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T H E

NATURAL HISTORY

O F

B E E S.

CONTAINING

An Account of their Production, their Oeconomy,
the manner of their making WAX and HONEY,
and the best Methods for the Improvement and
Preservation of them.

ILLUSTRATED

With Twelve COPPER PLATES.

Translated from the FRENCH.

L O N D O N :

Printed for J. and P. KNAPTON, at the *Crown* in
Ludgate-street; and P. VAILANT, in the *Strand*.

M. DCQ. XLIV.



ADVERTISEMENT.

THE care and culture of Bees have always been one of the most agreeable and useful employments of a country life. The antients cultivated these animals with care, from a prospect of honey, which was among them as much in use as sugar among us. But since it has been thought proper to substitute sugar in the room of honey, the latter has fallen into considerable discredit: but then, in return, wax has become the subject of a very considerable commerce. By this means Bees have always claim'd our care and regard, and the publick utility demands it.

'Tis not in towns we train up Bees; 'tis only in the country. Two sorts of people employ themselves in the culture of these laborious animals: the country people in

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A D V E R T I S E M E N T.

hopes of profit from them ; and persons of easy circumstances add to this view that of an agreeable amusement.

The first of these, too much taken up in laborious and continual employments, wherewith to gain their daily subsistence, can bestow on their hives but few, and those stolen moments, and a too negligent concern for such an increase of Bees, as the good of commerce requires.

The other sort, whom an easier fortune and a more improved genius would render capable greatly to advance an art, which at this time makes a considerable branch of the commerce of the kingdom, are discouraged by the difficulties of approaching these animals, always to be dreaded, and which one cannot manage easily ; which makes them neglect those experiments, that would enable them to make greater improvements than have hitherto been made.

If one has a clearer intelligence of these matters than others ; if a man has rules to
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lay down on the best conduct of Bees, 'tis to such an one that we ought to refer them. Their skill, their knowledge, their time, which is more in their own power, makes it easy for them to try, and even to execute the most favourable methods for the multiplication and preservation of Bee-hives. If they succeed, others will soon know how to imitate them.

'Tis not enough to inform persons of understanding of the best methods we know, but we ought to make them sensible of the reasons. By this means people born with a certain sagacity execute with greater pleasure, and more easily bring to perfection the new discoveries of others.

The practical reasons for the success of Bees are nothing more than the knowledge of their wants; and these wants can't be known, if one is not acquainted, with the utmost exactness, of their method of living, their temperature, their nourishment, the dangers to which they are exposed, the most favourable situation they can be placed in;

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if one knows not how to make them change their habitation, &c.

The antients have loaded their history of Bees with so many fables and absurdities, that it is not at all strange, if the prejudices, which arise from these false representations, have retarded the progress, which might otherwise have been made, in the training up of Bees.

To reinforce this profitable art, and to render it capable of the highest perfection; it was necessary, that somebody should give himself the trouble to make Bees his study more than the antients have done. This has been effected in our time; and we are indebted to three celebrated authors. Swammerdam is the first, who applied himself, with all that knowledge, of which so great an anatomist was capable: but his studies and discoveries go not beyond the interior and exterior parts of these animals; their generation, and their food: his design not extending

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ing to what might be useful either to preserve or multiply them. In short, his work, wrote in Latin and Dutch, is of no service to the persons we have in view. The late M. Maraldy, like the gods of the poets, who sometimes quit heaven to amuse themselves with terrestrial creatures; M. Maraldy I say, diverted himself, amidst his astronomical observations, with the study of Bees. This author has left us a very minute history of Bees, accompanied with many observations and discoveries. It is to be found in the Memoirs of the Academy, and consequently beyond the capacity of those persons, who have the most need of it. Besides, this author, as well as Swammerdam, gives no rules for the training up of Bees. They are both satisfied to examine them as naturalists. At length M. de Réaumur uniting the discoveries of all his predecessors to his own, has lately oblig'd us with a new history of these animals; which one may consider as the most compleat and perfect work, in all respects, that can be hop'd for in this kind; as well with regard to the natural history of Bees, as to the new

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and easy methods, there proposed, for their increase and improvement. This tract is found in the 5th volume of his *Memoirs intended for a History of Insects*; a work, which for the price, bulk, and extensive learning, seems only fitted to the capacities of the learned and the curious.

Thus the destiny of Bees has this in particular, that all those, who have most successfully interested themselves for them, who have best known them, and who have treated of them most learnedly, and with the greatest exactness, have not writ but for such, who have it not in their power to profit by their discoveries, and lectures, and have no real relation to Bees: whilst those, who breed them, and who might make their advantage of them by enlarging commerce, have scarce any knowledge of them.

This reflection has given me the notion of making those discoveries and improvements more general, which seem lock'd up in the cabinets of the learned; to place before the

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eyes of all those, who have any desire or any interest to be acquainted with them, the most proper means to bring up these animals, and so enlarge the commerce of wax.

'Tis with this view, and for these persons only, that I have attempted this *History of Bees*. I have taken all the materials from the memoirs of M. de Réaumur. One will be easily persuaded, that I could not draw from a purer nor a more copious source. The form of dialogue, which I have pitch'd upon, appeared to me the most proper for instruction, without having that dogmatizing air so discouraging to readers; who, through want of practice, find themselves not fitted to attend to a continued and connected discourse.

As my only aim was to make myself useful, I have made no scruple to make use of the observations, remarks, experiments and discoveries, which have already been made upon Bees by others; and have likewise employ'd their descriptions, such as I found them, either intire or abridged, and sometimes

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times by enlarging them, when I was certain of not exceeding the bounds of truth. To what M. de Réaumur has said, in his Memoir concerning Bees, I have added every thing which had relation to that subject, which is found in his other memoirs. I have preserved, as far as possible, his terms and expressions, being persuaded, that when things are well express'd, an attempt to express them otherwise is almost an inevitable risque to express them ill. If my conduct, in this particular, had need of an example to authorise it, I could cite that of M. Rollin in his antient Greek and Roman history.

As to the form of dialogue, which I have chosen, and the manner in which I have executed it, it belongs to the public to judge, whether I am in the right or no. I shall content myself with representing Clarissa as the mistress of a family, residing in the country on her own estate, and whose understanding has no other improvement, but that which a good education, a knowledge of the world, and the reading of books, not absolutely trifling, commonly give. Eugenio, the other person of
the

A D V E R T I S E M E N T.

the dialogues is the author; and though he borrows almost all his facts from M. de Réaumur, though he often copies his expressions, 'tis still Eugenio, who is accountable for the use he makes of them. If he is deceived, his mistakes are to be imputed to himself alone.

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Twelve COPPER PLATES to be
placed at the End of the Book.

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THE
NATURAL HISTORY
OF
B E E S.

D I A L O G U E.

EUGENIO and CLARISSA.

CLARISSA.

I WAS extremely disposed, Eugenio, to follow your advice, and to read the *History of Bees*, in the fifth volume of *Memoirs*, intended for an *History of Insects*, which you lent me. I was pretty certain of finding there all that you had promised me. But two Reflections made me change my design; the first is, that not having a head for abstract sciences, all that has the form and appearance of it terrifies me. You, however, represented this history, not only as very amusing, but as very learned. Perhaps you don't know, that if the amusing makes me advance ten steps forward, the learned, on

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the contrary, sets me as far back. The second is, that it appears to me, that if I was desirous, at this time of life, to employ myself in those studies, in which it is unusual to instruct our sex, and embellish my mind with them, such a parade would but ill suit with my other indispensable employments. What would the world say to see the mistress of a family, at the head of a country farm, go alternately from the examination of a problem, to a review of her poultry, or from reckoning with her farmers, to a geometrical calculation? Methinks I should have the awkward grace of those country ladies, who having been at Paris, or Versailles, mix the air of the court with their own country jargon. Let us each rest in our own proper sphere: Whether it be, that men have made these laws in consequence of their own interest, as we are sometimes apt to upbraid them; or whether it is the sole effect of reason, stripp'd of all private views, which presides over these customs: the laws are made; our birth subjects us to them, and we must obey. I am of the same sentiment, with regard to customs; and consequently with regard to that, which condemns us to an ignorance of the sublime sciences. So, see here's your book again: keep science to yourselves, and leave us to read only books of amusement and diversion; 'tis all that our sex, at least myself, must aim at.

EUGENIO. You do not use. Clarissa, to take things with so much vivacity. Curious and probable disquisitions have always appear'd to me.

to be in your taste ; and yet you cry out against them as much as if I had put into your hands Descartes, or Sir Isaac Newton, to comment upon. Now our *History of Bees* has nothing of resemblance ; it is the life of a people, industrious, laborious, and indefatigable ; rigid observers of their own laws ; full of foresight and oeconomy ; whose reigning passion is the good and prosperity of the Family ; of a people, in a word, who seem to have taken their model from you. What can you find here so rigid and abstracted ?

CLAR. This is a most obliging Compliment : but what causes my apprehensions, is to find the word problem at the opening of the book. We are there told, by way of applause, that one M. Kœning, the disciple of Bernouilli and Wolfius, (strange names for a woman!) had resolv'd a problem, which the Bees put in practice every day. After this, we are presented with a detail of the problem ; which I most unfortunately light upon, and where I had like to have lost myself. I am the Bees most humble servant ; nor think I myself worthy to be acquainted with such able Geometricians.

EUGEN. You reproach the author with the greatest merit of his whole work. He shews us, that what man gains not but by a long train of deductions ; that what Archimedes, Descartes, Paschal, and so many others, who preceded the invention of sublime geometry, were

not able to demonstrate ; he makes us see, I say, that the author of nature causes this to be executed before our eyes, by animals, to whom our pride denies understanding.

CLAR. I will confine myself to the moral, and will draw proper instructions from it ; but I have no need, in order to admire the Creator's work, to lose myself in demonstrations, that pass the bounds of my capacity. In a word, to abridge our dispute, I consent, that you, yourself, give me the *History of the Bees* ; nay, I beg of you so to do ; but spare me their classes, genius, species, and all that learned detail. I only desire to know the life, manners, inclinations, the employments, labour, and industry of these little people. As when I read the *History of China*, I have no need to have the Chinese Kalender explain'd to me ; but I should like to be inform'd, how the ladies there, with a very pretty little foot, a small nose, little eyes, plump cheeks, a shape short and fat, appear charming ; that they there find a husband, who, after ten years marriage, has not had a full sight of his wife, tho' he has had several children by her. To conclude, I ask nothing of you but a romance, but the true romance of the *History of Bees*.

EUGEN. I will endeavour to satisfy you : I will relate nothing but what has been carefully observ'd, and well attested : there will enter a good deal of the marvellous into my recital, but nothing of the false. I shall destroy the antient fables, with which, I doubt not, your infancy was

often amus'd. In return you shall have truths, that will not less surprize you, and will give you more satisfaction ; but I shall have need of several audiences for this purpose.

CLAR. You shall have as many as you please. Every day, after dinner, we will retire into my walk of lime-trees ; and there you shall tell me, at your leisure, the wonders of that people ; with whom, according to you, we have liv'd so long, and of whom we know so little. This place will be so much the more proper, as we shall have in view a dozen of hives ; the advantage of which, hitherto, has been only known to my gardener.

CONVERSATION I.

Of the first objects, which a bee-hive presents.

EUGENIO.

ME thinks I see, among your hives, one, that is a glass one.

CLARISSA. Yes, 'tis that, which I order'd to be made according to the plan, which you gave me. However, I own my cowardice; I never dare go near it, so great a fear I have of their stings.

EUGEN. Let us draw near to this glass-hive, and fear nothing. These are not men, but animals, instructed by nature, and faithful to their instructions; animals, that do not suffer themselves to be hurried away by the movements of an irregular passion. Do not attack or menace them, and they will not attack you. Glass hives are very commodious, to see, in gross, the work of the bees, their combs, and their different movements. This invention, tho' simple, is new: a hundred years ago it was unknown. The antients, who probably did not apply glass to so many purposes as we do, had some hives made; whose glazing was transparent horn: but these last ages have brought glass-making to great perfection. Before we take a view of the
inside

inside of a hive, let us begin by examining the outside, which presents itself first to view. A hive is a city well peopled, where we find commonly from sixteen to eighteen thousand inhabitants. This city is itself a monarchy, compos'd of a queen, grandees, soldiers, artizans, purveyors ; of houses, streets, doors, magazines, and a polity. The queen, whom our fore-fathers (who did not make such nice observations) call'd a king, inhabits a palace in the inside of this city. I do not at all exaggerate, when I call it a palace ; it is a dwelling vast and remarkable ; of which I shall give you a clearer idea by and by. There the grandees have their hotels, and the populace their houses. All these pieces, that you see pendant from the top of the hive, are call'd combs : they are all of pure wax ; 'tis the same wax, which we make use of. These holes of an hexagon figure, which you there see, are their houses ; of which some are more capacious than others. Here are the hotels, or apartments of those, who, after the queen, hold the first rank in the republic, who are nearer to her person, and partake of her favours. The others are destin'd for the populace : they call them cells, or *alveoli*. All those bees, which you there see in the air, either going, or returning from the fields, those, which enter into the hives, or issue from thence with prodigious vivacity, compose that very populace, of which one part goes in quest of forage, or returns from thence : some bring food into the houses, where

it is distributed *gratis*; others return loaded with materials proper for building the public edifices. For the greater precaution, each Bee carries with him his lance; that is, that very sting, which to you appears so terrible. It would not be safe to plunder them upon the road; nor would an enemy find a kind reception, who should take it in his head to disturb their work, or insult their city. Every working-Bee is not only an artisan; he is likewise a soldier, always arm'd for defence.

CLAR. That puts me in mind of those Jews, who repair'd the walls of Jerusalem; with the trowel in one hand, and the sword in the other. Ah! Eugenio: see, here's a Bee on my hand. See — he couches his lance.

EUGEN. Don't touch him, Clarissa; don't stir; permit him to retire, according to his own fancy.

CLAR. You are in the right; see, he is gone, without doing me any harm!

EUGEN. It will always be so. Permit them to walk upon your arms, your hands, your neck; and even on your cheeks: you will have nothing to fear, if you do not disturb them. Bees grow tame with men; their neighbourhood does not at all terrify them. Let us go nearer.

CLAR. Stay a moment. Tho' I have great confidence in you, I shall be glad, before I take one step farther, to clear up a certain suspicion: Have not I heard, that they can't suffer strong scents? I must inform you therefore, that I have
put

put into my hair some pomatum of jessamin. Will therefore this trifling delicacy bring upon me a stroke of their lance?

EUGEN. This aversion for scents is one of those fables, with which it has pleas'd the antients to embellish the *History of the Bees*. If we were to give credit to divers writers, we ought not to approach them, 'till we have strictly examin'd our consciences. They assure us, that they cannot suffer impure persons, and especially those, who are guilty of adultery: that they give no quarter to robbers: that there are virtuous Bees, who love the virtuous, and know how to distinguish them. That fops, and curl'd and powder'd beaus, are their aversion. They tell us too, that there are certain times, when it would not be safe for the women to approach them. Aristotle goes farther: he pretends, that odors, whether good, or bad, determine them to attack the person, from whom they proceed. Believe nothing of all this: all those aversions are pure fables. We see them continually lighting on the most odoriferous flowers; namely, on jonquils, tuberoses, and lillies, which make your head ache; as well as upon the jessamin, your favourite; from whence they extract their honey, and collect their wax. One sees them too settle and continue a long time on places moisten'd with urine.

CLAR. I have nothing to say against their lillies and tuberoses; but for those places, so disagreeably moisten'd, I could not have suspected them of so vitiated a taste.

EUGEN.

EUGEN. We are all too hasty in our judgments. Pray what constitutes a good or bad taste ; a good or bad scent ? The senses, as well as the sentiments, don't fall in with the distinctions one may be apt to make : a whole nation of people differ, in this respect, from others ; and, without going farther than ourselves, your smell is gratified with the scent of your sheep-folds, which offends mine ; while that of woad, which you dislike, gives me pleasure.

CLAR. Methinks it would not be very difficult to determine certain smells to be really bad. In taking the plurality of voices, I fancy, one should find but few, who would speak in favour of those last mention'd places, which the Bees frequent.

EUGEN. Perhaps, more than you imagine. If the question was to collect the voices, in order to come at the proof, it is but justice to admit the beasts, since we are willing to judge of a sense common both to us and them ; and which is nothing but a mechanical affection, where reason does not always preside. Now, in such an assembly, compos'd of men, beasts, birds, and insects, whose class is far superior to the others, taken collectively, I doubt whether I should not find the greatest number of votes. But, see, we are wander'd far from our subject : let us resume the thread of our history.

CLAR. With all my heart ; for, without reproach, you place yourself in pretty bad company. I should much rather be satisfy'd on the
object

object I see before me. What are those lazy Bees about, who hang down in clusters from one of those combs?

EUGEN. Speak, if you please, with more respect, of a people, who go not to labour or repose, through laziness or caprice, as we do. They are Bees, which have deserv'd the repose they take ; after which, they will return again to work, with greater ardour. If there is any thing particular in this their method of taking repose, 'tis not only in collecting themselves in a heap, as you see them there, but likewise hanging in to each other, by their feet, and being suspended in the form of a garland. This may be seen through that other glass square.

Ibid.
Fig 2.

CLAR. This is really a very pleasant fashion of taking a nap. I can't think, that the first, which support all the rest, are very much at their ease.

EUGEN. And I believe they are as commodious there, as they would be on your couch : animals know how to take their rest as well as men. We are not sufficiently acquainted with the mechanism of their springs, to judge of the attitudes, that best suit them. But we may safely refer ourselves, in this particular, to nature. We see, every day, something more surprizing in other animals. Do you call to mind that caterpillar, which I shew'd you one day on one of your apple-trees ? Reflect, that I made you observe, when it had crept up one branch, and had fill'd itself there, its body was stretch'd out

to

Plate I.
Fig. 6.

to its utmost length, and tenaciously supporting itself with its two hind legs, form'd, with the branch, an angle of forty-five degrees; or, to speak less learnedly, the animal appear'd streight, like a stick erected on its end upon a plain, and in an oblique position; which our most expert vaulters can't perform for one moment, let them heek their feet with what force they please: and yet in this posture it is, that the caterpillar takes its ease, and judges of us, perhaps, as we do of it. The repose of Bees therefore, having nothing more to furnish us with, let us take our seat on this bench, over-against this other glass square, where we shall better observe the inside of the hive. See those combs I spoke of, which depend from the top: there is a space between them, big enough for two Bees to march a-breast, without embarrassing each other; these are the streets. There is a tract more spacious, of which there are several in a hive; these are the public places: these holes, or narrow passles, which cross the combs on each side, are lanes or narrow streets, wrought transversely: these are made by the Bees to shorten the way, when they are dispos'd to pass from one comb to another. You are not, however, to suppose, that every hive, which we shall see, has exactly the same disposition: they vary, as in our towns, according to the circumstance of places.

CLAR. I am now well acquainted with their streets; let us enter into their houses. These, probably, are those hollows of six sides, which
are

are on the surface of the combs, and which you told me were nam'd *alveoli*. Each Bee has, without doubt, one peculiar to itself; where it performs family offices; and in the possession of which, 'tis but just to maintain it.

EUGEN. Where there is no property, there can be no justice. Every thing is common among these people: there is no such thing as mine and thine, and consequently no plaintiffs or defendants. The *alveoli* are public edifices, which, like all the rest, belong to the whole society. Some are magazines, closed up, where they deposite their honey against a time of scarcity: others are open magazines, for the daily food of those Bees, which guard the house: in others these deposite their unwrought wax, for those who work, without ever stirring out: others (and these, without comparison, the more numerous) are destin'd to receive the eggs; from whence new Bees are to take their rise, and to nourish and bring up the little maggots, from whence they proceed.

CLAR. If it be so, tell me where the Bees pass their nights: it is likely they lodge in the city. That gives me some disquietude.

EUGEN. You have cause to interest yourself for them: they deserve it; since they actually labour for you. But bid adieu to your fears: they pass their night without changing their roof; either in clusters, as we have just now seen them, or in the form of a garland, before their houses.

CLAR.

CLAR. Before their houses ? That is to say, that they lye in the streets. Farewel then the palace of the queen ; farewel the hotels of the grandees, and houses of the populace : see every thing converted, in a moment, into magazines, or the cradles of infants. I expected quite another thing from so politick a nation. The pleasing description you just now gave me, causes great regret in me to see it vanish so soon.

EUGEN. We do not always pass a right judgment, when we refer every thing to ourselves, and believe we are the common measure, by which every thing ought to be regulated : and that what does not resemble us cannot be right. When the Creator had form'd this earth, he peopled it with animals, that is to say, with men and beasts ; and provided for the wants of both the one and the other. Our own wants are known to us ; we know what to supply them with. Beasts have the same knowledge. Why should they be worse used than we ? They are, says Montagne, of the same family with us. But it was not necessary we should be treated after the same manner ; each is as they ought to be, and that well too, tho' in different manners. Omnipotence shines not less forth in the variety of created things, than in the creation. To sleep before the door of its house, is as much the property of Bees, as for us to repose in our beds, or for a hare in the middle of a field. As to the queen's palace, and those hotels you thought demolish'd, they subsist still in their perfection.

perfection. It is true, when the Bees are arriv'd to a certain age, which, among us, we call maturity, they no longer make any particular use of them : they reside in open air, and employ themselves in their infancy. Let us now pass to the different states, which compose the nation of Bees. A hive commonly consists of a queen, the only one of her sex, of two, three, up to seven or eight hundred, and even a thousand males, commonly called Drones ; and of fifteen, up to sixteen thousand or more Bees, of no sex, which I call the Workers ; because they are those, to whom the whole management of the family is entrusted.

CLAR. One only female, a thousand husbands, fifteen or sixteen thousand domesticks, who are neither male or female ! You begin to tell me wonders betimes ; will you abate nothing of all this as we proceed ?

EUGEN. With regard to their number, I shall sometimes have reason to retrench, sometimes to augment ; but never, with respect to the fact. You will sometimes see two, three, or four Mother-bees ; but, after winter is over, there is never more than one ; and this one is so necessary, that a hive cannot subsist without her. The Queen, or Mother-bee, or Queen-mother, (for I shall indifferently give her one of these names) is the soul of the hive ; 'tis she, that puts every thing in action. In a hive, where there is no mother, all languishes, all labour ceases. Aristotle talk'd idly, when he told us, That
when

when the Bees are depriv'd of her, they content themselves to make wax combs, but lay in them no store of honey : but he had only seen them superficially. When they are destitute of a queen, they no longer amass either honey or wax ; having no prospect of prosperity, they embarrass themselves no more about futurity : they do not hoard, like our misers, for the pleasure of hoarding. When they perceive there is none to survive them, they no longer disquiet themselves ; they live from day to day, and content themselves to take their melancholy repasts in the fields : but, presently, the uneasiness to see themselves the last of their race, makes them pine away, and they perish in a little time. Give yourself the pleasure to take the Mother-bee from the hive, and you will soon see it empty, either from mortality, or desertion : I have had the experience of it.

CLAR. I shall never do so : diversions of this nature are not for me. Methinks, you learned gentlemen, the desire of knowledge makes your hearts terribly cruel : If beasts are of the same family with us, you are but bad relations.

EUGEN. The orders you give your cook, in consequence of which he dispeoples your courtyard of its poultry, or your pidgeon-house ; those you give your huntsman, are they much more humane ? Methinks your table is no commendation of that tenderness of heart, which animates you against the learned. Which has
more

more right to be cruel, the desire of satisfying one's appetite, or that of instructing ourselves? own frankly, that we have nothing here to reproach ourselves with : So let us continue our subject. I shall have frequent occasions to mention the attachment, tenderness, respect, and duty, which the Bees pay to their queen : but, to give you, at present, a high idea of that admirable fidelity for their sovereign, which renders them so praise-worthy, I will only relate two very odd facts. Swammerdam, an author you are not well acquainted with, but whose testimony may easily be admitted, drew the Mother-bee of a swarm by one of her legs, with a small bit of thread fasten'd to a long pole. The whole swarm immediately assembled round the end of this pole, to cover the Mother-bee. This swarm was carry'd wherever the bearer pleas'd, in pursuit of the pole. The other fact is this. I remember to have seen you reading the *Travels of P. Labbat* : I make no doubt but you took for a pure romance that, with which that father inlivenes his history, his relation of the Bee-man.

CLAR. Help me to recollect the fact.

EUGEN. These then are pretty nearly his words : “ He receiv'd a visit from a man, who
 “ call'd himself the master of the Bees : whether he was their master, or no, 'tis certain
 “ they follow'd him as a flock of sheep does their
 “ shepherd, and even closer too ; for he was
 “ entirely cover'd with them. His cap, particularly, was so covered, that it perfectly re-

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“sembled

“sembled those swarms, that endeavouring to
 “settle, fix on some branch of a tree. They
 “bid him take it off, and the Bees placed
 “themselves on his shoulder, his head, and his
 “hands, without stinging him, nor even those,
 “who were near him.---This man must needs have
 “rubbed himself with the juice of certain herbs.
 “He was pressed to tell his secret, but they
 “could get nothing out of him, but that he
 “was the master of the Bees. They all followed
 “him, when he retired: for, besides those he
 “carried about with him, he had legions, which
 “attended him.”

CLAR. This man had certainly Swammerdam's pole; or, rather, he was him himself.

EUGEN. I make no doubt but this jugler had some Mother-bee fixed to his ear, or some neighbouring place, since that was sufficient to make a whole swarm follow him. You may judge of this by the natural attachment the Bees have for their queen.

CLAR. You continually encrease the desire I have to be acquainted with a mother so beloved.

EUGEN. 'Tis my design to make you acquainted with her. But I fancy we have talked enough about her for to-day; and that it would be proper to renew the same conversation to-morrow; when I will discourse with you, not only of this mother and her people, but likewise of the different states, which compose her numerous family.

CON-

CONVERSATION II.

*Of the queen of the Bees, and of the males,
or drones.*

CLARISSA.

YOU remember, Eugenio, that you owe me the description of a queen ; of whom I have, before-hand, form'd a very high idea.

EUGEN. Let us see the idea you have form'd ; we shall afterwards give ourselves the pleasure to compare it with the reality.

CLAR. In the idea of a reigning queen, which is likewise that of every other sovereign, I figure to myself an assemblage of clemency and justice, of humanity and haughtiness, of prudence and action, a grand and majestick air, of an access easy, and full of goodness, of a continual attention to the prosperity of her people, and of an inflexible severity with respect to discipline and the laws ; and a great many other fine things, which are not actually present to my imagination, and which, I fancy, I shall find in your Queen-bee.

EUGEN. Sovereigns, according to the portrait you have begun, and which, if you had pleas'd, you could happily have finish'd, are necessary among men, on account of the depravity, with which our nature is infected. Those

who govern, ought to be possess'd of moral virtues, that they may be oppos'd to the vices of them, who are governed : but, where moral evil is unknown, nothing but natural virtues are required. Therefore you make a wrong calculation of the virtue you judge necessary to a Queen-bee. Our fore-fathers, who made no scruple to supply by fables, drawn from their imagination, what they could not discover in their search of natural things, have given to the Mother-bee all the knowledge, foresight, wisdom, in a word, all those qualities, and all the virtues necessary to govern a numerous people ; over whom they have likewise given her a despotick power. They imagin'd, that nothing was done in the hive, but by her orders. They have likewise given her strength and power to execute those orders. Two authors, of great name and reputation, talk to us of the Mother-bee in terms, which ill suit with their reputation. The illustrious *Rollin, citing

* Hist. Anc. P. 47. Xenophon, compares a wise woman to the Mother-bee, commonly call'd, the king of the Bees. He says, that she alone governs the whole hive, of which she has the superintendence ; that she distributes employments, animates their labours, presides over the construction of their little cells ; that she watches over the subsistence and nourishment of her numerous family ; that she regulates the quantity of honey, destin'd for that use ; and that, regularly, at certain fix'd times, she sends the new swarms from the hive, to form a colony. To conclude ; all which they do, either

either within, or without the hive, they make them perform in consequence of the queen's orders. The head of a Bee, sufficient for so many different views, would be a strong head indeed, and much to be valued : but that of the Mother-bee, is probably exempt from all those cares. If she reigns, 'tis over subjects, who every moment know, that the good of their society demands what they perform ; and who therefore never fail to do it. They never have occasion to receive orders. In this state every one, whether monarch or subject, pursues their original design, from which they never vary.

CLAR. It is very easy to be a sovereign, at this rate. I could easily accommodate myself to a government, which would require no greater fatigue. Since all the world necessarily knows what ought to be done, it seems to me, that our queen has no other cares than those of making much of herself.

EUGEN. We shall presently see, whether you would change condition with her, and, upon the same terms, hold the reins of empire. The sole office of a queen, but an office, the importance of which is known to the other Bees, and which makes this mother so valuable, is to produce a numerous posterity : 'tis this, to which she seems entirely destin'd, and the only title, by which she lays claim to royalty.

CLAR. It is likewise the principal object, and what one expects from the queens of all people.

EUGEN. It is true. But the views and wishes of the people terminate in obtaining an heir for the empire : but, among the Bees, their demands are much higher. A queen, who would merit the love of her subjects, must produce between ten or twelve thousand children in seven weeks, and, commonly, from thirty to forty thousand in a year.

CLAR. Ho ! ho ! you are in the right to fancy the honour of a throne is a dear purchase in this country.

EUGEN. This prodigious fecundity is an article, which demands a whole conversation, with which I will entertain you another time : at present, I will satisfy myself with finishing the portrait of the Mother-bee, and the two other orders, which compose a hive. The queen is easily distinguish'd from the rest, by the form of her body : she is longer, and more slender than the males : her wings are very short in proportion to her body ; whereas the wings of common Bees, and those of the males, cover their whole body : those of the female hardly reach beyond the middle, and end about the third ring.

CLAR. Would it not be better to give me a sight of her, since we are over-against a hive ?

EUGEN. Doubtless, if the thing was easy ; but it scarcely ever happens, to have a sight of the Mother-bee. Many of the country people, whose business it is to take the honey and wax, have never seen one ; and die without the sight.

I have

Plate I.
Fig. 3.

Ib. Fig. 5.
Ib. Fig. 4.

I have had, for many years, a glass hive, without having ever seen the Mother-bee : the fault, certainly, was not for want of carefully looking for her; and I should, perhaps, not yet have known her, had I not had recourse to some expedients ; of which I shall give you an account some other time. In fine, the queen is bigger than the males ; the males than the working Bees : thus the queen is the largest person of her whole realm : she joins to this air of majesty a grave and solemn gate, a good deal of sweetness, and a prodigious fruitfulness. 'Tis to this, that all the great qualities you suppos'd to find in her, are reducible ; excepting this, and some other slight differences, a detail of which would not be very agreeable to you, she pretty much resembles, with regard to her exterior form, the working Bees ; and has, like them, a sting.

CLAR. A sting !

EUGEN. Yes, a sting. This, likewise, is an ancient error, that the king or queen (for they were so ill instructed, that they could not agree about the sex) was not provided with that offensive weapon. The Mother-bee carries about her a sting, which differs not from those of other Bees, excepting that it is bigger, and a little curv'd. The sheath, which furnishes the venom, which this sting introduces into the skin, is likewise found in her. I had the curiosity to put some of this venom upon my tongue, and can tell you, it is burning and caustick. We ought to do justice to Aristotle, and except him from the general number of the an-

cients, who have denied this Queen-bee a sting : he was but half deceiv'd in this particular. He agrees, that the Mother-bee is provided of a sting ; but then he pretends, that she is not arm'd with it, but for dignity ; and that she makes no use of it. It is true, she is extreamly pacifick ; and that one may handle her, and turn her, and even teaze her, for some time, before she determines herself to vengeance ; but, at last, she determines, when it is absolutely necessary. The fault was wholly my own, that I had not the honour of being stung by a queen : but I judg'd it proper to deprive myself of it, believing, that experience would teach me nothing more than I had seen.

CLAR. You are not, Eugenio, as yet, above half learned: having felt the venom, you ought likewise to feel the sting. I have a right to refuse my assent, 'till you have been well stung.

EUGEN. When the presumption is strong for the affirmative, the negative is not admitted, but after sufficient proof, on the part of him, who denies. Therefore I would not advise you to wrangle ; but firmly to believe, that when a Queen-bee has been at the trouble to sting some insolent, who has made himself too familiar with her, she causes a wound larger and more painful than the other Bees, a wound proportion'd to the instrument, which makes it.

CLAR. 'Tis a truly royal character to be slow to punish ; but to do it in such a manner, that the example may be capable to deter others ;
and

and that the remembrance of it may continue a long while.

EUGEN. Your reflection is just. But, besides the moral sense, which you rightly draw from it, there is likewise an essential physical reason, which requires it should be so. It is this : The whole safety of the republick depends on the life of this queen ; and, as it is of importance, that so valuable a life should not be so often expos'd as that of ordinary Bees, nature has bestow'd upon her a pacifick disposition ; which exposes her less than others, to serve herself of that weapon ; the effect of which is almost always fatal, both to the offender and revenger : as I shall explain to you some other time. Let us now pass to the drones, or males ; that is, to the thousand husbands of this single queen. They call them the drones, to distinguish them from other large flies, more commonly known under the name of Drones. They are not ordinarily found in hives, except from the beginning or the middle of the month of May, till towards the end of July : their number is encreasing every day, during this interval : and 'tis never greater, than when the queen is in a condition to multiply the species, and in those, which immediately precede that, wherein they all disappear, or the majority of them ; and, in few more days, they too will finish their life by a violent death.

CLAR. How, by a violent death ? You make me tremble ! Would the Mother-bee be a person

person to renew the frightful nuptials of the daughters of Danaus ?

EUGEN. 'Tis one of those true and singular facts, many of which you will see in the course of this history ; but it is not yet time to entertain you with them. The drones, of which I have already made mention, are smaller than the queen, and larger than the working bees. As we are yet in the season proper to find them very easily, let us look through this glass, whether we cannot meet with some.

CLAR. Is not this one of them, here ?

EUGEN. You are in the right ; see, here are many of them, which take their walks very negligently. The life of these is very different from that of the other Bees : it is conformable to the sole employ, to which they are destin'd, to the honour of being husbands to the queen, and fathers of a numerous posterity : that certainly requires a distinction ; therefore they have a very great one. Except the moment, in which their services may prove essential to the queen, they are exempt from all labour. To live, is the only thing they have to do. A life so soft and delicate could not be supported, but by very substantial food ; therefore they eat nothing but what is very choice, and of easy digestion. They live, in reality, on nothing but honey ; whereas the working Bees eat a good deal of coarse wax. These, being brought up more hardily, take their way to the fields, at the rising of the sun, and return not home without being charged with

honey and wax for the common good of the society. The drones, on the contrary, go not out, till about eleven in the morning, to take an airing, and a slight repast, and return exactly before six in the evening ; so much are they afraid of cold air and damps. To bear arms is not intended for the slothful and voluptuous : they would be of no service, but to dishonour them ; therefore they have them not. They wear no sting. Some body, but let not that some body be you, Clarissa, might be tempted to envy the honour of these drones, and their softness of life ; but would soon find cause to repent. We shall see, in the sequel, that the term of a life so delicious is very near its commencement ; and that it always finishes by a tragical end.

CLAR. So much the better : it is an example I will never fail to represent to my children.

EUGEN. The best use one can make of human knowledge, is frequently to draw from thence instructions for ourselves and others. The drones not being form'd for the gathering wax, or putting it to any use, nature, who makes nothing in vain, has not given to them as to the other Bees, pallets, which may serve them as so many baskets to bring wax to their hive, nor teeth jutting out and proper to knead and fashion it. The teeth of these drones are little, flat, and obscure : their trunk likewise is more short and thin. There is likewise some other dif-

Plate II.
Fig. 1.

differences in their exterior parts ; but there is one, that can't be pass'd over, without particularly attending to it ; that is, their eyes. The eyes of the males cover the top of all the upper and under parts of their head, whilst those of common Bees only form a kind of oval cushion, or roll on either side. I see, very opportunely, at the bottom of the hive, several dead Bees, which will assist me to shew you that, which I could not so clearly describe to you. Here is one. 'Tis a male, too. Don't you see these two large eyes.

Ibid.
Lett. A A.

CLAR. They are prodigious. It appears to me, as if the two together are much bigger than the rest of the body.

EUGEN. That is true. This part, so essential to every animal, who has occasion to transport itself from one place to another, has been, (luckily for us) examin'd very carefully, by able philosophers, in our own times. Nay, it seems too, as if they had given the preference to the eyes of flies, on account of the particularities they have met with in them, and which are common to all, as well Bees, as other kind of flies. For this reason I shall enlarge a little on this article, and hope to find discoveries on this subject, which will, at least, afford you as much pleasure, as the pretty little feet of the Chinese ladies.

CLAR. I understand your raillery, Eugenio : Let us see then the rarities you have to inform me of, with regard to the eyes of flies.

EUGEN.

EUGEN. Insects have not, perhaps, any other part more proper to shew us, with what prodigious magnificence nature has form'd them, and to shew us, in general, how many wonders she has wrought, which escape us. So those, who have employ'd most time in studying insects by a microscope, as Bonnani, Hooke, Lewenhoeck, Puget, have not fail'd to take notice of these eyes. Those of flies, beetles, butterflies, and divers other insects, differ in nothing essential. All these eyes are, nearly, portions of a sphere : their exterior case may be consider'd as honey. They call the outward covering of every eye horny ; as well our own, as those of other animals. That is it, which you may touch with your finger, if you are dispos'd ; the lid remaining open. The eyes of those insects, which we treat of, have a kind of radiance, which often present colours as much varied as those of the rainbow. It appears to the naked eye, unaided by a microscope, as smooth as glass. However, look at the eyes of this dead Bee through my magnifying glass, and tell me what you see.

CLAR. They appear, to me, cut facetwise, like a diamond. A work truly wonderful ! What art ! what regularity ! What an hand that is, which is able to effect such things ! The number of these facets is prodigious ; is innumerable.

EUGEN. The number, however, has been counted. Lewenhoeck has computed 3181, upon the horney part of a beetle's eye ; and upon each of those of a fly. And M. Puget has calculated

17325 upon each of those of a butterfly. And, not to make you wait any longer, that which is most surprizing is, that they pretend each of these facets to be so many eyes : so that, instead of two eyes, which some have scarcely granted to butterflies, we ought to ascribe to them 34650 ; 16000 to flies, and other insects more or less ; but always in a very surprizing number. The discoveries made by these learned gentlemen incontestably prove, that every facet is a chrystalline ; and that every chrystalline is attended with that, which forms a compleat eye. This is one of their experiments. They detach'd the horny substance from the eyes of several insects : they took off all the matter, that adher'd to it ; and, after having well cleans'd the inward surface, they put in its place the lens of a microscope. This horny part, thus adjusted, and levell'd against a soldier, made a whole army appear ; against a flambeau, one of the richest illuminations, that could be seen. Lewenhoeck has carried his dissection so far, as to discover to us, that every chrystalline has its optick nerve.

CLAR. I do not at all doubt of the sagacity and exactness of your virtuosi ; and it is that, which causes my embarrassment. When a Bee sees a violet, an anemomy, it really sees more than thirty thousand anemonies, or violets : how, then, can this fail of puzzling it ? How can it light, without hesitation, on the flower, which is real, since all the other are only illusions of the sight.

EUGEN.

EUGEN. You have two eyes ; and yet, when you look at me, you don't see two Eugenio's.

CLAR. Philosophers save themselves by comparisons, when reasons fail them.

EUGEN. Reasonable philosophers have likewise another manner of saving themselves ; which is often my own ; and that is, to own my ignorance. We are not very well acquainted, how we see simple objects, altho' we see them with two eyes : but the fact is certain ; nor do I believe that you will doubt of it. From thence it is easy to conceive, that insects, which may have a thousand eyes, may see objects single. But it cannot be that they can see them with all their eyes at once ; the convex figure of the horny substance does not permit rays reflected by certain objects to fall on more than a small number of chrysellines, notwithstanding the thousand of eyes, which we consider as the organs of sight in animals, of which those two orbits are composed. The greatest part of flies have three others, placed in such a manner, as will appear to you very extraordinary. Those three eyes, which are as many chrysellines, but very smooth, and are not cut into facets, are much less than the two others. They have a triangular position on their head, between the skull and the neck. See them here on this Bee ; where you may easily discover them with my glass.

CLAR. I see them. Their design seems to be to look towards heaven.

Plate II.
Fig. 12.
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EUGEN.

EUGEN. You may judge from this, that a fly, which walks on a plain, ought to see on several sides at once. The difference of the eyes in the same insect, the several places bestow'd on the one and the other, give us room to suspect, and with some probability, that nature has favour'd insects with eyes, differently modified ; with eyes proper to different purposes ; that she has bestow'd upon them some to discover objects at a distance, and others to see them, when very near : that she has provided them, as one may say, with microscopes and telescopes. For example : A Bee, whose business it is to form an *alveolus*, and to work up its angles, according to the most geometrical demensions, ought to have its eyes very near the object. You would discover nothing, was you to look as near to the object as a Bee : its eyes then ought to have a construction very different from our's, and fitted to see objects, not only very near, but likewise in the darkness of a hive. A Bee ought likewise to see afar off. For she sometimes wanders a whole league from her hive, and returns without any hesitation or fear of losing herself. In fine, if we see on the same insect, several globules of eyes, which differ considerably among themselves, both as to bulk and figure, ought we not to conclude, that these globes contain eyes of very different offices : and wherein can the difference consist, but in causing them to see some objects near, others at a greater distance, in representing their bulk in the proportion it bears

bears with the body of the insect, either in shewing their bigness augmented or diminished. A singularity carefully to be remarked, and which is found on the greatest part of these eyes, form'd facet-wise, is, that they are cover'd with hair. When one views those of Bees with a very good glass, they are found to be cover'd with hair, which appear to us not very well placed. It is reasonable to suppose, that these hairs may hinder the rays of light from falling on these facets; but it must be observ'd, that they are upright, and not inclin'd, and that by this means, no rays, but in a certain direction, can fall upon them: besides, they are capable of detorting too great a quantity of useless rays, which would only embarrass the sight; and in this case would have the same use with our eye-lids.

CLAR. After so many subtle discoveries and enquiries, I should be scrupulous of proposing one of those objections, which I have heard are so confounding among philosophers, who love dispute.

EUGEN. Since truth is the aim, scruples and management are out of the question. Propose your difficulties, and confound me, if you can.

CLAR. Since you assume, Eugenio, this air of assurance, I absolutely deny the existence of eyes; and maintain, that you take for organs of sight, those, which are destin'd for other purposes; that, besides, their eyes are, for example, at the end of horns, as in snails.

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EUGEN.

