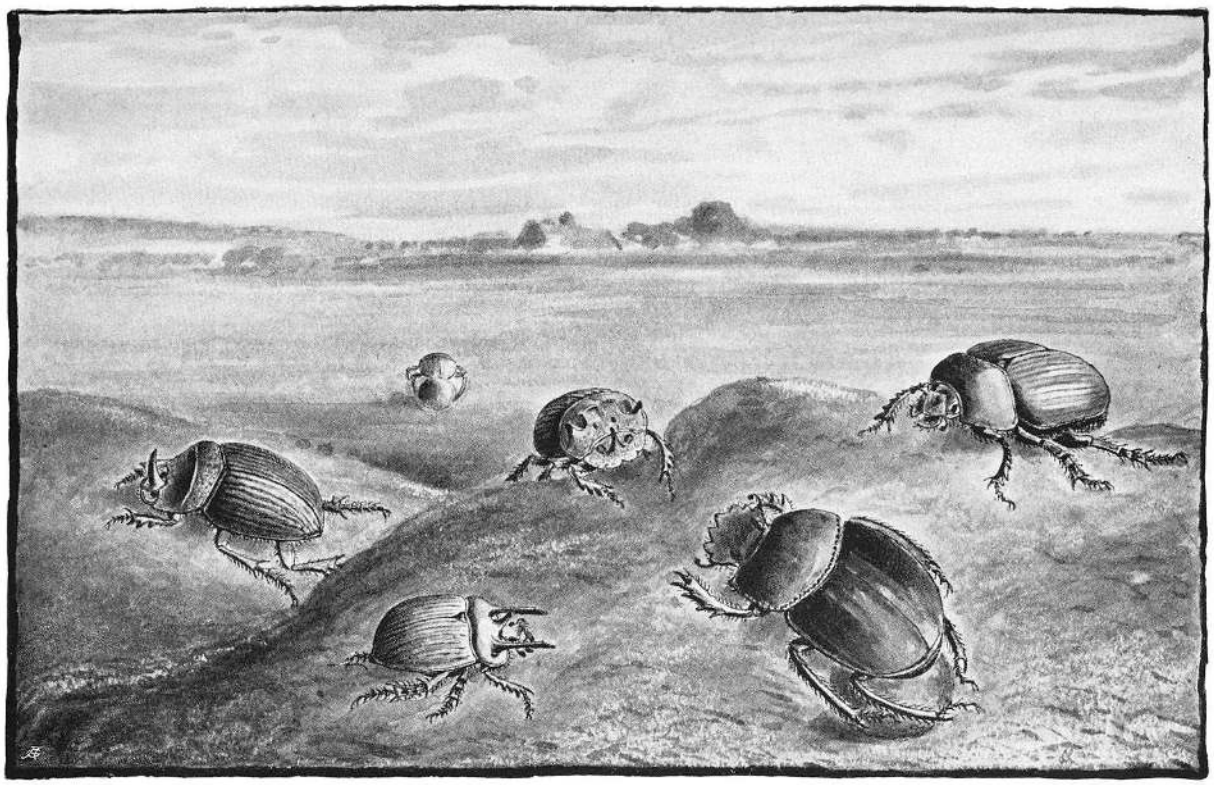
What is the one now trotting towards the heap, fearing to arrive too late? His long legs work with a brusque, awkward action, as if moved by some machine inside him; his little red antennæ spread their fans—sure sign of anxious greediness. He is coming, has arrived, not without upsetting some of the guests. It is the Sacred Beetle, all in black, the largest and most celebrated of our dung beetles.

Here he is at table, beside his fellow-guests, who are giving last touches to their balls with the flat of their large front legs, or enriching them with a last layer before retiring to enjoy the fruit of their labours in peace. Let us follow this famous ball in each stage of construction.