EUGEN. Some philosophers, and M. de la Hire, among others, have had the honour of being of your sentiment. He would not own for eyes, those globes cut facet-wise. But attend to experiments, which I believe will convince you, as he himself would have been convinc'd, had he known them. Mr. Hooke tells us in his *Micography*, that he had taken out the eyes of some flies, and that they wandred about as blind. Swammerdam had recourse to a method more gentle and as certain; he put upon the eyes of certain flies, a covering of black steep'd in oil; he observed, that in this state they flew at random, that they seemed to have no strength, and that wherever they settled, they did not avoid the hand, which would take them. I my self have made some experiments upon these eyes wrought in net-work or facet-wise, of certain Bees, all taken from the same Hive. I spread upon their eyes, a covering of dark colour'd varnish: I shut them up, with some of their companions, which I had not touch'd, in a large powder-box. I was not above eight or ten steps from the hive, from whence I had taken them. When I had taken off the cover of the box, those, which had their eyes clear, immediately took their flight, and went to their habitation: those, whose eyes were varnish'd, made no haste to get out of the box, they had some difficulty to determine themselves for flight; and the greatest number directed it at random, and on different sides, and went not far. To oblige some of them to fly farther, I
threw

threw them into the air ; they raised themselves vertically 'till I had lost sight of them, and knew not what was become of them. A pretty amusing hunting of crows has been found out. Holes are made in the ground, in an open field. They place in these holes a coffin of paper glew'd on the inside, and at the bottom of this coffin a bait. The crow, which touring in the air, perceives a bit of reddish flesh, alluring to its taste, falls upon it, and makes himself a ruff of this paper, thus smear'd with glue, and so much the more incommoding, as the ruff covers his eyes, and he knows not which way to get rid of it : thus muffled up, he raises himself in air, till you have lost sight of him ; and they tell you, that he keeps flying so long, that he falls down, without any strength, and almost dead. My Bees, whose eyes were thus varnish'd, represented to me, in small, an image of this hunting of crows. Not only those, which I flung up in air, but all those, which being more lively and more restless than the rest, took a more elevated flight, fail'd not, in mounting higher and higher in the air, to disappear from my eyes, and not one of them seemed to know the way to his hive. I was desirous likewise of knowing what would happen, if I stopp'd the three eyes they have on their head. I put therefore varnish upon them in the same manner as I had done to those eyes formed in facets : I set them likewise at liberty, about three or four steps from the hive : not one seemed to know the way, or even to seek it. They flew

from all sides upon the plants, but did not fly far. I never more set eyes on those, which mounted in the air, as those did, which had their large eyes varnish'd over. It happens also sometimes, that they make themselves blind. I have often seen Bees, which flew, in whirling about near the surface of the ground; they did nothing but turn round, as if they had been mad. Without doubt these motions proceeded from the powder, put on the hair of those eyes, made in net-work, for those Bees appeared all powder'd. Judge you, Clarissa, whether there would not be enough, from these experiments, to give a sufficient answer to your formidable negative?

CLAR. Do you think, Eugenio, to pay your court to me, when you reduce me to a necessity of not being able to contradict you? I give you notice, that if you continue always to have your reasons, you will push mine to the extremity.

EUGEN. You save yourself by pleasantry, as I did, just now, by comparisons. I have described to you the Mother-bee, the males or drones: it remains, that I should bring you acquainted with the Working-bees. We shall not find a whole conversation too much for this. It shall, if you please, be the subject of the first we have together.

CONVERSATION III.

Of the Working-Bees.

EUGENIO.

I AM, to day, Clarissa, to entertain you with the Working-bees, those very Bees, which have the care of the whole hive, which collect the honey and wax; which fabricate, fashion and work up the wax; which build their *alveoli* with it; bring up the young; keep the hive clean; drive from thence the strangers, and employ themselves in all those other concerns, of which we shall speak, as occasion offers. I shall not speak, at present, but of their exterior parts; and that I may manage your delicacy, an enemy of long dissertations, I shall only discourse of those parts, which have their offices well known, or have something singular. First of all, let us gather up this dead bee, and make use of my magnifying glass, to observe it. That, which is seen by our eyes, strikes and effects us more than what we hear: first remark its head; it appears to you triangular: you are to know, that the point

Plate II.
Fig 4
Plate II.
Fig. 5.
Lett A A.
Plate IV.
Fig. 2.
Lett. A A

that of instruments proper to break and divide the food. Among the Bees it is the least noble of their employments : they are instruments, by means of which, they perform those works most worthy of admiration. This is what I shall acquaint you with, when we come to the structure of their *alveoli*. These two teeth, which appear to you as flat plates, are nothing less than flat : separate one from the other with the point of this pin, you will find they are a kind of spoons, whose hollow is on the inside. The exterior circumference appears to you border'd with hair. I will tell you, in a moment, the use of these concave teeth.

Plate II.
Fig. 5.

CLAR. I see perfectly all that you tell me. These two teeth have the air of pincers, and cutting, such as voracious insects are possessed of.

EUGEN. Our Bees, however, are not carnivorous : there is something more, which is, that these two teeth are not in the mouth, or, to speak more justly, the mouth is placed elsewhere. I will give you sight of it, in its turn : but must first show you its lungs.

CLAR. You pass, very quick, into the inside of the animal. We ought, methinks, to have a good many of the exterior parts to examine first.

EUGEN. The lungs are exterior in all these insects. The method of respiration, in these insects, is so different from ours, that it deserves we should stop there a little. Raise up the two wings of the same side you hold it, you will find

find near the origin of the under wing towards the stomach, an opening resembling a mouth.

Plate II.

Fig. 6.

Lett. A.

CLAR. I see it.

EUGEN. That is the opening of one of the lungs. Let not this term impose upon you; there is nothing that bears less resemblance to our lungs, in regard to their form, than those of insects: but the use of them being the same, with regard to respiration, and that being now our subject, I think it will be proper to make use of a well known and useful term. There is another of them more high, concealed by the first leg; and two more on the opposite side, which make the corcelet, (we call that *corcelet*, in insects, which in other animals we name the breast) without counting twelve others, which are distributed on one side, and the other upon the six rings of the body. All these insects in general, have like organs of respiration: the difference lies only in the number, and the places where they are fix'd. The silk-worm, and other insects of the same species, have eighteen: the *Courtilliere* has twenty. *The Memoirs for a history of insects* describe many species of worms, which carry their lungs at the end of their horn.

CLAR. The lungs at the end of the horn? how odd it is! This reminds me of what you told me some few days ago, that an infant had been seen, who came into the world, with his heart out of his breast, hanging like a medal before it.

EUGEN. The natural order in this infant had been inverted; it was monstrous, and the insect, of which we speak, would be equally a monster, if it had its lungs in its breast. Nature knows how to fix every think in its right place. These openings or lungs are named stigmata, and from them branch out, within the body, an infinity of small canals, form'd of a small whitish fibre, roll'd upon itself like the worm of a gun. These canals ramify themselves prodigiously, and convey air into all the parts of the animal's body. We emit air by the same canal, by which we respire: insects, on the contrary, take in air by these stigmata, and return it by the pores of their body. Were one to stop these openings with oil, you destroy the animal, because you deprive it of respiration. From hence it is said, that oil is mortal to insects. Let us pass to other parts of them. Draw back a little the head of your Bee, you will see that it adjoins to the breast or corcelet, by a very short neck, and this corcelet to the body by a very fine ligament. The body is cover'd over with six great pieces of scale, which slide one over the other, and form six rings which leave to the body all its suppleness, and defends it at the same time from fatal blows it might receive from without. To conclude, they are cloathed in armour, like our antient warriors, when they fought with bows and arrows.

Plate III.
Fig. 3.

CLAR. However, I believe they have little to fear from such like accidents.

EUGEN.

EUGEN. Don't possess yourself of too good an opinion of our Bees. They have doubtless surprizing qualities; but then they have others, which will appear to you so distant from what we call *reason*, and conformable to the abuse we are accustom'd to make of it, that you will be often tempted to blame them. They have frequent quarrels among themselves, and these quarrels often proceed to a fight with each other, or a combat of several against several. So it was necessary they should be arm'd, as well for defensive as offensive war. You will see proofs of it in time. Let us now finish our description. The *antennæ* are those two kinds of moveable and articulated horns, at the end of which you would willingly place the eyes of the Bee. Almost all insects have similar horns, whose use is yet unknown.

Plate II.
Fig. 1, 2,
and 3.
Lett. D D.

CLAR. I must inform you then, for I am us'd sometimes to observe and reason upon what I see; these horns are certainly the organs of touch or of taste: chuse.

EUGEN. I suppose they are neither one or the other?

CLAR. What are they then?

EUGEN. That is the very thing, that is unknown. It is perhaps the organ of a sixth sense, of which we have no idea. But let us pass to things more easy to be known. The second and third pair of a Bee's legs, have one part which we call the *brush*. This is it. This part is square, its exterior surface is bare and smooth; its

Plate II.
Fig. 7, 8.
Lett. A A.

its interior side is more charg'd with hair than our brushes; they are likewise placed in order. If one considers, with attention, a Bee upon a flower, the use it makes of these brushes is easily known, as the teeth and brushes are instruments given to the Bee, for the collection of that matter, of which wax is made: I will describe, more at length, what this matter is, and the instruments, with which it is collected. I see yonder a faded lilly, which I will gather, to explain myself more easily. You see rise from the middle of this lilly, sprigs surmounted by a heavy part, which lie upon their upper extremity, and so cross, as to give them the figure of a little hammer. These sprigs are called by the botanists, the *stamina* of the flower, and this little hammer, the *summet*. It is not always of the same form you see it here. It is sometimes only a capsula, which includes the powder, and at other times it bears its powder without; and this powder remains on the fingers of those, who handle it, as in the lillies. There are true materials of wax; 'tis more, it is wax itself, but rough and unform'd. I shall make another digression with regard to these *stamina*. I cannot let the occasion slip, of informing you of one of nature's secrets, which the modern naturalists pretend to have stolen from her. You see, in the middle of these sprigs, another part, which raises itself like them, and which terminates by a kind of button. It is called the *pistile*. It is said, that this pistile is the female part, and the *stamina* the male:

Plate III.
Fig. 1.
Lett.
A A A.

Ibid.
Lett. B.

that

that the two sexes are collected in the middle of the flower ; that plants are hermaphrodites : that the dart of these stamina falling on the pistile renders the seed fertile ; and that every seed, not thus vivified by this dust, remains barren. This system of the generation of plants has been carried a great way : inanimate, as they appear to us, they have their amours, which have not escaped the sagacity of our observators. This dust then, which falls upon these stamina of flowers, is the sole matter, of which wax is made, which I shall call rough wax. The seeds, which compose this dust, have not figures form'd at random, like bodies bruised or ground small. In every kind of flower, these seeds have a determinate figure : they are commonly of a round form, or rather oblong ; they have likewise, sometimes, very particular figures. The Bee, which would collect this dust or rough wax, enters into the flower well blown, whose stamina are loaded with this powder, which adheres but very slightly. Then the bristling hairs rub against this powder, and charge themselves with it : the Bee comes out all cover'd with powder, and of the same colour with it ; which is sometimes yellow, sometimes red, and sometimes of a yellowish white, according to the colour of the stamina : if these powders are shut up in the capsulæ, or boxes, as they are in many flowers ; the Bee employs those salient feet, which I shewed you, to open the capsula, and to get from thence that precious powder, with which all its hairs

are

are instantly covered: though there are several Bees, who, when they come to their hive, have their hairs full of this sort of dust, there are still more, who before they think of returning, take care to clean and brush themselves. I can't tell what determines them, to brush themselves by the way, or to wait till they are returned to their hive in order to do it: but I can tell you, it is very curious to see them. There is a certain time very proper for this; it is towards the latter end of winter, when they are weak and dispirited; for when the warm weather has made them lively, you can no more follow the movement of their feet, than you can the fingers of an able musician, who lightly runs over the violin or harpsicord. They have, as I have already shewn you, four brushes, upon their four hinder legs; but more particularly, two very large, upon their hindermost. It is easy to imagine how the Bees, by passing and repassing, its different brushes over the several parts of its body, can take off the powder, which sticks to them. When I say take it off, it is not as we do our cloaths, in suffering them to fall: these materials are of a very great value to the Bee: she collects them while she is a brushing, and rolls them up in a little mass. I have sometimes had a very great pleasure, to see their forelegs transport to those of the middle these small masses, and these again place and pile them up, on the triangular pallet of their extreamest legs. This pallet, which I have already spoke of, in telling you, that the

Plate II.
Fig. 7, 8.
Lett^r A A.
Ib. Fig. 8.
Lett A.

Queen-bee and the males have it not, because they are not destin'd to gather the wax, assuredly deserves not to be forgot. The Bee has six legs, all of which are compos'd of five parts, articulated like our arms, which affords them a number of various movements. The first parts are Plate II. Fig 7. very well furnish'd with hairs, and these hairs are form'd like the leaves of trees, to be more fitted to collect the powder of flowers: but the third part, in each leg of the third pair, is what we call the *triangular pallet*. These two words Plate II. Fig 7. Lett. B. mark out their figure and their use. You may very distinctly see it with my glass. You will see likewise, that the same part, in the second pair of legs, is shorter, streighter, and less triangular, and that in the first pair it retains nothing of this form. The exterior side of this triangular pallet of the third pair of legs, is smooth and shining; the hairs erect themselves above their edges: as they are streight, stiff, close set, and surround it, they form, with their surface, a kind of basket. It is there, that the Bee collects Plate III. Fig. 3. Lett. A A. those little masses of wax, and in the form of a pin-cushion, which is sometimes as big as a grain of mustard. The two posterior legs, are guarded, each, with a like cushion; the Bee returns home, charg'd with its plunder. In stooping a little, and looking at the door of the hive, we shall not fail to see some of them.

CLAR. I actually see many, who return thus charg'd; but they are not all equally so: probably

probably there are some of them better workmen than other.

EUGEN. That is true : but we must say, that fortune interferes sometimes in their affairs : that some find plants better furnished with powder than others. When our free-booters set out for their course, they do not all return with equal plunder : the Bees, like ourselves, are subject to the caprice of chance.

CLAR. What charms me, is the diligence, with which I observe those small animals return with their prey. Methinks I observe a greater joy in those who are well loaded ; workmen like these assuredly deserve to live.

EUGEN. And so they do. The author of their being has provided for their necessities, in a very extraordinary manner. A comparison will shew you all the advantage. If our reapers found, in the very field, where they reap'd, and at the foot of those plants they cut, sources of water, fresh, sweet, and delicious, and proper to satisfy them as well as to quench their thirst ; their condition would not be so much to be pitied, as it sometimes is. This is the case of our Bees : they find honey, at the foot of these sprigs, loaded with dust, which they collect. It is therefore from flowers, that the Bees extract their honey, as from thence they collect their wax. A modern author has observed, that flowers have a kind of bladders, or rather glands, which are so many reservoirs of a honeyish liquor. These
glands,

glands, in different flowers, are differently placed, but the Bees know where to find it.

CLAR. I will tell you where they are ; for I remember, that chance, who often likewise interferes in my affairs, caused me to observe, one day, a Bee at work upon a flower : I saw it very distinctly plunge its trunk into the bottom of the cup, and hold it there a long while, in the lower extremity of one of those colour'd leaves, which compose the flower.

EUGEN. They call, in terms of botany, these leaves the *petals*.

CLAR. Petals be they then. It seem'd to me to pump it. But I don't now remember on what kind of plant it was.

EUGEN. Except pumping, for that they never do, the observation is good. Let us talk of the trunk or *proboscis*, since the discourse leads us to it. But first of all, I must guard you against the common prejudice, in informing you, that the trunk or mouth are two parts, very different, and separated the one from the other.

CLAR. It is then, as in an elephant.

EUGEN. Pretty nearly. The use of this trunk is not only to procure itself necessary subsistence, but it is besides employed by the Bees to collect that, which we appropriate to ourselves, as if it had been made for us.

CLAR. You doubtless, mean honey. I fancy we have as much right to this honey, as we have to the wax.

EUGEN.

EUGEN. As much as to the wool upon sheep ; 'tis a pure usurpation on our part.

CLAR. Ho, for once, Eugenio, I catch you tripping. I shall be right, now, and you in the wrong. Answer me : Who manur'd this land ? Who sow'd these fields with corn, poppies, sanfoin ? was it the Bees ? Who adorn'd my *parterre* with so many beautiful flowers ? Who waters, forms, and works, during the extream heat of the day, this kitchen-garden, from which we have such pleasing hopes ? The Bees think you ? What, you will pretend, that they ought to come, with impunity, to take away the powder from the stamina of my flowers, without doing me the least damage ? And if this powder is so necessary, as you say, for the fecundation of the seeds, can you doubt, when they rob me of it, if they do me an injury ? How many of my seeds have they made unfruitful, to make themselves one pin-cushion of wax, as big as a grain of pepper ? This little wax may perhaps have cost me a bushel of wheat, or a dozen of my fairest peaches. It is but just, that they should make me some amends for what I do for them, and for what I give them to live on. All that I can do, on your consideration, and not to find them guilty of usurpation, is to consider them as farmers, with whom I have a contract for half their produce.

EUGEN. I did not expect, Clarissa, this sally. I am interested, as well as you, not to examine too nicely into this title of property. Therefore, not to have more debates on this head ;

let

let us resume our argument. I am now going to describe to you the trunk of your farmers; first, place one of their trunks before your eyes, and make use of my magnifying-glass. In holding the Bee in this position, you first of all discover one of these great eyes form'd facet-wise. Above are the two jutting teeth, and above them you see the trunk come down, applied to the hinder part of the head. It doubtless appears to you, as to me, a kind of plate pretty thick, very shining, and of a chesnut colour. I will immediately draw out the trunk with my little pincers, that you may see it at its whole length. You may now know, that there was but half the trunk to be seen, and that lay folded in two parts, of which one conceal'd the other. The concealed part begins at the place, which the point of my pin shews, and ends at the bottom of the head. This situation, where we have placed the trunk, facilitates the manner of letting you see the two essential parts, which were unknown before the author of *the Memoirs to serve for an history of insects*. The first part is that opening, which you discover at the beginning of the trunk, which is the mouth. The second, which is higher, and which represents a nipple, is a tongue. Now for the trunk: when it appears in its place, and folded, as it is in the Bee, which makes no use of it, and such as at first you view'd it, that is not the trunk; 'tis only its case; the trunk is within it. It would therefore be proper to uncover it, and make you acquainted

Plate III.

Fig. 4.

Lett. A.

Lett. B B.

Lett. c.

Plate IV.

Fig. 2.

Lett. B F.

Lett. B.

Lett. c.

Lett. D.

Lett. E.

Plate III.

Fig. 4.

Lett. c.

E

with

with its several parts : but you have so expressly forbidden me to enter into these learned minute-nesses, that I have no other method but to persuade you to read the book, of which I have given you an extract. If you are resolved to take it on trust, you can't refuse your admiration and acknowledgment to him, who, with so profound a sagacity, has discovered to us all the springs of so astonishing a machine. You will there see a description of more than twenty parts, of which it is compos'd, and almost as compleat an anatomy of this wonderful organ. In fine, as you read it, you will fancy you see a workman, who takes to pieces a watch, which he himself has made, who lays before you the several pieces, makes you remark their fitness, their adjustment, their uses, the play of their springs, the pivots, and the pillars ; for all these are found in the trunk of a Bee. I have formerly seen a painting, which would suit as well or better our author, as him, whom it represented. There was Aristotle, with his pen in his hand before a table : over against him was Nature personized, speaking to him, instructing him, lifting up her vail, to permit him to see her, and describe her.

CLAR. If you meet again with that picture, I bespeak one copy of it.

EUGEN. Though I should cause an original to be made, you shall have it. I have but one word more about this trunk ; which is, that it is not an hollowed tube from one end to the other,

other, as is commonly believed; nor is it a tube, which contains a pump, proper to suck and extract the honey: 'tis a kind of tongue, which moves like those animals, which lapp: it plunges itself, and is buried in the honey-liquor, to make it pass upon its exterior surface, together with the case of its trunk, from a canal, by which the honey is convey'd: but it is the trunk only, which being a muscular body, causes by its different inflections and vermicular motions, the liquor to mount, and which pushes it towards the throat. We may reckon the Bee's stinging among the exterior parts. Though it is conceal'd, when the animal would make no use of it, it appears but too often when vengeance and anger put it in action. Let us give ourselves the pleasure of seeing one with our eyes. I will seize a living Bee; here is one; take it by its corcelet.

CLAR. I am your humble servant: if it was dead, well and good; but as it is active, and I very unexpert, I will take care of myself: hold it yourself: put it into what disposition you shall judge most proper: make it sting you, stab you, if you please, I shall be a sympathizing spectatress, but I pretend not to be exposed to its strokes.

EUGEN. The ladies well know, that a little cowardice don't misbecome them: it is an advantage, which they do not neglect on occasion.

CLAR. I have never heard, that the bravery of your Cæsars or Alexanders was the most shining qualification of a philosopher.

EUGEN. The repartee is lively ; I may find some occasion to retort it as we go on : but I am of opinion to dispatch, first of all, what I have to say about the sting of a Bee. You see, Clarissa, that in holding it as I do, between my two fingers, I have nothing to apprehend from it : it has liberty to dart its sting ; it spares not to do so, but it is to no purpose to torment itself, to twist its body on all sides, it can only pierce the air. See how it behaves with this glass.

CLAR. I see a lively image of choler and fury.

EUGEN. I must now let you see this sting in a state of rest. We need for that, only to force it to come out, and shew itself perfectly, by pressing the back of the Bee. Behold it attended with two white bodies, which together form a kind of box, in which the instrument is lodg'd; when it is in the body, that it may not hurt the inward parts of the animal. This small dart, which appears so fine and thin, is only a tunnel hollowed from one end to the other : I will presently convince you of it. Remark, that I press it towards its base, and you may see, that in pressing it, I make a small drop of liquor, extremely transparent, ascend towards the top. I take off this ; see another, which succeeds it. You have have cause to suspect, that this is that fatal liquor,

ate IV.
g. I.
ett. A.
ett. B B.

liquor, which poisons the wound made by the sting. Fine as this instrument is, it is not so simple as one would suspect. This point, upon which you have seen the little drop, is not so but with regard to our eyes: it is really blunt, and makes the extremity of a canal, which we have hitherto call'd the sting: but it is time to be undeceiv'd. This canal is not the sting, but its case: the real sting is within it: from the extremity of this case it shews itself, and at the same time darts its poisonous liquor. Let us proceed from wonder to wonder. This sting, so very fine, is not simple but double. I intend to say, that there are two, attach'd together, which act at the same time, or separately, according to the pleasure of the Bee. Their substance is horny or shelly. To conclude, that I may thoroughly terrify you, their extremity is cut like a saw, whose teeth represent the barb of an arrow, which easily enters, but can't be got out without making terrible gashes. It has fifteen or sixteen on each side. At the base of this sting, but within the body, one finds the bladder, which holds the venom: the same strings, which make the sting play, at the same time press upon this bladder, to force from thence the deadly liquor, and dart it into the wound. Plat. IV.
Fig. 3.
Lett. B & C

CLAR. This is like those savages, who fight with poisoned arrows. I am sorry, that so barbarous a method of revenging themselves obliges me to retract a good deal of that esteem, which I had for these animals. Lett. c.

EUGEN. To make you amends, they will furnish you with an example, which you will inculcate on your children, that vengeance almost always returns upon him, who takes a brutal revenge, in the heat of his passion. When an irritated Bee has fixed his sting in our flesh, or into some other body presented to it, as a glove; if one hurries it to depart, as hardly ever happens otherwise, it leaves its sting there, but not that only; the greatest parts of its dependances remained attached to it, as the bladder of venom, and several of the muscular parts. In flying from him, whom it has wounded, she tears out her own entrails, which costs it dear, more dear than a blow would cost a man, who should immediately lose his arm by it. In fine, the wound, which it causes to itself, is terrible and mortal, and which it can't long survive. The Bee soon feels the same pain it was desirous to inflict on others.

CLAR. This is a fact, which I will this day register in my collection, and will not fail to inform my children of it.

EUGEN. You are worthy, Clarissa, to be a mother. I mean by this to say a great deal, for very few women merit that praise. It seems as if malice surviv'd the revengeful Bee. A proof presents itself, which you will find pretty odd. After the Bee is gone, having left the fatal dart in the wound it has made, to die somewhere else, one would say it has committed to this dart, in parting, a provision of irritated and
 I chole-

choleric spirits, to finish its vengeance. Tho' the Bee may now be far off, the sting continues to move in his flesh, who has been wounded: do but see how it inclines alternately to contrary sides: it plunges itself more and more, and strives to make the wound it has given still deeper.

CLAR. I dare not propose to contradict you, Eugenio: You are so well prepared to answer all the objections I can put to you, that I am resolved only to ask simple questions. I shall therefore first enquire of you, how you know, that this little drop, which appears with the sting, is a venom, which enflames and poisons the wound? Secondly, if this liquor is equally venomous at all times? Thirdly, if there are any present remedies against this sting? Fourthly, with what design, nature has given to the Bee a weapon so cruel?

EUGEN. You will imagine, Clarissa, that all these questions demand a long conversation. This shall be the subject of the next we have together. I tell you beforehand, that I shall begin with informing you how we know, so as not to doubt of it, that this limpid liquor, which flows from the sting of the Bees, is a real venom, and that which makes the wound so painful. You will learn too by the manner, which we have taken, to come at the certainty of this, that philosophers know when it is necessary, not only to despise, but even to encounter pain.

And I hope too to answer your pleasantry, in forcing you to agree, that philosophy has its Cæsars and Alexanders too, as well as war.

CLAR. I consider it as a hardy attempt; I am apprehensive too, it will be a rash one. We shall see to morrow how you will extricate yourself from it.

CONVERSATION IV.

Of the venom of Bees : the wounds they make with their stings : their private and publick quarrels.

CLARISSA.

YOU are then going to prove to me, Eugenio, that philosophy is capable of raising the courage, so as to despise the greatest dangers, and to undertake the most arduous enterprizes : that is, in a word, philosophers are so many Cæsars.

EUGEN. Can you think, Clarissa, that I should have much trouble to find, among philosophers, heroes in courage equal to those, whom the history of those conquerors present us with ? Every age, and almost every year, furnishes us with examples. Would you have one of the most recent and most striking ? Compare the performances of the campaign of Charles XII. king of Sweden, during the severe frost of 1709, to the battle of Pultowa exclusively, with those of our Academicians, under the polar circle, to take the measure of the earth. You will find in both the same fatigues, the same courage to support them, equal obstacles, and equal intrepidity to surmount them ; great and bold designs, and worthy of the most distinguished valour : and in order to extricate them, men, whom neither hunger or thirst, desarts,

defarts, or craggy rocks, the most severe colds, or cruel beasts, could deter. To this I could add a million of other examples, which would not indeed be so distinguished, but which would be more than sufficient to prove, that philosophy knows how to constitute a hero.

CLAR. I give up the fact, and will stick only to the number. You will own, that such men, as you have just now mention'd, are soon counted over.

EUGEN. So are likewise the Cæsars and the Condes : but agree with me, that there are situations, which reflect an honour upon a brave man, though inferior to these great names. You will give me a place among them, when I shall have told you the voluntary pains, by which I arrived at the knowledge of the power and force of the Bees poison. I have already supposed it a very limpid liquor, which renders painful those wounds, which, otherwise, would be but scarcely felt. This then I must demonstrate by a very simple experiment. I made it, at first, upon myself : and some of our Academicians, and other lovers of natural knowledge, would have me try it upon them. With a very fine pin, I made a puncture on one of my fingers : before I did so, I took care to furnish myself with a Bee upon a needle : after I had pricked myself with the pin, I squeezed the venom from the Bee ; I forc'd the Bee to shew itself, and the venom to come out. I then took on the point of my pin a little drop of this liquor, collected at
the

the extremity of its sting: afterwards I caused the point thus dipped to enter into the wound, where I kept it but a moment: that was long enough to introduce the poison; which was no sooner done, than I felt a pain equal to that, which is felt, when one is stung by a Bee. The smart of the wound caused by the envenom'd pin resembles the stinging of Bees, more acute, or more moderate, according to the quantity of venomous liquor, infus'd into the wound; and, perhaps, according to the condition of the wound, that is, the largeness of the vessels, that have been open'd, and according to the greater or less sensibility, of the nervous fibres, which have been wounded. I repeated this experiment, one day, on one of our Academicians, who doubted of its effect, or, at least, of the degree of it. The better to convince him, I was not sparing of the liquor; I caused a great drop to be applied to his wound, which I had taken from the sting of an Humble-bee. The proof was stronger than he desired: although very courageous, and one of our Cæsars, he could not feel the cutting pain of this little wound, without a good deal of stamping and swearing at the experiment. After this, which I have told you, I made another experiment upon myself, repeated several times, and on others likewise. Having drawn some of the poison from the bladder of a Bee, with the head of a pin, and put it on my tongue, I felt at first a kind of a sweetish taste, but which soon became sharp and burning: I afterwards found such a kind

kind of heat, as is caused by the milky juice of a thistle. That part of my tongue, on which the little drops had been applied, continued for some hours to feel, as if it had been slightly burned. Sometimes it was only a little over-heated. Swammerdam, who made this experiment before me, says, that this liquor had set his mouth all on fire; 'tis likely, that he had applied a stronger dose. Are you now convinced, Clarissa, that when the Bees sting, 'tis this liquor, thus introduced, that enflames, burns, and renders the wounds painful?

CLAR. I believe you as much, as if I had felt it myself. We are perfectly well exposed here to make the experiment without chusing it. Should that happen, I fancy myself philosopher enough to stamp to some tune.

EUGEN. Now to your second question, Whether their stings are at all times equally painful? I shall inform you, that all other things being equal, there are some times, when the wounds, occasioned by Bees, are more sensible than others. Those, which happen in winter, when they are benum'd with cold, are not near so painful, nor for so long a time, as those, which are given in the summer; nor are they attended with so many accidents. It is likely, that the liquor is more exalted, more spirituous in summer than winter. Besides, the Bee has not, perhaps, so great a quantity of it in winter, or, it may be, has not the force to make so much of it come out. Not only the different seasons of the year diversify the
different

different degrees of pain, but different persons are not equally sensible of it. Some there are, which mind these wounds as nothing, in comparison of what they cause in others. I have a servant, who scarce regards them at all. In whatever place he is stung, the place scarce swells at all: the parts round the puncture rise not like what they do in other persons. There is too a third cause, which renders these punctures less dolorous: it is when they are repeated by the same animal: the last are nothing in comparison of the first. I happened one day to be stung by a wasp: I thought it worth the while to receive the wound with a good grace; I permitted him to sting me at his own leisure: in such a case, the Bee, draws his sting from the wound, safe and entire; and I had occasion, that the wasp's sting should be so likewise; for having immediately seized it, and irritating of it, I placed it on a servant's hand, who had been accustom'd thereto. The wound, which it inflicted on him, was but little painful. I took the wasp again, and forced it to sting me a second time; I scarce felt the second puncture. In fine, it was to no purpose; it would not be moved to sting a fourth time. The venomous liquor was exhausted in the three first essays.

CLAR. This proves very well, the great sensibility, caused by the puncture, proceeds from the venom introduc'd by the insect. But if I should tell you, that I know an animal, for whom this dagger and this venom are only sport and pass-time; that the bear voluntarily suffers him-
 I self

self to be stung by the Bees, and that those wounds are to him, but an agreeable titillation.

EUGEN. Could I suspect you of having read Pliny, I should believe it is from him you have this little story, which, however, he tells somewhat differently. He tells you, that the bear, when too fat, goes with a design to provoke the Bees, lodged in the trunk of a tree; and that he causes an infinity of punctures to be given him, especially on his snout, which are very salutary to him. But honest Pliny has many of these stories, which would be better placed in the voyage to the Severambes. There is not, in all appearance, any animal, not excepting even the bear, to which such venom would not give pain; the bear can only have more or less of it. It is certain, that this liquor is so brisk and penetrating, that one puncture of a Bee, if well season'd, conveys it to the head, and the head grows stupified with it. Every country, and almost every county, tells you a story of an horse, who having rubbed himself against a hive, and thrown it down, was attacked by these angry animals, and died of it in less than a quarter, or half an hour at most. A similar fact has been told by Aristotle, and confirmed in our time, (which was very lucky,) by witnesses worthy of credit. There have been authors, who have determined the number of punctures, which would kill so large an animal: some have fixed them to twenty. I know not, if the dose of venom, contained in that number of punctures,
may

may sometimes be sufficient for the death of the animal: but it is at least certain, that there is a dose, which distributed to the different parts of the body, would cause such pains, inflammations and irritations, and, in fine, a sort of fever, under which the most robust person must sink.

CLAR. One can't refuse you, Eugenio, the commendation of great courage. The voluntary trial you have made of a Bee's sting, and its pernicious poison, with the only view of knowing its force, and to inform us of what we had reason to doubt of, merits certainly a place among the heroes of philosophy. But I suppose you to be wise enough, to have taken a precaution, with which you have not yet obliged us. When you made these experiments, had you not some balm of Fierabras to apply to your wounds, to stop the pain, the moment you thought it proper, that you might not suffer more than was necessary?

EUGEN. You have reason to think, Clarissa, I did not play the brave, beyond what I am: it is certain, had I known a remedy against this pain, I should have used it. I will tell you too, that I did what I could to find one. A remedy against these punctures was one of those questions you put to me yesterday, and which I ought to inform you of. The late M. du Fay, of the Academy of Sciences, upon the foundation of some experiments, made in England, fancied, that the oil of olives was a specifick against the stings of bees: he had so much the more confidence in it, because in England they ascribe to this remedy,

dy a virtue more powerful ; since it is judged proper to cure the bites of vipers. In spite of all the credit one is inclined to give to the virtuosi of that nation, M. du Fay was minded to make the experiment on himself. He made it. The opportunities of being stung by these animals are not difficult to be met with : he was stung on the nose. When the oil was spread over the little wound, the pain was appeased ; it returned no more, nor did any swelling appear. One day he told me the fact, knowing I had more occasion than any body to try the experiment of this new remedy. In such cases I had often proved the effect of the oil of sweet almonds ; and the success, which it had, could not dispose me to think well of that of the oil of olives. However, I was tempted, at the end of a few days, to give it more credence.

CLAR. You was in the right ; for why should not you allow, that certain oils may have virtues, which other oils have not ?

EUGEN. I do not at all doubt, that different oils may have different virtues ; but one may lawfully doubt of facts, where essential circumstances are wanting. When they have not been examined in every case, that may make them vary : you shall see a proof of it. One of my servants was likewise stung on the nose : as I was present, I declined not to supple the part with oil of olives : he seemed to be well, and assured me, that he felt no more pain, nor had the least swelling on his nose. One would have thought,
from

from these two experiments, join'd to those made in England, the reputation of the oil incontestable. I should have thought so as well as you, had I not known, how often certain experiments require to be repeated and varied. The next day I went upon an operation, that required I should have several hands to assist me: it was one of those, from which one seldom comes off, without being stung; it seemed to me to be very favourable to repeat the trials of the oil: the affair was to make Bees pass from one hive to another. One of my assistants received a puncture upon his forehead, between his eyes, I took out the sting, and rubb'd it with oil of olives: he thought himself eased, but his joy was of no long continuance; after a quarter of an hour, he could scarce open his eyes; the swelling, communicated to both eye-lids, kept them almost closed. I was myself stung five times, on the fingers and arms: you may reasonably conclude, I did not fail to apply this specifick; but as the old proverb says, I lost both my oil and my time: my fingers, hand and arm remained swelled, and were painful. This remedy had no better effect upon many others, who had tried it.

CLAR. Why then did it succeed so well with M. du Fay, and your servant?

EUGEN. I met with a solution of this difficulty the same afternoon. The same servant, who found himself so well by the application of the oil, was stung by more than a dozen Bees, during our operations, on the fingers, hands and
F arms,

arms, without complaining, or even without giving himself any concern about it, or any swelling attending the puncture, or having the least recourse to the oil. I have known people in the country, who would not so much as vouchsafe to put a glove on that hand, with which they cut the combs in the inside of the hive, although they knew they should be stung more than once. These punctures, extremely painful to other men, were minded so little by them, that they did not seem to think it worth while to confine their hand for them, and make it less at liberty, by wearing a glove. There are, perhaps, but too many remedies, which owe their reputation to some cause like the former, where we employed the oil; that is, because they have been given in circumstances, where they were of no service to cure the hurt.

CLAR. Can the wounds, inflicted by Bees, be the only ill, against which medicine has no remedy, and apothecaries no plaister?

EUGEN. One finds some in choice books, as one does for the gout, the pain of the teeth, corns upon the toes, &c. whose greatest virtue is, to keep those, who vend them, from starving. However, with regard to remedies, a man has no right to deny, what he has never tried. I have applied the juice of several plants, which have been told us, by divers authors, against this venom of Bees. I have tried urine, which is very much cried up, as likewise vinegar too. I have light upon nothing, which, though in some circumstances

circumstances successful, has not proved useless in the end. What appears too much for a remedy one is minded to prefer, is, that there is not one of them, at the instant it is applied, which has not diminished or appeased the pain. Water alone has produced this effect, but the pain always returns afterwards, attended with its consequences. Shred parsley is the only thing I have tried, which has procured some ease, but with so little effect, that though I am one of those, who feel these punctures very painful, I do not think it worth while to have recourse to it. In a word, I know no remedy one can depend on. By the by, I will give you one advice, in the room of something better, which will be useful to you in case of necessity; if not to cure you, at least to hinder the troublesome consequences of these wounds: it is, never to fail to pull out the sting from the wound, as soon as you feel yourself stung.

CLAR. Since you leave me without a remedy against the stings of Bees, and that I am abandoned by the physicians, tell me, however, for my comfort, what reasons could nature have, to arm these terrible animals, to annoy us?

EUGEN. It is not certain, that we are the first objects of these animals vengeance. The Bees have several other important occasions to serve themselves with it, and have enemies of several kinds. The fruit of their labours, their wax and honey, excite the envy of many greedy and lazy insects: they have also other enemies to

defend themselves against, who are more fond of eating them than their honey. It sometimes happens, that other insects are foolish or rash enough to enter brutally into their hives, where they would destroy and overturn every thing, if our Bees, like a squadron of Hussars, did not fall upon them, and put either to death or flight those rash and inconsiderate creatures. I have already inform'd you of a time, in which the husbands of our Queen-bee must be exterminated, and sacrificed to the good of the society. They are larger and stronger than the Working-bees: body to body, a Working-bee would have but bad sport with a drone; but by means of its impoison'd sting, it brings its designs about. There is still another circumstance, wherein this sting may be of use to them. 'Tis in those quarrels they have either among themselves or foreigners, and which, some time or other, I shall entertain you with.

CLAR. Why do you put it off to another time, since a fit opportunity now presents itself? I have an extreme impatience to know what the duels of Bees are, and to hear a recital of their general battles.

Plate VI.
Fig. 1. EUGEN. It is easy to satisfy you. Don't you see at the foot of this hive those two Bees, who struggle and roll each other in the dust?

CLAR. I have seen them a long while, but I thought they were at play together, and amusing themselves.

EUGEN.

EUGEN. This is not childrens play : those are quarrels, that pass the bounds of pleasantry, and terminate most commonly in death : 'tis, in short, a duel in all its forms. In fine and hot days, one may have often occasion to observe these deadly combats among the Bees of the same hive. Sometimes the attacker and the attacked go out of the hive, taking fast hold of each other. Sometimes it is without the hive, that one Bee will fall upon the other, which is flying : at other times it falls upon one, in a state of repose, or which is gently walking on the outside of the case of the hive. However the battle was begun, when they are once join'd, they presently fall to the ground. They could not give each other sure blows in air ; and it would be difficult to support themselves there, while they endeavoured to give mortal wounds to each other. It is easy to observe, who will be thus engaged before a hive ; you have actually a proof of it before you.

CLAR. Since this is a duel, let us stoop down, and observe it at leisure.

EUGEN. Take notice, that these two combatants put in practice, what two wrestlers would do, whose aim is to deprive their adversary of life. See how both one and the other strives to gain that position, which is the most advantageous. See them both lying on the same side, holding each other reciprocally in their claws, head against head, back against back, and twisted in such a fashion, as to form a circle or an oval. It is owing to the motion of their wings, that

they whirl about from time to time as you see, and sometimes put them a foot distance from each other, but always even with the ground.

Plate VI.
Fig. 1.

Take care. Here is one, which has got the ascendant over his enemy, and mounts upon his body : all their movements, their flexions and different positions have no other tendency, but to find a soft place in their adversaries body, where there sting may easily enter. Admire the readiness, with which their stings are darted. The most famous gladiators have not their wrists more at command. I perceive this duel draws to an end. The death of a Bee will ensue. Observe how that of the two, which keeps the other prostrate under her, applies its tail upon the neck of its enemy. There is an end. The one is dead, and the victorious Bee towers in air, to enjoy its victory.

Ibid.
Lett. A.

CLAR. I own, although I have not a cruel turn of mind, I have taken a singular pleasure in seeing this duel.

EUGEN. These combats would last but an instant, if the Bees were less advantageously armed; but in spite of their scales, with which their flesh is covered, it is not however inaccessible. If a Bee could pass his sting between the scale, and that vacancy or ring, which it some times covers, by joining itself to the under scale, it would soon plunge it into the flesh. If the Bee, which defends itself, should, ever so little, stretch out its neck, it becomes uncovered; if its enemy's sting is then ready, it may wound it, as you have

have just now seen. I have taken notice, that they likewise mutually strive to prick each other towards the base of their sting, it may be in the anus.

CLAR. Don't they sometimes attempt to cross each others stings? for all animals, which are armed for the defensive, ordinarily oppose arms to arms; oxen, horns against horns; dogs, teeth against teeth.

EUGEN. I would not deny, that this is their intention. As to the rest, I happened one day to make an observation, which decisively proves, that a Bee may plunge his sting into the body of another. I saw two fighting as they came out of a hive. The combat passed upon the exterior part of the stand. It was not long: I immediately saw one of them vanquished and expiring. I took it, examin'd it, and found, that the other Bee's sting remained between the two rings of the belly of this. But, I suppose, this case is rare: for if it was common, every combat would cost the two Bees their life. These battles are sometimes very long. I saw one, that required a whole hour, for one to kill the other. Sometimes both fatigued, and despairing of a compleat victory, retire, and each flies its own way. When they have both known how to avoid the strokes of the sting, the combat does not terminate in death.

CLAR. The folly of fighting is then in the head of these animals, as well as in that of men.

EUGEN. What is true and real folly in man may be only mechanism in beasts: it may,

perhaps, only be an impulsive force, which would not proceed from their own choice, but from the institution of nature, who has views of her own.

CLAR. I could be glad to know, what reasons nature had to instruct one Bee to insult another, in cold blood, and make it draw its sword; or to fall, without the least warning given, upon another Bee, who says nothing to it, and is going about its business, in order to kill it without other forms of process.

EUGEN. Repuls'd as we are in penetrating into the views of nature, by the little success, which we frequently meet with, one cannot help returning to it whenever occasion offers itself. If we are allowed to guess at the policy of the Bees, or rather the intentions of nature, and to believe that their quarrels are not founded on such frivolous motives, as ours too often are; one may think, that a reason similar to that, which determines them to kill the males, determines them also to kill other Bees. The Bees, thus proscribed, are, perhaps, lazy, gluttonous, who only add to their number, and consume their food: perhaps they are idiots, who know not how to form an *alveolus*, according to the most exact rules of geometry: or they may be old, such, whom age hath rendered incapable of performing their offices, and who only cause an embarrassment, among an active and laborious people.

CLAR. I am of their opinion, in exterminating and driving from their civil society the lazy, the gluttons, and the ignorant, who know
not

not how to do any thing : but with regard to the old ones, I am utterly against them ; I make myself a party in a cause, in which I hope to be, one day, interested. Is it a reason to cease to live, before the appointed time, because but little of life remains ? This polity appears to me abominable : how can you reconcile it with natural sentiments, which are the only motives from whence brutes act ? For simple nature, which is not yet perverted, directs us rather to respect old age than to destroy it. Apicide, as well as homicide, appears to me an act contrary to nature.