The edge of the beetle's head is large and flat, and armed with six angular teeth arranged in a semicircle. It is the tool for digging and dividing, the rake to lift or reject such vegetable fibres as are not nutritious, to seek out what is best and rake it

together. A choice is thus made, for these keen connoisseurs like one thing better than another—a somewhat careless choice, indeed, if the beetle alone be concerned, but one which is rigorously scrupulous if the maternal ball be in question, with its central hollow where the egg will hatch. Then every scrap of fibre is rejected, and only the quintessence of the stercorous matter is used to build the inner layer of [6]the cell. Then, as soon as it is hatched, the young larva finds in the walls of its dwelling a dainty food which strengthens digestion and enables it later to attack the coarse outer layers. For its own needs the beetle is less fastidious, contenting itself with a general selection. The toothed head hollows and seeks, rejects and gathers, somewhat at haphazard. The forelegs aid mightily. They are flattened, bent into the arc of a circle, are furnished with strong nerves and armed with five stout teeth. If an effort has to be made, an obstacle overthrown, a path forced through the thickest part of the heap, the dung beetle elbows its way; in other words, throws its toothed legs right and left, and clears a half circle with a vigorous sweep of its rake. Room being made, these same feet have a new task; they collect bundles of the material raked up by the head, and pass it under the insect to the four hind-feet. These are planned for the turner's trade. The legs, especially the last pair, are long and slender, slightly bent in an arc, and ending in a very sharp spur or talon. A glance shows that they form a spherical

compass, capable of holding a globe in the bent legs to verify and correct its shape. In fact, their mission is to shape the ball. Bundle after bundle the material accumulates under the insect, held between the four legs which by a slight pressure lend it their own curve and something of shape. Then from time to time the rough hewn ball is set in motion between the legs of the double spherical compass, turned underneath the beetle, and rolled into a perfect sphere. Should the outer layer fail in plasticity and threaten to scale off, or if some [7]part be too fibrous, and refuse to be shaped by rotation, the faulty part is retouched by the forefeet; little taps of their broad surface give consistency to the new layer and imbed the recalcitrant fibre in the general mass. When the sun shines and work is urgent, one is amazed by the feverish activity with which the turner labours. Work goes on fast; first there was a pellet, now it is as large as a nut, by and by it will be of the size of an apple. I have seen some greedy beetles make up a ball as large as an apple. Assuredly there is food in the larder for some days to come!



[*To face p. 6.*

DUNG BEETLES GATHERING PROVENDER

Provender being gathered, the next thing is to retire from the *mêlée*, and carry it to a fitting place. Now we see some of the most characteristic habits of the Scarabæus. He sets out at once, embracing the ball with the long hind legs, whose talons, planted in the mass, serve as pivots—leans on the intermediary legs as pivots, and using as levers the flat of the toothed forefeet, which press the ground alternately, journeys backward with his load, the body bent, the head low, and the hinder part upraised. The hind feet, which are the chief organs in the mechanism, move continually, going and coming and changing the place where the talons are stuck in, to alter the axis of rotation, to keep the load balanced and

advance by an alternate push right and left. Thus the ball comes in contact with the ground in every part of it, which gives it a perfect shape and lends consistency to the outer layer by a uniform pressure. Courage! it moves, it rolls, and the journey's end will be reached, though not without trouble. Here is a first difficulty. The beetle [8]has to cross a slope, and the heavy ball would naturally follow the incline, but for reasons best known to itself, the insect prefers to cross this natural slope—an audacious plan, which one false step or a grain of sand to upset the balance will defeat. The false step is made, the ball rolls to the bottom of the valley, and the insect, upset by the impetus of its load, staggers, gets again on its legs, and hastens to harness itself afresh. The mechanism works capitally. But look out, scatterbrain! follow the hollow of the valley, it will spare labour and misadventure. The road is good and quite level, and your ball will roll along with no exertion. Not a bit of it. The insect has made up its mind to remount the slope already so fatal to it. Perhaps it suits it to return to the heights. Against that I have nothing to say, the Scarabæus knows better than I do whether it be advisable to dwell in lofty regions. At all events, take this path which will lead you up by a gentle incline. Not at all. If there be near at hand some very stiff slope impossible to climb, then that slope this wrong-headed insect prefers. Then begins the labour of Sisyphus. With endless precautions the monstrous load is painfully hoisted, step by step to a certain

height, the beetle always going tail first. One asks one's self by what miracle of statics such a mass can be kept on the slope. Ah! a clumsy movement brings all this toil to naught. Down goes the ball, dragging the beetle with it. The escalade is repeated, soon followed by a fresh fall. The attempt is renewed, and better managed at the difficult points; a nasty grass-root, which occasioned the previous tumbles, is prudently [9]turned; we have almost got to the top. But gently! gently! the ascent is perilous, and a mere nothing may ruin all. A leg slips on a bit of smooth gravel, and ball and scavenger roll down together. The beetle begins all over again, with tireless obstinacy. Ten times, twenty times, will it attempt that further ascent, until persistency vanquishes all obstacles, or until, better advised, it takes the level road.