EUGEN. That is a question, Clarissa, that is not easy to answer, to determine what is, and what is not natural sentiment : that is, what is moral good or evil. Happy for us, the Christian religion has settled our doubts in all necessary cases ; but among those people, who are not enlightened by our religion, the mind must be often embarrassed to judge of what is good or otherwise : experience furnishes us with many examples. 'Tis commonly agreed, that nature inspires us with a particular reverence for the dead. To give them to be devoured by beasts, appears to some an act against nature, to others not. We bury them, and believe we abandon them to worms. “ The * Romans burnt them ; the * Cicero. “ Egyptians embalmed them ; the Persians wrapped them up in wax ; the Magi interred them “ not, till they had caused them to be torn by “ beasts ; in Hircania, it was thought the most “ honourable tomb a man could have to be eaten
I “ by

“ by eaten by a dog; the rich maintained
“ some at their houses, for this purpose, and
“ there were some, which were fed at the publick
“ charge.” There are some people, who eat
their dead fathers and mothers, from a principle
of piety. If there be in the world a sentiment,
that may pass for natural, 'tis certainly paternal
love. Yet the people of Bengal throw their
children into the river, when they have more
born than they can maintain: others sell them,
and deliver them up to slavery. The Lacedæmo-
nians would kill those children, who they thought
would be a charge to the publick. The Chinese
laws permit them to expose them in the streets.
Another sentiment, which is equally one of
those, which nature dictates, is the respect of chil-
dren towards their fathers and mothers. Yet one
has seen people, who pretend to be civilized, a-
mongst whom it was a pious office, to kill their
fathers and mothers, when come to a certain
age: this custom still subsists among the Hotten-
tots. Why should we refuse to Bees a charity
equal to that of these people, who believe they
treat their aged parents very favourably, in short-
ning the duration of their lives; those days, which
they would otherwise pass in pain and misery? At
least there is a probability, that it is for the good
of their society, which is the motive of their
actions, that the Bees kill those, whom they
know to be no longer in a condition to contribute
towards it.

CLAR. I am, it seems then, unacquainted with natural sentiments. I lose myself in this subject: all the answer I can make is, that I am perfectly convinced, that we must keep to those, which our religion, laws and customs have handed down to us: and that it is, to search too far, to endeavour to know the motives, which prevail on brutes, since we are often at a loss to give a reason for those, which influence ourselves. Therefore let us leave this argument, and return to our Bees. After having been so lucky as to find myself present at one of their duels, may I not flatter myself to see one of their general battles?

EUGEN. I cannot promise you that; they are not very frequent. It is possible to excite them to it, but there must be preparations for it. In the mean time, I am going to tell you what I know, and what I have seen. 'Tis scarcely ever but in swarming time, that one sees these publick rencounters. When a colony of Bees, abandoning their domestick lares, goes in search of a new habitation in some foreign country; if it should fall unluckily upon one already inhabited, that is, upon a hive, which other Bees are in the possession of, (it matters not whether it has been long since, or only some few hours) the new comers meet with their match. The proprietors being in their own quarters, are strong, and not much disposed to divide their habitations; they therefore defend their castle. 'Tis then that one of these general battles is fought.

CLAR.

CLAR. This pretty nearly resembles the invasion of the Huns and Vandals.

EUGEN. We often find in the actions of brutes comparisons between them and men, which do not turn out to our honour. I remember one day, that being resolved to confine a certain number of Bees, with their queen, in a hive, which they found to be too little for them, after a good many trials on both sides, of theirs to depart, of mine to make them enter, at last they escaped, and with their conductress went to mix themselves among a swarm, which had lately settled itself in the neighbourhood, in hopes, it should seem, to make but one people with those, which were already there. These last not finding themselves disposed to admit these strangers, receiv'd them very ill ; I had room to believe they would be all massacred. This is certain, that they had scarcely introduced themselves, when there was a considerable humming heard in the hive, a proof, that every thing was in great commotion there. This hive was like those towns surprized by a rash but too feeble enemy, who feel by a hasty flight, what their temerity deserved. Immediately I saw Bees either dead or dying, which other Bees brought out of the hive. The field of battle, and the places adjacent, offered nothing to the sight, but scenes of death. After an hour and a half, the time, at which the Bees of the little hive took it into their heads to make themselves masters of the great one, until five in the evening, the slaughter was

was great, and presented me with a spectacle as much diversified as mortal. Sometimes I saw two Bees proceed from the hive, one of which was drawn by the other, who seized it wherever it could, and try'd to mount upon its body ; when it was fixed there, it seized the conquered Bee by the neck, and strangled it with its teeth ; I say teeth, even in the literal sense. When the vanquish'd Bee had been bit, and grip'd near the anterior part of the body, she was dead, or dying : the victor left it lifeless in the dust, or ready to expire there : then she abandoned it, but continued settled near her, as if to enjoy her victory, in rubbing itself with its two hind legs, as a man rubs his hands, when he has done something, with which he is satisfied. At other times I have seen them come out of their hive, holding the vanquished Bee under their belly, and conveying the dead far off ; other Bees drew those, who were expiring, from the hive, and cruelly dispatched them before my eyes.

CLAR. These are, I own, base, little animals ; their murdering, quarrelsome, insolent humour hath given me so great a dislike to them, that, if it was not for their wax, which I have occasion for, I think I should immediately turn them out of my house.

EUGEN. Their wax ought to be no motive. Do you believe, Clarissa, you who value yourself on a most exact justice, that it would be permitted you to keep servants of a bad example, because you draw advantage from them ?

CLAR.

CLAR. Good! I see your malice: You would fill my head with scruples, that I may lose my wax. Let us put off to another time the decision of this case of conscience; when we shall see, whether your maxim, which is true from man to man, is to be applied from man to brute. Let us, at present, think the time is past, which we allotted for our conversation.

EUGEN. I even think, that we have gone beyond it, and that I have broke into the regularity of your employments. I will add one word more, which will, probably, bring us to the door of your apartment. We must not confound these combats with another sort of quarrel, which never ends in death. I have often seen three or four Bees after one; they seized her by the leg, each Bee on his own side, they dragg'd her, harrafs'd her, sometimes bit her body or her corcelet. I own, at first, I had pity on the unhappy wretch, who was attacked with so much cowardice, and such superiority of numbers; but when I observed the Bee, thus attacked by so many enemies, had an easy method to free herself from them, I understood they had no design on its life. The combat was at an end, when the creature, thus bit and tormented, put out its trunk: for immediately one of the aggressors came to suck it, by applying to it its own trunk, as did the others in their turn; so that all these Bees seemed to have no other end in their attack, than to force her to disgorge the honey, which she had refused them.

CLAR.

CLAR. Misfortune on misfortune! 'Tis not enough then, that they commit treason, and engage in the most destructive war, but they must tear the bread from each others mouths. Are these the animals, of whose praises, the antients and the moderns have been so lavish? these the people, which your Virgil has sung in such tune-ful verse? I should have been as well pleased, if he had celebrated the Caraibs and the Anthrophagi.

EUGEN. I have already told you, that the antients were in the wrong, to praise them without bounds, and Virgil among the rest. They were all of them but badly informed. We have now seen one part of what we have to reproach them with, supposing them free agents. Now we are going to take a view of what they have of good, admirable, and by so much the more admirable, as we would deprive them of intelligence, and reduce them to pure mechanism. You will find their bad qualities compensated by their good ones. To convince you of it, we need only give a detail of their birth, labour, industry and politics. And to give to their history a suitable order, we will begin, in our next conversation, to speak of the fruitfulness of our Mother-bee, the preliminaries thereof; and, at the same time, will give you incontestable proofs of the sex of the three species of Bees.

CONVERSATION V.

*Of the generation of Bees, and the fruitfulness
of the Mother-bee.*

CLARISSA.

WOULD you persuade me then, that no animal proceeds from corruption?

EUGEN. Yes, doubtless, I would persuade you to it; and see you renounce for good this old error, which subsists only among the populace, and which men of true learning have banished for ever.

CLAR. It is because it is old and out of doors, that I chuse to protect it.

EUGEN. Prodigious generosity!

CLAR. Pleasantry apart, I believe this change of opinion is not owing to the present mode. Tell me, from whence proceed those worms, which spring from foods long kept, from standing waters, from cheese, and from stuffs locked up in chests?

EUGEN. From a father and mother, as we do.

CLAR. You kill me! What will you pretend, that a worm, in a very hard and well closed nut, was generated there by its father and mother?

EUGEN.

EUGEN. No doubt of it. Only allow generation to be the cause of insects; it is a fact now owned for true and capable of proof: it is a subject I shall not pretend to maintain in its utmost extent. I shall only speak of our Bees; and endeavour to give you the most just ideas of their birth. But as before men sow good grain, they are accustomed to root out pernicious weeds; so before I acquaint you with the generation of Bees, it is necessary to inform you, what they have believed, and what they ought to believe no longer. I am going to set before you the opinion of the antients; afterwards I will inform you what we ought to adhere to. The antients, who treated insects as imperfect and contemptible animals, granted them, at the same time, a prerogative, which, had it been true, would have raised them far above us: that was, to be produced two different ways, of generation and corruption. They believed in the first case, the sperme ought to be fecundated by the male; and in the other, a certain plastic virtue, the effect of corruption, or rather the child of their own imagination, was to them instead of father and mother. The privilege of this double birth was granted principally to flies. They had seen flies coupled together; they had likewise seen them proceed, if I may so say, from the bosom of matter, as those which owe their birth to stagnating water, which proceed from the galls of trees, or from those nuts, of which you just now spoke to me, or from stuffs locked up in chests.

They never gave themselves the trouble to observe their eggs had not been laid there. They supposed that to be true, which they but ill observ'd, which but too often happens. On this a system was form'd, which could not fail of being ridiculous. They pretended, that from a bull's corrupted flesh were produc'd Bees : That a lyon, in a state of corruption, furnished the most courageous, as those, which owed their origin to a cow, were more gentle and tractable: That a meer calf could only furnish very languid ones. They ascribed to a dead horse the privilege of engendring wasps and hornets; to an ass that of beetles, and to certain trees the production of other insects. They at last proceed so far, as to give to dirt and mud an engendring faculty. I am astonish'd, that they did not say all at once, that an ox might spring from a cock of putrid hay, a stag from the leaves of trees, a wolf from dead flesh : It would not have cost them any thing more.

CLAR. You are in a passion, Eugenio, against the antients : If they did not say so, it was certainly, because they were aware of the absurdity.

EUGEN. This I doubt of; since they have said still more. The Egyptians, in those golden ages, when arts and sciences flourish'd among them, did they not pretend, that their ancestors sprung immediately from the mud of the Nile? But to keep only to our Bees; has not Aristotle told us, that it was an opinion generally followed

in his time, that Bees produced neither eggs, nor maggots? 'Tis the same, which Virgil has prefer'd ; he tells us they disdain the pleasures of love, and that the pains of production are to them unknown ; that it is from plants they gather their young. Some have told us, that they went to search upon flowers a certain matter they carried to their hives, which, after having been made proper to become a seed, would produce maggots, which in time would turn into Bees. Disputes likewise have been raised, from what kind of plant the Bees collected this wonderful matter. Some would have it was from the flowers of cerinthus, which is our balm, others from olive trees, and others again from a kind of reed.

CLAR. This is too much for once : I give up the antients. To seek for infants ready made from trees ! I should never have suspected them to have carried their system of the generation of insects to so childish an absurdity.

EUGEN. If the philosophers have made great advancements, when they were in a right way, they have made as great when they lost themselves. But at last the time was come, in which, for the preservation of reason, this liberty of imagination ought to be curb'd. Descartes put a stop to its impetuosity, in shewing us how to examine the most received ideas, and, of them, to adopt none, which were not clear and evident. Could you, at this time, be of the sentiment of Alexander of Montfort, who, in his book of *The spring-time of Bees*, says, the king is form'd

from a juice, which the Bees extract from flowers : That the ordinary Bees are sometimes produc'd from honey, sometimes from gum.

CLAR. You insensibly condemn my favourite author. Liger, in *his Country-house*, which I consider as an abridgment of all good housewifery there, tells us “ In order to make Bees
“ by art, one has nothing to do but to kill an
“ ox in the summer, to shut it up in a well-
“ clos'd chamber, and to leave it to corrupt there
“ in its skin ; at the end of forty-five days,
“ there will proceed from it an infinity of Bees.” Does not this opinion in an author I like, and have a confidence in, merit some favour from you ?

EUGEN. Pay no complaisance to any bad reasonings ; of which there will always be too much in the world. That is not the only old-woman's tale one reads in that book. Let us put another fable, related by the same writer, upon the subject of the generation of Bees, on the same foot. He tells you, that to procure silk-worms by art, you must feed a cow with young with mulberry-leaves, 'till she has calv'd, and continue to feed her and the calf likewise with the same leaves ; “ At last, says he, cut
“ the calf into pieces, without taking any thing
“ off of her, not even the hoof of her feet, ex-
“ pose the same to be corrupted by the air, in a
“ granary ; from thence will issue forth true
“ silk-worms.” I have all my life admir'd
with

with what ease people swallow fables, as well to relate as to believe them.

CLAR. You open my eyes, and I begin to be more and more sensible of the folly of these systems. How can there then, at this time of day, be people, who call themselves philosophers, and who, notwithstanding, are so fond of these old opinions?

EUGEN. 'Tis because truth is a sun, which shines not to all the world; every body, that wou'd, can't see it. There are some persons, over whom their prejudices domineer so much, and so surmounted with thick darkness, that the light cannot pierce through them. We have an instance of it in a book printed at Paris in 1720, where the Author, who otherwise lays down very good rules for the management of Bees, has subjoin'd a dissertation upon their production, in which he pretends to establish, by reasons and observations, that the crude wax, which the Bees bring home on their legs, becomes vivified in the hive: That as the maggots of certain flies ('tis his own comparison) spring from putrid flesh, so the maggots, which are to become Bees, take their birth from this wax, which the warmth of the hive had corrupted. This author tells his story, as if he himself had been an eye-witness of it.

CLAR. You prove to me, what I have often heard, that the history of the progress of sciences is, at the same time, the history of errors, and, one may say, of the extravagancies of the human understanding.

EUGEN. That is what ought to make the progress of science very dear, and very desirable to us, since its only aim is to introduce truth, and to reason wise and circumspect. There has not been more agreement about the sex of Bees, than their generation. Some have thought, that the kings were males, others that they were females; some have regarded only the common Bees as males, others as so many females. Others have pretended, that they mutually coupled together. An English author, one Butler, in his *Female Monarchy*, is among those, who would have it, that queens produce queens, and common Bees are the mothers of common Bees. He makes the drones produc'd from ordinary Bees. Others have consider'd these drones as contributing nothing to the generation of Bees in a hive; others, on the contrary, will have it, they are females. Some have even thought, that the kings have ow'd their birth to the drones: whereas Pliny makes these drones imperfect Bees, produced by others, who are superannuated. In short, these different accounts, with regard to the sex or the no sex of Bees have been made, and they have all found their abettors.

CLAR. I am no longer surpriz'd at it. When one has not truth for one's guide, all paths appear right.

EUGEN. As for us, laying aside all these different sentiments, which thwart and destroy each other, let us keep nature in view, as far as she permits us. I have had a perfect view of
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the generation of Bees, and can give you an account of it. I will tell nothing but what has passed under my eyes, and through my hands, nothing which you may not see here, at least in part, if fortune favours us. Before I relate how and by what means they are produc'd, I ought as an exact and faithful historian, first to treat of what regards their common mother, what puts her in a condition solely to produce a numerous people, to the numbers of thirty or forty thousand in a year. Towards the middle of May or the beginning of June, when a new swarm quits the hive it was born in, to look in the trunk of a tree, or some empty hive, a more commodious habitation; this new swarm is then compos'd of one queen at least, of a number of drones or males, which march by hundreds, and of working Bees, which move by several thousands. Scarcely has the colony arrived at its new habitation, when the working Bees labour with the utmost diligence, some to build the alveoli, others to seek materials necessary for life and building. There is no time to lose, lodging must be had; they must immediately provide for their new establishment. Sometimes in less than four and twenty hours they have made combs, more than twenty inches long, and between seven or eight wide: Thus one swarm makes more wax in the first fifteen days, than they do in all the rest of the year. In the first days, every one bestirs itself, with ardour, to those labours, for which nature has intended it: The working Bees for

the gathering of honey and wax, for the publick edifices; the queen, to give successors to these new inhabitants, which they are incapable of giving to themselves. There are only the drones, who have nothing else to do, but to wait the good pleasure of the queen.

CLAR. This seems to me to be a very humbling office for the males.

EUGEN. It must be own'd, that among the Bees, the males make no distinguish'd figure. I have told you, that when a new swarm takes the fields, it takes along with it one queen at least, that is as much as to say, that there are sometimes two, three, four, and even more. If there is none, the swarm will never settle; if, as it often happens, there are many, that too is a great inconvenience; but in this case the supernumerary queens only lose their lives: For, to establish the good and peace of the monarchy, there requires but one; the rest are put to death. I will inform you of this massacre, as we go on. The remaining question is, to know how this queen behaves to become a mother; how she acts with her hundreds of husbands; how she conducts in her numerous seraglio?

CLAR. I impatiently expect the particulars; I imagine the gallant anecdotes of the Mother-Bee would make a very entertaining history. Having examined, as you have often done, these with so penetrating an eye, I make no doubt you have surpriz'd the queen throwing her handkerchief,

EUGEN.

EUGEN. You have room, however, to doubt of it: For it is in this seraglio, as in that of the Orientals, there are none but the sovereign and the servants of it, who can know what passes within. I have tried all sorts of methods to penetrate into that of the Bees, and to discover its mysteries: they have always been religiously concealed from me, because it is in the bottom of the hive, that this queen performs the designs of nature. Perhaps you think, that shame and modesty engage her thus to hide herself. There is nothing of that; and you will see by and by, that shame is a virtue, which was given her gratis by the antients; and that she less deserves to be praised on that score, than any animal I am acquainted with. I can't then tell you, if, amongst this great number of males, one only is worthy to be honour'd with the queen's favours, or if many have a share in her good graces. I am entirely ignorant of this, and don't at all attempt to guess; but that which I know for certain is, that she demeans herself for the propagation of her species after the same manner, and by the same methods, that other animals do. I procur'd a proof of this, by no means equivocal. I had, for this, recourse to two very simple expedients. The first is anatomy, which gave me a view of the interior parts, as well of the females, as the males, compared with those of the Working-bees. The second is the method I found out, to oblige the Mother-bee to submit herself before me, and with my own eyes saw her

her perform the duties, which nature requires of her ; and to act, in my presence, with one spouse taken at random, what she does with one, or more, of her own choosing. I will begin with the anatomy, and will make it before you, that you may have no doubt or scruple, on that account. Don't you see this ? It is a pregnant queen, which was ready to lay, and perhaps did so, when she was taken and strangled.

CLAR. From whence comes, Eugenius, this Mother-bee ? How did you catch her ?

EUGEN. I conceal'd her, to give you the pleasure of a surprize. I yesterday communicated to your gardener the secret of catching the Mother-bee. It is true, this secret has cost you a whole hive : But I would have this queen, to prove to you the incontestable marks of her sex ; to let you see, that this king of the antients is a queen, and the more so for her fecundity. Let us now open anatomically the belly of this here, and observe what will first present itself. Assist your sight with my glass, and judge.

CLAR. It is not at all doubtful. What a prodigious number of eggs ! It is pretty strange, that when it is so easy to know the sex of a Bee, men have, for so many ages, reason'd wrong, on a fact so very obvious. Was it that there was no anatomy in Aristotle's time ? A moderate sight suffices ; even your glass is of no service.

EUGEN. The antients liked arguments better than experiments. A person distinguished himself

himself in their times, by reasoning true or false ; but men are now distinguish'd by experiments. 'Tis in pursuance of this maxim of the moderns, that Swammerdam has given us a very good cut of these eggs, or rather of these *ovaria* ; for that is the name he has judiciously given to these two bundles of eggs. See here. I am going to Plate V. give you a particular account of them. The Fig. 1. *ovarium* for a Bee is a collection of vessels ; for Lett. all these eggs, that you see in so great a number, aaa, &c. were not placed there at random ; they are contained in several intestines, or transparent bowels, of so great fineness, that they can't be perceived but by the means of a very good glass. I will now convince you of it. Take notice, that in Lett. D. raising with the point of a pin one thread of those eggs, they don't separate ; but are continued from end to end. All these vessels, which Lett. B. together compose the two bundles of distinct eggs, derive their origin from the same place, and terminate in the same common canal. When Lett. T E. one opens a Mother-bee, when her laying time is far distant, as I have open'd many in the winter, and other seasons of the year ; you see nothing in the room of these *ovaria*, but bundles of threads finer than those of a silk-worm. By means of a very good glass, one may however perceive some little inequalities, some little knots, which seem to end taper. But when the Bee, as this before us, is in her full laying time, her body seems to be filled with nothing but a prodigious number of different strings of eggs, which

Plate V. which reach from the upper part of the body
 Fig. 1. quite down to the hinder. Observe, that these
 Lett. T E. eggs, which are found in this lower part, near
 the common canal, are long, and such as those,
 which you'll find deposited in the *alveoli* of the
 wax; and the more you trace them towards the
 top, the more they diminish, that is, they are
 less formed.

CLAR. Methinks I find a fault in this draw-
 ing of Swammerdam; all these strings of eggs are
 collected and united, in one of these two *ovaria*,
 as they are in the Bee you hold; but in the other
ovarium they are dispersed.

EUGEN. That is not a fault; 'twas the au-
 thor's design in the graving. He intended, that
 one of these two *ovaria* should give the idea of
 a mother ready to lay; and the other of one, at a
 farther distance from her time; and in this here,
 he has separated the threads to render them more
 obvious. There are then the two *ovaria* well
 distinguished. Let us now see the rout, which
 these eggs take, to come out. These two great
 vessels are conduits, into which the eggs fall at
 their leaving the *ovaria*; from thence they unite
 themselves in this great canal, which Swammerdam
 considers as the matrix. This other spherical
 body, adhering to the matrix, is thought to con-
 tain the viscous liquor, with which every egg
 ought to be lubricated, in falling from the body
 of the insect, in order to be attached to the bot-
 tom of the *alveolus*. These two great muscles
 serve for the play of the sting, and the bladder
 of

of venom. Here is the vessel, that conveys the venom into it. At last the dreadful stinging, curve, and greater than those of the Working-bees, and the two parts, which serve it for a case.

Lett. v.

Lett. s.

Lett. f.

Lett. p p.

CLAR. What is the use of that great bladder I perceive between the two *ovaria* ?

Lett. x.

EUGEN. Swammerdam looks upon it as the pulmonary bladder, which, in this animal, performs the office of lungs, that is, a reservoir of air, which in the Bees compresses or dilates according as it needs.

CLAR. Although this anatomy is very well executed, very delicate and ingenious, yet I doubt, whether it would fully satisfy those women, who would be more curious than I am, and desirous of knowing more.

EUGEN. I am apprized of what these curious ladies would know with regard to anatomy : If they were here, I would tell them, in order to make nicer discoveries, they must have recourse to analogy. 'Tis likely it is with the Bee, as with the female butterfly. Malphigi has very well discovered and described what I mean. He pretends to have found, in a female butterfly, a vesicula in the form of a pearl, and that this pearl is a reservoir, which contains the fecundifying matter, which the male had deposited : that this matter is conveyed into the *ovarium* by a canal of communication : that, when there, it moistens the eggs, and vivifies them as they pass the *ovarium* : and that without this precaution,

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the eggs would be laid unfruitful, as those of hens, which lay without the interposition of a cock.

CLAR. You have supposed in me a desire of knowing that, which, perhaps, I have not. You are lucky, that I am not disposed to quarrel. As to the discovery, it appears to me one of great penetration, and gives me a very high idea of the sagacity of this Malphigi. So that I make no doubt, but he has carried his enquiries so far, as to count how many eggs there are in the belly of a Bee.

EUGEN. It is not him, 'tis Swammerdam, who is not at all inferior to him, who has undertaken the calculation. His estimation is, that each *ovarium* has more than a hundred and fifty vessels destin'd to contain the eggs: that each vessel contained seventeen eggs, which are visible; and consequently that the two *ovaria* of a Mother-Bee, ready to lay, contain five thousand one hundred visible eggs. This being so, one will have no difficulty to believe, that a Bee may produce, in seven or eight weeks, ten or twelve thousand Bees or more; for one easily conceives, that the number of those, which are not visible, which will grow large, during the time the others will be laid, and which take their place in the *ovaria*; that the number of these eggs, I say, which escape our sight, on account of their smallness, are by far superior to those other. After having shewn and proved to you, undeniably, as I suppose, that the Queen-bee is a very fruitful

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mother;

mother ; we must now let you see, that the drones are the males, and that the Working-bees are of no sex : that they hold in this seraglio the same place, that the black eunuchs do, in that of the sovereigns of Asia : that they are only there as domesticks, destin'd to all the work within doors ; but are excluded from the privilege of repairing those chasms, which death makes every day in the state. To have a full and entire conviction with regard to these drones, I am going to seize one, open it before you, and by the comparison I will enable you to make of their interior parts, with those of the Mother-bee, you will be a judge of the demonstration of our proofs. If the examination of the interior parts of a Mother-bee has been sufficient to let us see, that she alone was able to give being to so many thousand Bees, who are born every year in one hive, the examination of the interior parts of the drones will not be less certain to convince us, that they are allotted to render the eggs fruitful, and that they are the males. When one has discovered, Plate V. as I shall presently, the interior parts of a drone's Fig. 2, 3. body, it will be found, that the cavity of it is almost wholly filled with vessels, and reservoirs, whose use serves only to prepare and contain the liquor, proper to vivify the eggs. The parts you see, which, with regard to the place where they are lodg'd, are of a considerable size, and which are whiter than milk, owe their colour to the liquor, which they contain. None of these parts bear any resemblance to those you have seen,

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in the body of the female ; nor will you see any likeness to them, in those of the Working-bees. I shall not enter into a farther detail on the subject of those parts. If fancy, or curiosity takes you to know them more exactly, I refer you to the author, who has furnished me with all my knowledge.

CLAR. I know as much, on this article, as I am desirous of knowing. Now open the body of a Working-bee, that I may have no doubt of the three different species.

Plate XI.
Fig. 3.
Lett. v.
Lett. v.
Lett. a.

EUGEN. Here is one. You see here the canal for aliments: a first stomach, which contains the honey: a second stomach, and the intestines filled with crude wax: but beyond this, you observe no part analagous to the *ovaria*, nor any thing, that resembles, or that one can even suspect to be eggs: moreover, you see no part, which has the appearance of being that of the males or drones.

CLAR. That is true. I shall however raise one objection. How are you sure, that there is in one hive one only female ; that what you call drones, are all males ; and that the Working-bees are, without exception, of neither sex : to conclude, that the Bees are all, each in their kind, such as you have open'd ? It appears to me very difficult to verify this exactly.

EUGEN. The certainty of it is very simple and easy. You have only to devote, as I have done, an entire hive ; to destroy all its people, either by smoak, or water, and then to examine every

every particular Bee : it is not even necessary to open them ; 'twill suffice to press them between your two fingers : one can easily make the characteristic parts of the sex appear in those, which have any ; and the default of that appearance will indicate those, which have none.

CLAR. What possibility is there of resisting so great an evidence ? After what I have seen, there is no room for dispute ; one must surrender.

EUGEN. To take advantage of the good disposition you are in, I pass to the recital of the Mother-bee's amours. A Mother-bee, who is the only one of her sex found in the hive, as she is at certain times found there, with seven or eight hundred, and sometimes a thousand drones, seems to be there in the midst of a very numerous seraglio of males. They have however pretended, that she admits none of them to any intimacies with her. It is true, that, hitherto, no person has seen her seek their union, or, at least, no person has writ, that he has seen it. But this is one of those cases, wherein a negative proof cannot have much force : for without ascribing modesty to this Bee, there is no reason to imagine, that she quits the interior part of the hive, where she likes to pass her time, and that she endeavours to expose herself to the spectators eyes, when she would permit a male to render her eggs fruitful. The queen of * Achem is in the same case with the queen of the Bees, that is, to have a seraglio of men at her command. If then one of those travellers, who traverse the world to

* Gemelli
Carreri.

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instruct

instruct themselves in the manners and customs of different people, should keep himself in the suburbs of the city of Achem, in hopes, that this queen will come to seek him in the fields, with some one of her favourites, to make him a spectator of what secrets pass between them, he would, probably, wait a great while to no purpose : and if he should take it in his head to conclude, that men attend this queen, like your small Bologna dogs, only for the pleasure of being look'd at, I fancy he would not find many readers so simple as to believe his relation. Let us make the same inference with respect to the Bees. We have it not in our power to be witnesses of all their actions. Our eyes are not formed to see through their waxen combs, covered with several layers of common Bees. But we are certain, it is behind these combs, that the mystery of fecundation is carried on. Being thus instructed of the place, where the operation is performed, nothing more remains, but to know the time and the manner. The time is easy to be known. At the beginning of spring, open a hive, you will not find there one single male : from the middle of May to the end of June, you will find hundreds of them : from thence to the following spring you look for them in vain : the time therefore of fecundation can be no other, but when there are males, that is, about six weeks, taken in the months of May and June. With regard to the manner how things pass to cause this fecundation, 'tis what I myself have seen,

seen, and of which I will give you an exact account. I found the secret to force a Mother-bee to act before me, in the same manner as she does in the bottom of her hive.

CLAR. Hold, Eugenio : your virtuosi may have the liberty of seeing, what is improper for the ladies to hear.

EUGEN. There are ways of talking to the understanding, without shocking the ears ; these ways I intend to make use of. Towards the beginning of May, I took a mother, who had already given birth to a great number of Bees, and who was going to give it to several more. I put her into one of those glasses, which we make use of for powder, where I shut her up with seven or eight males. I was curious to observe how they would behave with her, or she with them. They were taken from the same hive, and were some of her husbands. They treated her, however, with an indifference I did not expect. Near upon two hours I left them together, in which time nothing passed between them : each continued on its own side, in a perfect inaction, as people, who would never be acquainted.

CLAR. It seems as if this experiment is not much to the advantage of what you would persuade me to.

EUGEN. When one makes experiments of this nature, it is equally advantageous to know what makes them fail, as what succeed. This last did not succeed for the following reasons. In order to get this Queen-bee, I had plunged
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the whole hive into water, and, by this means, had taken out the queen almost drowned. Return'd therefore in so small a time, from the gates of death, it is not at all to be wonder'd at, that she had not those passions, which are the effects of full and perfect health. Beside, she was in the middle of her laying time, when all animals of both sexes, have no mutual desires. Add to this, she was not a young mother; the condition of her wings proved her age, as ours is known by the wrinkles on our foreheads: her wings were notched, and the edges of them shivered away. The observations I was desirous of making demanded therefore, that I should shut up with some males a female, which, as yet, had no communication, or very little with them. Towards the middle of June they brought me one, which I had reason to believe was such as I wanted. She had been found, that morning, near a hive, which had swarmed the night before. For, as I have already told you, there are some times supernumerary queens amongst the swarms: this I speak of, was one of the swarm, who, 'tis likely, had saved her life by flight. The good condition of her wings, and her colour, made me conclude, that she was yet young; and the bulk of her body, not so great as that of a female ready to lay, seemed to prove, that she had no other eggs, but such as were extremely small. I shut her up in the glass, where I put likewise a male with her, which I had ordered to be taken from one of my old hives. I discovered the character

rafter of this young queen, as soon as she had been put to the proof. I had never seen any but queens, accustomed to be treated, every instant, by the Working-bees, to receive from them presents of honey, thousands of caresses, and a thousand little marks of esteem, of every kind. Thus I saw, with some surprize, that all the deference, which common Bees have for the mother, the same this young queen had for the drones, I had put to her. Not satisfied to come near him, she delayed not to put out her trunk, sometimes successively to lick different parts of the male's body, at other times to offer him honey: she turned round about him, continually caressing him, either with her trunk or legs. The drone stupidly submitted to so many indearments, as if they had been his due, nor seemed at all moved by them. It seemed, as if it had been goodness in him to suffer himself to be caress'd: however, at the end of a quarter of an hour, he seemed to be a little animated; and when the female, placed in sight, full over against him, had brushed, with her thighs, the head of this insensible, and had softly set at play her *antennæ*; the male was determined, at length, to answer her advances, by similar ones, of the same nature. The female redoubled her vivacity, and placed herself in those positions, which agree not very well with the idea which has been attempted to be given us of her modesty: it is to make use of a weak term, to stile these positions only immodest; they approached to something superior, unknown to

us, a superiority, which overthrows the general order of nature, by subjecting the more noble species to the other. All these indearments were by no means useless to this passionate queen ; her indolent spouse became more active ; he was animated more and more. One might see, as I did distinctly, that many of those organs, which you observed within him, when I open'd the male, appear'd without him. The whole transaction continued three or four hours, during which he found time for repose, and repeated acts of love. At length the drone fell into one, which to the queen seemed to be of too long a duration. She was desirous to draw him from his lethargy ; she seized him, with her teeth, by the corcelet ; she cheer'd him a little ; sometimes, in order to refresh him more, she put her head under his body ; but so many marks of her repeated regard were useless ; he was dead.

CLAR. How ! what do you say ?

EUGEN. I say he was dead, nor is he the only one I have seen expire in these critical moments. I fancy so immediate a death in such circumstances may appear to you suspicious, or, at least, an extraordinary event, but the consequences were so. When I knew this little animal was absolutely depriv'd of life, I only thought of consoling the widow, and I fancied I could not better succeed in this, than to present her another spouse young and vigorous.

CLAR.

CLAR. That is to say, that you reason'd on the account of this Bee, agreeably to the malicious principles, which men are possess'd with in regard to our sex. Could a philosopher of your cast have any taint of vulgar prejudices?

EUGEN. Grant me more justice. I thought of no inference injurious to the ladies; I was only desirous to treat this Bee like a brute; but to my great astonishment, she behav'd like a virtuous wife. The living did not at all console her for the dead. She remain'd all the rest of the day fix'd to the body of her unfortunate spouse, continuing the same cares, and loading him with the same caresses, which she had conferred during life. The widow of Mausolus could not better discharge her duty.

CLAR. You begin to interest me for this tender queen. I am curious to know her destiny.

EUGEN. You shall soon be satisfied; night being come, I drew from the glass the two spouses, the living and the dead, and shut up in their room a hundred common Bees, to keep our queen warm, during the night. The next morning, I presented her with a new husband. I bestowed likewise another on another queen, which they had brought me to repeat the experiment. The two females behaved in the same manner, in which the first had done the day before with a male in perfect health.

CLAR. This spoils all. Was then one night sufficient to cause your Artemisia to forget her Mausolus?

EUGEN. What is approv'd among us, let us not charge as a crime to her. We find nothing blameable, that a young widow should admit new engagements, after her year of widowhood. One night with a Bee may be equivalent to one of our years. Time ought to be measur'd according to the duration of life. An animal, which has but three or or four years to live, cannot admit so long interval between two actions, as that, which has sixty or seventy. Besides, from all you have seen, and from all I have told you, we have a right to conclude that, in the hive the Mother-bee acts as that did in the glass ; and, consequently, that Bees are produced like other animals, and not from corruption.

CLAR. That appears to me extreamly true. But I think it no less strange, that this queen should gratify the desires of her sex, in a manner so opposite to natural order.

EUGEN. This inversion of nature ought not to surprize you ; it is even necessary in this case : For when it has been once establish'd, that a female should cohabit with a thousand males, the consequence ought to be, that these males should be sleepy, and to be awaked only by her ; that she should be free to chuse among them all him, whom she would honour with her favours. You easily conceive what confusion, what a terrible situation it would be for a woman, to find herself in the midst and at the mercy of a crowd of active, petulant husbands, who would all be masters the same moment.

CLAR.

CLAR. You are in the right ; that is easily admitted. The imagination requires no assistance, to present to itself a just image of the disorders, which would result from thence.

EUGEN. You now know, Clarissa, how the Mother-bee becomes fruitful ; you know what puts her in a state to people the world with so numerous a posterity. We shall see the next time we meet here, how she acquits herself of this important and laborious office. That is, we will talk of her laying, and, on that occasion, of the homage and respects, which are paid her by the other Bees.

CONVERSATION VI.

*Of the Mother-bee's laying her eggs, and the
homage paid her.*

EUGENIO.

I Congratulate myself, Clarissa, on shewing you, this day, the manner of the Mother-bee's laying her eggs, and, it may be, in giving you a sight of her. The season being favourable (for the strongest time of her laying falls out about the end of May, and the beginning of the next month) I hope we shall take the queen in the fact, and meet her, while she goes from cell to cell, planting an egg in each, and sowing, as I may call it, her posterity. This is an operation of great importance: 'Tis not the queen only, that is interested; it concerns the whole hive; 'tis the affair of the whole people, and the safety of the state.

CLAR. Though the birth of the Dauphin were the subject, you could not make use of more emphatic words.

EUGEN. The parity is with regard to the public interest, but in reality, the difference in fact is very great. In the last case, queens give but one successor to the head of the empire; in the other, the Queen-bee ought to produce a whole people together with their head.

CLAR.

CLAR. That is, that she lays both the monarch and monarchy.

EUGEN. That is exactly true. Call to mind what I have already told you, that when a swarm with a queen at their head, falls upon an empty hive, the Working-bees, that instant, apply themselves to labour; that they have nothing more at heart than building their *alveoli*; that they engage in this work with zeal and a prodigious activity: A comb of wax, twenty inches long, and seven or eight wide, is the work of four and twenty hours. Their principal aim is not only to have cells, in which they may deposit their honey, which makes them then redouble their activity; a stronger motive seems to animate them; they seem to know, that their queen is in haste to lay her eggs, and that one cell is necessary for each particular one. I will not, at this time, describe to you, the manner, in which the Bees build their cells or *alveoli*; that shall be an ample subject of entertainment for another day. Let us satisfy ourselves now, to see through this glass hive, a Mother-bee in that office, which distinguishes the females from the males.

CLAR. What do I see, Eugenio? Our hive is in a very different state from what it was three days ago. It seems to be only a hive begun, whereas it was, in our last conversation, an old one and well stock'd. Has any misfortune happen'd to it?

EUGEN.

EUGEN. I was the author of all the mischief. The last time we parted, I went to prepare that hive for the design I had form'd, which was to give you a sight of the Mother-bee laying her eggs. To accomplish that, I caus'd all the Bees, which were in this, to pass into another hive, by means of smoke. I took out the combs, and after I had clean'd and perfum'd the inside, I presented it to a young swarm, which was in the fields, and in quest for lodging; these made no great difficulty to enter. Scarcely have passed twice four and twenty hours, since the swarm has been lodg'd in this hive, and since it has been at work here, and, probably, the queen lodg'd some eggs. Let us stoop down near this glass square, and fix our sight on these new combs, which are not yet in sufficient number for one to obscure the other. I make no doubt but, with a little patience, we shall see the queen enter into these empty cells, which you find before you, and of which the greatest number is destin'd for eggs.

CLAR. I shall keep my eye upon them. But as we have nothing to do, and wait for a sight of this queen, I will beg the solution of a difficulty, which embarrasses me. This swarm, which we now see at work, and which has not quitted its hive, wherein it received its birth above two days, and which cannot date its existence but a little time before; how is it the issue of the queen's body, who, in all appearance, was born at the same time with it? How can
one

one say, that this queen is the mother of her people?

EUGEN. We ought not to say so at present. This is not the time to make use of this expression. To give you a juster notion, you must know, that a hive is a continued circle of living and dead Bees. As we ought to fix a point to this circle, to trace the life of this people from their birth to their death, I set out from a swarm, that is, from the departure of a colony to found a new hive. This date appears to me the most commodious. The Bees destin'd for this transmigration are not only those, which were last born; there are some old ones too, which mix themselves with the new ones: one part is of the preceeding year, another part, as you observ'd, began to exist but a few days before. But the queen is always one of these last, and by consequence a young mother. When the Romans sent out colonies to repeople those countries, which they had ravag'd; they were composed of people of all ages, to the end that by the vivacity of the young, temper'd by the prudence and caution of the old, there should result a spirit of wisdom, vigilance and good government.

CLAR. You hurry on the relation of a fact, which I find a little difficult to believe. You thought, perhaps, that in embellishing it, with a fine comparison, I should not so nearly attend to it. However it appears difficult, that you should be able to distinguish so nicely the different ages of Bees, those of the last year and those of this.

All that I see, seem to me to be alike. I don't suppose, that you would have me understand, that you know how to distinguish the traces and wrinkles, which time impresses on the features of a Bee.

EUGEN. Pardon me. That is nearly what I would say. I have promis'd you, Clarissa, that I would tell you nothing false, would exaggerate nothing, with regard to facts : as to the expression, I afford myself a little more licence. You know me sufficiently to take my promise as a sure warrant for the truth of my recitals. If the experiments and observations, on which facts are founded, were a delicate sort of legerdemain, which depended on a slight of hand, the twinkling of an eye, a swift and rapid moment of time, you would have a proper foundation, not to trust me without caution, and I myself should not draw any consequences, but with the greatest circumspection. But these, which I have made on the Bees are so evident, and I may say so palpable, that it would be but an ill-plac'd merit to speak of them with timidity. Whoever has been accusom'd to see the Bees of the present year, and those of the preceding, well knows, that the first are brown, and have white hair, and the other their hair red, and their wings less brown : these colours are peculiar to different ages. Among those, who put themselves in the train of a new queen, one observes these two colours, and the different shades, that are between them. Join to this observation that of the state
of

of their wings, which are sound and intire in youth, and which, in more advanced age, are broken and notch'd through hard service. To conclude, if those, which remain in the old hive, are examined, one there observes some young, some old, and some of a middle age. The swarm then is composed of Bees of all ages, and there remain those of every age in the hive. Those, which happen to be at the door when the queen takes her leave, fly along with her, and compose that troop form'd by chance, which we call a swarm.

CLAR. One must say then, according to you, to speak with exactness, that a Mother-bee, which conducts her swarm abroad, is no more than their sister ; that she is a young sister, attended by elder and younger brothers, who all have one common mother, which they have left, in quest of a more commodious habitation in a foreign country. That this queen will become a mother in her turn, and in her turn will likewise be abandoned by one part of her children, who will go elsewhere to seek their fortunes in disincumbring the house.

EUGEN. You are perfectly right. You need only add, that before this last transmigration, and during the time the young queen multiplies, by a continual laying, the number of her subjects, so far as to oblige them to divide themselves, she may with justice be called the mother of her people ; or, at least, of that part of her people, which spring from her, in the same hive.

CLAR. O, Eugenio! is not that yonder the mother, so much expected, who advances in the middle of a croud of courtiers? Let's speak low, for fear of frightening her.

EUGEN. No need to use this caution, for it is not she. I cannot tell you, what this little groupe of Bees do there, which you took for the queen and her court; but I plainly see it is not her.

CLAR. That being so, to fill up the time, which will be lost in silence, I am going to propose to you questions suitable to the present subject. This Bee, which we wait for with so much patience, and which actually lays at the bottom of the hive, does not, certainly, lay eggs unfruitful. What time has she taken to give them life? Was it while she was yet in her natal hive; or since her leaving that and settlement here? Was her marriage (to make use of that expression) celebrated before she had placed herself at the head of the troop, which she ought to conduct abroad, or in the repose, which her new habitation gives her? In a word, what was her age, when she commenc'd a mother?

EUGEN. A young mother is in a condition to lead a swarm from the hive, where she was born, four or five days after she has appear'd in it with wings; that is to say, after she has quitted her nymph-state (I shall explain to you some other time what that nymph-state means) and when she has resolved on her journey, her eggs have been already fecundated. Thus, in the space of
four

four or five days, her sex discovers itself, and she makes use of it. I have a good many proofs, which concur to establish this fact. I have found swarms, among which there was not so much as a single male. In a hive, where a swarm has settled itself not more than four and twenty hours, I have frequently observed combs, in whose cells I have seen eggs.

CLAR. What do I see? What means this tumult? Is it the queen, who advances?

EUGEN. It may be her. Let us wait a moment——no it is not her.

CLAR. Let us then ask questions, for it is in this manner, that I delight to instruct myself. I here see several *alveoli* but half formed, and as it were abandoned by the Bees; that to me has the appearance of wax put to bad purpose. Is it that joy for the queen's lying-in has turn'd the head of her little people? or do they forget, from time to time, that consummate geometry you ascribe to them?

EUGEN. That which you treat as an unfinished work, is one of the most admirable marks of foresight, which our little animals give. There are some times, when they are in the utmost hurry of work, when they know their queen is in as great a hurry to lay. In this case they bestow on their new cells but part of the depth they ought to have; they leave them imperfect, and defer the finishing of them, 'till they have traced out the number of those, which are necessary for the time present. You do not see here the cells

of the drones, nor the royal cells. The reason is, that the Working-bees, which are of no sex, seem to know what passes in the body of their sovereign, and even what passes there as a consequence of her sex. They know, if she is made fruitful, if her eggs will be numerous; they know she will produce many thousand workers like themselves, several hundreds of males, and three or four, and sometimes more than fifteen or twenty females: they know, that the females are larger than the males, the males bigger than the workers: that the queen will not lay any male eggs, 'till she has produced a great number of workers; nor females, 'till after those of the males. And as they are sensible of all this, they build *alveoli* proportionably to the number and size of the subjects, and according to the times, in which they are to be produced.

CLAR. You bestow on them a pretty deal of science.

EUGEN. I shall hereafter let you see, that one can't refuse it to them.

CLAR. Ho, for once, see there she is!

EUGEN. That is not she yet. But in waiting till she appears, I shall take notice of a word you just now mention'd, to remove an error of the antients. You ask'd me, if it was joy for the queen's lying-in, that turn'd the head of these little people? Some authors have given us the time, in which the queen lays her eggs, for a time of feasting and rejoicing, during which there is an absolute vacation in the hive. They are
 *
 mistaken.

mistaken. If it was so, these little people would be very happy ; joy would be almost always the consequence. For this mother lays most months in the year. However, they would run a chance of being starved to death, by indulging themselves too much in joy. In the greatest monarchies, while the queen gives a presumptive heir to the state, the artisans are employed in their shops in their ordinary labours ; the people know nothing of what passes of importance in the palace of the king, where he acts, as if he knew nothing of the matter. It is just the same in each monarchy of the Bees : the publick labours are not at all interrupted during the queen's laying her eggs : honey and materials for wax are brought to the hive ; building and finishing their cells go on as usual. Your patience, Clarissa, will not be long put to the proof, for the queen, with all her train, advances this way. I leave you the pleasure, to distinguish, by your self, the various employments, in which the subjects of this little court engage themselves.

CLAR. There she is ; I see her, this so much Plate VI.
 desired queen, in the centre of ten or twelve Bees, Fig. 2.
 who surround her. I know her by her bulk, her short wings, which make her a kind of mantlelet ; I admire her gravity, and, as I may say, the majesty, with which she conducts her steps. She enters into a cell, where she goes, no doubt, to deposite an egg.

EUGEN. She only enters for that purpose. But take notice it is at two different times, and in two different manners. She at first enters head foremost, and, after she has stay'd there some moments, she comes out again. She enters now, for the first time, in order to retire, which is to examine, if the cell be empty, clean, and that there be nothing, which may be hurtful to the precious depositum, which she is going to commit to it: the second time will be to lay her egg there.

Plate VI.
Fig. 2.

CLAR. How, she comes out already! an egg then is soon deposited? It appears to me to be the work of a moment. See there she goes to another cell. Observe, Eugenio; how all these Bees place themselves in a circle round their queen; how they all have their heads turned towards her; how they contemplate her, and give her demonstrations with their trunk; one would say, that they endeavour to make their court, and render themselves agreeable to their sovereign; that they present to her their homage and respect.

EUGEN. One might say so, and I really believe we may truly say it.

CLAR. Ho, see what is more remarkable! There is one of them, that licks her; another which gently rubs and cleans her; this here presents her honey with the extremity of its trunk. Yet our queen advances not. Is she reposing herself?

Let. A.

EUGEN.

EUGEN. 'Tis very likely, for she commonly does so, after having laid five or six eggs together.

CLAR. Good! observe those Bees, who redouble their zeal. There is one, that licks her extreamest rings: hah! the little pretty animals! This is a charming sight, and very sensibly touches me; for nothing affects me more, than the tender concern of children for their mother, or subjects towards their sovereign. What I would desire at present to know is, if these twelve Bees, which compose the court of the queen-mother, who follow her every where with so much love, are chosen by the queen, or deputed on the part of the people; or if they are the first, that offer themselves, at the moment the queen lays, and whose office it is to exercise the chief employments of the crown.

EUGEN. That is what I shall not amuse myself by guessing at, but instead of losing ourselves in these frivolous conjectures, let us endeavour to eradicate those, which has been transmitted to us. It has been pretended, that the Bees made a curtain of their bodies, to cover the queen while she was laying: that they were well apprized of what they had to suffer, if she was not concealed, during an operation, which ought to be hid in darkness. To conclude, they were desirous of honouring her all along with a virtue she less deserves than any animal. I have given you proofs of it, and you have just seen some effects of it.

CLAR. I will attest, whenever you please, that there is not, in nature, a little animal, more unedifying.

EUGEN. However, let us justify the antients as far as we can. One part of their mistakes does not always rise from their imagination, which endeavoured to divert itself, and amuse us also with pretty tales : it often proceeded from objects ill seen, or from those whose use was but ill guessed at. The praise of modesty, which they were pleased to bestow on Bees, took place from hence, that they had often seen them in groupes, as hanging in masses, or garland-wise : they took these masses of Bees for curtains, which concealed those operations, which usually pass in the dark. But from whom would they conceal their queens? By whom would this queen commonly be seen, but by Bees similar to those, which would conceal her? In fine, if there was any indecency in a Bee to lay eggs, all this would be saved, when the part, from whence they proceed, is hid in the cell. There might happen to be Bees disposed in the form of a curtain, whilst the mother laid her eggs ; but it is not because she laid, they are disposed in this manner ; it is to take their rest, as you saw in our first conversation. Since we are upon the subject of caresses and homages, which the Bees pay their queen, I must tell you all I know on this particular. First of all, don't suppose, that the same ceremony always takes place, when the queen lays ; that she always has twelve Bees for her assistants ;
that

that it is always the same, which presents her with honey, that brushes, that licks her, &c. The ceremony is not so regulated, that it does not often change. I have sometimes seen queens, ready to lay, which were not attended with more than four or five Bees. There are other occasions, besides those of laying her eggs, in which the Bees pay to their queen their most tender devoirs; for example, in publick calamities. I will give you a relation touching one of these occasions, of which I was both witness and author, and which gave me, at that time, a singular pleasure. Willing to be certain, if there were two mothers in one swarm, I divided it into two parts, which I caus'd to enter into two different hives, which I kept near to receive them in. If this swarm had one mother, and but one, as 'tis frequently asserted, this mother must needs be found in one of my two hives, and not in the other; which accordingly happened. I was desirous of seeing from this experiment, how the Bees, which have a queen, behave, and those which have none. But this is not the subject at present. I will only inform you what passed with relation to the queen, in the midst of the disorder and confusion, during her removal, and that of part of the swarm, from one hive into another. After having observed for about half a quarter of an hour the hive, in which the queen was, (you take for granted, that all those hives, from whence I took my observation, were glazed on all sides) and after the grand agitation of the

Bees, shut up with her, was a little calm'd, it was that very day, wherein for the first time I had ever seen a Queen-bee, who marched at the bottom of the hive with a slow pace, and was alone; she seemed to me so neglected by the other, that I was tempted to conclude, all that had been said of their court to her, and of the train, wherewith she was attended, was more the effect of imagination than observation. This deserted queen therefore, continuing to walk alone, came to one of the glass-squares, along which she mounted, to come to one of those large masses of Bees, which had formed themselves on the upper part. A little time after she again shewed herself at the bottom, all this while being very much deserted: after having been mounted a second time, and concealed herself, during some moments, from my sight, among a collection of Bees, she returned a third time to the bottom. But then twelve or fifteen Bees surrounded her, and seemed to do so in order to compose her train. In the first attacks of any great trouble or confusion, one thinks only for one's self. Should any one find himself in a great hall, well filled with company, whose fall should be sudden and total, he would forget at that very instant, whatever was most dear. The Bees clapt tumultuously into a hive, which had been turned several ways, at several times, found themselves in the like case. In the first moment each thought only of itself; but when they came to themselves, they then began to think of that mother they had either forgotten

gotten or neglected. The mother, with her little train, placed herself again among a cluster of Bees, where she disappeared. She did not continue there long, without being seen again at the bottom. Scarce was she come there, when about a dozen Bees attended her: others made haste to advance towards her: these last placed themselves on two files, on each side, while the mother continued her march; others, who met her, still surrounded her. Her court every moment grew more numerous. Immediately a circle of more than thirty Bees was formed round her. The ranks of those in front open'd, in proportion as was necessary to leave her a free passage. Some advanced nearer the queen than others, and licked her with their trunks. Others stretched out theirs, and in that manner presented them to her, in offering honey. I sometimes saw her stop to suck the offer'd nectar. Sometimes likewise, in her march, she suck'd the trunk of some other Bee. All this behaviour lasted several hours, during which time, I frequently saw the Mother-bee, and always with a train, which seemed desirous to confer honours or good offices upon her. In some cases, however, this mother seemed a little neglected. But their cares and assiduities were so frequently paid her, that one ought to consider as certain a great part of what has been affirmed concerning those appearances of respect, which other Bees pay to their queen.

CLAR.

CLAR. What you say, and what I have seen, leave me no room to doubt of it : on the contrary it presents me with a very pleasing image. I still think I see this queen majestick in her mantelet, in the pains of child-birth ; surrounded with all her court-ladies, stirring to ease and comfort her under those pains. I admired how one presents her with a honey caudle, in what manner another combs and cleans her , and how others load her with kisses, try all means to please her, and, in fine, offer her their continual services. But while I reason at random, behold our queen there, who again regales me with her presence. She is going to enter, head foremost, into an *alveolus*, and after she has left that, without depositing any thing, she passes to another.

EUGEN. I have already prepossessed you upon the choice she makes of the places destined to receive her eggs. The first visit the queen makes to an *alveolus* is to examine it, to see if nothing be wanting there, if it is well made and clos'd, and if her eggs will be safe there. There is likewise another reason, which is well known to us, which makes her pass by an empty cell, without stopping : it is when it is too large or too little for the egg, which she is going to lay.

CLAR. Can they be too large or too little ? You have represented to me these Bees as geometers of the first class, capable of reading lectures to your Newtons or Varignons : how can they be out in their measures ?

EUGEN.

EUGEN. Have you already forgot, that three sorts of *alveoli* are required in a hive, of which those, that are the least, are destin'd for the eggs of common Bees, those, which are bigger, for the males, and the largest of all, and of a figure different from the rest, for those, which will turn out queens. The Bees don't give them these proportions at hazard. These proportions have relation to the number and quantity of eggs, which their queen will lay; and the queen, on her part, to answer this foresight, will not fail to place her eggs in cells correspondent to their bulk: so that when she perceives the egg she is going to lay, is for a Working-bee, she chuses the least cell; if it is for a drone, a larger; if for a female or a queen, she carries it into one of those grand *alveoli*, which I have represented as the palace of the queens.

CLAR. You give to our Mother-bee a knowledge, for which I should have paid a good price, and that very willingly, in the first years of my marriage. You pretend she knows, if what she is going to produce, will be male or female, or a Bee of no sex.

EUGEN. I make no doubt of it, since she is never deceived in depositing her eggs in different places, convenient for them; since there is no saying she is conducted thither by her eyes, nor any of her exterior senses, we must, in spite of ourselves, agree, that these Queen-bees have an inward sense, by which they judge, and which is refus'd to us.

CLAR.

CLAR. Should we not have some pretext to complain of nature, which instructs so well a simple Bee, since she leaves us ignorant of the sex of the infant we are to bring into the world?

EUGEN. Brutes are favour'd with many other advantages, of which we should have room to be jealous, if they were not all more than compensated by one, that is peculiar to us, and which raises our condition to a rank far superior to that of other beings: this advantage, this exclusive privilege is reason, which teaches us to know the Author of the blessings we enjoy, and to pay him our acknowledgments.

CLAR. You skip over the difficulty, in a Christian like manner; one can't but be obliged to you for the favour of the instruction. Not to fatigue you with too long a conversation, I will reduce to one simple question, what I now desire to know of you with regard to this Mother-bee. How many eggs does she lay in one day?

EUGEN. There are times, when she passes some days, and without doubt many together, without laying: but it is not in spring time; for then is the height of her laying. I can't justly tell you the number of eggs, which she emits when she lays the most; but one may judge how many she lays in that season, and the calculation may be drawn from the number of Bees, of which a swarm is composed. Suppose a swarm born towards the end of March, and to take its flight about the twentieth or twenty-fifth of May.

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Notwith-

Notwithstanding their departure, the hive often remains as much or more peopled, than it was at the beginning of March. The swarm, without considering it as a robust one, may be composed of more than twenty thousand Bees. The mother then has laid more than twelve thousand eggs, in less than two months, supposing the two months compleat. If we take a medium, we divide by sixty days the twelve thousand eggs laid during the two months, and find the Mother-bee to have laid, every day, about two hundred. This prodigious fecundity is not only given to our Mother-bee; several insects surpass her in that; but that of the Bee is attended with one singularity, that deserves remark; it is, that the Bee keeps in her body, and for a long time, those impregnated eggs, or (which better agrees with the discoveries of Malphigi, and causes the same effect) she there, for several months, and without alteration, retains, I say, that living, penetrating matter, trusted with her by the male, and intended to enliven the eggs, at the time of their exclusion. Whichever of these two sentiments is true, the same wonder subsists. You may remember I told you, that the males of one hive live but six weeks with the mother; that, after the expiration of that time, they are put to death without quarter. And yet the mother, who, from the month of June, has been deprived of all her males, fails not to produce several impregnated eggs, during the rest of the summer, and the beginning of autumn: but the spring following,

lowing, and before the birth of the new drones, will chiefly be the time, that she will lay eggs enough to furnish a swarm. These last eggs then ought to be impregnated, nine or ten months, before they were laid. It is very particular, that while these eggs, which are not ejected with the embryo's they include, before nine or ten months after they have received life, are not yet produced more perfect than those, which, though impregnated at the same time, are laid several months after, and during all the intermediate time.

CLAR. I comprehend but obscurely the wonder you would have me understand. Can't you make it more obvious to me?

EUGEN. A comparison will suffice. I shall take it from animals, well known and familiar to you. When, in spring, you couple your nightingales to make them lay, if, after the first eggs, you separate the male from the female; and, notwithstanding this divorce, the female, shut up by herself, in a cage, should continue to lay several eggs, during the course of the year; if that after she passed the winter in the same widowhood, she should begin the spring following to give you more, and all these should be impregnated, and she still a widow, you would cry a prodigy. It is this very prodigy, which ceases to be one amongst the Bees.

CLAR. I comprehend you.

EUGEN.

EUGEN. Since you would have our conversation end here, suffer me to make a small recapitulation. I have now told you, that swarms are composed of Bees of all ages, both old and young. I have shewn you, how one may know the age of these Bees: at what time the queen may be rendered fruitful: that the antients were mistaken, in fancying the time of laying to be a time of joy, during which all labour ceas'd in the hives. You have seen the queen lay; you have been witness of the respects, homage and services, which the other Bees pay her on that occasion. I have inform'd you that there are other circumstances, wherein they pay her the same: that the workers don't endeavour to conceal their queen, during her time of laying, as was commonly thought; the reasons, which she has to prefer some cells to others, to deposit her eggs in: in fine, how many she lays in a day, the greatest part of which are not excluded, till a great while after their impregnation. The natural order will lead us to discourse, on the first occasion, of those eggs; in what manner the Mother-bee deposits them in the *alveoli*, and the maggots, that proceed from them.

CON-

CONVERSATION VII.

Of the eggs: the birth and nourishment of the maggots, and the tissue they spin.

CLARISSA.

YOU see, Eugenio, that I am come first to the hive. You may judge, by my diligence, of the inclination you have given me to understand the wonders, which these admirable Bees present us with. I was desirous to try, in your absence, if I could not discover some eggs, and give you the pleasure of finding me ready instructed. But they are plung'd so deep in their cells, and these cells defended by an army of Bees so noisy and brisk, that for this quarter of an hour, since I have been employ'd on this comb, where we yesterday saw the queen lay, I have not yet been able to see them, but very confusedly.

EUGEN. There requires some little application in our observations, if we are minded to spare ourselves a good deal of trouble, and see distinctly what we are desirous of seeing. It is not by thus observing at a distance, and through a glass, that you can see, as you ought, the Bees eggs. Here is a piece of a cake of wax, which I order'd to be cut this morning from one of the hives. I was pretty certain I should find eggs
in

in it. I cut off from this comb, this cell, I pre-
sent you with, or rather this half of a cell. I
cut it longwise, that you may there see the egg
in the same place and situation, in which the Bee
deposited it. This little white body, attach'd to
the bottom of the cell, like a nail, is the egg.
Let us first examine its form.

Plate VI.
Fig. 3.

Lett. A.

CLAR. I fancy that will not be difficult,
since these eggs appear to me like those pickled
cucumbers, whose taste you so much commended.

EUGEN. This comparison gives a juster idea
of your spleen than the form of the egg: It does
not fix in the mind any determin'd figure, which
represents to us the different dimensions, which
are proper to all bodies; it does not instruct us con-
cerning the exterior appearances, which characterize
the thing one would be acquainted with. Should
you ask a person what a wolf is? would you be
well inform'd, if the answer was, it is an animal
representing a dog.

CLAR. Not much, truly. Teach me there-
fore to make a description according to rule.

EUGEN. 'Tis a science born with every
person, who has judgment. It is your own fault,
if you don't use it right. A Bee's egg is five or
six times more long than broad; its two extre-
mities are rounded, but one of the two is much
more so than the other: 'tis that, by which the
egg is not fastned: it is a little bending, which
gave you the notion of a pickled cucumber: its
colour is of a bluish white, something resembling
an opal: The cod, which serves it for a cover-

Plate VI.
Fig. 4.

ing, is like that of several other insects, a flexible member; it is its self so: one may bend it almost in two, and make it take again its first figure.

CLAR. Bend an egg! that is pleasant.

EUGEN. Pleasant as it is, 'tis no less true, and equally true, that it may be done without injuring the embrio. To the naked eye, aided by a tolerable magnifying glass, this egg appears extreamly smooth; but seen through a microscope, which magnifies very much, you will perceive some work, which you wou'd think on its surface, and which, perhaps, is in the inside. I have seen streight strokes resembling very long lozanges. As to the manner it is plac'd in, it is as singular, as its flexibility. The Bee fastens it by the smaller end, to an angle at the bottom of the *alveolus*, and the most usual situation she gives it, is to be parallel to the horizon.

Plate VI.
Fig. 3.
Lett A.

CLAR. Parallel to the horizon! a very learned word. It is lucky that the view of the object assists me to conceive it. I conceive likewise this manner of placing an egg is pretty singular. If my poultry should so stick their eggs against the wall, I should have something to laugh at.

EUGEN. If it was their custom, and in consequence of a natural instinct, you would not think it so adviseable to laugh at it; your curiosity would only carry you to know the reason of it. I can only guess at that, which determines the Bees to act so. I shall inform you of it in its proper time. Let us pursue the fate of our eggs. I have given you to understand, the Mother-bee
leaves

leaves but one egg in every cell. 'Tis however a rule with exceptions; and the case, in which it admits it, is easy to be seen. If a mother press'd to lay, finds not as many empty cells, as she has eggs ready to be excluded; or if the Bees have not sufficiently advanc'd their work to afford a cell to each of these, she has nothing else to do than to deposite several in one. She sometimes lays there two, sometimes three, I have seen as many as four; but all these supernumerary eggs are absolutely lost: they are clapp'd there only to ease the mother, who could defer the time no longer. One cell can be of service to bring up no more than one maggot. The time comes, in which the insect, at its exclusion from the egg, and under the figure of an nymph, will fill the whole cell. Two eggs, and, consequently, three or more, would be lodg'd there, but little at ease. The Bees, who know this, as well as they know every other thing that is necessary for them, and whose highest interest it is to preserve the life of the maggots, go from cell to cell, to remove the supernumerary ones, and to leave no more than one egg in every cell. I am assur'd of this by my own eyes: an experiment, of which I will spare you the detail, convinc'd me of it. Whether the eggs thus taken away by the Bees are destroy'd, or whether they are placed elsewhere, in order to preserve the embryos, I am not able to inform you. But one circumstance, which ought not to be omitted, is the deference, which they pay to those eggs, from whence queens are

Plate IX.
Fig. 3.
Lett. A. A.

to be produc'd. The Queen-bee, who is well appriz'd of what she is going to lay, never fails of placing them in those large *alveoli*, which we name *the royal cells* : there is no fear, that she will put more than one there ; she considers them of more importance than to treat them as the populace. You have now seen an egg laid, and put in a place proper to give birth to a Bee. You expect, doubtless, to know how it will be hatch'd. This is likewise one of those articles, concerning which men have entertained very false ideas. The greatest part of authors, who have wrote of Bees, without having nicely examin'd them, have pretended they hatch'd their eggs, deposited in their cells, after the manner of birds. Some have bestow'd this office on the males ; some have even call'd them by no other name than that of the hatching Bees. Vandergroen, in a work, which has this title, *The Low-country-Gardener*, directs, that when a swarm has left a hive, one should throw it down, and visit all the combs ; and he prescribes, *with a very sharp knife, to cut off the head of every hatching Bee, and likewise the heads of those, who are not yet parted from their cells.*

CLAR. This burlesque precept gives me no great idea of your Flemish gardener.

EUGEN. Other authors have charg'd the Working-bees with the care of hatching the eggs : But all these different opinions are erroneous.

CLAR. Is it, however, necessary they should be hatch'd ?

EUGEN.

EUGEN. It is not necessary they should. Nature knows how to come at her ends by different ways. The turtle, the ostrich, the crocodile, and all the numerous tribe of fishes, don't hatch at all. The general rule amongst insects, is to leave their eggs to the disposition of the air, and the warmth of the Sun. The Bees eggs require nothing, towards their hatching, but the warmth dispersed through the hive. This is no moderate warmth ; it approaches very near, and sometimes exceeds that, which a hen can bestow on her chickens, on whom she constantly sits.

CLAR. How was you able to collect these two kinds of heat in order to compare them ?

EUGEN. By means of a thermometer ; and I found that both one and the other exceeded, by two degrees, the heat we felt in our hottest summers, as were those of 1706, and 1707. Thus both the eggs of hens and Bees undergo the same degree of heat ; but not for the same time. The first for one and twenty days ; but the Bees not above three or four at most. In two or three days, a Bee's egg is laid and hatch'd : and as they are laid successively, they are hatch'd so too during all the months of the year, excepting winter. I can't give you a sight how the eggs are hatch'd, nor how the young one comes out of it ; there are some moments, which one has not in one's own power. You will, at present satisfy yourself with hearing an account of it, which will not, however, make so strong an impression, as if the object was present.

CLAR. Instead of an object to aid my imagination, I will represent to myself, during your discourse, my little chickens quitting their eggs, and from thence will draw a comparison, with your Bees leaving their eggs.

EUGEN. Take heed, Clarissa, and do not compare things so dissimilar together. Nature does not here less observe the same laws, than she does in the production of large animals. It is an article, which well deserves to be explain'd to you at large, because it will dispose you to comprehend an important metamorphosis, which the Bees undergo, presently after their birth. Large animals are born, either from an egg inclos'd in the belly of their dam, if we give our assent to the opinions of great numbers of anatomists, or from an egg hatch'd out of their bellies, which causes the first to be call'd *viviparous*, the others *oviparous*. Both in the one case and in the other, they proceed from the perfect egg. Nature seems to have made greater preparations for them, than for us. She has made them pass (at least the greatest number of winged insects we are acquainted with) through several states, before she brings them to perfection: She causes them to be three species of animals successively, which, by their exterior figure, seem to have no relation one to the other. Let us examine a butterfly. It is at first contain'd in an egg; but how does it get out of it? It is not a butterfly; 'tis a worm, which outwardly resembles it, in nothing; a worm, which we call a caterpillar, which crawls,

I

brouses

brouses the herbage, has strong grinders, a prodigious stomach, a great number of legs, which spins, and make itself a cod, with great art. After certain days, prefix'd by nature, this worm changes figure and becomes what we call faba, or chrysalis, and nymph, in other insects. The animal does not take this form, 'till it has put off its skin, its legs, the exterior covering of its head, its cranium, its grinders, its spinning-bag, and its prodigious stomach, with part of its lungs. In this state it covers itself with a hard and strong membrane, which encloses it round, without affording it the liberty of any of its limbs: thus pack'd and bundled up, it passes a very remarkable time, some more, others less, some more than a year, without taking any food and in a total inaction. During this lethargy, is made an insensible transpiration of the superfluous humours, which occasions a solidity to the interior parts of the chrysalis; and, at last, from this body, between a living and dead animal, an animal comes forth, who retains nothing more of its first figure. The first crawl'd; this flies; the first brousd the herbage, and trail'd itself clumsily on the ground; this inhabits only the region of the air, lives on honey, on dew, and juice, extravasated from flowers. When a worm, it had grinders to break its food; now a butterfly, it has only a trunk to suck. The worm was perfectly ignorant of the pleasures of love; it had no knowledge of its sex. The butterfly seems to have no other relish, and to be only born to pro-

pagate its species. The old philosophers reason'd very much on these changes, and often very ill. Some of them took these changes for compleat metamorphoses, others considered the state of the *faba*, or *chrysalis*, as a real death, and the return of the animal into a butterfly, as a perfect resurrection. There is nothing more opposite to truth, and even to reason, than these contrary opinions. The silk-worm, take it when you will, be it worm, or *chrysalis*, or butterfly, never ceased to live, or to be the same animal: the only difference to be remarked in these different states is, that it had, when a worm, parts, which must be useless to it, when a butterfly; they are dyed up and destroyed, when the worm has taken the form of a *chrysalis*: the other parts are necessary to the butterfly, as wings, and a trunk; the parts of generation being of no use to it when a worm, began not to expand themselves, but when the time of using them drew near.

CLAR. Those parts, which are destroyed in the middle age of the insect, the others, which succeed them, for the uses of a new kind of life, appear to me very singular.

EUGEN. What astonishes you in these kind of animals, takes place in us, without giving you any wonder. How many parts become useless to a child just ready for birth? The *thy-mus*, the *foram enovale*, parts, which, I suppose, you are not well acquainted with, the umbilical string, which you are a better judge of, and several

more, are effaced and disappear after birth : other parts, unknown to our early infancy, unfold themselves in time. This change, to call it so, of the parts, is made in great number, and in a shorter time in insects, which renders it more remarkable. This likewise has given a handle to some authors, to consider the caterpillar or silk-worm, as an animal different from the butterfly, and to fancy, that the butterfly is a foetus nourished and brought up in the body of the worm : it is however easy to shew the contrary. A foetus may be lost in the belly of its mother, without her receiving any hurt. The mother subsisted ; nothing was wanting to make her a compleat animal before the formation of the foetus ; and the foetus, after its birth, leaves the mother as perfect as she was before ; because the mother and the foetus are two perfect animals, which have each one heart, lungs, a brain, and all the parts necessary to life. It is not the same with a worm and its butterfly. Let us draw our example from the silk-worm. If you have recourse to anatomy, and open a silk-worm, while it is in its vermicular state, you will see it has distinctly a heart, or a long artery, which performs its office, the spinal marrow, a brain, a great number of muscles, lungs, or to speak more justly, overtures that supply their place. Open a similar animal, when a *chrysalis*, open it when a butterfly, you will always find there the same brain, the same spinal marrow, the same muscles, and part of the lungs. All these parts, essential to
life

life and motion, are one, each separately, or in a number necessary for an animal. There are not then two animals, for one of these would want a heart, a brain, muscles, lungs, &c. which cannot be supposed.

CLAR. This reasoning appears convincing. You unravel, Eugenio, mysteries, wholly unknown to me. I brought up in my youth, nay, I was already a pretty big girl, I brought up, I say, silk-worms, I fed them and made them spin. What I have now heard makes me blush at that stupidity, in which I saw them pass from the state of a worm to that of a *chrysalis*, and from that to a butterfly, without the least notice of what was wonderful in these changes. I was only touched with those pretty cods or balls, with the silk yellow, or white, which they spun for me. I was a child, which one may be at every age; I only then saw the superficies of things. The little discernment I had suffer'd me to see no wonder in a subject, which every way offers itself. 'Tis a misfortune for youth, when it finds nobody to teach it to behold objects, as they ought to be seen. My family will be the better for your lectures.

EUGEN. You will likewise inform them, nor will you be a loser by so doing, that the Creator has diffused so many marks of his omnipotence upon the earth; that if reason is given us to know him, 'tis in his works we ought to seek that knowledge: 'tis there we find that light, by which we discover him, which pervades, which
astonishes

astonishes us, by which we are convinced, and which leads us to adore him, and which makes us pass from adoration to love. What think you now of those persons, who despise, or treat as childish trifles, the study of natural history, and especially that of small animals; who imagine, (for there are still such, as you once was, they are in their infancy, they judge only from superficies,) who imagine, I say, that the less a body is, the less attention it deserves: that it is more noble to study an elephant than a pismire; a horse, on which we ride, than a worm we tread on: as if Omnipotence was less conspicuous in a little worm, that breaths, that moves, that eats, digests, and produces its likeness, than in a tyger or rhinoceros, which do nothing more? These sort of men, doubtless, measure the power of the Creator, by the foot, the inch, or the line.

CLAR. The most indulgent thing I can do for them, is to pity them. If I know myself, I should never leave these reflections; and we should make great advances in them. However we must put an end to them. I know at present, and pretty well too, the metamorphoses of insects, and to what they are reducible. Let us apply this knowledge to Bees, and trace them through their three states.

EUGEN. The three states of a Bee, after it has left its egg, are those of a maggot, then a nymph, then a Bee.

CLAR.

CLAR. You owe me an illustration of the difference between a nymph and a *chrysalis*.

EUGEN. 'Tis true. When a subject is treated, which we are full of, one precipitately makes use of terms proper to that subject, or art, which we discourse of; and that often, without perceiving, that the persons spoken to are not obliged to understand the language, if I may so speak, of the country they are transported to. It is a vivacity, or rather a fault I am subject to; but I take it for granted, you will remind me of it as often as it will be necessary.

CLAR. Depend upon me, and be assured I shall not suffer any term to pass, that I don't well understand. You may have already took notice of this.

EUGEN. Till these last ages, the naturalists have often indifferently made use of these two terms, *nymphe* and *chrysalis*, to express what is called in a silk-worm *faba*. But now the meaning of these words is fix'd. *Chrysalis* is said of the change of the worm into a *faba*, when after it has spun its cocoon, the worm quits its skin, remains bent, becomes almost reduced to a pap, and covers itself with a new membrane, which grows dry and solid: this membrane preserves it, as if it was in a box, it is all incrusted with it: the silk-worm and all the caterpillars take the figure of a *chrysalis*. We term that state of insects, in which they are surrounded, by a very fine, transparent, flexible membrane, and which permits

permits us to see the whole form of the future Plate VI.
 insect in its *nympha-state*. This is the manner, Fig. 5.
 among other animals, of flies and Bees. But the
 Bee, before it is a *nymph*, is a maggot, and as
 such we will now consider it. Let us retake our
 divided comb, that we may place the object be-
 fore our eyes. I have already told you, that the Fig. 3.
 egg exists not but three or four days, after which
 there comes out a maggot, which falls to the
 bottom of its cell. You see its fall cannot be
 very considerable, and can hardly hurt it: it
 cannot incommode it so much as its shell would
 do, which by its cracks might give it pain, if it
 had been fixed to its side in the first moments of
 its existence. 'Tis this, perhaps, which deter-
 mined the Mother-bee to fix this egg at a certain
 height. The maggot is long: see here a small Fig. 10.
 drawing I have found among my papers, which Plate VI.
 will give you a just notion of its figure. When
 it is a little grown, it keeps itself continually
 rolled up like a ring, and its head touches its Fig. 6.
 back. As it is fleshy and fat, the middle of
 this ring becomes plump and filled up by the
 flesh of its belly. If we had come at a time to
 see one of them quit its egg, you might have
 observ'd, as I have often done, that it keeps itself
 constantly at the bottom of its cell. When it has
 attained its full size, it resembles, at first view,
 those great, white worms, which one often finds
 in the trunks of rotten trees. This here is un-
 provided of its legs, they would have been useless
 to it, since it must pass its whole vermicular state,
 roll'd

Plate VI.
Fig. 7.

Let. L L.

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Let. E.

roll'd up, and without change of place. In proportion as it grows, it becomes white, approaching to the colour of milk; it is very weak and benumb'd, which one may know by its slow and feeble motions, when it is taken from its cell. Its head resembles a little that of a silk-worm; it has, like it, an upper and under lip, and at the two corners of its mouth, two hooks scaly and moveable, which stop the entrance of it in uniting together. These two hooks answer to the two teeth of the silk-worm. However, the maggot of the Bee is not to be fed but by a kind of pulp. For what purpose has nature given it scaly teeth? I know not. One may however guess, that they will be necessary to it, when the time of spinning is come; for there is a time, wherein they spin. Before I quit the head, I should make you observe two little globes, which are as white as the rest, but more shining; they are eyes, or rather two windows of chrystal, which cover those fifteen or sixteen thousand eyes, which you have seen in a Bee in our second conversation. An important part, and that not very well known, is its spinning bag, placed under its mouth, that is, an instrument like to that, with which silk-worms spin their pretty cods or balls. Though this maggot be very well fed, and they suffer it not to want, it does not appear, that it daubs its *alveoli* by any excrements. All its nourishment turns into its proper substance; which is the cause, in favourable seasons, that it acquires all its growth, in five or six days.

CLAR.

CLAR. All that you have told me is very curious; I have heard it with pleasure: but I think myself obliged to interrupt you, to make you remark, that you have had little regard to my ignorance, and that you pass too slightly over two articles, which would require a little more illustration. The first is that spinning bag, and the talent of spinning, which you bestow, perhaps, out of pure generosity, on your maggots; for I never heard, that any found either silk or cod in the hives; that to me is new. The second is, that you have brought this poor, little animal, to the last term of its growth, without taking the least morsel. You told me indeed that pap was given it; but may one know what sort of pap that is, who are its nurses, how do they give it a bill-full?

EUGEN. I am going to explain it to you. Let us begin by the nourishment of the maggot, and how it takes it. Laid at the bottom of its Plate VI. cell, according to this figure, it lies more softly Fig 6. there than one would suspect. One sees there a pretty thick layer of a kind of jelly or pap, something whitish: it makes, as one may say, the bed, on which the maggot is roll'd; or more justly, the back of its seat. This same matter, on which the maggot reposes itself, is likewise that, whereby it is nourished: it would be incapable to go in quest of it: it would not be in its power to draw itself out of its lodge, but must continue there in quiet: it will be always abundantly provided

vided there with every thing necessary. The Working-bees are the nurses, which nature has provided for those maggots; she has bestowed an affection for them, on which one may more surely depend, than, among men, one can for that of the nurses, which mothers chuse for their children. Several hours of the day, a Bee is seen to enter, head foremost, into the cell, where the maggot is, and there continue some time: what she does there can't be observed, but we are at least sure, that it furnishes the maggot with that matter, wherewith it should be nourished, and that it renews its provision. After this Bee is gone, sometimes one is seen, or several, successively, and at different times, that put their head into the entry of the cell, as if to see whether the maggot there lodged has every thing it wants: a single view suffices them, for that often they pass forward in an instant, and 'tis not sometimes till they have examined several cells, one after another, that they enter into one, which they have known not to be sufficiently provided. When a Bee continues some moments in the maggot's cell, it is, without doubt, there to disgorge that kind of pap or jelly, against which the body of the maggot is supported, and with which it is surrounded. When that is done, the little one wants nothing but to turn its head, open its mouth, and swallow; it has no occasion for a bill-full.

CLAR. I am pleased with the situation of your maggot. Our new-born children would spare us a good deal of trouble, if we could get rid of them in laying them upon a heap of pap, which one should have a care only to keep up in proper quantity, and acquiesce, after that, in their discretion. 'Tis then that a body may say, very justly, that nurses have a good time of it. Excuse me this trivial saying ; you are free to return me another. Let us now see what this pap is, with which the Bees nourish their young.

EUGEN. You are not aware, that one observation, of which you should be curious, is first due to you. That is the manner those eggs and maggots are treated with, from whence queens are expected. I have already told you, that these privileg'd eggs are deposited in much the largest *alveoli* : that these are so many palaces, which have been raised to receive these important and valuable Bees, which are the hope of the state. 'Tis not enough, that persons of a superior rank should be distinguished by the number of their servants, by the magnificence of their castles ; they ought to live too in an abundance and superfluity, which is less a sign of their immoderate desires, than of that splendor, which should always attend on the supreme rank.

CLAR. That is what was said of the wisest of all kings, that he supported his wisdom with magnificence.

L

EUGEN.

EUGEN. You will say the same of our queen. Not only the workers are at a greater expence of wax, to build her a royal cell, than they are at in building a hundred, or a hundred and fifty common ones; they bestow likewise food on her to excess, and far beyond what is necessary: a great deal of it is left, which dries in the cell, after the time of making use of it is over. The kitchen too furnishes for her different ragouts. I have tasted of her pap; it was a kind of seasoned ragout, a little sugar'd, mixed with something hot and acid. This sauce, perhaps, appears odd to you; but every one has his taste. If they bestow, on the queen, food without measure, and with a sort of profuseness, it is not so with the other maggots; their morsels are number'd. Their nurses proportion their pap in such a manner, and with so much œconomy, that when the time is come, wherein they have no need to eat any more, there remains nothing. Their care for these young embryo's is not confined to the proportioning the quantity of their food, but likewise to the accommodating its quality to its age. The pap is made lighter and more delicate for the young; 'tis stronger and more substantial, in proportion as they grow and become more vigorous.

CLAR. You must certainly have passed your life in a hive, to know these things.

EUGEN. That is not necessary. It was sufficient to taste this liquor at several times. I have taken some of it in the cell of a young Bee, and found it wholly insipid, and like paste.

When

When I tasted that of the maggots, beyond the middle size, I found it not so insipid ; it had a small relish of sugar or honey. The matter taken from the cells of the oldest maggots had a taste of honey very plain and sensible. In fine, in the cells of those near their term, that is, near the time when they were to leave off these sort of aliment, the jelly had a strong taste of sugar, without the insipidness of honey, but only a little tartness. The differences, which the taste furnishes, are not the only ones, which are found prepared for the nourishment of their different ages ; attentive eyes can discover others. The nourishment of the young maggots more resembles pap, and is whitish : that of the more aged is more like jelly, more transparent, and its whiteness disappears : it sometimes borders upon the yellow, at other times on the green. It seems as if it were by degrees, that the Bees conduct the maggots to be in a condition to feed themselves with real honey, of which they are to make use, when in the form of Bees. As to the origin of this food, I was not able to learn it : I can't tell you whether the Bee gathers it, as she does honey and wax. Swammerdam, who had observed and studied it, leaves us nothing positive concerning it. He proposes a conjecture, which he himself soon after destroys, to hint another, which I would willingly assent to. He thinks, that the honey, and I would add the crude wax, which the Bees have lodged in their bodies, receives there a preparation, by which it becomes a

fort of pap, which is the nourishment of the maggots: in digesting this more or less, they give to it the several degrees of insipidity, or the sugar'd taste, which we found in it. This supposes them to have a very peculiar faculty. When we have taken food into our stomach, we have no longer any power over it; the only remembrance left is what intemperance or gluttony may occasion. But it seems the Bee feels the degrees of digestion, through which the food passes, and that she has it in her power to work it up to such a degree, more or less perfect, as she shall judge proper, to form that pap, which we have found so different in its taste.

CLAR. I should never have imagined, that the taste could have been of so great service in philosophy. You have tasted the venom of the Bee, the pap and jelly of the maggots. What have you tasted besides?

EUGEN. Swammerdam carried his curiosity farther than I. Those maggots, which are white, fat, and in good plight, tempted his appetite. He was determined to know, by his own experience, what taste they had: he tells us he found it very disagreeable, resembling that of the pancreatic juice of fishes.

CLAR. Pancreatic juice! there is a word for a female ear.

EUGEN. I mean a taste like rusty bacon.

CLAR. That is better understood, but makes the food not more delicate.

EUGEN.

EUGEN. After the maggot then has liv'd five or six days, some times a little longer, according as the season is more or less favourable, she prepares for her change into a *nympha*.

CLAR. Could not you have tasted too of a *nympha*, without boasting?

EUGEN. You seem to be gay, Clarissa, and to have forgot the obligation you have to the person, who first eat a fresh oyster; you, who had thought, a little while ago, to erect a statue to him. But let us leave off pleasantry, and finish our history. I have hardly any thing more to say to you about them to day. When the Bees find, that the maggot has its full growth, they leave off bringing it food: they know it has no more need of it, and that it is time to dispose itself to one of the most laborious operations, wherein its life will be in danger. For the change of the maggot into a *chrysalis* or *nympha*, is a passage as dangerous, as child-birth among us. The Bees, who have supported the young maggot 'till now, have still a last service to pay her, in which they never fail: it is that of shutting her up in her little lodge, and to block up the entry into it exactly with wax, to the end it may not be expos'd to visits, which can't but incommode it, and that it should not have any communication with the exterior air. That being done, and having no other services to pay her, they leave her to chance; 'tis her business to look after the rest. The rest is nothing more than to hang her cell with silk. You will be no more

inclin'd than I to believe her vanity puts her upon this expence. We must then believe, that the bed of wax, which was proper for the maggot, is not so to the *nympha*. Our solitary foresees, that the skin, which will cover her after her metamorphosis, will be more delicate than that, which cover'd her when a maggot, and that it is not to be expos'd, when it is new and excessive tender, to the touch of its cell's partition. As there is now no more of that pap, which secur'd the maggot from this inconvenience, nature has instructed it to guard itself by another method. 'Tis in hanging its *alveolus* with a soft, dry, and consistent matter, which hinders the wax from penetrating to her. Nature, in giving her this foresight, has provided her at the same time with the way of coming at it. She has bestow'd on her a provision of silky matter, which she spins out of her body, and with a proper instrument to draw it into a thread, like that of a silk-worm. 'Tis that instrument, which we call a spinning-bag, and which I shew'd you in the first design. The filken thread, which our maggot spins, is extremely fine and close: it is hung against all the interior sides of the cell; it falls in with the angles; it serves, as one may say, for a lining to the whole *alveolus*; it is compos'd of silky threads very near, and which intersect each other. I shall not wait 'till you demand proof of a fact to you unknown, and which you can't be tempted to believe. There is, however, nothing so easy as to be convinc'd of it: you need only gently melt,

Plate VI.
Fig. 7.
Lett. E.

melt, by a fire, the wax of an *alveolus* thus stopp'd up, or to break it with some care ; the wax separates, and falls, and the silky tapistry, which is stronger than the wax, remains intire ; it remains like a thin membrane, beyond which one sees the maggot, or its *nympha*. This membrane or pellicule is compos'd of many membranes clapp'd on, one over the other ; one may tell twenty of them. The reason of so great a number of linings ought to be known. When a worm has hung its cell, and is become a *nympha*, and then a Bee, and when this Bee has pierced the partition with which the others had block'd up its cell, the workers come that instant to clean the place, take away the filth, the old vestments, or, in terms of art, the *exuviae* of the maggot, and those of the *nympha* ; but they don't destroy the tapistry. The *alveolus* thus brought to its former cleanness may serve to bring up another maggot ; the Mother-bee comes there to deposit another egg : the second maggot, which inhabits this cell, there spins, like the first. The same cell may therefore be hung with a new lining of silk, many times in a year. It is the same cell, which has serv'd for the habitation of several maggots, and which, consequently, hath received several silky linings. The cell, which has had most of them, far from being less in value, is stronger and more solid than the other ; it is less liable to be broke, than those which are only compos'd of wax. The tapistry supports and strengthens the walls. Some authors pretend, that these cells

were hung with the old skins left off by the Bees, in the time of their metamorphosis: but they are mistaken, and have laid down this assertion, because they were ignorant, that our maggots had the art of spinning silk. What I have told you, only regards the common cells; as for those, destin'd to receive the queens, they are treated with more distinction; they never serve but once: when the Mother-bee has left it, the others come to destroy it that instant; they leave only the foundations, on which they build hexagon cells.