The scavenger does not always roll his ball single-handed, but frequently takes a partner, or rather, a partner takes him. The affair is usually managed thus: the ball being prepared, a beetle comes out of the throng, pushing it backwards. One of the newcomers, whose own work is hardly begun, leaves its task and runs to the ball, now in motion, to lend a hand to the lucky proprietor, who appears to accept the proffered aid in an amiable spirit. The two work as partners, each doing its best to convey the ball to a place of safety. Was a treaty made in the workshop, a tacit agreement to share the cake? While one kneaded and shaped, was the other tapping rich

veins whence to extract choice material for their common use? I have never observed such collaboration, but have always seen every beetle exclusively occupied by his own affairs on the field of labour, so that the last comer has no acquired rights.

Is it, then, an association of the two sexes, a couple about to set up house? For a time I thought so. The two scavengers pushing a ball, one before and one behind, with equal zeal, used to remind me of certain couplets once on a time popular on barrel-organs—

Pour monter notre ménage, hélas comment ferons-nous?

Toi devant, moi derrière, nous pousserons le tonneau.

[10]

But the evidence of the scalpel forces me to give up this family idyll. There is no outward sign of sex in the Scarabæus, but on dissecting a couple employed on one and the same ball they often turned out to be of the same sex. In fact, there is neither community of family nor community of labour. What, then, is the reason of the apparent partnership? Merely an attempt at filching. The eager fellow-worker, under pretence of giving a helping hand, cherishes the project of carrying off the ball at the earliest opportunity. To make one for itself at the heap demands labour and patience; to abstract a ready-made one, or at least to foist one's self in as a sharer of the feast, is much more convenient. If the owner's

watchfulness should slacken, one will flee with the treasure; if too closely looked after, one can at least sit down at table on the pretext of services rendered. With such tactics all turns to profit, so that pillage is carried on as one of the most lucrative of trades. Some, as I have just said, play an underhand game, hastening to the aid of some comrade who has not the least need of them, and under the cloak of charitable assistance conceal a highly indelicate greed. Others, bolder or more confident in their strength, go straight to the goal and rob by main force. Every moment some such scene as this will take place. A beetle departs alone, rolling his ball, his own property, acquired by conscientious labour; another comes flying, whence I know not, drops heavily, folds his smoky wings under their elytra, and with the back of his toothed feet oversets the proprietor, which, being hindside before, cannot defend itself. While the latter [11]struggles to its feet the aggressor stations itself on the top of the ball, as a point of vantage whence to repel attack, folds its feet under its breast, ready for action, and awaits events. The bereaved owner moves round the ball, seeking a favourable point whence to attempt an assault; the thief revolves on the top of the citadel, constantly facing him. If the former raises itself for an escalade, the latter gives it a cuff which stretches it flat on its back. Secure on the top of the fortress, the besieged would bring to nought for all time the efforts of its adversary to recover its lost

property if the besieger did not alter his tactics. Sapping threatens to bring down both citadel and garrison. The ball being undermined, staggers and rolls, carrying with it the robber, struggling his hardest to keep at the top, which he generally succeeds in doing, thanks to the hurried gymnastics that enable him to regain the altitude lost by the rotation of his standing place. If a false movement should bring him to the ground, the chances become equal, and the contest turns to a wrestling match. Robber and robbed grapple body to body, breast to breast. Their feet twist and untwist, their joints intertwine, their horny armour clashes and grinds with the harsh sound of filed metal. Then one will succeed in throwing its adversary on the back, and, freeing itself, hastily takes up a position on the top of the ball, and the siege is recommenced, now by the robber, now by the robbed, as the chances of the fight may have decided. The former, no doubt a hardy brigand and adventurer, often gets the best of it. After two or three defeats the ex-owner wearies of the contest [12]and returns philosophically to the heap and makes a new ball. As for the other, when all fear of a surprise is over, he harnesses himself to the conquered ball and pushes it whither it seems good to him. I have occasionally seen a third thief rob the robber. And upon my word I was not sorry.