CLAR. See then our little maggot well clos'd and cover'd in its apartment, and very commodious in its furniture; we may leave it there. You will inform me, the first opportunity, how it changes into a *nympha*.

EUGEN. This article will not keep us long: we may likewise see its passage from a *nympha* into a Bee, and the first excursion of it when a Bee,

CONVERSATION VIII.

Change of the maggots into their nympha-state, and of the nymphæ into Bees. Prolongation, at will, of the life of insects. The first issuing of the infant Bee from the hive.

CLARISSA.

SINCE our last conversation, Eugenio, I have had my head so fill'd with the ideas of the chrysalis, eggs, maggots, and metamorphosis, that I know not where I am. I dream of nothing but their pap and jelly. This morning too I carried the distraction so far, as to ask of my child's nurse, how my little *nympha* did; I call'd its cradle an *alveolus*, and its clouts *exuvie*. I took it in my head to be displeas'd, because the little innocent did not pay me respect and homage. In fine, I had such a confusion of new ideas in my brains, that ran counter to those of the antients, that I had lik'd to have lost all patience, and bid adieu to the observation of Bees, for the remains of my life. Yet my curiosity has led me hither again. I am determin'd, at all hazards, to go through it; and though I should become a *nympha* myself, resolve to know how a *nympha* becomes a Bee.

EUGEN. Without becoming either *nympha* or *chrysalis*, you shall know, when ever you please,

please, how to distinguish between your old and new acquaintance. Wherefore I shall make no difficulty to relate the last accident of maggots, from whence they are to become Bees. When the covering of wax is once put upon a cell, the maggot there inclos'd, of whatsoever sort it be, whether female, worker or drone, has no farther need of any foreign assistance; it is big enough to look after itself. It unrolls itself, becomes longer, spins silk, hangs its chamber with it, and, at length, transforms itself into a *nympha*; that is, it quits its skin of a maggot, and cloaths itself with another much finer, for that is the result of this first Metamorphosis. This *nympha* is, at first, extremely white; afterwards its eyes take a tincture of red, which becomes more and more visible; greyish hairs appear upon its body, and on its corcelet. When all the parts of the *nympha* have acquir'd, by an insensible transpiration, the consistence proper for a Bee, then it is in a condition to appear abroad. It begins by putting off its fine covering, that kind of white and transparent veil, which held all its exterior parts bound up, and which constituted it a *nympha*. Afterwards it makes use of its teeth, to pierce and throw down this waxen partition, with which the Bees had enclos'd the entry of its cell. You have seen, that the maggot pierces its egg two or three days after it was laid; that it takes food for five or six; but the *nympha* continues fifteen or thereabout enclos'd. Thus we compute one and twenty days in favourable seasons,

Plate V.
Fig. 5.

seasons, betwixt the laying of the mother and the birth of the Bee. In cold weather the process is longer, and shorter in warm.

CLAR. Have you a good reason to give me up on this difference of growth, which you make depend, more or less, upon heat? All the animals I am acquainted with have a fix'd time, which does not depend on the variety of seasons, for the carrying of their young, or hatching their eggs: it is invariably the same, be it winter or summer.

EUGEN. I could give you, instead of reasons, many examples of animals, whose growth is more accelerated in warm weather than in cold. I could even carry you much farther, in letting you see from incontestable experiments, that we can prolong or shorten, at will, the life of insects, without any other mystery, than distributing to them the seasons at our own pleasure. But this would be a deviation, which would lead us too far from our subject.

CLAR. How! prolong the life of animals at pleasure?

EUGEN. Yes. An insect, for example, who, according to the course of nature, could not live but six weeks, or two months, I can make live three or four years, it may be more; I know not how long.

CLAR. Ho, you excite my curiosity too much. This is no deviation; I am desirous of immediately knowing this secret.

EUGEN.

EUGEN. I must satisfy you then. To make the thing more plain, I will again have recourse to a silk-worm, which is so well known to you, as well as its progress. That will serve as an example for all other insects. The egg of a silk-worm is seldom hatch'd, till mulberry leaves begin to appear; but you have sometimes happened to have tardy eggs, which have been preceded by these leaves: you had nothing to do then, but to clap them into your bosom, and the warmth of your body hasteneth the birth of the worms. From its birth to its change into a *faba* or *chrysalis*, is about three weeks. During that time, the animal takes nourishment, and receives all its growth. The whole progress of this growth may be check'd, by keeping the animal in cold air, and accelerated by putting it into warm; but that will make no great alteration. So that is not this the period, wherein we have it in our power to prolong its days beyond the intention of nature; to make it live five or six times, it may be, a hundred more than it naturally would? The worm, while it continues so, is under a necessity to augment its size, by the addition of foreign matter, or food; to give to its parts more strength and consistence, that they may arrive at that state, which we call *chrysalis*, which is stationary between an encrease and decrease. 'Tis there we can seize its life, fix or abridge it without doing it any injury.

CLAR. Without doing it any injury! I can easily conceive you do it no injury in prolonging

ing its life ; but it seems difficult to comprehend that you do none in shortning it. As for myself, I should think a good deal was done to me, should any one have it in his thought to abridge my life of a single day ; and I assure you I would cry out murder against any one, who should attempt it.

EUGEN. I see clearly, Clarissa, that I must give you a more distinct idea of life than you have at present. What is life ? It is, according to the design of nature, a continual revolution of thoughts and actions, of degrees of growth and a decrease ; for which there must be a certain time. However rapid, however sudden our sentiments and thoughts appear, both the one and the other may be much accelerated. What would there be wanting to any person in the same duration, or, to speak more justly, in the same value of life, who, by some miracle, could have, in few months, the same increase or decrease of body, and the same train of thoughts and sentiments, which he would not naturally have had but in the course of a common life ? Assuredly with regard to the body and thoughts, nothing would be wanting to him ; his life, though of the shortest, would be as compleat, as if it had obtained its natural course. A father, who could conduct, and that in few weeks, his children from their birth to compleat age, would he be an unnatural father ? especially if in these few weeks, he had the talent of adorning their understanding with all those advantages not attainable

tainable in less than seven or eight years of application.

CLAR. You embarrass me.

EUGEN. 'Tis the same in an insect, which we draw from its state of a *chrysalis*, sooner than it should have quitted it : we make it run, in few weeks, through the same train of degrees, that it would not have passed over but in many months. That is done in exposing it to a degree of heat, which hastens its growth : just as when I cause, in my stove, and in the middle of winter, the *chrysalis* to disclose and expand itself, which otherwise would not have been till the month of June or July following. Thus much for the life of insects when abridged ; let us proceed to their extended life. The worm never changes into a *chrysalis*, but when it has no more room to grow. The butterfly is then wholly formed ; it has only need of a transpiration to free it from its superfluous humours, of those humours, in which it was, as it were, drowned, and in a drowsiness, which, in part, intercepted the course of the animal spirits, and suffered not the muscles and nerves of the exterior members to have that stiffness necessary to motion. This transpiration can't be excited but by heat ; when that is greater, it becomes more quick, and more slow, when less. From thence the developing of the butterfly becomes more or less quick. If this transpiration was stopp'd short, you clearly see, that there would be no more expansion, and the animal would necessarily remain under the figure of a *chrysalis* : It would be constantly so, till a new heat

heat should cause its transpiration. I must now prove this reasoning by an experiment. You know, from the birth of the silk-worm, to the death of its butterfly, is about six weeks; it is during this time, that nature makes it run thro' all the revolutions of its life. It grows as long as it is a worm: while it is a butterfly at liberty, it is at its highest period; after that it can't but decrease. The interval between these two states is what I have mentioned, that of a *chrysalis*. Hinder this *chrysalis* from transpiring, you stop the whole machine, as you would stop a watch, by fixing the balance. Since it is heat, that causes fermentation within the *chrysalis*, and this fermentation provokes transpiration, carry your *chrysalis* into a place, where it will be deprived of this heat, as, for example, into a cool cave, or an ice-house, there will be no longer either fermentation or transpiration, at least in the cave it will be infinitely diminished, in the ice-house totally stopt. I was led to think in this manner, by observing the progress of nature with regard to insects. There are several insects, and, among them, a beautiful and remarkable caterpillar, which lives upon fennel, which, if it turns into a *chrysalis* in the month of July, becomes a butterfly in thirteen days after. But if it is not in this state till the end of August, it passes the winter, and continues so for nine or ten months together. It was easy to conclude from hence, that in order to stop or retard the change of a *chrysalis* into a butterfly, nothing was required but to prolong its winter. This is what I have done. It is now three years,

since I have kept in my vault some of these 'in the form of a *chrysalis*, who are yet very lively, and would not have lived but one or two months, if I had suffered nature to operate.

CLAR. This experiment is not only curious, but appears to me to be very interesting. I don't doubt but you will procure to yourself some considerable advantage from hence, and hope you will permit me to share with you. If it was only to live in a cave to enjoy immortality, I could easily resolve on doing so, and know a pretty many honest people, who would think this a very easy condition.

EUGEN. I was afraid, Clarissa, that your imagination would readily seize this flattering idea of immortality; but I desire you to give up this hope: a privilege like this is not made for us. A hundred good reasons, as well moral as natural, might be produced; I shall confine myself to one of the last sort. One of the principles in all animals is blood. Our blood, like that of all large animals, is of a nature very different from that of insects, if we would chuse to give the same name to theirs. Our blood thickens, and coagulates; immediately after it has ceased to circulate, and is once coagulated, we are perfectly dead, because no heat is capable of liquifying it, and restoring to it its primary quality; without reckoning, with regard to us, that there is no more return for the soul, when once separated from the body. The blood of insects, on the contrary, would become dry, would dissipate and evaporate

evaporate, sooner than coagulate. When it is well enclosed, and out of the power of all evaporation, it continues itself a long while, during which it preserves itself in a state of fluidity, and ready to flow anew, when the air and heat shall set the machine in motion.

CLAR. 'Tis a great pity, that blood so happily constituted should be given to insects, preferably to reasonable animals.

EUGEN: Whether it be a real advantage to them, and whether they be in a condition to profit, by these two, three or four years, and perhaps many more we could give them, is the thing to be known. First of all, take notice, it is not while the animal is a worm, nor when it is a perfect butterfly, that is to say, while it has the enjoyment of life, that we can confer that good office: it only is, when it becomes *chrysalis* or *nympha*. Now the state of *chrysalis* or *nympha* is a lethargy, during which, life must be perfectly indifferent to the insect, because it neither performs, or can perform any animal functions. This lethargy can be compared to nothing better than our sleep. What use would it be to us, to live two, three or four hundred years in a profound sleep?

CLAR. I should not fail to find charms even here. The whole world is eager to see the accomplishment of their wishes, and I more than any body. If I could, for instance, this day sleep only for a hundred years together, I should, at my waking, have the pleasure to find grand
M children,

children, a pretty and numerous posterity, honourable alliances, good employments in my family, perhaps some one of my grandsons marshal of France, or governor of a province. It is said, that Alexander wished to wake after his death : had he not his reasons ? What satisfaction would he now have, in hearing the astonishing report of his renown ? To see, that when one is inclin'd to carry the praise of a conqueror to exaggeration, nothing better can be found than to draw the comparison from him. How many things are there in arts and sciences, that we are now ignorant of, and which will be better known a hundred years hence, if your academy continues its improvements, as it has done since its establishment ? How many new lights shall we have, it may be on the subject of Bees, which you are yet ignorant of, and which you would give a good deal to purchase ?

EUGEN. Let us see the reverse of the medal. The person, who should this day, go to sleep for an age, leaving a numerous posterity, noble, rich, virtuous, raised to the highest employments, might, at his waking, find an indigent family, children who died in misery, some dishonoured or dragging on a shameful nobility in vice and indolence. It might be almost wished, that Alexander could rise again, to receive the reward of his ambitious folly, in hearing, that at this time, *for good reasons*, all people of sense would give him an apartment in *Bedlam*. Should Descartes return, could he, without being piqued,

see,

fee, what terrible blows has been given to his favourite vortices, his three contested elements, and abundance of other physical and metaphysical ideas, which cost him so many wakeful nights and so much application? And as for us, let us not flatter ourselves, that our successors will not find some great fault in our philosophy. How many systems, which, at this day make the glory of their inventors, will cause pity, in three or four hundred years hence, to our descendants? I would, for a moment, give into this agreeable chimerical idea, which, at first, soothed your imagination. I suppose, that the lengthening life, by long sleeps, was found out, and that the offer was proposed to you: you would make, before you accepted, some reflections, you have not yet made. Would you dare to plunge yourself into a sleep, for a course of years, during which, you would be exposed to perish by a thousand accidents, against which you could not be in a condition to defend yourself; by fires, inundations, murders, the consequences of war, the greediness of your heirs, the negligence of those, who ought to watch for your security? I still go farther. Suppose you are lucky enough to avoid all these misfortunes, and to wake safe and sound, at the end of an age; what would you find in the world? A new world, not one jot better than the old; people, unknown to you, and who would not give themselves much trouble to gain your acquaintance: your estate divided among your heirs, who won't be in a humour to

part with it. You were rich at your going to sleep, but will wake poor.

CLAR. You make me tremble ; I had much rather die. Let us therefore amuse ourselves no longer with this dangerous chimera. You would therefore do well not to speak to me of those experiments, which only leave a sad regret to see my hopes vanish as soon as formed.

EUGEN. Experiments of pure curiosity have their charms ; but when they lead to something useful, the profit is double : that sometimes happens, when we think the least of it. Such are those we have made on the life of insects.

CLAR. I can't see the advantage, which a *chrysalis*, carefully preserved, three or four years, in an ice-house, or a vault, can give us. Is it a remedy against some distemper ?

EUGEN. This experiment will inform us how to eat eggs fresh all the winter, and in those times when your own hens and those of your neighbours have done laying. That is some small advantage towards good housewifery in the country.

CLAR. Surely no ; but it is a paradox, at which I should smile, if any other but yourself had proposed it. What affinity is there between a *chrysalis* and a fresh egg ?

EUGEN. I don't propose, that you should compare them together ; my design is only to tell you, that the art of preserving a *chrysalis* has led me to preserve eggs for years, and always as fresh as they were that day they were laid. To

draw

draw you from that embarrassment, into which my proposition has thrown you, please to remember, that the *chrysalis* is not preserved for several years, but by stopping its transpiration. A hen's egg, like that of another bird, is almost a *chrysalis*. By stopping its transpiration, you will preserve it, as one would a *chrysalis*. To prove it, let us observe what passes in an egg, in proportion as it corrupts in air, or receives its fermentation under a hen. Notwithstanding the compact texture of its shelly covering, the egg transpires daily ; and the more it transpires the sooner it is spoilt. Every body knows, that in a fresh egg, dressed or not, the substance of the egg very sensibly fills its shell, and, on the contrary, there remains a void in an old one, by so much the more sensible as the egg is staler. This vacancy is the measure of that quantity of liquids, which transpired through the shell. When you hold it between your eye and the light, if you perceive it has a vacancy in the upper part, you say it is not fresh, and you say right. The modern philosophers have found the method of discovering the canals, thro' which an egg transpires : they have seen those air ducts, which have a communication through the egg to the exterior air. The peasants of some of the provinces of the kingdom act as if they understood this part of natural philosophy. They preserve those eggs, which their hens laid in autumn, to send them to Paris in winter. They keep them in tubs, surrounded on all sides with ashes, close pressed. They keep them also in water, which

has nearly the same effect; but neither the water or the ashes absolutely stop all transpiration; they only make it more slow. The egg continually finds more or less of the dissipation made in its liquor. Whoever then could communicate the secret to stop it entirely, would, at the same time, give you that of preserving your eggs through years, and perhaps through ages.

CLAR. I would settle on the person, who could furnish me with that secret, a perpetual rent of two fresh eggs every morning.

EUGEN. My fortune is made. Take pots, fill them with new laid eggs, and pour over them mutton fat melted. Only take care, that this fat be not too warm to scald the eggs; it will run into all the hollows, that are between, will surround them perfectly on all sides, and guard them from all communication with the outward air. By so simple a method you may preserve them for years. I have actually some by me, which I have kept for two years. A fortnight ago I ate two, which had no fault to be found with them.

CLAR. I will this very day give orders, that your rent shall be exactly paid, and to-morrow I will make a present of this secret to all my neighbours. It is time to return to our Bee, which we have left in its little prison. Tell me how she extricates herself from it.

EUGEN. As soon as the *nympha* had got rid of her skin, she commences a perfect Bee. Her first care is to perforate the wall, with which they have cloistered her up. At first she makes

use of one of her teeth, to make a hole about the middle. This being made, she employs her two teeth to dig down the wax, and make it humble; the opening by degrees makes it more large: at length, in about three hours, when the recent Bee is vigorous, and the season favourable, it makes the opening large enough to admit its coming out. The Bees less strong, and in days not very warm, are sometimes half a day in doing this. This work is likewise above the strength of some, who die in their cell, after having made an opening, through which only their head or part of it is able to pass.

CLAR. Ha! What becomes then of that tender love, those officious cares, that charitable vigilance of the Bees towards their young?

EUGEN. That is what I cannot tell you. I own it would cost them little to help these poor little creatures, in a work very laborious for their weak condition. It was natural to imagine, that the Working-bee would open that prison, which they had made. Swammerdam believed, as you was disposed to imagine; however Swammerdam was mistaken. The young Bee has no succour to expect from his companions; his destiny at that time wholly depends on its own strength: 'tis an inevitable misfortune, if that should fail in time of need: but at length when the Bee has made a sufficient opening, it puts through its head, then its two first legs, which it fixes on the edges of the hole, and by the means of which it draws itself forward. Soon after its other legs

are ready to come out in their turn, and then it is not long before it disengages its whole body. This labour over, it appears a perfect Bee in full sight; it supports itself on its six legs, pretty near the cell it has quitted. Its wings unfold themselves and grow strong: its body and all the exterior parts are yet wet; but although the warm air of the hive, would not be sufficient to dry them soon, they would not long continue wet. The Bees, which perceive this recent companion, approach near; they seem to take notice of her, by their good offices, and the joy they express to see her. Two or three place themselves round the new comer; they lick and clean her on all sides, with their trunks; some among them even present it with honey.

CLAR. Here is a good deal of oddness. How! a Bee, to whom, but just now, they would not vouchsafe to lend the least help, but let it miserably perish at its door, because it had not strength to open it; this Bee happily extricates itself from its danger: see it, in a moment, saluted, careffed, and loaded with presents? This forgetfulness and this successive return of brotherly friendship has a good deal the air of one of nature's sports.

EUGEN. Let us not use this expression, the sport of nature, which has no signification; for nature neither sports or trifles; she inviolably pursues the laws imposed on her by her Creator. But let us agree to place this among the number of those things, which we are condemned to be

I

ignorant

ignorant of. I have told you, that young Bees may easily be distinguished by their colour ; that of the old one is more red, that of the young one greyish. The rings of these last are browner, which become more distinct as the animal grows old ; the hairs of the young are white, those of the old ones red : the Bee just produced has a great belly ; if it is open'd, 'tis found full of the last honey she ate while a maggot. All the parts of a young Bee are scarcely sufficiently dried ; the wings are hardly proper for motion, till it becomes a perfect Bee, and knows all it has to do for the rest of its life. Don't be astonished, that she is so well instructed, and so early : its instruction is derived from him, who made it.

CLAR. How happy should we be, if he, who formed our children, had given them to us perfectly instructed !

EUGEN. Take care, Clarissa, not to complain unjustly : he would have given you nothing but machines, instead of docile children, as yours are : he would have deprived you of the most sensible and the most soothing of all pleasures, that a mother can have, that of conducting them yourself to virtue by your counsels and your examples.

CLAR. I did not seek for a compliment, but you will furnish me with more than one occasion not to be behind hand with you.

EUGEN. Our new-born Bee then perceives itself made for society ; that she ought to labour to acquit herself of those cares they have taken
for

for her ; she walks some time upon the combs, by way of trial, then she disposes herself to take the open air. Other Bees, which are continually coming out of the hive, shew her where the door is ; she never wants guides to direct her the way. Is she abroad ? behold her upon flowers ; from them she knows how to extract wax and honey. We have already seen her companions offer her this nectar before her first going abroad ; if then she goes to gather some, soon after, at the bottom of flowers, 'tis less to nourish itself with than to begin to work, for the common good ; to collect it, in order to convey it to those places destin'd to receive it. What fairly proves, that it is not for her own interest, that she takes the field, is, that she sometimes gathers only crude wax. M. Maraldi assures us, that he has seen Bees loaded with two large balls of wax, returning to the hive, the same day they became Bees : it is thus, that a Bee is formed, and 'tis thus they all are. The queens must always be excepted. Among Bees, as among us, kings and queens are not formed of more precious material than the bulk of the people ; they are all equal as they come from his hands, who makes them ; but whence once they come among creatures like themselves, things admit a change. The royal majesty is, among Bees, of divine institution, as it is among men. That respect and distinction due to them is a consequence of it. I have already prepared you, on a great number of these distinctions, but have not yet told you, that they carry

carry it so far as to give to the royal maggot, in its *alveolus*, a quite different position from the others; and that when a *nympha*, it keeps this position, of which I shall speak more largely, when we come to the royal *alveoli*. When this Bee is become a queen, she goes not, like others, into the fields: her person is too choice to be exposed to the dangers, which may overtake her out of the hive. She may take her walks through all the streets of her kingdom; she is certain of finding every where magazines filled with food, or Bees that will present her with some. In waiting till I can shew you in the original, Bees, for the first time, leaving their cells, you will satisfy yourself with this drawing, which will give you a pretty just notion of it. The cells marked Plate VI.
BB, are those the Bees have already quitted. Fig. 8.
Those marked CC have their covering still on; the nymphs are yet inclosed within them. That marked M gives you the view of a common Bee, which has put off its skin of a nymph, which has gnawed thro' the covering of its cell, and is preparing to leave it. R, S, is a royal cell, from whence part of the wax has been taken, or, if you please, in which has been made a window, to discover the *nympha* of a Mother-bee, such as it appears in its *alveolus*. You see how much it differs from others, in situation and lodging.

CLAR. Without doubt the drones too have honourable privileges.

EUGEN.

EUGEN. They have not been forgotten in the distribution of honours ; they hold the place of grandees in the state, but of those grandees of shew, whose lot is very much bounded. Besides the privilege of leading a soft and effeminate life, and not working for the publick, a poor privilege, and which will never pass for a title of honour, they are distinguished by greater *alveoli*, than those of the Working-bees. This is another drawing of part of a comb, which was intended for the drones. The cells marked O, are open and empty ; all the rest are closed, which yet contain the maggots or *nymphas* of the drones ; you see their coverings are not flat, as are those of the other *alveoli*, but convex and swelling outwardly. I know no other distinctions they have. You now are pretty well informed, Clarissa, of the birth of Bees. Consider, before we pass to other subjects, if you have any doubts, if I have not forgot something you would willingly know.

Plate VI.
Fig. 9.

Ibid.
Lett. P P.

CLAR. 'Tis your business to see, Eugenio, that you have fulfilled your promise. If I remember right, you told me, a hive was a circle of living and dead Bees ; and that to come at a fixed point, you divided them from a swarm. It appears to me, that in order to finish this revolution of a circle, you should carry me to a swarm.

EUGEN. The observation is very judicious. To answer it, call to mind what we said, in order to connect with what I shall now say. This Bee, which we have seen lay her eggs, in our
sixth

sixth conversation, was newly come to a hive, together with her swarm. You have seen her deposite her eggs in the *alveoli*. I have told you how from these eggs maggots are produced ; that these again take the form of *nymphas*, and these likewise that of Bees. I told you when a Mother-bee was arrived at the height of her laying, she emits two hundred eggs a day : these eggs are to be hatched in nearly the same proportion : the hive therefore is daily growing more populous, and in few weeks the number of inhabitants becomes so great, that it cannot contain them ; they must be divided. This is what gives occasion to swarms. These swarms might be the subject of our next conversation. Yet I think it will be more conformable to the order I have laid down, to discourse first of all, of the actions of Bees, of their manner of living in their hives, and their works ; in a word, of every thing, that passes between the arrival of one swarm and the departure of another. As a swarm is liable to have many queens, and as they begin no kind of work in a new hive, till the number of queens is reduced to one ; I will first speak of the massacre of their supernumerary queens ; and, not to return, several times, to so mournful a subject, I shall join to it that of the males and maggots.

CONVERSATION IX.

*Of the massacre of the supernumerary queens,
with that of the males and maggots.*

EUGENIO.

IF you do not bring along with you, Clarissa, a heart of brass, you are greatly to be pitied.

CLAR. Can you think, Eugenio, that one has hearts to change, as often as there may be occasion.

EUGEN. At least one ought to have something to fortify ourselves against those shocks, which cruel objects give a tender heart.

CLAR. I shall find that assistance within myself. Tragical and melancholy as these adventures may be, which you have to relate, I am ready to hear them, and prepared for every event.

EUGEN. That is very *a propos* for you. I am going to begin with what passes in a hive, on the account of a plurality of queens. You already know when a Queen-bee has begun to lay, she sometimes produces seven, eight, and even twenty females. I, one day, found forty, at least forty royal cells. It is not difficult to comprehend the reason of this plurality. If there was only one queen born in each hive, that would not be a sufficient provision for the multiplication

tiplication of Bees. The swarms would often want a conductress. A thousand accidents may destroy the little maggot, from which a queen is expected, before it arrives at its metamorphosis into a Bee. It would not therefore be sufficient, that the mother should lay but one of these female eggs each year; it is necessary she should lay a sufficient number of them, to guard against accidents. There are therefore many of them born; and from hence it comes, that when a swarm is ready to depart, many of these female Bees, which observe they are too numerous, join the colony, and follow it. The others, less diligent, or more attach'd to the place of their birth, continue there; it may be too, the pleasures of love detain them there.

CLAR. The antients were undoubtedly ignorant of this multiplication of kings or queens, since I never heard of above one king of the Bees.

EUGEN. All the antients, to begin with Aristotle, have acknowledg'd several kings. They affirm, that it some times happens, that a swarm has two kings or two queens. They inform us of what is done in such a case, which is not an uncommon one. But, according to their custom, they have not been able to contain themselves within the bounds of simple truth, but have added to it a mixture of the false marvellous. They well knew, that it was necessary, that one of these two kings should resign the kingdom to the other; but they have spoken of the preserv'd king as a
king

king possess'd of all the qualities which render him worthy of that advantage, and as endowed with an outward appearance proper to procure him respect ; but they treat the rejected king as a wretched fly, unworthy of the sovereign power, which he was ambitious of usurping. They have been very lavish in bestowing on him the names of usurper and tyrant ; they have represented his form as hideous and at the same time contemptible. It is after Aristotle that Virgil has described both the one and the other, and asserted, that the forms of those two kings were very different, that one of them, *viz.* the good one, had reddish scales, which shone like plates of gold ; that its figure was noble, whereas the other was disagreeable to the sight ; that it seem'd all over dusty, with a large belly ; in short, that it deserved nothing but death.

CLAR. A poet, like Virgil, may be permitted to amuse us with his agreeable stories ; nobody can be deceiv'd by them : 'tis what is expected ; poetry draws its ornaments from fiction ; but that a grave philosopher, as your Aristotle was, should give us fables for realities, is the thing, that shocks me. Of whom then can we learn truth, if these sages join with the poets, to impose upon us ?

EUGEN. The time of fables is over. If we speak of them, 'tis only that those, who are ignorant, should not confound them with true facts. It is with this view, that I shall tell you, one cannot read without astonishment the ex-
tream

stream with confidence, which Alexander de Montfort speaks in his book, call'd, *The spring-time of the Bees*, of this rejected Bee, assuring us, that what he is going to say, is the product of several years observation. You shall judge of the worth of his observations by the advantage, that will result from them. Montfort calls this unhappy Bee, *the tyrant or quarrelsome prince*. He says, *his dusky colour, his large belly, his swollen legs, and languid gestures, are signs of envy, ambition, gluttony, cowardice, laziness.*—*That this quarrelsome prince has a hoarse accent, which echoes in every quarter, caressing the new souldery, whom he endeavours to inebriate, and draw into revolt against their sovereign. The quarrelsome prince leaves the hive with a swarm, departs from his king like a traitor, or piece of counterfeit money, that dares not shew itself. As soon as the sun shines upon his head, his bad qualities appear, and cause one part of his people to revolt.*

CLAR. This jargon of Alexander de Montfort, as well as his quarrelsome prince, appears to me a mere fiction.

EUGEN. It is so in reality. Charles Butler, in his *Female Monarchy*, comes nearer the truth; he will have it, that when the new queen has taken possession of her *capitol*, and the empire has been granted her, the second in rank is condemned to death, by a decree of the people, and immediately this decree is executed. He does not tell us, that he saw this execution; but he mentions terrible battles, which lasted in the hive

for two days together, where two strong swarms had enter'd, which did not end 'till one of the two mothers was kill'd. But to substitute more simple and truer facts, in the stead of those, which are loaded with circumstances more imaginary than certain ; I shall tell you a truth, that a swarm, when it leaves a hive, has often two queens, and sometimes three ; and there often remain behind several supernumerary Bees in the hive. I am capable of giving you an exact account of what becomes both of the one and the other. What I have to say, is from ocular demonstration : when a swarm goes from the hive it was born in ; they are often seen to divide themselves into two bands, which settle upon the branches of some neighbouring tree. This division is a sure sign, that there are, at least, two queens ; but then it often happens, that there are more in one cluster than the other. One will not be, sometimes, bigger than one's fist, while the other shall be as large as the head. Whatever the cause may be, that the queen of the smaller cluster has drawn no more Bees after her, her company in general are not faithful to her. The Bees love to live in numerous societies : the queens themselves are not pleas'd, when they have but few at their service ; they seem to know the inconveniencies, that result from it. A small cluster is not then of long continuance ; the Bees detach themselves from it by little and little ; and when the troop is reduced to a small number, they, together with
their

their queen, go to unite themselves with the other. Then the swarm has two mothers.

CLAR. I clearly see, that we are near upon the moment of the catastrophe. I remember there ought to be no more than one queen in each hive, and that the other must be sacrificed to the public repose, and to that law, which requires there should be but one monarch in one monarchy. I fortify myself beforehand against those horrors you are going to relate.

EUGEN. I would willingly spare you the recital of them. But the faithfulness of history requires, that we should speak both of the good and the evil. When these 10, 20, 30, or 40 eggs, which the Queen-bee has laid, are become female Bees, there are born, at the same time, hundreds of males, and thousands of workers. The whole hive becomes prodigiously peopled. If all equally pursued the same end, and labour'd only for the public good, every thing would go on perfectly well. But the lazy, that is to say, the drones, and the supernumerary queens, thinking on nothing but amours, and living without any advantage to the society, the magazines of honey would be quickly exhausted. To nourish so many useless mouths, the workers would not be too numerous, with all their strength; and their only employment would be to seek food in the fields, and continually to re-victual the place. During which time the *alveoli*, and other public works would be neglected. Besides, the reigning queen has not yet done laying; she has need

of other cells to deposite new eggs in. A swarm, which carries with it two or three queens, does not wholly disincumber the hive of all its supernumeraries, because we know there often are 30 or 40, which will be so many mothers, and which will soon take up all the *alveoli*. Death alone can be the safety of the hive.

CLAR. Would it not be more worthy of a wise government civilly to desire them to retire, or even to drive them out, if they are obstinate, than to lay violent hands on persons so august as queens ; as I am afraid will appear in a moment ?

EUGEN. I will suppose they should enter into your compassionate sentiments : where would the poor unhappy creatures go ? Into some corner, there to languish in misery, and then die two or three steps from it ? for every queen, that carries not a swarm with her, has no retreat. She immediately becomes a prey to uneasiness, chagrin, or birds, and above all to cold. The workers know, that it is most expedient for these poor unfortunate, to put an end, as soon as possible, to a life, which can only end in a tragical death. They kill them out of pity.

CLAR. It is great pity they were born !

EUGEN. As for them, in particular, it would have certain been better they had never seen the light ; but the general œconomy of the universe requires it should be so. It would not be difficult to prove, that many animals, to begin with ourselves, are the prey of distempers, wars, murders, cruelty, and the avarice of our fellows ;

fellows ; and that there are none, wholly free from these accidents. In short, that we may return to our murder'd queens, I remember, that six mothers were brought me one morning, found dead upon the stand of one hive, from which the swarm had parted the evening before. The lot of those, who save themselves by following the swarm, is not more happy : one only is reserved, the rest are sacrificed to her safety. The first proof I had of it, was from a swarm, which left their hive in June. The Bees, of which it was compos'd, divided themselves into two bands of unequal bulk, which quickly reunited. The division, which was first made, gave me reason to conclude there were two mothers ; but the consequence shew'd me there were three. Thus the numbers, which a swarm divides itself into, are not always equal to the number of queens. I have learn'd from other observations, that it does not always happen, that a swarm, which has two mothers, divides itself. I was curious to follow the swarm I was speaking of. It entred peaceably into its new hive ; two days after, every thing appear'd very calm. I did not perceive, in the hive, those battles, which are there said to be fought, when there are several mothers. Next day, about three in the afternoon, the air seem'd to be fuller of Bees ; and more out of the hive, and especially about the door, than was customary. I open'd one of the shutters, to observe what pass'd within, and was quickly satisfy'd there had been some commotion.

The Bees had left the top of the hive, where they had kept themselves the first day, and where they had already built two small combs. I had room to conclude, there had passed some bloody expedition. I examin'd the ground before the hive, and there found some dead, among which there was a queen. All the day, in which this battle was fought, the Bees did not work at all; they likewise passed the whole night near the bottom of the hive, without regaining the top: there too I found them the morning afterwards: three hours after I found another dead mother, near the place where I saw the first. This was the last, that was to die: thus order and peace were restor'd to the hive; the Bees gain'd the upper part; they placed themselves as they had done before, and as they ought to do, and applied themselves to work in good earnest. The swarm, I mentioned, is not the only one I have had, out of which two mothers have been kill'd. It is then incontestable, that there are times, in which the Bees cannot suffer many females, and that one only is requir'd to the Bees of one swarm.

CLAR. It would surely be worth your while, to penetrate the reasons, that determine the Bees in the choice they make of their queen. For we have seen till now so much agreement among them, that it is not probable they take a queen at hazard, on whom the safety and preservation of the state depend.

EUGEN. I will not positively affirm it is the consequence of their reasoning and settled judgment, that they prefer certain Bees to others,

to constitute their sovereign ; but 'tis most likely, that she, who is rais'd to that high rank, is the most worthy. I do not however, nor is it necessary that I should, pronounce this seriously, that she is endow'd with every moral virtue, which has been thought necessary to her. Neither do you think the mothers, which have been put to death, deserv'd so tragical an end, because they had that blackness of soul peculiar to usurpers and tyrants, and all the vices, that Alexander de Montfort charges them with. What I think most probable is, that the queen, which is kept alive, has, in the highest degree, the virtue, in which they are most interested, namely that of laying the most eggs, and more than those females would have laid, that were sacrificed to the public tranquillity.

C L A R. I easily conceive it not to be necessary, that the Bees, which compose a swarm, ready to fly, should come to an election in form, to give themselves a head. Nor make I any doubt but they would accept her, which should first offer. A moment, it may be, decides it. I mean, that among the late born females, she, who is sufficiently active, and restless to part first from the hive, may determine the Bees, who no longer like their old habitation, to put themselves in her train, in the search of a new lodging.

E U G E N. I am of your opinion. We may however still add one circumstance, very capable of determining a choice so bounded in its views

as theirs may be. It seems the sovereignty may be granted, as in our most famous monarchies, to the Bee, which, by its birth, can lay the best claim to it. The first is she, who has acquired the most vigour, who has been the soonest impregnated, and the most ready to lay. This title would be sufficient to merit a throne among the Bees. I think I have even a proof of it.

CLAR. Trifling as those motives may be, which lead them to the choice of a sovereign, they will be always more reasonable than those of a people, who set their crown to sale.

EUGEN. I am not, any more than you, disposed to approve that method of giving themselves sovereigns. Could you, however, suspect the Bees to be captivated by the brightness of gold? Virgil has described the King they have chose, as a person of grand air, and all shining with gold; and the abandon'd kings, as hideous and of an ignoble figure. This figure is not absolutely foreign to probability. I have always observed the chosen queen to be of a more reddish colour, than the rest. This colour was sufficient to create gold in a poet's eyes, and perhaps may have the same effect on the eyes of the Bees: for those, who are put to death, have always appear'd to me more brown, and not so large. So Aristotle has affirm'd, that the elected king is red, the other black, that is more brown. This constant difference of colour may a little justify the exaggerations of Virgil, and
give

give the Bees a motive for their choice, which is determin'd as their eyes are affected. However, this reddish colour is not an advantage bestow'd by nature, and given preferably to some rather than to others, to mark out superior merit ; 'tis only a prerogative of age : the mothers, like other Bees, become redder as they grow older. When they are first born, they are brownest : the nearer they are to their laying time, the bigger and larger their bodies are, and the more shining. From hence it appears, that she, who is preserv'd for queen, is the first born and the nearest laying, because she has a higher colour, and an air of grandeur sufficient to strike the eyes of the other Bees. Thus royalty among them would be due to *primogeniture*, and the reward of fruitfulness.

CLAR. The choice, which the Bees make of their queen, leads me to suggest to you a little reasoning of mine, on this subject. I like, that one should reduce, as you do, the actions of animals to their just value. I can't bear, that people should endeavour, as I, every day see thousands do, to raise the intelligence of beasts to an equality with ours, and continually compare us with them : this parallel has always shock'd me extreamly. In a dispute, which I have often had with Madam *** who, like several other women, knows nothing better than what she thinks ; this good lady, always in an ecstasy on the pretty manners of her dog, will have it to act from a reason similar to her own.

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If I offer to contradict her with politeness, she strikes me dumb with this fine argument : This must be so, because neither you, nor myself, can conceive how it can be otherwise. It is to no purpose to reply, that the bounds of our conception are not those of omnipotence ; and that if omnipotence could be bounded, there would be an end of all argument. That beasts perform mechanically that, which we can't perform but by the assistance of our reason : and certainly, I don't, on that account, less admire the author of nature. I think it too great a rashness for men, to imagine, that every thing, which has a resemblance of reason, can't be effected but by a reason similar to theirs ; as if God was not sufficiently powerful to accomplish his own ends by a diversity of means.

EUGEN. If you would please to take the trouble oftener to give us arguments in your own manner, our conversations would be much the better for them.

CLAR. You are very obliging. Since we are on the subject of the actions of Bees, I will propose one question concerning the massacre of the queens. Is it on the account of the Bees lately settled in their hives, that the mothers are put to death ? How will that agree with the affectionate concern, which is well known they have for all the mothers in general ? Is it not more likely, that the two mothers, jealous of one another, should fight each other ; and that the weakest should be the victim ?

EUGEN.

EUGEN. That is what I could never see. What would make me think, that the two mothers, though naturally very pacific, attack each other, is, that they are arm'd with stings, which they have scarcely any other occasions to make use of ; for they don't use them against the Bees of their own hive. However, in spite of all the respect, which these last have for their queens, in spite of the love they testify towards them, there may be times and circumstances, in which they don't hesitate to take away their lives. You will presently see, that after they have taken infinite care of those maggots, that would become Male-bees, there is a time, wherein they make a dreadful carnage of them : this is an article, that can't be better plac'd, than after this, which we have been just treating of. Let us resume our plan, that we may not wander from it. We have parted from a new lodg'd swarm. If this swarm come into its hive, with several queens, I have told you, that before they apply themselves to work, they proceed to the choice of their sovereign, and that the other candidates are destroy'd. The drones, or males, who have followed this colony, are treated with more indulgence. They remain with this only queen ; they are suffer'd to enjoy the sweets of life about six weeks, reckoning from the day of their transmigration.

CLAR. The respite, with which the drones are favour'd, appears to me an effect of pure goodness on the part of the working-bees. I do not know what good can accrue to them, to maintain, for so long a time, these idle creatures,

tures, which are of no service to the society: I have not forgot, that one queen does not put herself at the head of a swarm, till after she has taken care, in her old hive, to be in a condition to lie in now; and that she actually does so, the day after her arrival there. These males, therefore, are of no other service to her. Does she keep them as husbands, *ad honores*, for the dignity and honour of her rank, and as the Eastern princes do their sultans?

EUGEN. It is not probable, that this luxury, or, rather, this debauch of mind, has intruded itself among animals. It is true, when a queen leaves her old hive, she is already in a condition to perpetuate her species. But it is likely too, that the prodigious number of eggs, that she has in her body, requires the drones to stay some time with her. The Bees are too good managers of their labour and their provision, to maintain, for so long a time, those lazy bellies, which contribute nothing to the public good. What proves it is, the diligence, with which they get rid of them, when the time is come. 'Tis likely, this time is noted to them by the perfect indifference, with which the queen begins to treat these males. The workers, who take notice of it, then declare the most cruel war: for three or four days they make a terrible butchery of them. Notwithstanding the superiority, which they seem to have by their bulk, they can't hold out against the workers, who are arm'd with a poignard, which conveys poison into the wounds they make.

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Besides, the number of those, who attack, are considerably more numerous than the attacked, and they are not asham'd to join, two or three together, against one. While these days of carnage last, one sees them, from morning to night, incensed against the males, which they draw from their hives, dead or dying. During the six weeks the males continued in the hive, with the queen, she fail'd not to lay eggs of both sexes. The moment of their proscription come, there are found males of all ages in the hive, and some in their cradle, which till then were nourish'd with the tendernefs of a mother, and some there are which be still in their egg. The law of the state, which has pronounc'd the destruction of the males, has no exception ; it extends equally to those, who do not yet breath, as to those who do. The whole sex must be totally destroy'd, and is so. Love changes into fury ; hate succeeds maternal fondness ; the workers make a narrow search in all the *Alveoli*. Whatever is a male maggot, as well as that which is only likely to be so, all is torn away, butchered, dispersed, and carried off into the high ways ; the hive is cleansed of them, as it would be from a contagion. It becomes then a theatre of horror and of murders. There are hives, in which, this carnage takes place sooner ; others, where it is later, according as the swarms are, which have enter'd there. One sees this in the months of June, July, and August.

CLAR. We have suspected the queen to have convey'd a criminal sting into the bosom of the other queens, her rivals: could one have believ'd her likewise guilty of the death of her husbands?

EUGEN. I have no reason to think so; and, if any thing could determine me to pronounce her innocent of these terrible executions, it is, that she is not at all interested in them. The drones are too great cowards and too indolent to give her umbrage, or dispute her rank. You know the funeral dues, which one of these queens paid to one of her dead husbands at my house.

CLAR. I should rather have suspected her of too much tenderness than guilty of cruelty. We are doubtless come to the last act of the tragedy. I hope you will now efface, by more agreeable relations, the black and melancholy images, with which my imagination has been filled.

EUGEN. You were willing to know, Clarissa, the life of Bees; you order'd me to give you a recital of it. To retrench the circumstances proper to characterize them, would not be the way to answer what you expected from me. There are still wanting, to what I have just now said, certain traits, which I ought not to omit. You know the love of the common Bees to the maggots born in their hive. I thought it would be curious to know, whether this love would be extended towards those maggots, which took their birth in another. To inform myself of it, I one day,
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convey'd into several hives, parts of combs, which I had taken from others, and whose cells were filled with the eggs of maggots of every age, and with *nympha's*. The *nympha's*, having no farther need of the assistance of the common Bees, became Bees, in their new hives: they there procured for themselves, in a moment, their freedom, and augmented the number of their inhabitants. But I did not see the Bees of these hives take any care of the foreign eggs and maggots; they even treated these last with the utmost barbarity; they tore them from their cells, and threw them away. There are still some cases, in which they treat the maggots, born among them, in the same manner. It is, when a comb falls down, by some accident, or some part of a comb, the Bees are seen to collect themselves together; nor do they spare any of the maggots found in the open cells; they tear them out, kill them, and throw them far off.

CLAR. In this there is not only an insufferable barbarity, but a crying injustice. Why must these little innocents pay, with their life, the folly of their parents? Are they guilty of the fall of the combs, which, perhaps, fell, because they were ill fastened?

EUGEN. I will not attempt to justify this procedure; but there is reason to imagine, that the maggots of the fallen combs would never survive. The cells of these combs, in their first position, had their axis almost horizontal; but when fallen it became vertical. You give me to understand, that

that when we talk to ladies, we ought to use clearer terms. I will do so. The most advantageous position of our new-born infants is to lie along: they would perish in a little time, or, at least, would succeed ill, if they were placed in an upright posture, and their legs loaded with the weight of their little bodies. It is so with the maggots we speak of. In fine, (and this is the most strange adventure, and which causes the greatest horror with regard to cruelty,) it sometimes happens, that the Bees of certain hives tear the maggots from their *alveoli*, kill them, and carry away their bodies, though no accident has befallen the combs; though we can see no reasons, that can determine them to practice these cruel extremities, so opposite to the tender affection, which they commonly shew for those of their own hive. 'Tis just as if mothers, forgetting at once their natural tenderness, should butcher their children in cold blood.

CLAR. Are you resolved, Eugenio, to make me quarrel with the Bees, to avenge yourself of the trouble I give you in telling me their history?

EUGEN. I am not at all revengeful; but I would not be reproached to have left you ignorant of things essential to be known. It was my duty therefore to inform you of this barbarous practice. But a little to efface the blackness of it, one can't but think such a procedure is founded on good reasons, such as the Bees could inform us of, if they could plead their cause before

us. Among others which I guess at, the too great fruitfulness of their queen may be one. I have told you already, that part of the *alveoli* are destin'd to receive those eggs, which the queen is to lay ; and the other for the crude wax and honey they lay up in reserve, as well for the daily nourishment of the Bees, whom their works in the hive keep at home, as for rainy days and winter, when they can't stir abroad. But if a queen is so fruitful, as to take up all the *alveoli* with her eggs, at a time, which invites them to gather in their stores, nothing remains to be done between these two equally bad extremities ; namely, to preserve the maggots, and expose all the people to the hazard of perishing through want, in neglecting to make provision for their sustenance ; or to sacrifice those maggots, in order to employ their cells, for laying up provisions to nourish the people against a time of necessity. Now the latter of these is certainly more conformable to the publick good.

CLAR. If this be the reason, which influences them, I can't blame them ; for I agree with them, the safety of one's country is the supreme law, to which the safety of particulars ought to give place.

EUGEN. I am the more inclined to judge in their favour, because I have remarked it to be on those days, in which they could more easily, and in a short time, make great collections of honey, that I have seen them make these bloody expediti-

ons. Now observe another circumstance, where-
in they make a carnage of the maggots.

CLAR. Still another carnage!

EUGEN. 'This will be the last, and which, like the former, does not merit your reproaches against their cruelty. When their numbers are so great in the hive, that they find difficulty to lodge themselves there, and their queen no longer lays these eggs, from which queens are to be produced, or those, which she has laid, have had ill success; this is an unlucky event, and which would embarrass the hive, and is to be guarded against. I will not say, that our Bees reason and foresee, but that they act as if they did both. Observing then, that they shall be destitute of a queen to conduct their colony, they prevent, by destroying the maggots, the number of Bees from multiplying too fast. It may be too better reasons, than we are acquainted with, force them to this cruelty. We are not sure those maggots, which appear to us sound, are not in a distemper'd state; and that the Bees, into which they would be metamorphis'd, would not be too weak. And how many other reasons are there, which we know not, and with which they are better acquainted than we? You seem desirous of finishing a conversation, which has lasted too long, and has given pain to your sympathizing, compassionate heart.

CLAR. I have not suffer'd it, but on condition, that you would efface, as soon as possible, by gay and pleasing subjects, those melancholy ideas,

ideas, with which you have filled my imagination.

EUGEN. I promise none but such, as will be found in the order, which our history in general requires. But before we part, I must inform you, that the two rules, which I laid down as general among the Bees, namely, that there is never to be found above one queen in one hive, and that they kill all the males six weeks after their arrival there, admit of exceptions. I have sometimes found two queens in one hive, but the case is very rare. It may happen in one, where the Bees, superior to their labour, shall judge they have nothing to fear from this multiplicity. I have myself put several into hives, where they have, at first, been well received, and even caressed and maintained for several days; but their end has always been fatal. With regard to the males, it sometimes, though rarely, happens, that the workers do not kill them all, at the prefixed time: whether they despairing of succeeding, consent to a peace; or whether a confidence for the weakness of their queens prevails with them, to leave them alive. Then these males pass the autumn in the hive, and, at least, part of the winter. This is a well-known fact among those, who deal in Bees; but so far from foreboding success to these hives, they consider them as lost. They fancy their loss proceeds from the males eating up all the honey, reserved for their winter stores. In this they are mistaken. It is more probable to believe, the eggs suffer alteration in

the body of their queen, who lives with these drones a good while beyond the time fixed by nature. In a word, it is a derangement of the natural order ; and whatever cause 'tis owing to, it is certain, that all those hives, in which the males have spent the winter, perish in spring. The first work of a swarm new settled is to reduce the number of their queens to one only. That is what we have already said. The second is to build and frame their habitation. This is what I have to inform you of the first opportunity ; and will begin with the *propolis* and wax, which are the principal materials of their structures.

CONVERSATION X.

Of the propolis or rosin, with which the Bees close the clefts in the hive of the wax.

C L A R I S S A.

WE ought to have been here, Eugenio, three hours ago. If it had not been for the troublesome visit of our very idle neighbours, we should already have seen a hundred charming things. They have made us lose the finest time of the day, and the most commodious to see the labour of an hive. I am afraid, as it is now five o'clock, we shall find our Bees fatigued with their day's work, and disposed to take that rest they have need of.

EUGEN. Though it is late, we may yet find enough to satisfy our curiosity with. As the Bees know how to divide among themselves their different works; they likewise know how to divide, at different times, the works of a different nature. The evening is passed in things worthy of observation, and which would be difficult to be met with at another time, as is, for instance, their gathering of the *propolis*. To make you the better comprehend, wherein this collection consists, and for what reason I speak of it, let us resume the series of those things, we

discourſed about yeſterday. You will agree, Clariſſa, that I ought not to have ſpared you theſe tragical recitals, which made the ſubject of our laſt converſation. A traveller, who undertakes to deſcribe faithfully the manners of an unknown people, can't be diſpenſed with from giving an account of their laws, as well thoſe, which have a tendency to make the people happy, and rich, by their labour and induſtry, as thoſe, which are made to keep every one to their duty, and cut off from the civil ſociety the citizens, who diſturb or prejudice it. It is the laws and cuſtoms of nations, which characterizes their genius. The firſt philoſophers, who only ſtudied as they travelled, collected, by way of preference, the laws of various people, through which they paſſed: it was from this collection they drew the principal maxims of their wiſdom. We have ſeen ſome of the Bees laws, which tend to retrench whatever is found prejudicial to their ſociety: we are now to treat of that, whoſe only aim is the eſta bliſhment, the multiplication, and preſervation of the ſtate.

CLAR. This policy of theirs you will now entertain me with, will be more to my mind, than that, which was wholly taken up in the diſtribution of pains and puniſhments.

EUGEN. Immediately after the arrival of a ſwarm into its new hive, where there is but one queen, all the people diſpoſe themſelves, and, in an inſtant, run to their different employments: if there be a plurality of queens, the firſt thing they think

think on, before they apply to any work, is the choice of her, who ought to reign. When the election is made, and the pretenders to the sovereignty have, in losing their lives, restored peace to the state, they apply themselves to the building of their cells. It must be remarked, that the Bees must have an inclosure ready made there, to deposite their combs. Nature, who knew they would easily find one, has dispensed with them from making it. A hole of a wall, or a trunk of a tree, are commonly the places they choose, when they can procure no better.

CLAR. I one day found a swarm, which had settled themselves between the two frames of my cabinet.

EUGEN. It was a glass-hive, which chance had procured you, and of which you might have made good profit.

CLAR. I might; however I did not; it was when I was young, and at that time, when objects only speak to the eyes, and don't affect the understanding.

EUGEN. At this time, that you have your sight, as I may say, more knowing, we shall have occasion to make a better use of it. Let us place ourselves on this form over against our hive, to have recourse to it on occasion. If we suffer the Bees to place themselves in fixed and immoveable places, as walls are, we can't commodiously make an advantage of their labour, and procure their wax and honey, which we easily do, when we present them hives of our own
O A making,

making, which are called *baskets*, such as those before us : for we have nothing to do but to overturn these, in order to get their combs. When therefore a swarm is entered into one of these hives, or baskets, of whatever fashion it is, some of the Bees, that moment, apply themselves to build their *alveoli* ; some to stop exactly all the holes, clefts, and crevices, that are found there. These are the two first labours of our Bees, with which I shall now entertain you. Their habitations should have no other openings but such as serve for doors : every where else they should be close. Our Bees have reason to fear those insects, which covet their honey, their wax, and themselves, should find passages for their entrance.

CLAR. Have the Bees then, like ourselves, thieves and assassins to fear ?

EUGEN. 'Tis the common lot of all living creatures. I know of no animal, which may not be the prey of some other. It is more easy for the Bees to oppose themselves to the incursions of their enemies, when they have but one, or, at most, two gates to guard. In fine, the entries ought not only to be shut against insects, but against damps, air, and even insinuating winds.

CLAR. Here is a great deal of delicacy in animals so laborious and warlike.

EUGEN. It is of great consequence to them to be lodged very warm, which is a thing I will some time shew you. The matter, with which the Bees stop the openings and crevices of their hives, greatly deserves to be known. It is not

the same, with which they compose their wax, nor is it the wax ready made: 'tis of quite a different kind, that has no need of being work'd up, and which they know how to find, ready prepar'd, on plants.

CLAR. They have so good a manufacture of wax, and wax is so commodious for stopping of holes; wherefore then do they give themselves the trouble of seeking other materials?

EUGEN. The oeconomy, with which they employ their wax, gives us room to think, that this collection is not so easy to them, as you may imagine. But the matter, with which they use to close their hives, is much more commodious for the use it is design'd for. It is a rosin easy to be rolled out, fixes itself more easily, and has a good deal more tenacity than wax, and, besides that, requires no preparation. It was known to the antients by the name of *propolis*.

CLAR. *Propolis*? That name is not unknown to me. I remember one day, it was used with success, in a drug, which had that name, on one of my children, who had received a wound. They talk'd very magnificently of it, which made me have recourse to my dictionary of simples, which gave me a very particular explication of it.

EUGEN. In which, however, I would not advise you to acquiesce.

CLAR. How so? It did a great deal of good to the patient, and perfectly cur'd him of a dangerous wound.

EUGEN.

EUGEN. That is what happens every day ; one reasons very ill on remedies, that are apply'd very well. Experience informs us, that men know how to apply them, but not what they are. This dictionary treats of the *propolis* as virgins wax, or a kind of mastick that the Bees make. The *propolis* is nothing else but a rosin, which they collect from trees, and which they employ as they find it, without being forced to make any change in it. It is thought to be from poplars, birch, and willows, that they collect it. I have, however, seen them in countries, that had none of these trees, and they employ'd the *propolis*. It has not been my fortune, as yet, to meet it on plants, where the Bees know where to look for it ; that is a discovery yet to be made, and which, perhaps, is reserv'd for you.

CLAR. Could you bear, that a woman should snatch away this glory from you ?

EUGEN. I should only dispute the honour of being the first to shew my gratitude. However it be, the *propolis* is a rosin, easily dissolvable in spirits of wine and oil of turpentine, which grows very hard in the hive, but which may always be softned by heat. That which is found in different hives, and even in different parts of the same hive, offers not only a great variety, with respect to its consistence, but likewise as to its colour and smell. It commonly diffuses a very agreeable one when it is heated ; nor is it unfrequent to find it of an aromattick smell ; and some that might deservedly be rank'd among perfumes.

Its outward colour is a reddish brown, sometimes clear, some times deep : its interior, when broken, resembles wax, and is a little yellowish. At the time when the Bees make use of it, it is soft, and as pliable as bitumen, to careen the hive. I suppose you know the meaning of that word.

CLAR. My science goes thus far. They are said to careen ships, when they rub them over with suet or pitch and tar, to make them impenetrable by the water.

EUGEN. That is it: the *propolis*, therefore, being very tenacious, and having the viscoufness of a gluey kind of rosin, which sticks to the fingers, is very proper to be thus applied. When it has once been so, it grows every day more consistent, and becomes much harder than the wax. I must now let you see, how far the Bees give it the preference, to other materials, which, to us, would appear equally good for stopping the hives. Observe the rims of your glass-hive.

CLAR. I observe, that you stuck there, on the inside, slips of paper, as we do on the squares of our windows ; and that you have very likely repented of it, since you afterwards tore them off. This is what I learn from those fragments, which still remain sticking on the glass.

EUGEN. It is true, that I had stuck slips of paper on the hive, before I introduc'd a swarm. I well knew the Bees would destroy my work, and that is the thing I would have you observe. We and our glaziers, are but bunglers in comparison of them, in closing and stopping the squares

squares of windows: the Bees have more sagacity in this, as well as in other particulars, than we have. For this reason they cannot bear that we should interfere in their affairs. It was they that tore off these bandages of paper, and hack'd them at this rate, to substitute, in their room, their own rosin. See, there is one yet at work this moment, to let me see what I had done signifies nothing. Let us draw nearer, to view her the better.

CLAR. I see her perfectly. I fancy I observe by that vivacity, with which she destroys the remains of your work, that she is in great wrath, and accuses you of being a very ill-advised person. She is probably going to careen the whole place that she has laid open.

EUGEN. Whether she or some other does it, the opening will certainly be clos'd. I will not however answer, that she will take for that the time, which will suit us. The Bees neither observe our orders, nor our hours. They labour at this work in the night, as well as in the day. But I discover another, which will give us the sight, in part of what we look for. Observe below there, on the stand of the hive, two Bees, which keep a third in a corner, and seem to rob her. They haul her as two robbers would do a passenger, at the turning of a street.

CLAR. You have already told me, that they sometimes tear the bread out of another's mouth: if this be the present case, I know the design.

EUGEN.

EUGEN. 'Tis quite another thing, the plunder in question is a charitable succour, which the Bees afford one to another, on the account of the *propolis*. Stoop down. This sight will give you pleasure, and we shall owe the obligation of it to the impertinent visit, which oblig'd us to come here later than ordinary. Three hours sooner, we should not have had the pleasure of seeing this: for I have very often remark'd, the Bees choose the morning, preferably, for the gathering of the crude wax, and the evening for the *propolis*. I say preferably, and not exclusively.

CLAR. Lend me your magnifying glass, Eugenio, to observe nearer these officious Bees, which plunder their companion, out of charity. I will begin this very day, to see learnedly. I am going to give an account of what I observe, and you shall tell me frankly, if I make a right observation, and if there be any hopes of my becoming a good naturalist. Hear the relation. I see a Bee between two others, which pull her by the claws. Good heavens, how they lug her! They will tear off her legs.

EUGEN. Observe, carefully, if it is by the legs she is seiz'd.

CLAR. You are in the right, I was mistaken; they each of them tear away something that sticks to her legs. I now see what it is. It is the very *propolis*. I know it by its colour, by its reddish brown. Each of these two make strong efforts, to pluck away this matter; they

pluck it away with their teeth ; the *propolis* gives way, and draws out in length, like a thick gum. The patient suffers all this without complaining. There is one, who has just got off part, and flies away with its booty. I see another, that comes to take its place, and which requires some for its share. The little ball diminishes of its size insensibly. The purveyor should, methinks, suffer a good deal ; for it seems to me, this rosin cannot be got off, without constantly tearing the hairs that surround it, and keep it on.

EUGEN. All that is well observed. Now take notice, on what part of its body the Bee carries this *propolis*.

Plate XI.
Fig. 7.
Lett. B.

CLAR. It is in the basket you made me observe, that she piles up the matter, of which wax is made, in that hollow, at the third articulation of her hindmost legs. I give you back your glass. Methinks this is not amiss for the first time.

EUGEN. If you don't become a naturalist, you will reproach yourself all your life, in being wanting to what you are so well fitted for. Now you understand the subject so well, you will comprehend, with more ease and satisfaction, one observation of the same kind I formerly made. I order'd a hive to be made, on the top of which was placed a moveable stopper. The Bees, who took notice of it, sealed it with their *propolis*. An experiment I was willing to make, requiring I should take off this stopper, requir'd likewise, that after I had put it in its place again, it should

should not stop the hole intirely, so that part of the *propolis*, with which it was masticated, was found outwardly. As it had not been long, since the Bees had sealed it, this rosin was yet fresh. The Bees, which observed it, judg'd they might spare themselves the pain, to go farther in the search of it. I saw two or three of them, who came to get their share of it, and one among the rest staid there a long time. This Bee was placed the most favourably in the world for me; she gave me the intire pleasure of observing the collection she made of it. This tenacious gum, which had been a little dried, since it had first been us'd, did not yield but to the redoubled efforts of the Bee: nevertheless, it at last became pliable. The Bee loaded herself with it: she made on every leg a ball of enormous bulk: thus she was employ'd a good while. A long half hour was pass'd before she could make up her bundle. This matter incomparably more difficult to get off, than the powder of the stamina of flowers and more troublesome to manage, suffered not the Bee to go off very quick; a circumstance lucky for observation. I examin'd it, with the glass in my hand, during the whole half hour: I saw, with pleasure, how often she was oblig'd to use her teeth and pull it, to detach a small particle of this matter: at length she work'd it up with them: her two first legs help'd her to give it its proper figure; one of the Bee's charg'd itself with it, and bestowed it on the second leg of the same side, which convey'd it to the third,

which applied it to the heap already begun; when she had fix'd it there, she knock'd it with her palet, and gave it three or four blows. It was a very pleasing sight, to see these little balls pass from leg to leg. The Bee chose the *propolis*, that was least dried; she suffer'd some fragments to fall, that seem'd to her too dry, and neglected them, as not being any longer fit to be work'd up.

CLAR. I have a thought, which will prove I am become a philosopher, and that too of the best sort, that which you approve, and is conducive to the public good: Pharmacy is in possession of the *propolis*, for the advantage of our bodies: Can't arts and trades divide with philosophy the honour of drawing from thence something, that may be useful in common life?

EUGEN. Your notion is a very good one: I had the same idea, and have made some experiments; which have inform'd me, that *propolis* dissolv'd in spirits of wine or oil of turpentine may be substituted in the stead of that varnish, which is used to give a golden colour to silver or tin reduced to thin plates. If, for example, it is incorporated with mastic or sandarac, it will be very useful to gild leather.

CLAR. What do you mean by making gilt leather of varnish: is there such a thing as gilding without gold?

EUGEN. Perhaps you think, those fine beautiful hangings, with which your parlor is adorn'd, are enrich'd with real gold.

CLAR.

CLAR. I frankly own, that I thought so 'till now, and that it was leaf gold, like those that are laid on the frames of our pictures. I even hoped, that, in case of necessity, one might have some little relief from thence.

EUGEN. The proverb, that tells us all is not gold that glitters, is, in this case, literally true. The art of making hangings of gilt leather informs us of the secret of gilding without gold. The gilding of these leathers, which are sometimes very beautiful, depends upon a varnish, which, when in a lump, is of a brown colour. After one has cover'd those parcels of leather, that are to be gilt, with leaves of polish'd tin, the varnish is laid over these leaves ; in a moment they appear to be that precious metal, which arms one part of the world against the other. The white colour of the tin, which appears through the varnish, and is mix'd with it, composes a shining perfectly resembling gold.

CLAR. Farewel then my hopes. For one knowledge more, I have one hope the less. I know not, Eugenio, if I am a gainer by this change.

EUGEN. A pretty subject to reason upon *pro* and *con* ! But we have something else to do to day. Let us finish our propolis. It is not only useful for Bees, to close exactly their habitations with : they apply it likewise to another purpose, which manifestly seems to prove, that these wonderful little animals reason to a certain degree, and that they know, as well as we, to deduce

consequences. Observe the fact. They suffer as little as possible, foreign bodies in their hive. When they find any such, not superior to their strength, they carry them out. Notwithstanding it sometimes happens to insects, and more particularly to ill advised slugs, and snails not not well instructed, to insinuate themselves as far as their waxen combs. Is it at all wonderful, that the Bees do not spare such heavy animals, or that they kill them with their stings. But what is to be done with them after they are dead? They can never think of transporting such heavy bodies: they know, however, these bodies will putrify, and from this putrification a bad smell will arise, which will be destructive to them. See the inconveniency, from which they are to guard themselves. What would you do, Clarissa, in the like case?

CLAR. I would leave my lodgings, and save myself among my neighbours.

EUGEN. The Bees are better advised. Not to be obliged to break up house, and abandon what, to them, is the most valuable, they embalm these dead bodies, and cover them all over with propolis. M. Maraldi tells us, that he saw a snail, that they had entirely cover'd. I have often, myself, seen the like. I have seen some slugs, whose skin hath been a little dried, and which they embalm'd like so many mummies: I observ'd, one day, that they employ'd the same materials, for a like end, and with more oeconomy, upon a snail. This weak animal,

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having enter'd into one of my glass-hives, had fix'd itself on one side of the squares of the windows, where he patiently waited, till a moist air should invite him to march on. The Bees, not able to chase him away, fasten'd him more solidly there, than he would have fixed himself, and more strongly than he desired : they applied a girdle of propolis all round the extremities of its shell, with which he was masticated against the glass. When he afterwards wanted to disengage himself from his voluntary prison, where he had plac'd himself, his efforts were found unavoidable : All the viscous liquor, that he had disgorg'd, was not capable to soften the propolis ; he was obliged to perish where he was fixed.

CLAR. I agree that this industry, and this foresight of the Bees, have something wonderful in them.

EUGEN. You, who like we should reduce the actions of brutes to their just value, and have so much repugnance at hearing that animals reason like us, how will you now do, not to put us on a par with them ?

CLAR. Upon the whole, that is embarrassing ; but it will always be reasonable to say, that the creator of all things has sufficient power to accomplish his own ends by a diversity of means.

EUGEN. Your solution is likewise mine. Nature, like religion, has its mysteries. I put a great difference between examining the actions of animals, and knowing the principles of their actions. In the first we admire the works of the

Almighty ; it is there, that he would have us know him : in the other, it appears, that we search to know the secrets of the Creator, and enter into his councils ; a curiosity so much the more ridiculous, as it is unavailable. We proposed to ourselves, to day, to examine the two first labours of a new hive ; namely, that of keeping the enclosure, into which the Bees must enter, close and inaccessible to outward enemies, and the other, the structure of the *alveoli*. I have just told you, in relation to the first, all that I know of it ; let us now proceed to the second. An *alveolus* presents two different objects to be consider'd, the matter and the form, that is, the wax, and the rules, on which the *alveolus* is founded. To begin with the wax. Shall I repeat, Clarissa, what I have already said on this subject ?

CLAR. I will myself tell what I remember of it, that you may judge if your scholar answers your care and expectations. There is crude wax, or the materials of which it is made, and wax properly so called. The crude wax is the powder of the *flamina* : it is this colour'd powder, that sticks to one's fingers, when the sprigs are squeez'd, which lie at the bottom of the cup in flowers : the real wax is that, which the Bees have made, such as we take from the hive. See the whole of my knowledge : if you are desirous I should know more, you have nothing to do, but to instruct me.

EUGEN.

EUGEN. It is all I have, at present, told you. Now we are going to examine it more minutely. You might doubt, if the dust of these *stamina* were not the real wax. You must judge by yourself, what it is. I seiz'd, this morning, a Bee coming from the fields : she was loaded with this crude wax. I kill'd her without allowing time to get rid of her loading ; Plate III.
Fig. 3. this is she. You see two little balls of wax, which are yet attach'd to her hind legs. Let us take these balls off. Make them up only into one lump. Now they are united, work up this Lett. A A. little bowl between your two fingers, as you would work up wax ; endeavour to reduce it into a flat thin plate. Have you done it ?

CLAR. By no means. I see plainly, that this is not wax ; for the common wax grows pliant, and becomes flexible like paste : that is ductil, and this little ball is not so ; it does not at all grow soft betwixt my fingers ; on the contrary, it breaks.

EUGEN. Take my glafs, and consider this matter more attentively.

CLAR. I see very distinctly it is only a collection of seeds, each of which, in spite of my repeated pressures, and the warmth of my fingers, preserves its round figure. They seem to be united together only by a little moisture.

EUGEN. This is not then the real wax, but the principles of it : to give you the clearer proof, I will add one experiment, that I made upon that, which you have been just working. I

put a little bowl, formed of several little balls of crude wax, into a silver spoon, and that spoon upon lighted coals. If these little balls had been wax, they would in an instant been in a state of fluidity, and melted; whereas they preserv'd their figure, emitted smoak, grew dry, and were reduced to a coal. There is also another manner of making this experiment. Take several of these little balls of crude wax, make them up long wise, into a kind of thread, by rolling them with your fingers; put one end of this thread to the flame of a wax candle: you will see it will burn without colour, as a bit of dry resinous wood would do. Another proof is, that if you throw this crude wax, even the most dried, into water, it will fall to the bottom, and there continue; whereas an equal bulk of real wax would swim at top, and remain upon the surface. It follows then, that this matter requires preparation, and that the Bees know how to work it up, but what is this preparation? Try to imagine, Clarissa, wherein it consists. How would you do, if, supposing you had the power to create a Bee, to which nothing should be wanting but a skill to make wax; how would you do, I say, to bestow on it this talent?

CLAR. If I had the power to create it, it seems as if the rest would not be very difficult. We know it is provided of a very strong, and sharp tooth; I should instruct it to make use of it to bruise and reduce into fine powder those seeds, you call the *stamina*: then I should provide

vide it with a particular liquor, and proper to work up this flour into a paste, which, by the secret virtue of my liquor, would be turned into wax. Have I guessed right, Eugenio? Is it thus the Bees form it?

EUGEN. The founder of the Peripatetic philosophy, our master Aristotle, could not have spoke better, and he would not have been mistaken. 'Tis thus the antient naturalists often contented themselves with imagining, that they knew what nature ought to do; instead of consulting her, and following her with their eyes, by seeing how she really acted.

CLAR. That is to say, in good English, that I have reason'd like the antients, and have reason'd very ill.

EUGEN. To reason like the antients is almost always to reason well; but with regard to natural history, and nature, 'tis almost always otherwise. I was desirous to let you see by your own experience, how much one is subject to be deceived, when the philosophy is drawn from the imagination; that is, when the product of the imagination is substituted to the truth of facts. Probabilities ought to be rejected, when nothing is wanting to inform one's self, but to open one's eyes and see. But that I may console you for having guessed so ill, I shall inform you, that Swammerdam, who so long and so well made his observations on Bees, and so many happy discoveries, and that too with wonderful sagacity, has gone before you in this mistake:

his notion and yours, on the formation of wax, are perfectly conformable, and unluckily are not true.

CLAR. A fine subject of consolation, for a blind person, who tumbles, to hear that another, as blind as he, has tumbled in the same place !

EUGEN. 'Tis the best thing I can do for you. Experiment has taught me, that is not sufficient for Bees, to work up the crude wax between their claws, after they have moistned it with some liquor ; it has shew'd me it is in the very body of the Bee, in which this crude wax is to be wrought ; that the true laboratory is to be found there, where the conversion is made from this into wax properly so called. Some authors, who have treated of Bees, have suspected it. I think myself able to give an incontestable proof of this. I made a great number of trials to turn this crude into real wax, or to see, if it would not be possible to extract, by art, a perfect wax from this crude one. For it would be a great advantage for the multiplication of this matter, of which so prodigious a quantity is consumed, if we could concur with the Bees to make it likewise. But all my experiments had no other end, but to inform me, that it is not more easy to make wax from the *stamina* of flowers, than it is to make chyle from the different substances, whether animal or vegetable, which daily pass through our stomach ; or to make silk from the leaves of the mulberries. I therefore had recourse to my eyes : it was by observ-

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ing the Bees, that I saw without trouble, what you shall have a sight of whenever you please. I saw what became of the crude wax between the Bee's claws. I am going to tell you, what my eyes discover'd to me.

CLAR. I begin to comprehend, that the eye is a great instructor, in matters of natural history ; but there are novice eyes, such as mine ; and there are learned eyes, penetrating and observing every thing, such are yours ; and such have the power of seeing.

EUGEN. Novice eyes, such as yours, soon become skilful. One day, as I was looking on some Bees, going into their hive, I observed one of them loaded with two balls of crude wax : she plac'd herself, at a little distance, on the stand of the hive ; there she kept herself quiet, and so quiet, that she seemed to have no inclination to change her place ; when, in order to observe her nearer, I put one knee to the ground, and approach'd her with my glass in my hand, to take particular notice of all her motions. I saw then, that there were some moments, in which she turn'd her body round, to permit her teeth to approach her posterior legs, and to cut from thence a small portion of one of those balls of crude wax. At last she resum'd her proper posture, and her teeth acted one against the other, to grind the matter they had remov'd. Every moment this matter diminished, and, in a little while, totally disappeared. Then the teeth were immediately employ'd, to detach
another

another little parcel from the same ball, which they ground, as they had done the former. These operations were repeated more than half a quarter of an hour, at the end of which nothing remained of the ball of wax ; she had intirely ate it. In proportion as the teeth had sufficiently divided one part of it, the tongue, whose figure and place I have elsewhere determin'd, and of which have a clearer view in this design, (where it appears raised, to make it more visible) was ready to seize it, and did so, to conduct it to the mouth. During this repast, the trunk remain'd in a perfect inaction ; it continued folded, and inclin'd against the posterior part of the head, as it always is when it does not act. Which proves (contrary to what has been thought) that the Bees make no use of that organ to eat their wax with. This recital, I have now made, is not that of an action, which I have only once seen ; I have surprized several others in the same circumstances. If you are not satisfy'd with this proof, I will furnish you with an anatomical demonstration, which will admit of no reply. In opening the belly of a Bee, lately kill'd, I will shew you the stomach and intestines, fill'd with this matter : you will there find, that one part of these feeds, those which are not yet digested, retain their first figure ; and the same dust of the *stamina*, will still be found there.

CLAR. I don't find in myself that philosophical hard-heartedness, necessary to support with
patience,

Plate IV.
Fig. 2.
Lett. E.
Plate IX.
Fig. 1.
Lett. L.

patience the sight of such an experiment : I had rather believe you, and that you would answer one question I have to put to you. Don't the Bees eat this crude wax, merely to turn it into real wax ; or does it serve them for food ?

EUGEN. Both the one and the other.

CLAR. How both the one and the other ! Is the wax then nothing else but the dregs of the Bee's nourishment ? I have known a time, wherein you have given it a nobler origin.

EUGEN. I have not changed my opinion. But you make a little too much haste to draw consequences from my principles. In telling you the Bees eat up the crude wax, I did not tell you what became of it, that is what I am now to do. But I perceive some body comes to tell us, that other cares demand your presence at the castle. Let us be now satisfied to know, that the Bee swallows the *stamina* of flowers, and that she digests them. We shall see, by the first opportunity, how she changes these *stamina*, partly into wax, and partly into her own substance, together with the use she makes of it, for the building of her *alveoli*.

CONVERSATION XI.

*Continuation of the origin and nature of wax ;
use which the Bees make of it, both for food
and for the building their cells. Description
of a cell.*

CLARISSA.

I Was so unsuccessful, Eugenio, in giving my opinion the other day, that I find 'twill not become me yet to set up for a *connoisseur*. To listen with attention, to employ the whole power of my eyes, and be respectfully silent, are the dispositions which I bring to this day's conversation.

EUGEN. You are mistaken, Clarissa. In order to learn, you must see, hear, ask, give your opinion, contradict ; and yield to nothing but evidence.

CLAR. May we not also yield to authority ?

EUGEN. Doubtless. But then the assertion of the instructor, to whose authority we submit, must be in the class of evident things.

CLAR. There I fix. The confidence I repose in you, my thirst after knowledge, and my indolence, will all find their account in it.

EUGEN.

EUGEN. I would have dispensed with the compliment ; but will not allow you to forbear starting objections, whenever you may judge them necessary.

CLAR. That may be very easily done, and will well enough suit my inclination.

EUGEN. I will not dispense with your examining, with your own eyes, whatever is capable of being survey'd. For, in facts, I prefer the knowledge drawn from the eye, to that acquired by the ear. Our last conversation clos'd with a Bee, who, before her arrival at the hive, had swallowed all her provision of crude wax. But this is not her common practice. Frequently the Bee enters the hive, loaded with her two balls or pellets of wax ; when proud of this provision, she skuds up and down the combs, or stands still upon them, fluttering her wings. You may, if you please, imagine, that the Bee, by these tokens, joyfully signifies her arrival to her companions, and invites them to come and ease her of her burthen ; the sequel may justify this suspicion, which has all the probability that can arise from the gesture of an insect : for immediately three or four bees draw up round, and endeavour officiously to ease her. Each of them takes, between its teeth, a small portion of one of these balls of wax. The first takes one piece, a moment after a second, then a third ; the others doing the like. In a word, they don't quit the wax in question, till they have swallowed it all.

CLAR.

CLAR. Methinks our Bees are very ravenous.

EUGEN. This is not done to satisfy hunger. Their hasty manner of eating is not owing so much to a desire of nourishing themselves, as to make a large quantity of honey in a short time. This is manifest from the season in which they appear most ravenous; I mean when they are to make a new settlement; when 'tis necessary for them to build a great number of cells; and consequently to get, with all possible diligence, a large provision of wax. In the seasons when necessity does not impell, (as when they possess a large number of combs) these purveyors don't meet with any of those obliging Bees, who come to unload them in the way; they themselves are not so urgent to work it up; they are contented with laying down their waxen burthen; after which they deposit it in store-houses, of which mention will be made afterwards. Let us proceed with the crude wax swallowed by them. I before observed, that 'tis in the stomach and intrails of the Bee that it becomes true wax. I add, that 'tis in her second stomach, she having two. The same aperture by which this substance entered when unwrought, or crude, serves to discharge it when employed in working. This I discovered in manner following. I took a magnifying glass, and survey'd attentively, through it, a Bee who was employed in building a cell. On this occasion I perceived, that the labouring Bee did not barely move its two teeth one against the other,

other, or rather against the small plate of wax held by them ; but I saw, under the teeth, a fleshy, whitish substance, that was in a perpetual, strong motion ; and which darted forward, and drew back, like the tongue of a serpent or lizard. And indeed this was the bee's tongue, whose figure was perpetually changing. Sometimes it was sharper, at other times broader and flatter ; and at other times again, more or less concave. 'Twas sometimes partly hid by a sort of foam ; and sometimes by a kind of paste or substance like pap, which the tongue, by its various motions, forced out of the mouth, and employed in lengthning the cell. The instant, this humid paste was dry, (which it was presently) 'twas just like our ordinary wax. I could not be mistaken, in supposing that this paste which the Bee discharged, was true wax ; the instant I was certain, after surveying, the animal at work a long time, that her labours went forward ; that her cell increased in length, without her taking wax from any other part of her body ; that there was none on her legs at that time ; and that the paste she drew from her intrails formed the whole work. It may happen, that the shavings or chips of wax par'd by the Bees, from a cell newly built, and which they repair, may serve to form, instantly, part of another cell ; and I think I have seen the Bees using them for this purpose. But I am very certain that they can work with only new wax ; such as has not had time to be quite dry ; and that they cannot make
any

any use of such as has acquir'd all the perfection which a very short time gives it.

CLAR. Let us come to proofs, for I am fond of them.

EUGEN. These may be easily supplied. In all seasons of the year, that excepted during which the Bees are benumb'd with cold, whenever honey is offer'd them, they suck it in greedily; they chusing to feed upon a quantity which is set before them, rather than draw it, by infinitely small drops, from the flowers scattered up and down. But if honey-combs are offered them, even at a time when they have not an opportunity of getting a harvest from the dust of the *stamina* of flowers, they don't regard it. They indeed cleave or cut them sometimes; but this is done only to get out the honey with which they are a little moisten'd. But they never attempt to carry the wax, of which these combs are formed, to their hives. I have left combs (very near my hives) on which there was not a particle of honey, during five or six months; and I did not find that the Bees took a single particle from those combs.

CLAR. As you desire that I should acquire knowledge, by my eyes rather than my ears, you should have shown me a Bee discharging wax in order for building a cell.

EUGEN. To give you this satisfaction three things will be necessary. To watch the instant, (which is not met with very often) when a Bee raises a cell very near a pane of glass: this Bee must stand full in sight, and so, as not
to

to be hid by other Bees. These moments are to be met with by such observers only as are more masters of their time than you are of yours. But I'll now offer you a readier and more easy expedient. We have here several hives which promise to swarm soon. Give orders for your being call'd, the instant a swarm flies to a tree, in order to settle upon it. You then will observe that, among the several Bees of which it is composed, very few will have any unwrought wax upon their legs; and these will be such Bees only as, returning from the fields, shall have met the swarm in question, and joined with them. Nevertheless, the moment you shall have hived the swarm, you'll find a little comb of wax, fixed to the place, left by them on the tree. Now, where could these Bees have taken the wax, to form this little comb, except from their intrails? For we see, on many occasions, that such Bees as have wax (quite wrought) in their stomachs, are always eager to employ it; it seems to annoy them, and that they frequently build with no other design than to ease themselves of it.

CLAR. Though I should see those little combs fixed on the trees, still this would not be a full proof to me, and there would yet be room for me to doubt. You grant that alien Bees will unite with such a swarm; and that the former will have crude wax upon their legs. Why may not I suppose that these little waxen combs are their work?

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EUGEN.

EUGEN. I could show the contrary by the size of the combs, which, how small soever, will always be larger than one which should be formed from the balls of wax brought by the alien Bees. But I had rather point out to you an easier method, which must necessarily remove all your scruples. Turn the Bees out of one hive into another: do this early in the morning, before any of these insects have taken their flight to the fields. Being thus forced to dislodge suddenly, they will not carry off any unwrought wax upon their legs, nor on any other part of their exterior. Nevertheless, if they delight in their new habitation, you will perceive, before night, honeycombs begun; though not a single Bee went in or out all that day. Chance once favoured me with an incident something like this. I had settled a swarm in a new hive. For two days together, to compute from the moment of their migration, it rained incessantly; insomuch that not one Bee was able to stir out during the whole two days. Notwithstanding this I saw, at the end of the time abovementioned, a comb fifteen or sixteen inches long, and four or five thick.

CLAR. This experiment is more satisfactory to me.

EUGEN. I have made an hundred times one observation, which shews plainly, to the eye, that crude wax is not perfect wax. Those pellets which the Bees bring from the fields, are seldom alike in colour. Some are very pale, and almost white; and others yellowish: they usually
are

are of a beautiful yellow, others of a hue inclining to orange; others reddish, and others almost red. I have observed that some are green. The wax laid up in the store-houses, is likewise of all these colours, which are the same with those of the *stamina* of flowers, when not changed; that is, when they have not been in the Bee's stomach. Nevertheless, the combs made by this crude wax, of different colours, are all of the same colour; an evident proof of the considerable change wrought by the Bees in the crude wax. This change may be compared to that which our stomach causes in aliments. What colour soever these may be; even though black as coffee or chocolate; yet our stomach converts them into a chyle white as milk. The stomach of the Bee makes the same operation on crude wax. Every new-made comb is white; and frequently of as perfect a white as the most beautiful wax-taper.

CLAR. How happens it that I never saw any but what were yellow or yellowish?

EUGEN. The reason is; these combs which come so very white from the Bees, lose, little by little, and pretty speedily, their bright hue in the hives: they turn yellow there; the oldest turn of a colour almost as black as foot. The vapours which rise from the bodies of Bees; and from that of worms or maggots, most of which exhale from honey that ferments and evaporates, contribute greatly to the change of colour wrought in wax.

CLAR. This appears probable to me. I yet presume that there is a still more fix'd, internal cause, which gives this yellow hue ; as art cannot whiten some kinds of wax, in the same manner as others.

EUGEN. I grant this to be true ; it being but too well known to our whitsters, by whom, some sorts of wax can never be brought to a beautiful white. Hence we may suspect, that the substance of which wax is formed, is not suited, in all countries, to take a perfect white colour ; whether the air, or the quality of the plants, contributes to this. This (Clarissa) is all I had to observe to you, with regard to the origin of wax ; which is nothing else, (as I just now inform'd you) than the dust of the *stamina* of flowers, swallowed by the Bees ; digested in their stomach ; and cast up, by the mouth, in form of a kind of paste or pulp, which, by drying, becomes wax properly so called, of which they make combs : that these combs are commonly exceedingly white ; that they grow yellow insensibly ; but that the whitsters have found out the art to whiten them, when worked up into tapers.

CLAR. I am very much obliged to you, for deducing such a number of operations successively. But there is another I did not well enough comprehend, and of which I should be very willing to have a more perfect idea : I mean, in what manner the teeth and tongue of the Bees operate, in order to form, with the paste in question, plates or leaves of wax so very thin, and so artfully framed.

EUGEN. This is a work I could not attempt to explain. To do this accurately and justly, one must be a Bee, or have been such. All I can observe on this subject is ; that if you are desirous of forming to yourself some idea from it, you need but assist your imagination by a comparison. Figure to yourself that a Bee is a mason ; his stomach the trough in which he dilutes his white-lime plaister, and makes it fluid ; that his tongue is the trowel which collects, beats, and lays down the plaister ; that his teeth are hands which work it, and give it the proper form : here you will have an image very much resembling the labour of a Bee, when building his cell. This comparison does not, indeed, raise the dignity of this insect ; but 'tis the happier, because plaister is liquid when made use of ; and, when once dry, cannot be dissolved by water : Wax, in like manner, issues liquid from the Bee's stomach ; and, when employed, takes immediately such a consistence as resists every dissolvent. Fire only is able, not to destroy, but to suspend it. To proceed now to the second use of crude wax, I observed to you, in one of our first conferences, that the males live on honey only ; but that as the Working-bees want a more solid food, crude wax was of great service to them. This is pretty generally supposed by those who trade in Bees. In Holland, in Flanders, and in Brabant, crude wax is called Beesbread. Authors who have writ treatises on Bees, have thought proper to give it a nobler name, by

stiling it Ambrosia; and, in order that Bees might be treated, in every respect, like goddesses, they declare honey to be nectar. Pliny bestows Greek names upon it, the acquainting you with which would be to little purpose.

CLAR. Say rather, that it will be of purpose to me not to know them; for, having a good memory, I perhaps might be so ridiculously absent, as to employ them sometimes.