Vainly do I ask myself what Prudhon introduced into Scarabæus-morality the audacious paradox that "Property spells theft," or what diplomatist taught

the dung-beetle that “they may take who have the power, and they may keep who can.” I have not the evidence required to lead me to the origin of these spoliations which have become a habit, or of this abuse of strength in order to seize a ball of dirt. All that I can affirm is that among beetles theft is universal. These dung rollers pillage one another with a cool effrontery really matchless. I leave it to future observers to elucidate this curious problem in the psychology of animals, and return to the couple rolling their balls in partnership.

[*To face p. 12.*

GEOTRUPES STERCORARIUS FIGHTING FOR THE PELLET

But first let us dissipate an error current in books. In the magnificent work of M. Emile Blanchard,

Metamorphoses, Habits, and Instincts of Animals, I find the following passage: “Sometimes our insect is stopped by an insurmountable obstacle: the ball has fallen into a hole. At such a time the Ateuchus[1] displays a really astonishing grasp of the situation, and a yet more astonishing power of communication between individuals of the same species. Recognising the impossibility of getting the ball over the obstacle, the Ateuchus seemingly abandons it, and flies away. If you are sufficiently endowed [13]with that great and noble virtue called Patience, remain near this forsaken ball. After a while the Ateuchus will return, and not alone; it will be followed by two, three, or four companions who, alighting at the appointed spot, will join in trying to lift up the load. The Ateuchus has been to seek reinforcements, and this explains why several beetles uniting to transport a single ball is such a common sight in dry fields.” I also read in Illiger’s ***Entomological Magazine***: “A Gymnopleurus pilularius,[2] while constructing the ball of dung destined to contain its eggs, let it roll into a hole, whence the insect tried long and vainly to extract it. Finding this only waste of time, he hastened to a neighbouring heap of manure to seek three of his kind, which, uniting their efforts to his, succeeded in getting out the ball, and then went back to their own work.”

I humbly beg pardon of my illustrious master, M. Blanchard, but assuredly things do not happen thus. First, the two accounts are so much alike that they

must have had a common origin. After observations not followed up closely enough to merit blind confidence, Illiger put forward the story of his Gymnopleurus, and the same fact has been attributed to the Scarabæus because it really is a common thing to find two of these insects busy rolling a ball, or getting it out of some difficult position. But the partnership does not at all prove that one went to ask help from the other in some difficulty. I have had a large measure of the patience [14]recommended by M. Blanchard; I may claim to have spent long days in the intimacy of Scarabæus sacer; I have tried every means to comprehend its manners and customs, and to study them from life, and never did I see anything which suggested that one had called its companions to its aid. As I shall presently relate, I have put the dung-beetle to proofs far more serious than that of a ball fallen into a hole, and into far graver difficulties than having to climb a slope—a thing which is mere sport for the obstinate Sisyphus, who seems to enjoy the rough gymnastics required by steep places, as if the ball grew thereby firmer, and therefore more valuable. I have invented situations where the insect had extreme need of help, and never could I detect any proof of good offices between comrades. I have seen pillaged and pillagers, and nothing else. If a number of beetles surrounded the same ball, it meant battle. My humble opinion is that several Scarabæi gathered round a pellet with intent to thieve was what gave

rise to these stories of comrades called in to give a helping hand. Incomplete observations have turned an audacious robber into a serviceable companion who put his own work aside to do a friendly turn. It is no slight thing to admit that an insect has a truly surprising grasp of the situation and a facility of communication between individuals more surprising still; therefore I insist on this point, Are we to suppose that a Scarabæus in distress conceives the idea of begging for help?—flies off, explores the country round to find comrades at work on a dropping, and having found them, by some pantomime, especially by movements of the antennæ, addresses them more [15]or less thus: "Hullo, you there! My load is upset in a hole yonder; come and help me to get it out. I will do as much for you another time." And are we to suppose too that his colleagues understand him? And, more wonderful still, that they leave their work, their ball newly begun, their beloved ball, exposed to the greed of others, and certain to be filched during their absence, in order to help the supplicant! I am profoundly incredulous of so much self-sacrifice, and my incredulity is borne out by all which I have seen during many long years, not in collection boxes, but on the spots where the Scarabæi work. Outside of the cares of maternity—cares in which it almost always shows itself admirable, the Insect—unless, indeed, it lives in society like bees and ants and some others—thinks and cares for nothing but itself.

Let us drop this discussion, excused by the importance of the subject. I have already said that a Scarabæus, owner of a ball which it is pushing backwards, is often joined by another which hastens to its aid with interested views, ready to rob if it gets the chance. Let us call the pair associates, though that is hardly the name for them, since one forces itself on the other, who perhaps only accepts help for fear of worse. The meeting is, however, perfectly peaceable. The arrival of the assistant does not distract the proprietor for an instant from his labours; the newcomer seems animated by the best intentions, and instantly sets to work. The way they harness themselves is different for each. The owner of the ball occupies the chief position, the place of honour; he pushes behind the load, his [16]hind feet upraised, his head downward. The helper is in front, in a reverse position, head raised, toothed arms on the ball, long hind legs on the ground. Between the two moves the ball, pushed before it by the one, dragged towards it by the other. The efforts of the couple are not always harmonious, especially as the assistant turns his back to the road to be traversed, and the view of the owner is bounded by his load. Hence repeated accidents and ludicrous tumbles, taken cheerfully, each hastening to pick himself up and resume his former position. On level ground this style of draught does not answer to the expenditure of energy, for want of precision in combined movements; the Scarabæus behind would do as well

or better alone, and the assistant, having proved his goodwill at the risk of disturbing the mechanism, decides to keep quiet of course without abandoning the precious globe, which he looks on as already his. A ball touched is a ball acquired. He will not be so imprudent as to let go; the other would instantly take advantage of it. So he folds his legs under him, flattens himself, incrusts himself, as it were, on the ball, and becomes part of it. Ball and beetle roll together, pushed along by the lawful owner. Whether it should go over the body of the other, whether he be above, below, or on one side of the rolling load, matters not—the intruder lies low. A singular helper this, who lets himself be run over for the sake of a share in the provender! But let them come to a steep incline, and he gets a chance of displaying his usefulness. On the steep slope he takes the lead, holding up the heavy load with his toothed feet while his [17]comrade steadies himself to hoist the load a little higher. Thus, by a combination of judicious efforts, I have seen them mount ascents, the one above holding up, the lower one pushing, where all the obstinate efforts of a single beetle must have failed. All, however, have not the same zeal in difficult moments; some, just when their assistance is most wanted on a slope, do not appear in the least aware that there is anything to overcome. While the unhappy Sisyphus is exhausting himself in efforts to surmount his difficulties, the other remains passive,

incrusted on the ball, rolling down with it, and forthwith hoisted up again.

I have often tried the following experiment on two associates in order to judge of their inventive faculties in a serious predicament. Let us suppose them on level ground, the assistant firmly seated on the ball, the other pushing. Without disturbing the latter, I nail the ball to the ground with a long, strong pin; it comes to a sudden stop. The beetle, unaware of my treachery, doubtless believes in some rut, some dandelion root or pebble stopping the way. He redoubles his efforts, struggles his hardest, but nothing moves. What has happened? Let us go and see. Twice or thrice he walks round his pellet. Discovering nothing which can explain its immovableness, he goes behind and pushes again. The ball remains motionless. Let us look above. He climbs up to find nothing but his motionless colleague, for I have taken care to drive the head of the pin in deep enough to hide the head in the mass of the ball. He examines the summit and again descends; fresh thrusts are vigorously applied in [18]front and on either side with the same want of success. Certainly no scavenger beetle ever yet found himself confronted by such a problem of inertia. It is the very moment for claiming assistance, a thing all the more easy that the colleague is close at hand, squatted on the top of the dome. Will the Scarabæus give him a shake, or address him somewhat thus: What are you about, lazy bones?