EUGEN. I observed that crude wax serves as food to Bees; a circumstance, which it is the more incumbent upon me to prove, as the famous Swammerdam, that learned researcher into the actions and conduct of Bees, is of a contrary opinion. That able naturalist having examined, on one hand, crude wax; and discovering it to be nothing but a composition of little particles or grains; and judging, on the other, that the diameter of these particles very much exceeded that of the aperture of the trunk; he thence concluded, that the Bees could not swallow the crude wax; and consequently, that they did not live upon it. You yourself, Clarissa, by only recalling to mind what I before told you, may be able to refute Swammerdam's opinion. 'Tis in your own power to gain that honour.

CLAR. I'll try to do it. Let us see if I can recollect your lectures properly. I conceived, by the description you gave me of the Bee's trunk; that this organ is not a hollow canal, nor a sort of pump proper for suction; but performs the office of a tongue which draws in liquids; that
it

it sauces it self, as it were, in the honey'd liquor ; and, by its various inflexions, makes it flow, as through a gutter, into the insect's throat. I remember you before gave me an opportunity of comparing the Bee to the elephant. This affinity, which now occurs to my memory, presents itself with greater propriety than I at first imagin'd it would have done. The elephant drinks by his trunk, and eats by a mouth lying under it : the Bee drinks, in like manner, by her trunk, and takes in her food by a mouth situated above it. Thus your naturalist was guilty of a mistake, in declaring that Bees don't feed upon the dust of stamina, because the particles which compose them are larger, in diameter, than that of the hollow of the trunk ; this is as if any one should pretend to assert, that the elephant does not eat bread or hay, because neither of them could pass through his trunk. How was it possible for so able an enquirer as Swammerdam, to commit so gross an error ?

EUGEN. I cannot justify him, with regard to this article, but by censuring him upon another account ; I mean, in confessing that he did not know the Bee had a mouth ; he imagining that its only organ, for the passage of food, was its trunk. Thus he argued justly, according to his own notion ; but then his notion was false. Since our discovery of the mouth I show'd you ; and since I myself saw that mouth in action, at a time when the trunk was motionless ; you may believe, as a certain truth, that Bees swallow

Plate IV.
Fig. 2.
Lett. D.

crude wax ; and this, not only to convert it into true wax, but also to feed upon it. But this is not all. I'll show you, that the quantity which they consume of it, in order to support themselves, greatly exceeds that converted by them into wax, and vastly more than you could imagine ; I mean, that they are prodigious eaters.

CLAR. You are going to inform me of some new prodigy, at which I shall no longer be astonished.

EUGEN. In order to discover the whole extent of their wants, with regard to sustenance, we should calculate how many journies, (from an ordinary hive, one composed of eighteen thousand Bees, for instance) these Bees would take into the fields every day, in order to bring crude wax from thence. The number of journies has given me that of the wax-balls or pellets ; and the number of the pellets, that of their total weight ; from whence subtracting what is employ'd by them in making true wax, the remainder will give the quantity consum'd, by way of food. I had discover'd, by preceeding experiments, that in a hive consisting of eighteen thousand Bees, each of them took four or five journies every day ; which makes about eighty-four thousand journies, producing eighty-four thousand balls of wax. I might have doubled, as you see, the number of balls, as each Bee brings two ; but I chose rather to take but the half, that I might not be reproach'd with amplifying. Weighing the wax-balls with accuracy,
I found

I found that eight of them weigh a grain. Dividing eighty-four thousand by eight, the quotient gives the weight of the balls of crude wax brought during the whole day; and this amounts to ten thousand five hundred grains. Now the pound weight is nine thousand, two hundred and sixteen grains; consequently the quantity of crude wax made in a day, amounts to above a pound. There are several days in the year during which they make as great a harvest; and they often are favour'd with fifteen or sixteen together, either about the middle of May, or the beginning of June; in a word, the Bees, during such days as are least favourable, never fail to bring crude wax into the hive. As the Bees go forth for seven or eight months successively, they must necessarily gather above an hundred pound weight of this substance, and perhaps much more. Nevertheless, if the wax is taken, at the year's end, from such a hive as we are speaking of, we perhaps shall not find two pounds weight of true wax in it. Hence it may be inferred, that Bees extract, from crude wax, but a small quantity of true wax; that the greatest part of that substance serves them as food; and that the rest issues from their bodies, in the form of excrement.

CLAR. I had reserv'd my admiration for the Bees; but I now divide it, in favour of the ingenious manner, wherewith you have calculated, the quantity of crude wax which a Bee eats in the compass of a year.

EUGEN.

EUGEN. Reserve all your admiration for the subject on which we are going to discourse. You will not have too much, in order to praise and magnify the author of so many wonders, as will be exhibited to your view by means of puny animals, by meer insects ; who will set before you works which the whole powers of the human understanding could never have thought of ; and whose admirable structure was not well discover'd, 'till the most sublime and most transcendant geometry had been closely studied and applied. What I here hint at, is the construction of the cells. As we have found the origin of wax, let us proceed to the edifices in which they employ it, to these combs compos'd of cells. The first object which the Bees have in view, when all things are got ready for building their edifices, is to employ the wax ; and the small spot to which they confine themselves, with all possible œconomy, and yet to make the most of it. We cannot deny but that this is their design ; their every step having that tendency, and the perfection of their work being nothing else. That we may be the better able to judge of the intelligence with which they carry on their work ; let us first inquire what we ourselves would have done, in case the author of nature, after creating Bees, had left to us the care of lodging them, agreeably to the wants or necessities which we know them to have. We shall form a judgment, from the errors we ourselves should have fallen into, and which they do not
commit

commit, of the excellence of their work. Don't lose sight, Clarissa, of the three cardinal points following, on which the whole work ought to turn. I. To employ the smallest quantity of wax possible. II. To give, to the cells, the greatest capacity or space they can receive, on a determinate diameter. III. To employ the spot in such a manner, that none of it may be lost. The first idea fram'd by a man who was ignorant of geometry, who had never seen a hive, and was to prepare a habitation for Bees, would have been to make round tubes, and set them one upon the other. This is the form, in building, of many insects, the preparation of whose materials costs them no pains. But he who should have begun his edifice with circular tubes, had mistook in his first setting out; as he would have fail'd in one of the conditions, that of disposing his spot to the best advantage. For you easily conceive that circular tubes, laid one against the other, do not touch in every part of their circumference; but leave considerable void spaces between them, all which are lost. I'll trace before you upon the sand, my ideas in proportion as I shall point them out to you. Suppose these circles to be the mouths of so many tubes; you see that there are several void spaces between each of them. This is the first error. As these tubes must be stopp'd at one end, and open at the other, our architect would not have fail'd to have laid a bottom of wax; and, of a number of these tubes

Plate XII.
Fig. 1.

Plate XII.
Fig. 2.
Letters
A B C D.

Ibid.
Fig. 3.
Lett. A A.

Plate XII.
Fig. 4.

Plate IX.
Fig. 2.

Plate XII.
Fig. 5.
Ib. Fig. 1.
Lett. A B.

tubes, thus stopp'd and join'd together, he would have made a comb like that of the wasps ; and such a one as I now draw with my cane, where you see four tubes, each of which has a bottom turn'd the same way. Now this would be a second error. The Bees would have taught him, that two combs, laid back to back, form but one ; consequently, that a single bottom is sufficient for two cells, the one of which is on one side, and the other on the other ; which I prove in manner following. This figure exhibits to you four tubes, each pair of which has a common bottom. The architect above-mentioned would doubtless have made the bottoms flat, to expend less wax, like those here drawn by me. But this would have been a third error. We must send him to school to the Bees, and there he will learn, that pyramidal bottoms, such as those of the six cells which I here trace, are form'd with a less quantity of wax than flat bottoms. How many other errors would he have committed, which the Bees avoid with surprizing skill, as you shall see presently ? Let me set before you this piece of comb, and argue upon the objects as they lie before us. 'Tis necessary, as you proceed, that their cells lie all contiguous one to the other, without leaving the least void space between them. It must be confess'd that triangles and squares, such as these, would have produc'd the same effect. But as the triangle and square have a less area than a circle, whose diameter is the same ; the Bee, by this means, would have had less

less space for lodging commodiously ; and a second fault would be, more wax must have been consum'd. Such a figure must therefore be made choice of, which, under the same circumference, would be more extensive or capacious than the triangle and the square, and employ a less quantity of wax. I am certain that the Bee did not take up the rule and compass to find out this figure ; but man was forced to have recourse to those instruments, in order to inform himself of what they know soon after their existence, *viz.* that among the several polygons, from the triangle to the circle ; the hexagon, or figure with six sides, is the last of all, of which we may assemble together as many as we think proper ; all whose faces will join ; which will leave no void space between them ; and will be more capacious than figures, the number of whose sides will be fewer. Now this is the figure chosen by the Bee, who thereby has answered every end. I. The oeconomy of the wax, since the circumference of one cell serves to the circumference of those contiguous to it. II. The oeconomy of the spot ; since these cells, which join one to another, leave no void between them. III. The greatest capacity or space possible ; since, of all the figures which may be contiguous, or lie close one to the other, that with six sides gives the largest area.

CLAR. I comprehend all this perfectly, and that without the least aid of geometry or a problem.

EUGEN.

EUGEN. This is not the most difficult task, but we shall come to it by and by. 'Tis very proper that these tubes be clos'd at one end. 'Tis necessary for the Bees that this should be, not by flat bottoms, but by pyramidal hollows. Tho' you now have cells before you ; tho' by breaking them, you may see every part of their inside ; you yet would not easily discover the whole science and industry employ'd in their construction ; if I did not accompany them with some explications, the result of my reading, experience, and long observations. But, for this purpose, it will be necessary that you accustom your self a little to the stile of geometry, which I will adapt, to the best of my power, to your understanding.

CLAR. I must desire you not to employ the terms of that science, for these would certainly give me the head-ach. Do as well as you can : for I am resolved to listen to none but common terms, to such demonstrations as suit the capacities of children.

EUGEN. I must obey your commands ; and since you require it, we'll build together some card-houses which will have a vastly pretty effect. A circumstance which makes us easy is, that should any one come and catch us unawares, you'll have no just cause to reproach me, since I was forced to it. Let us first cut this card into three equal parts.

Plate VII.
Fig. 1.

CLAR. What are you going to make ?

EUGEN.

EUGEN. A card-cell ; such a one as I should make for your little daughter.

CLAR. Mighty well. Proceed in your play.

EUGEN. Let us fold one of these three pieces into two, doing this lengthwise. Afterwards cut one of the ends of this folded piece slantwise. Unfold it. You see that it terminates in a pyramid ; and that the fold made by us forms a kind of stay, which divides this piece into two equal spaces. Take notice of this fold, as it will be of service to us afterwards. Let us fold and cut, in the same manner, the other two pieces of the same card. Let us open them, but not entirely ; in order that the fold, which I term the stay, may seem to form two pieces of one only. Let us next set these three pieces upright, close one to the other. Now bring them together, in a kind of circular form, as tho' we were desirous to make a tube of them. Each of these three pieces being divided into two, by its fold ; 'tis plain that our tube consists of six planes, all which together form a hexagon, or figure with six sides. Thus we have a Bee-cell, from its opening (downward) to the part where its pyramidal bottom must begin. These three pieces joined together in form of a tube, terminate by three triangular points, leaving three void spaces between them. Now, in what manner will the Bee fill up these vacuities ; and terminate at the same time her cell by a single point, or sort of capital in a pyramidal form also ?

Fig. 2.

Fig. 3.

Fig. 4.

Lett. A.

Fig. 5.

Lett. E. f.

G.

Fig. 6.

Fig 5 & 6.

Lett. a.

Fig. 6.

Lett. B.

Fig. 6.

Lett. c.

Fig 6.

Lett. E. f.

G.

also? This the Bee has taught me, and I'll now represent it to you by cards. You know, or may know, that two triangles join'd, base against

Plate VIII

Fig. 7.

Lett. a, b.

Fig. 9.

Lett. E, f,

G.

base, form what is call'd a lozenge. The three void spaces can be fill'd only by three triangles revers'd; the cell must be terminated by a hollow pyramidal bottom, with three faces, compos'd of three triangular plates, whose bases shall lie on the bases of the revers'd triangles. You therefore must form six triangles, the three lower ones of which will serve to fill up the void spaces; and the three upper ones to form the capital or pyramidal bottom. But to save ourselves trouble, instead of six triangles, let us make three lozenges with our cards, in like manner as the Bee does with wax, and the same effect will be produced.

Fig. 9.

Lett. P. P P

Lett. mm,

mm, mm.

'Tis thus you perceive they give us the six triangles desired, three right and three revers'd, all which nevertheless form but three pieces.

Fig. 8 & 9.

Lett. P.

The lower triangular part of each lozenge, fills exactly one of the triangular voids of the tube; and the upper triangular part of the same lozenges, when join'd by their points, make that hollow pyramid which forms the bottom or capital of the cell.

Ibid.

Lett. P.

Let fall this little capital, compos'd of three lozenges, and you'll find that the three lower parts of the three lozenges, will go and fix in the voids of the tube, and fill them exactly. Thus you have a very rude figure of a Bee's cell.

Fig. 9.

Lett P P P

CLAR. How obstinate was you, in being absolutely resolv'd to split my head with your horrid

horrid terms, tho' you had so plain and simple a way of expressing your meaning. I understand you so perfectly, that, should the Bees forget the art of making cells, I am able to instruct them in that particular. I could let them into the whole affair at once, with only a couple of cards and a pair of scissars.

EUGEN. Come, don't be quite so much elevated with your proficiency. I have acquainted you with the mechanical construction of cells; but then, can you account for their mechanism? answer me this point.

CLAR. You stop me at once. Here, bring some cards. Come, here are scissars: cut away, and let me know the mechanism you are speaking of.

EUGEN. I am delighted with your sprightliness. Instruments are made to describe figures; but to display the reasons of figures, we must have recourse, not to instruments or tools, but to something else. Thoughts are express'd by words only.

CLAR. Well, let me have words then. Inform me of these reasons.

EUGEN. Observe that these lozenges have Plate VIII Fig. 9. Lett. P P P two angles more open than those of a perfect square; and that two are sharper or more acute. The Bees always make the two large angles of 110 degrees, and the two small ones of 70.

CLAR. I am afraid that there is geometry Plate VIII Fig. 9. in this; however, I will allow you this descrip-

R
tion,

tion, as I know the meaning of one angle being more open than another.

EUGEN. The Bees deviate as little as they can from this rule, conformably to which they shape their lozenges.

CLAR. This is wonderful. But I don't yet see the reason why they prefer this figure or shape.

EUGEN. 'Tis purposely to be as sparing as they can of wax.

CLAR. Strange! what can lozenges, cut in one shape rather than another, have to do with the saving of wax?

EUGEN. This is the mighty difficulty, which I'll explain to you as well as I can. In comparing transiently, a flat-bottom'd cell, with another whose bottom is pyramidal, we don't perceive (and even wou'd not believe) that of all kinds of cells, the flatt-bottom'd one takes up the greatest quantity of wax. It is yet demonstrated, and that too by geometry, that the Bees husband their wax, by making pyramidal bottoms. 'Twas enough that the Bees had discover'd this wonderful property, which, possibly, would otherwise have never been found out by man: the former have nevertheless extended their geometrical views farther. A choice might be made, among pyramidal bottoms, in order to find out such as would take up the least wax; and this the Bees have done. They discover'd that among the several cells of the same extent, and with a pyramidal bottom; the cell which can be form'd
with

with the least wax, is that, each of whose lozenges has two opposite angles of 110 degrees, and the other two angles of 70.

CLAR. You'll make me run mad with your angles, your degrees, and your pyramidal bottoms. Would you persuade me, that views of oeconomy prompted our ancestors to wear high-crown'd hats; and that those sugar-loaves took up less cloth, than the flat hats now worn by men?

EUGEN. I would gladly make you understand, without angering you, one thing which is certainly true; I mean, that a steeple-crown hat, rais'd pursuant to the rules taught us by the Bees, would take up less cloth than such a one as was flat, and in the shape we wear them. This is prov'd in manner following. But we must first set out with a theorem, which will lead us to a problem.

CLAR. You say right: we must set out, but 'tis from hence; for I find you are now possess'd by the dæmon of geometry. To lay him, let us change our subject, and set out homewards. As we walk along, I'll get you to clear up the following difficulty. How can such cells as are pyramidal, fix in with the cells opposite to them, and which are pyramidal likewise? In case they meet at their point, their bottoms are no longer common; consequently no wax would be saved in this respect; there even must be large void spaces left, which shows that the spot or space is not laid out to the best advantage.

EUGEN. You would certainly be in the right, was this really the case; but you should suppose, from the whole work of the Bees hitherto; that they foresaw this inconveniency, and provided a remedy for it. Their conduct on this occasion is the more ingenious, as 'tis the more simple. The small pyramids which terminate all the cells on one side or face, enter into that of the opposite face; so that the three lozenges which form the bottom of a cell of one of the faces, are, at the same time, (and each seperately) one of the lozenges of three cells laid one against the other. As the partitions by this means are common, a great deal of wax is saved, and no room is lost. Take this comb; stick a pin into each of the lozenges which forms the bottom of a cell. Now see, by the opposite face, where the points of our three pins meet.

Plate VIII
Fig. 10.

Fig. 11.

CLAR. They all three, indeed, have entered three different cells. I will not deny, Eugenio, but that I am struck with wonder, at the sight of this admirable work. I'm quite amaz'd and confounded, to find that such little animals, such contemptible insects should execute works, which, for beauty, elegance, and regularity, equal the attempts of the most enlightned human reason; of such reason as has been most exercis'd in sublime sciences. I scarce know how to reconcile these deep views with that sort of mechanical reason, by which faculty alone (as I imagine) brutes are guided.

EUGEN.

EUGEN. I don't see why this should disorder, in any manner, your system. The Being who taught the new-born child to make a pump of his mouth, therewith to draw forth his nurse's milk, at the same time that this child is utterly ignorant of pneumatics, has taught the Bee to make a cell without the assistance of geometry. 'Tis in the perfection itself of the Bee's structure, that I draw a strong argument, in opposition to the comparison which some would form, between our reason and that of brutes. What is human reason? 'Tis a faculty weak at first, but which afterwards displays itself by insensible degrees, and acquires lights or knowledge: it improves more or less by labour, and according to the use that is made of it: this faculty comes into the world ignorant, and stands in need of instruction; and accordingly 'tis instructed. The brute, on the contrary, is born as perfect as it can be; it knows every thing needful for it to be acquainted with; at its coming into the world, it issues from the hands of its creator compleatly fashion'd, in like manner as a tool or instrument out of the hands of a workman. The Bee, of a day old, is as perfect a geometrician as the Bee of a year. This difference between our reason, and the reason or instinct of animals or brutes (call it which you will) is enough to show that one is not the other; that each of them act upon different principles; that both of them are mysteries in nature, and that we must not expect to find out that of brutes, till we have first dis-

cover'd our own; or that the best course would be, agreeably to our determination the other day, to worship, in awful silence, the secrets of the Almighty.

CLAR. Your Reflection is exceedingly just. Let us separate with this moral, and we shall take with us the useful join'd with the profitable. I desire you to meet me to morrow, in order to discourse on some other subject. Tell me what it shall be?

EUGEN. We shall proceed with the cells, this being a topic not yet exhausted. You have taken a view of the deep knowledge, and the astonishing industry of our little artificers. But you don't know that they go still further; they committing mistakes, and afterwards correcting themselves; they meeting with obstacles, and surmounting them. You did not observe, that thriftiness, with regard to wax, engages them to make the walls or partitions, and bottoms of their cells so very thin, that one would scarce imagine those diminutive edifices were strong enough to support the weight of their bodies, their perpetual motions, and their heaps of honey; if we did not know that they, upon occasion, are able to prop and strengthen them. You have not seen them repair, improve, and give the finishing stroke to their habitations. We are still to examine the several dimensions of the cells, and the frame of the combs; and no mention has been yet made of the royal cells. Hence you may judge, that we shall have topics enough to discourse upon.

C O N-

CONVERSATION XII.

Continuation of the cells. Errors committed by the Bees in building them, and how they add the finishing stroke. Dimensions of a cell. Combs of a royal cell.

E U G E N I O.

YOU seem in deep meditation, Clarissa. Perhaps you may not be recovered from the surprize, into which the prodigious knowledge of our insects threw you.

CLAR. I don't design to recover from it, this tending directly to make me acknowledge the presence of a Creator ; a sight that is always precious to me, and which I am ever glad to have repeated. But our Bees have given me an opportunity of making reflexions I was revolving, and which I must communicate to you. Ever since we parted, I have not been able to get these cells out of my head ; and I cannot forbear still admiring so perfect a Work. I have been ever since figuring to my fancy, a Bee, handling its materials in the same manner as an artificer would do ; cutting lozenges under certain determined angles ; and discovering the utmost thriftiness with regard to the disposal of the wax. As I imagined to myself this insect busied in its work ; pursuing its ends with certainty, and this by the

best means ; I was perpetually tempted to allow them judgment or reason ; and even a series of argumentations, such as are necessary for man ; and such as few of the learned, among you, are capable of boasting. In the extasy to which this raised me, I was ashamed to see myself obliged to yield, in the article of understanding, to insects. But, how, is it possible for us to resist the temptation of systems, especially when it concerns our honour. I must give way to this also, as it will necessarily turn to the glory of the Almighty. The recalling to my memory the comparison with regard to the musicians, has been of advantage to me. I am thoroughly pleased with it ; and I thereby very well conceive, how it is possible for an animal, though uninformed by reason, to act as if she were indued with that faculty, and even the most sublime kind of it. It frequently happens to me, whilst I am sitting by my Harpsichord, to play on it, without once reflecting on what I am doing. I will play, whenever you please, *Couperin's Pastorals* or *Bees* * ; and talk with you upon any subject at the same time. On this occasion, my fingers only shall play. I shall be quite absent in thought with regard to the musick : my mind, the reasoning faculty, and even the will, will have as little share in it, and all these shall be employ'd in entertaining you. My fingers

* *Les Bergeries* ou *les Abeilles de Couperin*. These are pieces of musick.

once set agoing, shall perform of themselves a work almost equal to a cell ; and execute the whole quite mechanically. I then will boast my having form'd *automaton*-fingers ; fingers which play a harpsicord-air, without my being concern'd with, or my reasoning faculty having any thing to do with them. Now, why should we imagine the Almighty has not the same power ; I mean that of creating animals capable of executing, without the faculty of reason, such works as are the most complicated, and require the greatest industry ?

EUGEN. I am overjoy'd at my having given you so fair an opportunity, for arguing thus justly. You have set my comparison in the most sublime light ; 'twould, therefore, be a pity that I should weaken it, by those particulars which I am to observe to you farther. Nevertheless. happen what will, I must see whether we can carry it on to the end. Let us proceed with the Bee, quite to the conclusion of her work. How accurate, how geometrical soever we find the Bees, yet their cells with six faces are not always form'd quite free from errors. It frequently happens that, in the same cell, several of these faces or sides shall be wider than the rest ; and, a singular circumstance is, these irregularities are ever more considerable towards the bottom, than about the opening. Of this the Bee herself seems to be sensible ; and endeavours to correct all her mistakes, in proportion as her work advances forward. The irregularity

rity of the faces occasions some in the lozenges, which are not always made as regular as they ought to be. We should not be surprized, were the skill of our artificers to fall short, in a Work of so much delicacy ; but we may justly be so, to see Bees commit errors on this occasion.

CLAR. Why so ? To go on with your comparison ; I ought to be no more surprized on this occasion, than if my fingers, after being taught to play a harpsicord-air without me, should yet mistake in some note.

EUGEN. True. But would not your wonder increase, if those very fingers, after mistaking, should correct themselves ; and if, after striking a false note, they should correct themselves by substituting a third or a fifth ; or by some other note, which should complete the harmony ; and this without the aid of your will, or your having the least knowledge of it ?

CLAR. I don't think this possible.

EUGEN. And yet this is what the Bees do. Whenever the inequalities become too considerable in one cell, either by their own fault, or by some circumstance out of their power ; they are able to correct them, by adding to, or lessening the next cell. Thus these irregularities don't increase. If a pyramidal bottom, for instance, is too much extended ; they leave a small portion in the pyramidal bottom of the next ; and the contrary in the opposite case. They are guilty of such mistakes as may appear of much greater consequence. We sometimes meet with

pyramidal bottoms, which, instead of being composed of three lozenges, conformably to the rule, consist of four pieces ; and of these four pieces, two only will have four sides ; and the three others shall be composed of more or less. Hence it appears that our Bees may fall into errors ; they may fail in giving, to the first lozenge, its suitable dimensions and angles ; but then they know how to remedy their mistakes ; they then fix more pieces together, in order that the pyramid, may assume such a form or figure, as may be as little different as possible from that which it ought to have. But this is not all ; they suiting themselves to times and places. Whenever they are forced, by the inclination of the partitions of the hives, or from some other cause, to deviate from the right line ; they submit to this necessity by giving to their little tubes, or, to speak more clearly, the cavity of their cells, a proportionate curve : and thence it is, that we sometimes meet with cells which seem in the form of a crooked tube. Reconcile this now, if you can, with the comparison which gives you so much delight. See whether the *automaton* is master of retrospection ; or can turn back, at proper seasons, to correct such mistakes as it may have fallen into.

CLAR. I don't discover any impossibility in this ; and thus I conceive it. I have accustom'd my fingers ; have taught and disposed them to proceed without a guide ; to execute, singly, with the greatest exactness, certain regular and complicated

plicated motions. When once set to work, I attend to them no longer ; I let them go on, without any direction but their own ; and accordingly they proceed forward, without deviating from their first Impression. I own, indeed, that they may depart from it ; that this happens frequently ; and that whenever they do deviate, all is over ; they are bewilder'd, and unable to recover themselves. But it is enough that this does not happen to them always, for us to say that we are able to form *automatons*, which indeed are not so perfect as the Bee. But what are we, to compare our weak powers with the Supreme Being ! Must we infer, because we are not able to make better, that the author of nature cannot form *automatons* of a much more perfect kind than ours ?

EUGEN. This philosophical argument deserves thanks, at least, from me ; since it tends to defend a comparison which escaped me. We are now fallen on a subject that has already been well canvas'd ; and concerning which, it would be difficult for us to offer any argument, *pro* or *con*, that has not been alledged before. 'Tis my opinion that we had better return to our Bee-cells ; and this I will now do. As the gathering and preparing of wax cost the Bees much pains, it is incumbent on them to be extremely careful of it ; and we have seen how skilful they are in that particular. I will make you also observe, that this thriftiness prompts them to make the partitions of their thin cells, so as that the
solidity

solidity in their construction may supply for the defect of materials. No paper is so thin as the side and bottom-pieces of their cells. Nevertheless, these cells ought to be strong enough to resist the several motions of the Bees who go in and out of them continually. The parts most liable to injury, are the entrance to the cells ; these being the most strongly and most frequently attacked. Accordingly the Bees take care to strengthen them ; they adding, quite round the circumference of the apertures, a string or fillet of wax ; by which means this mouth is three or four times thicker than it would otherwise be, was it no thicker than the sides or faces. We even perceive this fillet about such cells as are but just begun ; it is thicker in the angles than elsewhere ; for which reason the opening of the cell is not a perfect hexagon. The building of a cell is not the work, merely of a moment, with regard to the little artificer. How dexterous and skilful soever she may be ; tho' ever so diligent and active in her toil ; it is only by time and the greatest pains, that she is able to raise the partitions of her cell, and reduce them to a proper thinness. She does not cast them in a mould. If a Bee, in building a cell, should form it (at first) as thin as it is necessary for it to be, she would do wrong. This part, being too weak to resist the weight and motions of the insect, would burst ; and accordingly she gives it much more solidity and strength, than is requisite ; the Bee afterwards lessening and paring it away,

away, as may be found necessary. This part (I mean the paring away) is left to other Bees, whose business it is to polish, as it were ; to repair and compleat all that is still rough, and give it the finishing stroke. This is the employment of the greatest part of our little labourers in wax. There is no difficulty in getting a sight of them when thus busied ; as it is their daily, and almost hourly, exercise.

CLAR. If this be so easy, let me discover it myself. Permit me to have this pleasure, and to instruct you in what you know much better than I. Let us stoop to the hive. Both of us will make observations, but I only will speak. It will not be just that you should have all the trouble. I will now inform you in what manner the Bees repair their cells. Methinks I perceive one planing or scraping. I am not yet well enough versed in their art, to use the proper Term. She works, very fortunately for me, at the entrance of her cell ; and I plainly see all her operations. She moves her teeth with prodigious swiftness, and scrapes the partitions. She now takes away some minute fragments of wax, which look like so many chips or shavings. My joyner is not more expert. These fragments she joins, and works them up into a ball. I really see one as big as a pin's head. The Bee flies away, and takes this ball with her. However, the work does not stand still. Her place is instantly supplied by another, who advances in farther ; probably to work at the bottom. I judge, from
her

her motions, that she is exercised in the like operation. My conjecture was right ; she going away, like the former, with her little ball of wax.

EUGEN. You have made very good observations, Clarissa, and been eye-witness to the manner in which the Bees repair their cells. We will now proceed to other particulars. Would you willingly know, with little trouble to yourself, how many cells there are in a comb ? This may be very easily found. Let us make use of the comb now lying before us. We will only count the first range of cells. There are twenty, as you perceive, on a line. Let us measure this line. It is four inches long. Our comb is fifteen inches in length, and ten inches broad. All the cells that ever were, or ever will be made, are two lines * $\frac{2}{3}$ in diameter. These several quantities being known, you will find, by a single rule in multiplication, that there are nine thousand cells on the surface of this comb. I speak only of the cells of the working Bees ; for those of the drones being larger, and their diameter of three lines $\frac{2}{3}$; twenty of these would cover a line of five inches, and six lines in length, and a little more.

CLAR. You declare then, that the diameter of all cells ever made, or that will be made, were and will be, two lines $\frac{2}{3}$ in diameter.

* A *Line* is a French measure, $\frac{1}{12}$ of an inch.

EUGEN. I do affirm this. But what inference would you draw from thence?

CLAR. You'll say I am out of my senses. But be that as it will ; I must tell you the crotchet that is come into my head. It has been wished, and will doubtless be long so, that men would invent one language which might be common to all the nations of our earth. I have read somewhere, that a certain philosopher had attempted to make one ; but, in all probability, this was endeavoured without success, since we hear no more of it, for which I am very sorry. I too am fired with the ambition of making my name famous, by an invention of the like kind. What think you of a person who should have discovered a measure which might be known to all the nations of the world, and proper for all ages ; that men might have, in all places, a model made by the hand of nature ; and, on which, every person might verify and compare the measure used by himself, and apply to it all the rest used in the world ? Would not this be a fine secret ?

EUGEN. An excellent one.

CLAR. And this I have discovered. 'Tis the dimensions of a cell. 'Tis a certain fact that all Bees which ever existed, from the creation of the world to this day, have built cells of the same size and diameter ; and will proceed in this manner till time is no more. I believe it is equally true that, from Peru to Japan, all the cells of Bees are raised upon the same laws, and with the same measures. Consequently ; was I

to inform a Japoneze, by writing, that a certain thing I sent him was four inches in length, he would not understand me ; but should I observe that its length was equal to that of twenty Bee-cells, he would understand me perfectly ; as likewise would the Peruvian, the Muscovite, &c. All these would instantly form to themselves an idea of a length, the same as what we understand, when we say four inches. Thus we have a measure that is invariable ; known to all nations, and found every where. In a word, 'tis an universal language with respect to measure, and will be understood till the end of time.

EUGEN. The farther we proceed in our conferences, the more I perceive your philosophic genius opens, strengthens and increases ; or rather, you discover talents which your modesty had hitherto concealed. Is it possible that I should have found the art (if a figure of Socrates will be allowed me) of being the midwife of your thoughts ? The philosopher who formed to himself the secret of an universal language was Mr. Leibnitz *, one of the most extensive and most sublime genius's that Germany ever gave birth to. He used to say, speaking of this invention, that he was forming an alphabet of human thoughts. This great man, whose only view was the public utility, would have obliged all the inhabitants of our earth to use one and the

* This had been attempted before by our bishop Wilkins, and by Algarme : But Mr Leibnitz did not approve of their method, and had formed to himself one quite different.

same language ; and reduced Europe, with respect to temporals, under a single power ; and under one sole head or chief with regard to spirituals. Being a German, you will not be surprized to hear that he gave the government of Europe to the emperor ; but you will be more so, when I inform you that Leibnitz, though a Lutheran, ascribed the church-supremacy to the pope : “ So

Hist. de l'Acad. des Sciences, in 1716. “ greatly, (says the illustrious historian of his life) “ did the systematic spirit, which he possessed in a supreme degree, prevail, in religious matters, over party spirit.” But all these fine projects remain still unexecuted ; the reason of which, (according to the same historian) “ is that different nations agree only in not “ understanding their common interests.” I am afraid the like fate will attend your secret, with respect to which I am sorry to observe, that you did not hit upon it first ; Mr. Thevenot, his majesty's librarian, having started it before.

CLAR. I wish that Mr. Thevenot had been far enough. What did he mean to thus anticipate me in an invention which, otherwise, would have immortalized me ?

EUGEN. The antients have played us many such tricks. But however this be, you'll be no great loser by it. This discovery has had no better success than that of Mr. Leibnitz. Let us go on with examining the other dimensions of the cells. Their depths are not so certainly fixed as their diameters. The cells of the Working-bees are commonly five lines and a half in depth ;

and such of the worms and maggots as turn to drones, eight lines, and sometimes less. When these cells are not necessary for bringing up worms, they turn them into store-houses for the honey. But some are appointed for this use only, and these are deeper than the others. I have seen some that were six lines in length. Whenever the provision of honey is so great, that the Bees can scarce get vessels enough to lodge it in; when these find it difficult to build a sufficient number of cells to contain all the honey made by them; they then either lengthen the old ones, or make the new ones longer than those built by them before. Hence it is that the surfaces of the combs are never equal; and some parts of them are raised higher than the rest, and bunch out. Methinks I have observed to you all that can be said, with regard to the cells of which combs are formed. Let us now consider the combs themselves.

CLAR. But pray now, what is become of your royal palace? What idea should we form to ourselves of a traveller, who, describing a city, should give an exact plan of all the common houses and hotels, and forget to mention the Louvre?

EUGEN. Your reproach is very just: nevertheless, this omission was not owing to forgetfulness in me; but from my opinion, that this subject will be more proper, after we shall have gone through what I have to say with regard to combs. The disposition of these, as well as that

of the cells, offers such particulars as do honour to the understanding of Bees. When these noble insects are once settled in a hive that pleases them; 'tis not long before they lay the foundations of a comb, which they lengthen and widen with surprising swiftness. But the Bees, before they give it the whole intended extent, divide or separate themselves: part of the workmen begin a second; and sometimes another party undertake a third. When there are two or three work-shops, a greater number of artificers may labour together, without hindring one another; and they have an opportunity of doing more business in a shorter time. Having a glass-hive here, which gives us a view of its inside, 'twere almost needless to tell you that these combs lie parallel one to the other; and that there is left between every one of them, a space which serves as a street; broad enough for two Bees to pass by together. Observe, on the surface of the combs before you, holes which go quite through it.

Plate IX.
Fig. 2.
Lett. a, a, a.

CLAR. Let me guess for what use these holes are design'd. I imagine them to be narrow streets; cross-ways or lanes made by the Bees, in order to pass from one comb to another, without being obliged to go a round-about way.

EUGEN. This is not mere guess, for you have hit upon the very thing.

CLAR. I must stop here a moment or two, and contemplate our hive: My love for observations increases greatly. What numberless multitudes are here! our most-frequented markets are not
more

more crowded with people than the streets of a hive. We are not tired with gazing upon this sight. How great an activity, what diligence, what love of labour do I behold! 'Tis with infinite pleasure I recall to my memory all you have observed to me on this subject. A hive is a city, the inhabitants of which don't dwell in their houses. They neglect their own conveniencies, for the sake of the public weal. If they build, 'tis only to hoard their common provisions, and to bring up their young; they contenting themselves with lodging in the streets, and the places of public resort. Another observation made, as Plate X. I survey our combs, edge-ways is, I perceive an Fig. 1. irregularity which displeases me a little. Can it be peculiar to this hive, or is it common to all? A regular parallelism is not observed between these several combs. I don't know whether you take notice, that I begin to speak the language of geometry. However, as I might mistake, in thus talking in a learned strain, I will explain myself. By this term regular parallelism, my meaning is, that these combs are too far distant one from the other at top, and that they don't fall perpendicular; they having left a void space, Ibid. which the Bees found it necessary to fill up with Let. A. an after-comb.

EUGEN. The term parallelism is very just on this occasion; and your observation is a new proof that Bees may commit mistakes, and are able to rectify them. These insects, whenever they begin their combs, form, at the top of

the hive, a sort of hand or foot, that serves as a tie or stay to the whole edifice, which is to hang from it. The Bees, at the same time that they lay the foundations of the first comb, prepare likewise those of the second. The latter must be usually placed at such a distance from the former, that both of them falling parallel, no more space must be left between them, than what is sufficient for two Bees to pass. Nevertheless, they sometimes happen to mistake, and the second comb is too far distant from the first. In order to recover part of the too great void space arising from this bad position, the Bees carry it on obliquely ; and give it, in proportion as they carry it on, an inclination tending toward the other. Sometimes the void is so considerable, that the Bees cannot bear with it. They then build a third between these, whose extent is no larger than just to fill up the too great void : they terminate it in that part where the two others leave, between them, such an interval only as may be proper ; like to that which gives us occasion to make this remark.

Plate X.
Fig. 1.
Lett. A.

CLAR. I return to the foundation of these edifices which are at top. I am not surprized that these combs should be liable to fall. Whenever this happens, 'tis as if the whole district of a city was to be overturned in an instant. This must be a sort of dreadful earthquake with respect to these poor little insects.

EUGEN.

EUGEN. This calamity, indeed, happens but too frequently ; on which occasions, a multitude of innocent, diminutive creatures among them, are killed, in their cradle, as it were. However, the Bees do all that lies in their power to prevent these catastrophes. Though the cells are formed of excessively thin wax-leaves, yet the combs grow heavy when very full of honey. Their own weight is strong enough to break the stays or ties by which they are suspended from the top of the hive. But our artificers have other methods to fix them ; they multiplying the stays wherever they have an opportunity to do this. You here have a proof of what I now observe. These small bodies of wax, one end of which sticks to the pane of glass, and the other to the comb, are stays or ties. There are others of the same kind on the opposite side of the comb, to fix it to the next ; and by this contrivance they are all bound one to the other. Those who prepare hives for lodging of Bees, set up (crosswise) in them small sticks, which afterwards serve as props ; prevent them from falling, and save the Bees a great deal of labour. But 'tis time that we proceed to the royal cells, to the palaces of the queens, a description of which I promised you. I'll first show you one, Plate IX. and afterwards argue upon it. D'ye see this ? Fig. 3, 4. Lett. A A.

CLAR. How ! Is this the thing which you term a queen's palace ? I should rather call it a mishapen lump of wax. Upon my credit, if the

Bees cut us out work, and puzzle us in geometry ; we are even with them, as to architecture.

EUGEN. We are not very sure of this. I would not venture to censure, so hastily, the figure or draught of this cell.

CLAR. You may, if you think proper, consider it, as elegant, light, and well wrought ; but I imagine you will not attempt to prove, that there is any thing in it which can be called designing.

EUGEN. As we have something else to do, I shall say but a word or two upon this question. Geometry is a science founded on clear and distinct truths ; or such as do not leave us the liberty of doubting. Now architecture is a science, the principles of which have no other fundamental rules than taste, which has none. Should you ask me what taste is ; the only definition I can give you of it is, that 'tis a *je ne sçai quoi* ; a certain something, which pleases I know not how. The Chinese, who agree with us in geometrical truths, differ from us with respect to the rules of architecture. They are not tempted to alter theirs for ours ; and possibly we may be the people to make the exchange, their drawings pleasing us already. To you the palace of a Queen-bee seems rude, and mean ; but, did you see with her eyes, it doubtless would appear to you spacious, grand, commodious, and worthy of her majesty. Let us therefore describe this edifice, without criticizing upon it. The Bees depart from their usual style

style of building, when they are to raise cells, for the bringing up of such worms as will become Queen-bees. These are not hexagonal cells, but, as you see, in a roundish oblong form ; having one end bigger than the other, with their exterior surface full of little cavities. There is an ornament called *rustic*, in our architecture, which resembles this pretty much. The Bees indeed seem, to us, to attend less to beauty and elegance in these cells, than to solidity : they are so studious with respect to the last mentioned article, that I don't wonder you should consider them as rude and heavy. Wax, which is employed with so geometrical a thriftiness, in the raising hexagonal cells, is expended with profusion in that of the apartments where the queens are to be brought up. The Bees are excessively lavish, when they are to build for the grandeur and magnificence of their sovereigns.

CLAR. This conduct pleases me infinitely. It agrees exactly with my own sentiments, and those of our countrymen.

EUGEN. Happy the king, happy the people where such sentiments are reciprocal!—I weighed one of these palaces, one of these cells, (which deserves to be distinguished by the epithet royal) with other cells in the hexagonal form ; and find that the former weighed almost as much as an hundred of the latter. And yet, the royal cell with which I made the experiment on this occasion, was not finished ; it not being carried on to its full length, nor was of the largest size.

size. I believe some of the royal cells weigh as much as an hundred and fifty common ones. Does this weight frighten you?

CLAR. I have nothing to object to their employing one hundred and fifty times the quantity of materials, in raising a *Louvre*, than in building a plebeian house ; but they don't seem, to me, to have chosen a convenient spot.

EUGEN. I cannot account for their reasons. But I know that they don't seem to endeavour to be thrifty with regard to place, in building a cell which is to serve as the cradle to a queen. They sometimes fix it, as here, in the very middle of the comb. Several common cells are sacrificed, to serve as a basis and support to it. Generally the royal cells issue from the lower end of a comb. Some of them descend (in like manner, from one of the sides) provided it does not touch the partitions of the hive. One thing I found certain, *viz.* that their largest end is uppermost ; and that their length is almost perpendicular to the common cells. When a royal cell is only begun, 'tis pretty much in the figure of a goblet ; or, more exactly, of the cup in which an acorn lies. Sometimes the cup has a stalk, like that of fruits. But the Bees lessen the diameter of the cell, in proportion as they lengthen it ; they also contract it more and more, in such a manner that the lower end may be more taper than the upper. The lower end they leave open, till the season for closing it comes ; which is not till such time as the worm that grew within it is ready for

Plate IX.
Fig. 4.
Lett. A.

Plate IX.
Fig. 3.
Lett. a.
Ibid.
Lett. A A.

Plate IX.
Fig. 4.
Lett. B, B

Ibid.
Fig. 3
Lett. a, o, o.

for

for transformation. The Bees make every one of these distinguished cells fifteen or sixteen lines in length.

CLAR. I suppose you defer, till another day, the informing me how 'tis possible for the Bee to live and support itself in a cell turned topsy-turvy, and open at bottom; how it is kept from falling out, as well as the paste or pappy substance.

EUGEN. That you shall know instantly. First, the paste belonging to queens is thicker than that of the other Bees; 'tis scarce fluid; and is the less so, as its bed is exceedingly thin. Hence 'tis in no danger of falling from the place in which it is laid. Secondly, when the worm, whence a Mother-bee will issue, is small, 'tis viscous and light enough to be kept and suspended in this clammy paste. In proportion as it grows, it touches more and more every part of the partitions of its cell, and presses them to the height in which it is situated. I observed to you, that the diameter of a royal cell always diminishes downwards. Consequently, when the worm takes up the whole diameter of the upper bottom of a cell, it cannot tumble out. To return to our royal cell. The Bees make it fifteen or sixteen lines deep. The superficies which is as yet but just sketched, and only in form of an acorn cup, is often smooth. It afterwards becomes rugged, and one would conclude, that the Bees had carved it into regular compartments. As the smoothing here gives them little trouble,

and

Plate IX.
Fig. 4.
Lett B, B.

and they employ this sort of work in the other cells ; we may suppose that these compartments, which are an ornament in our architecture, is likewise considered as one by the Bees, and that they add it out of respect to their queen.