Come and look here; something has broken down. Nothing proves that he does so, for the beetle long persists in trying to move the immovable, examining now on this side, now on that, now above, now below, while his friend still remains quiescent. In the end, however, the latter becomes aware that something unusual is going on; it is brought home to him by the uneasy comings and goings of his companion and by the immobility of the ball, so in his turn he comes down to look into the matter. Double harness does not prove more effectual than single, and matters grow complicated. The little fans of their antennæ open and shut, open again, quiver and betray their lively anxiety. Then a stroke of genius ends their perplexities. Who knows what may be underneath? They explore below the ball, and a slight excavation reveals the pin. They recognise at once that the crux is there. Had I a voice in the matter I should have said, "An excavation must be made, and the stake which holds the ball must be got out." This very elementary proceeding, and one so easy to such expert excavators, was not adopted nor even attempted. The scavenger beetle was cleverer than the man. The two colleagues, one on this side, one [19]on that, insinuated themselves under the ball, which slipped up along the pin in proportion as the living wedges raised it, the softness of the material allowing of this clever manœuvre. Soon the ball was suspended at a height equal to that of the beetles' bodies. What remained to do was more difficult. From

lying flat they gradually got on their legs and pushed upward with their backs. It was hard to accomplish, the feet losing strength the more they stretched upward, but they did it. Then came a moment when they could no longer use their backs to push, the highest point possible being reached. There was a last resource, but one much less favourable to the development of strength. Now in one of the postures in which it drags a ball, now in the other,—that is to say, either head downward or the reverse,—the insect pushes with hind or fore feet. Finally, unless the pin be too long, the ball drops to the ground. The perforation is repaired as best it can be, and the ball is at once dragged onward.

But if the pin should be too long, the ball remains suspended at a height which the insect cannot increase by rearing itself up. In this case, after vain evolutions around the inaccessible maypole, the beetles give up the struggle, unless you are kind-hearted enough to complete the work yourself, and restore their treasure, or unless you aid them by raising the floor with a little flat stone, a pedestal from whence the insect can continue its work. Its use does not seem to be immediately understood, for neither beetle shows any readiness to profit by it. However, by chance or otherwise, one gets on the stone. Oh, joy! as it passed it felt the ball touch its back. [20]Thereupon courage returns, and the struggle begins again. Standing on its platform the beetle stretches its joints, rounds its back, and hoists

the pellet. When that no longer avails, it manœuvres with its feet, now upright, now head downward. There is a new pause and new signs of uneasiness when the limit of extension is reached. Without disturbing the creature let us put another little stone on the first. By the help of the new step, which gives a support for its levers, the insect pursues its task. Adding one step to another as required, I have seen the Scarabæus, perched on a shaky pile of three or four fingers' breadth, persisting in its labour until the ball was completely freed.

Had it some vague consciousness of the services rendered by the elevation of its point of leverage? I cannot believe it, although the beetle profited very cleverly by my platform of little stones, for if the very elementary idea of using a higher base to reach something too elevated was not beyond it, how was it that neither beetle bethought him of offering his back to the other, thus rendering the task possible? One assisting the other, they might have doubled the height attained. They are far indeed from any such combinations. Here, each pushes the ball with all its might, but pushes as if alone, without seeming to suspect the happy result which would be brought about by a combined effort. When the ball is fastened to the ground by a pin, they behave as they would when the ball is stopped by a loop of dandelion, or held by some slender bit of stalk which has got into the soft, rolling mass. My artifice brought about a stoppage not unlike [21]those which occur when the

ball is rolling amid the many inequalities of the ground, and the insect acts as it would have acted in some circumstances where I had not interfered. It uses its back as a wedge and lever and pushes with its feet without at all varying its means of action, even when it might call a comrade to its help.

If it has to face the difficulties of a ball nailed to the ground with no assistant, its dynamic manœuvres are exactly the same, and it succeeds, so long as we give the indispensable help of a platform gradually built up. Should this help be refused, the Scarabæus, no longer stimulated by the touch of its beloved ball, loses hope, and sooner or later, no doubt with bitter regret, flies off, whither I know not. What I do know is, that it does not return with a squadron of companions whom it has implored to help it. What could it do with them, since it cannot utilise even the single comrade when one shares the ball? Perhaps, however, an experiment which suspends the pellet at a height inaccessible to the insect when its means of action are exhausted may be too much outside of ordinary conditions. Let us try a miniature ditch, deep enough and steep enough to prevent a beetle when placed at the bottom with its load from rolling it up. These are the exact conditions named by Blanchard and Illiger. What happens? When persistent yet fruitless efforts show the beetle that it can do nothing, it spreads its wings and flies off. Long, very long have I waited, on the faith of what these learned men say, expecting it to return with its