CLAR. Another thing which puzzles me only, (for I am persuaded that the Bees extricate themselves happily on these occasions) is this : when a royal cell hangs at the bottom of a comb which is not yet extended to its whole length, how do they do to make it longer ? Methinks this unweildy edifice must necessarily give them a great deal of trouble.

EUGEN. 'Tis impossible to act more dexterously (and this with the utmost simplicity) than they do. They stay till the female Bee has left it ; after which they destroy the royal cell, and build ordinary ones over it. But as they leave the foundations, we plainly see that part of the comb where this happened ; it being a little thicker in this place than any other, and there appearing a kind of knot upon it. Hence it may be concluded that, at certain times, we no longer perceive, in a hive, the royal cells which were in it at the spring season of the year. Such are the particulars which experience, and a series of observations have taught us with regard to cells. 'Tis generally supposed, that the cells of combs are the habitations which the Bees build for themselves, and that each has its own. This opinion arises from its being observed, at certain times, that each cell has its Bee in it, where they lie

eafy and motionlefs. But a clofer examination will discover, (and for this purpofe our glafs-hives are vaftly ufeful) that the chief ufe of the cells is not to afford habitations to the Bees. A great number of cells contain the young worms, and fome are ftopped up; and, of thefe, fome contain *nymphæ*, and others honey. Others again which are open, ferve as ftore-houfes for the crude wax; as likewife for the honey given as daily food to fuch Bees as work within; and ferve likewife for fufenance on thofe days when cold or bad weather prevent the colony from going out of the hive. Such are the ufes to which thefe edifices are employed. We muft enquire concerning honey and its nature; and thefe fhall be the fubject of our next converfation here.

CONVERSATION XIII.

Of the origin of honey ; its gathering in, or harvest : the two stomachs of the Bee : the store-houses of honey ; the different qualities of it.

CLARISSA.

A Moment after I had left you yesterday, Eugenio, I received a message from a lady of my acquaintance. She sent me word, that being informed of the strong desire I had, to instruct myself in the history of Bees, she had sent me the most compleat treatise ever wrote on this subject. You will suppose that I opened it instantly with the greatest eagerness and curiosity. I read the title, which is as follows : *The wonderful government ; or the commonwealth of Bees* *. I presently imagin'd that your mission was at an end ; and that I should learn more in this book than you could teach me ; especially as I did not doubt but the author, who wrote since Mr de Reaumur, had profited by his observations and experiments. I thereupon began to peruse it with great eagerness ; especially the part relating to the natural history of Bees. I was not a little surprized to find that the author, though so modest as to apologize

* *Le gouvernement admirable ; ou la republiques des Abeilles. Paris, chez Thiboust, 1742.*

logize for the defects which might be found in his style and erudition ; did not prefer easy and unambiguous experiments, when made by clear, attentive eyes, to his own ideas ; to ideas of a random kind, and to imaginary principles.

EUGEN. I know this book, and have perused it. The author appears to me a very honest, sincere gentleman. Nevertheless, in matters relating to physicks ; I mean with regard to the birth, generation, sexes, &c. of Bees. I would advise you to adhere to what Mr de Reaumur informs us of this subject. However, you may keep this book, and place it, in your library, after the *maison rustique* (country-house). You there will find many valuable precepts, with regard to the working (if I may so term it) of hives ; but it is not much to be depended upon, with respect to the natural history of Bees. For instance, he will teach you how to make good metheglin or mead with honey ; but then very few particulars are related, concerning the nature of honey, its different qualities, its uses as to life and health, and the store-houses in which the Bees reserve their honey. You may call to mind that this is to be the subject of our present conversation ; and chance has brought us hither very *à propos*. To begin then. It was antiently supposed, that honey was a dew which fell from heaven ; but this is not the opinion, at least of good writers, in the present age, experience having taught us better. It is found, on the contrary, that dew and rain are great enemies to honey ;

honey ; that they mix with the honey'd liquor which I shall speak to you of, and corrupt it. It is the same as with wax : the Bees collect the materials which form it from flowers ; but then they fashion it in their stomachs, and it there assumes the nature of honey. In it's first state, 'tis a sap or juice digested and refined in the hollows of plants ; a juice, which sweats through the pores, and thickens on the flowers. The Bees don't always wait till this substance has transpired ; they fetching it from the very reservoirs where nature stores it. These reservoirs are a sort of bladders or kernels, plac'd variously on flowers of different kinds. It is but of late years that botanists have discovered them ; but they have been always known to the Bees. Whenever a Bee goes into a flower which has some of these bladders, or reservoirs, very full of honey'd liquor, she sometimes finds this liquor in its storehouses, sometimes shed upon the leaves, and on the bottom of the flower. In spring we perceive trees, and among others the maple, whose leaves are all cover'd with a sort of honey or sugar, and with which they glitter. Whether this liquor be in the reservoirs, or issued from it, it is the first substance or matter of honey ; it is this which the Bee goes in search of and gathers ; therewith to compose a food, proper for the nourishment of herself and her companions. It would be forming a false judgment with regard to Bees ; and they would be very unjustly considered as lazy, in case, every time we see them
return

return to the hive, empty footed ; we then should conclude that they had wing'd their way to the fields merely for diversion sake, and to riot on dainties ; they frequently returning, on these occasions, with a large provision of honey.

CLAR. I am greatly oblig'd to you, for giving me an opportunity of retracting several erroneous opinions I had form'd to myself with respect to Bees. I had often observed these insects to return empty ; which gave me a most unfavourable idea, with regard to their so much boasted love for their community. This, indeed, was a circumstance, concerning which, I intend to enquire of you.

EUGEN. We cannot be mistaken with regard to those who collect the provision of wax ; the two large balls we see on their legs, being a testimony of this. But we cannot discover, in Plate III. like manner, their provision of honey, this being Fig. 3. shut up in their stomachs. Many a Bee who Lett. A A. appears light, with respect to provisions, is yet well furnished with them. Before I treat of the manner how this substance is converted into true honey, I must first speak of the harvest or provision made of it. The trunk is the instrument with which the Bee gathers it. I have nothing new to observe with regard to this organ, you being acquainted with it ; and knowing that it is not a pump but a sort of tongue which laps the liquid, and sucks it in. This I observed, but have not yet shown it you ; and therefore am tempted to give you this pleasure.

T

CLAR.

CLAR. So, I suppose that we must have recourse to magnifying glasses. Let us prepare ourselves then for ogling.

Plate XI.
Fig. 1.

EUGEN. To enable you to see distinctly the play of the trunk of a Bee, when sucking in honey, I have brought this glass-tube, the diameter of which is about five lines. I will first rub it, in the inside, with some little pieces of honey in different places; and this being done, I will imprison therein a Bee, whose captivity will not lessen his appetite; and so far from it, you will see her suck the honey, as it lies in the tube.

CLAR. Whilst you are preparing your tube and Bee, I will tell you what I am now revolving in my mind; a wonderful Circumstance which merits our utmost attention.

EUGEN. Nothing that heightens the glory of the Supreme Being, ought to escape us.

CLAR. Don't you admire as much as I do, how a Bee, that is scarce come out of her cradle, as it were; not having seen any object, and being wholly unacquainted with the world; should yet issue from the inmost gloomy recesses of her hive, the instant after her rising to existence; and fly directly to a flower, though three miles from the place of her abode; and there be able to find, in an instant, reservoirs of honey which the eye of man cannot discover?

EUGEN. Your admiration is exceedingly just. No human reason, how enlightned and sagacious soever, comes into the world with such talents. Our insects are a proof, that, if the au-
thor

thor of their Being has refused them an understanding like to that of man ; he has compensated for it, by sending them into the world ready instructed ; and much better instructed than if he had left to them (as is done to human creatures) the care of instructing themselves.

CLAR. The Bees may consequently boast their enjoying the singular honour, of learning from no one except the Creator of the universe.

EUGEN. Doubtless. Hence we can no longer wonder, that these insects should know so many things which surpass the limits of our understanding. See, our glass-tube is ready ; and the Bee in captivity, who is now preparing to fall upon the honey with which I smear'd the walls of her prison.

CLAR. It is my turn to make observations, and to inform you of the conduct of our Bee. Give me the tube and the magnifying glass. The Bee is now before me, in a very advantageous position. I perceiv'd, at the very first glance, that she eats very heartily. But the business is to tell you in what manner she does eat ; how the trunk plays on this occasion ; whether she chews, swallows, and sucks. First, I observe the trunk lying on the honey ; and the extremity of the trunk stretching beyond the little honey'd heap. One would even imagine, that the Bee avoids dipping the extremity in question into the honey. She turns her trunk in a bow-form ; and it is the most convex part of this

Plate XI. bow, which souces and dips itself into the li-
 Fig. 1. quor. The insect now rubs backwards and for-
 Lett. A. wards the glass with the bow-part of her trunk;
 & Fig. 2. and, if she goes on as she began, not the least drop
 Lett. A. of honey will be left. What a multitude of different
 inflexions does she make with her trunk, and how
 wonderfully swift does she move it up and down?
 One place, I perceive, is well lick'd, and quite
 done with; and she proceeds to another. She
 now stops again at a second diminutive drop of
 honey; she runs the bow-part of her trunk into
 it, and draws it back again.

EUGEN. Observe, whether ——

CLAR. Stay, I beseech you: should you
 interrupt me, I shall lose sight of my object.
 Behold she now raises her trunk, stretches it
 forth, and draws it in. She throws, from time
 to time, the upper surface into a concave form;
 as though she would give a slope or bend (to-
 wards the head) to the liquor she has taken in.
 Hitherto I have always seen the extremity of the
 trunk; this extremity, in which there would be an
 opening if the trunk was a pump, I ever per-
 ceived above the honey; and it did not come
 near it. Should any partizan of the old opinions,
 now assert, that the trunk is not a tongue which
 licks and laps up, but a hollow or gutter pierc'd
 at one end; you may call me to your assistance;
 sure of finding in me, a second, who is able to
 defend the truth.

EUGEN. I find my own opinion so strongly
 confirm'd, by what you now say, that I will not
 scruple

scruple to affirm, that this trunk is a second tongue, which we might call a hairy tongue (it being cover'd with a great number of bristles) to distinguish it from the fleshy one I show'd you before, which is more like the common tongues.

Now view, in large, (as drawn from the micro-Plate XI.
scope) what you perceived, in the tube, through Fig. 2.
the magnifying glass. You are now convinc'd, Lett. A.

by your own eyes, that it is by these various motions or inflexions that this tongue gets together the honey'd liquor, and carries it to the mouth. By repeating this observation, you will easily discover, that it is on the top of the hairy tongue the liquor passes ; and that the cases of the trunk are not, (perhaps) made so much to cover it, as to be as so many edges or brims, and to form a canal for the conveyance of the liquor. It would argue too much timidity in us, not to venture to assert, that the Bee does not take honey from flowers, in a different manner from that spread on a glass. The difference which may be is this ; the Bee, when in a flower wherein there is not honey enough diffused, employs the strong jaws, which we know they have, to squeeze open the bladders containing the honey'd liquor. This insect can use it to very good purpose, when it wants to hack the paper, which covers your boxes of sweet-meats, as you yourself frequently complain. Why should she not employ it with regard to flowers, whenever it may be necessary to tear the membranes of which the honey bladders are composed ? Such is the manner in which

the Bees procure the liquor wherewith honey is to be made. When this liquor, by means of the trunk, has pass'd into the stomach, and continued some time there, it comes out from thence true honey. For we may very naturally conclude, that this substance does not issue from the Bee's body, such as it entered; but that it is digested and concocted there (and this likewise is the opinion of Swammerdam;) which is the reason of its being thicker when it issues from the Bee, than when she took it in. The Bee has two stomachs, the one to convert crude wax into wax properly so call'd; and the other to change the juice of flowers into honey. I could show you these two stomachs.

CLAR. I shall be glad to view them, upon condition that you won't dissect, for that purpose, living Bees. I suffer'd too much by the cruel dissections of those insects, made by you to discover their sexes.

EUGEN. You'll find that I intended not to give you the least pain, since I have brought this draught with me, wherein you will perceive these two stomachs very distinctly. 'Twere needless to observe, that this figure is larger than the life, and was drawn from the representation seen in the microscope. I'll now explain the several parts of it to you. A is the *anus*, C the end of the *corselet*, or that part where the breast ends. My design is to show you all that lies between them, I mean the part call'd the Bee's *belly*, whence I have taken off all the scaly part from
the

the rings which cover'd it. The conduit or gutter signified by the Letters V V, beginning by a neck and ending with a thick belly, in form of a bottle, is the Bee's stomach. The neck of this stomach is a continuation of what we call the *gullet*, or *conduit for food*; the swell'd part is the true stomach, as we see it when quite full of honey. The other conduit contiguous to it, divided by rings like a barrel, and distinguish'd by the letter E, is the second stomach, or laboratory for crude wax. The honey-stomach is not always so turgid as you perceive it on this occasion; and 'tis not so easily discover'd when empty. For this reason I have made a separate draught of the same parts taken out of the belly. S is the neck or gullet; and, if you permit me to use the technical term, *Oesophagos*. V is the honey-stomach, which, as you may perceive, is very small, as there is little food in it. Next is the stomach of crude wax, which you'll discover easily by its rings. The part represented by the letter T, is a sort of net-work or fringe of yellow vessels, in that part where the second stomach joins with the intestines. I is the last intestine, in which crude wax is frequently found, as likewise in the stomach, but never honey. A is the *anus*. These particulars being known, you'll easily understand the rest. The *Oesophagos* throws the honey received by it into the first stomach, which is more or less swell'd, according to the greater or less quantity contain'd in it. When quite empty, it seems only a white, fine thread;

Plate XI.
Fig. 4.

but when well fill'd with honey, 'tis shaped like a bladder, with which children who live in the country are perfectly well acquainted, and are very fond of.

CLAR. 'Twas therefore after such bladders that a little brother of mine us'd to ramble formerly, and which he was very dextrous in procuring. He has regal'd me very often with them, at the time that we were both children.

EUGEN. 'Tis particularly in the bodies of large honey drones that the largest bladders are found ; and children hunt more eagerly after such, than those of the Bees.

CLAR. The Bees, consequently, owe their security to the little riches possess'd by them.

EUGEN. Every flower furnishes the Bee with only a very small quantity of this liquor ; she being oblig'd to travel over many, one after another, before she has taken all the quantity into her first stomach, that it is capable of containing.

CLAR. We have not found Aristotle or Pliny in an error this long time. Have they made no mention of the several particulars you have pointed out, and instructed me in ?

EUGEN. We need not go farther, in order to find, in the former, subjects for censure. According to him, the same Bee does not go from one flower to another of an opposite kind ; he does not go from a violet, for instance, to a primrose ; but always from one violet to another, from a lilly to a lilly, and from a rose to a rose.

But I have often seen Bees skud away, like butterflies, from flower to flower, without once regarding the species. However this be, as soon as the insect has filled her stomach with a sufficient quantity of honey, she returns to her hive. The instant she is enter'd it, she seeks a cell in which she may disgorge and deposit the materials brought by her. This leads us to inquire into the magazines or store-houses of honey. We are now coming to a wonderful article relating to the polity of our little insects, and which certainly deserves your enquiry. Figure to yourself a city, all the inhabitants whereof work only for the general utility ; where each individual is diligent and faithful in carrying to the publick store-houses, the harvest of the day ; contenting itself with taking just what may be necessary for its own support ; where the people store up, not only for the time present, but likewise for futurity ; where repositories are found ever full, and always open for daily subsistence ; repositories securely shut up and seal'd for winter, and seasons of scarcity.

CLAR. You put me in mind of a little fable I read formerly, which appeared very prettily work'd up, and to the following purpose. The wasps and hornets, once upon a time, form'd a kind of mercantile society together ; and propos'd, to the tenants of a Bee-hive, the stocking of their store-houses ; they engaging to keep these granaries perpetually full, and well provided with crude wax and honey ; which is as if we
were

were to say, with regard to mankind, well stock'd with corn and wine. The Bee-senate being met, a hornet, an eloquent speaker, display'd before the assembly the mighty advantages which would accrue to the former from these proposals. He laid a stress, especially, on the numberless cares and inquietudes which the Bees would be freed from by this means; that they might sweetly sleep away the whole morning, and spare themselves long and painful journies. Accordingly an instrument was drawn up; and the Bees abandoned to the new-comers the provisions already made, upon condition of being afterwards nourished by them. However, at the expiration of the year, the wasps and hornets disappear'd; and, with them, the honey and crude wax; they leaving only empty granaries, and the Bees sadly lamenting their folly.

EUGEN. I don't doubt but that a proper application may have been made of this fable. But to return to the general utility: this foresight of the Bees is known to all persons, who, at the same time that they are rais'd to admiration applaud these insects highly on this account. But what men imitate them? Many from a principle of avarice, and few from a view of serving the public. But let us leave moralizing, and resume our subject. 'Tis on the brink or edge of one of the cells whose turn it is to be fill'd, that the Bee which comes back from the fields, stops: she then thrusts her head in, and soon pours into it all the liquor brought by her. Mr. Maraldi observed
very

very justly, that the part by which she discharges the honey from her body, is over the trunk, and very near to the teeth ; or, in other words, that the honey issues through the opening which we call the *Mouth*. In order that the first stomach of a Bee may throw out the honey contained in it, it must have the power of contracting itself successively and alternately, in different parts ; and it is endued with such a faculty. This is asserted by me, because I have made such an observation on several living Bees, which I open'd for that purpose. A cell is very capacious, with respect to the quantity of honey which a Bee can pour into it at one time ; and, for this reason several Bees come, one after another, and disgorge what they gather'd and prepar'd, before one cell can be compleatly fill'd.

CLAR. Do they quite fill their cell with honey ?

EUGEN. Methinks I guess the reason of your asking this question. You cannot so well conceive, how 'tis possible to quite fill, with a fluid, a goblet or cup turn'd on one side : for we may look upon cells as little cups or pots lying in that position.

CLAR. I really could not conceive how this was done.

EUGEN. There are two ways of filling them. The one relates to those which stand always open ; the other to such as are to be clos'd. We may presently see the manner how the Bees fill the former. I perceive, in our hive, a

comb placed very favourably for that purpose. 'Tis, as you see, set against one of the glass panes ; and the cells contiguous to it are mutilated ones, whereof the glass makes part of the partitions, and serves instead of two of their faces. The transparent partition, or glass, gives us an opportunity of seeing the honey contained in it, and the manner in which it is lodg'd. Here's a cell half full. Observe that this last lay of honey, that surface towards its entrance, may be easily distinguish'd from the rest ; it looking like cream over milk ; a thick lay. 'Tis exactly the same in all honey-cells, whether they have a small or great quantity in them. This lay, by its thickness and consistence, makes a sort of lid or cover, which keeps in the honey, and prevents its running off. We may call this cover a *cataraet*, as it performs the office of those flood-gates which keep in the water.

Plate X.
Fig. 2.
Lett. P.

CLAR. This contrivance is excellent ; yet this does not quite remove all my doubts. I am still puzzled to know how it will be possible to fill this cell. Does every Bee, in proportion as she brings new honey, beat down the *cataraet* ? Does she put a new one in its place ? Is a new one made by the insect, every time she brings in honey ?

EUGEN. I am not surprized that, notwithstanding all your good sense and penetration, you have not been able to discover the plain and ingenious contrivance they have found, in order to fill, by insensible degrees, a whole cell ; by still employ-

employing the same cataract, without being obliged to destroy it, when new provision is to be brought in. A man, in order to discover this, must have seen it, and have learnt the practice from the Bees themselves. These insects have a thousand ingenious contrivances, which astonish us, when we have once found them; and after we have tortur'd our imaginations, to discover the manner in which they act on these occasions; if we only view them at work, we are surprized to find that there is the greatest simplicity in all their operations. This is just the case here. A Bee, who enters a cell half fill'd with honey which is kept in by a cataract, and wants to add to it the new provision brought in by her, lays under this cataract or honey'd crust, the two ends of her fore-legs; then bringing her head near to this opening, she throws in all the honey she was fill'd with. But before she withdraws, she mends with her legs the little opening made by her. Every drop of honey which each Bee brings, increases the mass; and this, when enlarg'd, forces the cataract forward. As a thousand things intervene in this way of stowing or heaping up the honey, inasmuch as the cataract may be brought more easily backward or forward; for this reason the cataract is never perpendicular, but always sloping. Among the cells fill'd with honey, some are to furnish the quantity design'd for the daily sustenance of the Bees; and others to preserve that which is to support them during a season, when it would not be possible for them

Plate X.

Fig. 2.

Lett A A.

to meet with any upon the plants. Even during those months in which the most abundant harvest might be gather'd, there are some days when the perpetual rains, or colds too violent for the season, confine the Bees to their hives. 'Tis then they have recourse to the honey, which they intended should be first consum'd. Those whose toils prevented their stirring out, and to whom the honey necessary for their support, was not presented time enough by such as brought some from the fields; the labouring Bees, I say, go to these cells, and take from thence what they want; but they never eat (except in seasons of great necessity, and during a real famine) the honey contain'd in a great number of cells, easily distinguish'd from the rest; I mean those we term'd shut or clos'd store-houses. When once, Clarissa, you are told the manner in which Bees build their cells; you will not be puzzled to know how they close them. This is done only by a plate of flat wax, with which they shut the entrances. The same objection you started, with respect to the honey kept in the cells which stood open, occurs here. How will it be possible to fill a pot lying side-ways, with a fluid, and close it afterwards? Tho' honey is a fluid, 'tis yet not so much so as water; it having a consistency which prevents its running off on a sudden; and especially, when contain'd in a vessel so narrow as a cell is, it can sustain itself there so long a time as is requisite for giving the Bee an opportunity of taking all the precautions
necessary

necessary for securing the honey laid up by her. This cataract or honey'd crust, which is thicker than the other parts, is brought insensibly to the brink or edge of the cell; and when the Bee perceives that the vessel is as full as it can hold, she then raises up its small cover or lid of wax.

CLAR. Of what use is this little cover of wax, since the cataract alone is sufficient to keep in the honey, and prevents its running out?

EUGEN. The Bees did not let me into the reason of this, but we may easily guess at it. Honey, when expos'd to the air, thickens and grows rough, hard and feedy. Now all honey kept in open cells, would become such before the end of winter. The heat, which is considerable, found in a hive, might in a few months cause the greatest part of the liquor to evaporate, to which its fluidity is owing; whereby the insects would lose the benefits that must naturally accrue from their oeconomy and provident care. Aliments, if intended to be kept long, must be shut up. The cataract would not be an obstacle sufficient to prevent the air from acting on the honey; but the small waxen inclosure seals the vessel hermetically; and by this means the honey may be ever preserved fresh and fluid, so long as may be necessary.

CLAR. I wish there was writ over the door of every hive, an inscription, in large characters, to the following purpose: *Counsel and advice to all who pass by. Here are given rules, with regard to prudence and government, for preventing a dearth.*

This

This advice being repeated so often as men should cast their eyes on Bee-hives, would perhaps make them, at last, firmly resolve to secure themselves from the most dreadful of all calamities.

EUGEN. This is excellent advice ; but we must add to it the fable of the wasps and hornets.

CLAR. Thus Bees furnish us with various and very important blessings. The observance of prudent rules may ward off the most dreadful of evils, and supply us with an agreeable food. Being fond of honey, and its taste pleasing me exceedingly, I should be glad to know how far you think it may conduce to health.

EUGEN. I will not pretend to advise you in an art of which I have but a very imperfect knowledge. But I'll here give you the substance of what two of our most eminent physicians, Messieurs *Hecquet* and *Andry*, have wrote on this article. The antients call'd honey a gift of the gods ; a celestial dew, an emanation from the stars : it served them instead of sugar, which was unknown in those ages. They considered honey as an antidote, a panacea, or universal remedy ; and imagin'd it capable of preserving from corruption, and of prolonging life. Herodotus speaks of a cook who, in order to preserve his viands from corruption, employ'd only honey for that purpose. Many sages, as Pythagoras, Democritus, &c. fed on nothing but bread and honey ; from a persuasion that this was an infallible secret for lengthening their days, and for maintaining their mind and senses in full vigour.

vigour. Augustus having one day asked Pollio, by what secret he had arrived to so vigorous an old age; he replied, that he had fed upon honey and rubb'd himself with oil. In fine, the antients imagined they perceived something divine in honey; whence it was considered as a venerable and sacred food.

CLAR. I am well pleased with myself, for agreeing in opinion with the antients; and fancy that, had I lived then, I should have turned Pythagorean merely thro' luxury.

EUGEN. I advise you at this time of day, for your health-sake, to copy another sect among the modern philosophers: for this food, so wholesome and delicious to our ancestors, is no longer so with regard to us. This gift of the gods, this celestial dew is now very much neglected, and left to the poor. If the apothecaries furnish their shops with it it, 'tis only to apply it to a use diametrically opposite to that of the antients, or at most for ptisans. And, indeed, it must be own'd, that it now suits few constitutions. Honey heats and dries, in what manner soever taken, whether by way of food, or as seasoning. It suits none but phlegmatic constitutions; old men, or those who, by sickness or other causes, abound in gross, viscous humours. But persons of a bilious complexion, according to the two physicians above-mentioned, ought not to use it.

CLAR. How can it be possible, that what was so good and salutary with regard to the health

of our ancestors, should be so pernicious in this age ; or, at least be abandoned as of no benefit. Is it the men, or the Bees, who have changed their nature ?

EUGEN. This is owing, according to Dr. Hecquet, to our different manner of living : this physician declares that mankind, in the present age, are more gluttonous ; and that ragoos (our perpetual food) give the blood a continual tendency to inflammation ; that the most ordinary food is degenerated from its antient simplicity ; that honey, being filled with volatile particles, finds the blood often too bilious, lively, and inclined to fermentation.

CLAR. Thus I am sentenced to abstain from honey, merely because I don't live after the manner of our good forefathers.

EUGEN. That's according as you are phlegmatic or bilious.

CLAR. Methinks I am rather phlegmatic.

EUGEN. You may then, according to Dr. Hecquet, continue the use of it. By the way, notwithstanding the veneration due to the memory of this illustrious physician, we yet may conclude, that he amplifies a little in his decisions against honey. I myself should be apt to join with the multitude, who look upon it, when of a good sort, as wholesome food enough. Since therefore you are so fond of it ; and can run no risk, if I mistake not, in continuing to use it, (during sickness excepted ;) it may be proper to inform you of what is observed in general, on
this

this kind of food. Some countries are more favoured by nature than others, with regard to animals and vegetables of every kind. The antients had a particular esteem for the honey of Attica; that of Hymettus was famous, and has been frequently sung by the greatest poets. The best honey in France (we are told) comes from Narbonne; or rather Corbiere, a small town nine miles from that city. This honey is white, light, delicate, fragrant; and has something aromatic in its taste.

CLAR. I use this honey much more than any other.

EUGEN. And 'tis the very honey we are speaking of, which Dr. Hecquet declares to be the most prejudicial of any, because of its good qualities.

CLAR. Your physicians are a strange sort of people, and fond of contradiction.

EUGEN. The physician just mention'd has reason on his side. He tells us, that as honey *abounds with volatile particles, 'tis therefore more apt to be carried along by the rapidity of an intemperate blood, and ever ready to ferment.* This agreeable taste, which makes it be preferred to all others, is owing to the aromatic plants, (such as rosemary and balm) with which the neighbourhood of Corbiere abounds. 'Tis certain that taste is a very bad judge, with regard to the wholesomeness of aliments. Whenever, therefore, you would have recourse to honey, you must prefer the new to the old; that of spring or sum-

mer, to the honey produced in autumn ; the white to the yellow ; that which froths but little in boiling, to the other which froths much ; the honey which is sweetly-sower, to that wholly sweet ; finally, the honey whence a gentle smell is emitted, to that which is too strong ; the latter being commonly adulterated. All kinds of honey are consequently not indifferent, and some may even be vastly pernicious ; and of this we have, so very memorable a story, in Xenophon, that I cannot forbear relating it. This famous author, in his history of the retreat of the ten thousand, informs us, that his soldiers being arrived near Trebizond, found a great number of hives ; and were not sparing of the honey. Immediately they were seized with a purging both upwards and downwards, and grew light-headed ; inso-much that such as escaped best, resembled men intoxicated with liquor ; and others, frantic or dying persons. The ground was then covered with bodies, as after a battle ; nevertheless not a soldier died, and the distemper ceased, on the morrow, at the very same hour it began ; so that the men rose up the third and fourth day ; but exactly like persons who had taken a very strong dose of physic. Mr. de Tournefort, that celebrated botanist, who visited this place, in his voyage to the Levant, is of opinion ; that the plant whence the Bees extracted so noxious a sort of honey, is one of the species called, by the botanists, *Chamærododendros*.

CLAR. I suppose you won't desire me to get this name by heart ?

EUGEN. I shall not, provided you don't insist upon my procuring you a sight of this plant ; for, very happily, none of it grows in our country.

CLAR. Since it is found that various plants give different tastes and qualities to honey, some of which are noxious and others salutary ; have not men studied which of them are most suitable ?

EUGEN. This shall be mentioned, when we come to the government of hives. I will only observe (by the way) that I endeavoured to try, whether it were not possible to make Bees produce a honey, more poyant in taste than the best honeys we are acquainted with ; one that should come nearer to the taste of sugar. For this purpose, I gave my Bees an opportunity of carrying sugar, instead of honey, into their hives ; during a season, when they could scarce get food enough for themselves in the fields. I lodged a small commonwealth of Bees in a glass-hive ; near which stood always a plate, wherein was sugar, diluted by water, to the consistency of syrop. The insects, who before the abovementioned supply, would have been forced to make far distant excursions, which had produced them very little ; took up with the liquor that was so near at hand, and in sufficient quantity. Accordingly my Bees made small honey-combs ; and, some days after, most of the cells of one of

these combs was filled with honey. Immediately I took away this comb, containing the honey, which I imagined would be quite sugary. Its taste, indeed, was more poyant than that of ordinary honey ; but I afterwards found a more essential difference between them, which is, that though I have kept the honey in question four years, 'tis no ways feeded, as common honey is ; but continues clear, transparent ; fluid as at first, and does not thicken like the true honey. I must tell you that I have seen Bees, in a season when they could get honey enough from the fields, despise powder'd sugar, with which I filled plates, and set near to very populous hives. Honey differs still more in colour than in taste. The whitest is most esteemed, and to this, time gives a yellowish tinge. Some is naturally more or less yellow. I observed one sort, whose colour was much more singular ; I never meeting with any, except that time, of this hue. This honey appeared so very green in the cells, that one would have thought it had been filled with the juice of the greenest herbs. Farther, its taste was more agreeable than that of the honey usually met with. Nevertheless, this honey which appeared so very green in the cells, was but of a slight, greenish cast, when laid in vessels of white glass.

CLAR. But, Eugenio, this green honey must be a very great rarity. I'll certainly procure some, though I should be obliged to set all the peasants of my village at work for that purpose.

EUGEN.

EUGEN. Is it, Clarissa, the greeness of this honey, or its being more exquisite to the taste, that excites your curiosity?

CLAR. 'Tis because it is so very seldom found. You have not given a loose to your criticisms this long time; and, very luckily, you now set about it late, and at an hour when we must part. Being naturally good natured, I shall excuse this little fling; upon condition that I answer it at a proper opportunity. In case you have any thing farther to inform me of with regard to honey, it must be postponed to another time.

EUGEN. I have told you every thing I know concerning this subject. Hitherto we have examined the materials; or, if you like the term better, all the utensils relating to a hive; every thing which concerns the building of the little edifices; their form, and their uses; the origin and quality of the food of Bees; with their manners and inclinations. We next must examine their way of living; and, as it were, their domestic life; from the settlement of one swarm, to the going out of another.

CONVERSATION XIV.

*Of the labours and occupations of Bees in the
hive.*

CLARISSA.

ME thinks, Eugenio, I have already hinted, that the circumstance which gives me most delight, in the perusal of histories and travels, is to inform myself of the interior of men ; to look (according to the common phrase) into their souls ; to learn their manners, customs, genius, talents, way of life, and even their domestic concerns. These particulars are infinitely more entertaining to me, than those of their wars and conquests.

EUGEN. 'Tis from this part of history that persons, in our station, may acquire such knowledge as is of greatest advantage to us. Battles, sieges, the conduct of armies, marches, retreats, ravages, burnings ; the laying waste of provinces, the subversion of monarchies ; all these, I say, are incidents whence we cannot reap any instruction : the most they can do, is to excite our wonder or compassion, and too often our indignation ; they being quite different from any thing which happens in our own families, and the societies of which we are members. But the care which parents took, in the reign of Cyrus,

with regard to the education of youth ; that love for our country, of which the Romans have given us so many and such rare examples ; the frugality of the Scythians ; the modesty, so dear to the Chineze ; the frankness and sincerity, for which the Swiss-Cantons deserve so much applause ; the sobriety of the Turks : In a word, the perpetual labour ; the love for the public good ; the oeconomy, vigilance, and foresight of the Bees ; their tenderness, and the reverence they shew to their sovereign ; all these afford us useful instructions, and examples fit for our imitation. The life led by the Bees is almost a treatise of morality.

CLAR. You have suggested to me a scheme, for the executing of which your assistance will be necessary. If we omit certain particulars in the life led by Bees, which are not very proper for us to copy ; there would be enough left for us to draw up (from thence) a little book on this subject, under the following title : *The history of the Bees, designed for the instruction of youth.*

EUGEN. We'll set about it whenever you please. In the mean time, I'll proceed in informing you of what I have to say farther, with regard to their actions. I cannot finish the relation of the several things done in a hive, (from the settlement of one swarm, to the issuing out of another) without repeating several articles particularized by me before. But this I'll do as succinctly as possible, in order that my repetitions may be less tedious. Our conversation, agreeably to the plan I this day laid down, shall relate
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to the labours and employments of Bees, and this in the shortest compass as I can. The instant a swarm is fixed in a hive ; when its government is once so well settled, that the Bees are certain of possessing a fruitful and only queen ; the three kinds of Bees devote themselves respectively, to the several functions for which nature designed them. The labourers divide the work between them. Some fly to the fields, there to seek for wax proper for building cells ; others get virgin-wax, to stop the chinks and holes in the hives : these several materials they bring to the common habitation, and give them to other Bees, who instantly haste and apply them to their proper uses. Whilst this is doing, other Bees go to the repository of honey, whence they first take (as it is just they should) so much as may suffice for their own nourishment ; and carry the overplus to feed such as are working within, and to fill their store-houses. Whilst the labourers are thus busied, either in building store-houses, and filling them with provisions, or in making cells to receive the expected posterity ; the Mother-bee is employed, on the other hand, in propagating the species : and is wholly taken up with skudding from cell to cell, in every one of which she drops an egg. She sometimes begins to lay, on the very morrow after her arrival in the new hive. The labourers have enough to do, to provide her, during these first days, with cells sufficiently to lay her eggs in. Whilst she is engaged in this important occupation, she is not once left by her
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little court. You may call to mind that the occupations of this little court are, to present their queen with honey ; to clean her ; to sooth, and do her all the kind offices which a good mother may justly expect from tender and affectionate children ; and, in fine, to divert her from all such cares, as might interfere with that which she herself only can discharge.

CLAR. 'Tis really business enough, to be destin'd to bring forth two hundred children daily ; and therefore 'tis fit she should have female attendants, to look to her person.

EUGEN. Whilst that the Bees are building cells, and the queen gives them hopes of having a numerous posterity ; the males or drones make a proper use of the six weeks, or thereabouts, of life allowed them ; computing from the day on which the colony was settled. The sole employment of these (after that to which the queen thinks proper to admit them) is to eat, drink, sleep and make merry. Their time being expired, they then will be extirpated, either by death or a precipitate flight, to which they are sentenced. The toils, the provisions, the harvests, the care of their habitation relates not to them ; this being the business of the artificers to whom I return. Scarce has beautiful Aurora darted her first rays and gilded the horizon, but the Bæe, ever industrious and an early insect, is on her feet, and soon upon the wing. 'Tis a pleasure to stand, at day-break, before the mouth of a hive ; and to behold the joy and sprightliness with which this diminutive

minutive people leave their gloomy mansion, where they had past the night, and fly into the fields. In an instant the whole air is filled with them. Which way soever you direct your eye, every Bee has her flower, whose sweets she rifles. During the months of April and May, our labourers work incessantly, from morning to evening. No time is lost in the spring ; for that season being mild and favourable, our insects make a proper advantage of it.

CLAR. An excellent lesson for youth, who imagine that the spring of life was designed for nothing but pleasure.

EUGEN. But as soon as the months of June and July are come, and the violent heats of summer begin to be felt ; the greatest toil is, from the dawn till about ten a clock. 'Tis not but that we always meet with some, who, fired by a love of labour or that of their community, work in the hottest part of the day, and return loaded with booty ; but the number of these, in comparison of the whole colony, is inconsiderable.

CLAR. You would make me apt to fancy that there are among Bees, as among mankind, some constitutions more robust, and more inured to toil than others ; that there are Egyptians and Ethiopians among these insects, with regard to whom the burning rays of the sun are but a moderate heat ; and, at the same time, Frenchmen and Germans, who don't chuse to leave their temperate Zone.

EUGEN.

EUGEN. I would not have you consider these particulars in this light. There are indeed Bees in all nations. The Russians have colonies of these as well as the Egyptians. The sun, who scorches the Lybian plains, sees fleets of Bees sailing up and down the Nile ; and, on the other hand, the air of Russia, though so piercingly cold, does not drive away those with which their forests are peopled. What I mean is this. The Bees would doubtless meet with as much dust (on flowers) at noon, as they would find in the morning. These particles, when dried by heat, might be more easily taken off ; but then it does not suit a Bee's purpose to gather them when they are too dry, because they could not easily unite them together, and form a mass of the whole. This may be done much easier, at a time that the particles in question are still moistened by the dews that fell in the night ; or by the fluid which transpired through them. Such Bees, therefore, who bring back pellets of wax at noon, had met with them in wet and shady places ; the flowers growing in which are as moist and fresh, during the hottest part of the day, as others in the cool of the morning. 'Tis true indeed, that, at the beginning of a settlement, the harvest or provisions are got in at any hour : be the heat ever so violent, wax, crude-honey and virgin-honey, must be procured ; and for this reason, as I observed, because their work, during this infancy of things, requires the utmost dispatch. 'Tis their business, at these seasons, to subsist, to lodge,

lodge, to shelter themselves; and make cradles or repositories for their younglings, whose birth is at hand; four exceedingly important articles, which cannot admit of the least delay. And accordingly, on these occasions, our insects spare neither pains nor fatigues to procure themselves the requisite necessaries; a Bee does not repine at a journey, though of a league, merely to gather a pellet of wax, no bigger than a pin's head. But when the community are once settled to their wishes, the purveyors make choice, for the getting in provisions, of such times and seasons as suit them.

CLAR. I applaud them for it; and would not have any one be more lavish of his toils, than of his repose. Is it not during these long excursions, that the Bees have recourse to contrivance, which I have often heard mentioned? I mean, to take up a little stone between their legs, and fly with it; in order that their bodies, by becoming thus weightier, may be less buffeted by the winds.

EUGEN. You'll soon be satisfied in this particular, when I shall have told you how they act in bad weather. The season is now very beautiful, the heat is temperate enough, our hives are well stock'd, and our Bees lively and at high work. You may perceive, at their doors, a concourse of insects, greater than that of men in such places as are most frequented. Some are returned from the fields, laden with materials and provisions; whilst others are upon the wing, in quest of the
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like things. You see them now wholly employed in going backward and forwards ; but then the season is, at intervals, so variable, that it will not always permit them to do this. It sometimes happens, at a time when the Bees are very assiduous and busy, that they cease their work on a sudden, and not a single Bee stirs out ; on the contrary, you perceive them hurrying back in, on which occasion the crowds are so prodigious, that the doors are too small for them. Now, whenever you perceive so unexpected a return, look up to the sky, and you'll soon discover the cause why the insects came home so very abruptly ; you'll perceive some of those little black clouds, which denote impending rain. Whether the Bees judge, as we do, of these clouds from their eye ; or are informed of their approach, by some sense of which we have no idea ; they generally anticipate a storm, and shelter themselves. However, some of them always fall a victim to their feebleness ; or, hurried away by a passion for booty, are carried off by the storm, and perish in it. But the Bees, in general, foresee rain ; and avoid it by returning home as fast as possible, or by taking shelter under the leaves. 'Tis these tempestuous seasons which made Aristotle, Pliny, and some other authors fancy, that Bees had found an expedient to secure themselves from the violence of the wind ; and that, to prevent their being its sport, they used to ballast

last themselves, (as it were) before they set out upon their flight, with a small stone placed between their legs. A Bee's life abounds with so many things purely miraculous, that there is no occasion for us to employ fiction to enrich it. The article, of the very small stones, is a mere story; the Bees never employing any such for the purpose here mentioned.

CLAR. Methinks, Eugenio, you are too hasty in your assertions: for I can assure you, that the superintendant of my hives (you know this is old James) affirmed this to me, as fact, and declared that he himself had been eye-witness to it. As he was one day walking in my garden with me, he took up a Bee which laid dead at my feet. He then shewed me the little stone, with which it had been freighted, lying betwixt its legs.

EUGEN. Old James may serve to convince you, that all people have not eyes; and that many who affirm, *I have seen*, ought not to be credited the more on this account. Had the honest old fellow clapt his spectacles upon his nose, and survey'd this object nearer, he perhaps would have discovered his error, which many others fall into likewise. I will now inform you of the circumstance which occasioned his mistake; as Swammerdam has very well observed. There is a species of Bees who build their nests, with mortar, against walls. These nests are pretty nearly in the form of half a pigeon's egg. The Bee
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in question is a true mason, who makes mortar with gravel and diluted earth. Whilst the insect isthus busied, we often see her in the air, or resting on some place, with the materials she carries. If we look at this insect but transiently, we easily mistake her for the true Bee; as did the superintendant of your hives, and Aristotle, Pliny, &c. These observers, who were too precipitate in their judgments, thinking this stone belonged to the Bee, supposed it applied to a use for which it was never intended. Had they been patient enough to follow the insect with its stone, and to see the use for which it was allotted; they would have perceived that it was flying towards a wall, and seen a half-globe raising against this wall: in a word, they would have found, that there is a very distant, and very imperfect resemblance, between this Bee, and that which produces honey. Let us strike this fiction likewise out of our legends, and keep to such particulars as are true, viz. That the Bees secure themselves from a storm as well as they can; and that the best secret possessed by them, is to return, on these occasions, with all possible speed to their hive. When the season is so favourable, as to permit our insects to follow their works as usual, agreeably to their inclinations; a prodigious and uninterrupted concourse of them is soon loaded with provisions. Some bring virgin-wax to stop the chinks and crannies of the hive. I have nothing to add to what I before observed upon this article. Others are freighted with honey; and the

vessel in which they bring it is their own stomach. A Bee does not always unload her honey in the cells ; she frequently getting rid of part in the way. Whenever they meet with some of their companions who want food, and had not time to go in quest of any ; they halt, straiten, and stretch out their trunks, in order that the aperture by which the honey issues, may be a little beyond the teeth ; and they force out the honey through this opening. The other Bees, who know very well that it must be taken in here, apply the extremity of their trunks, and lap it up. Some of those insects are frequently so zealous for furnishing the store-houses, that they rush at once into the hive, without offering the least portion of their honey to any one : If these happen to be met with by some of their thrifty, industrious brethren, who are in immediate want of food, and cannot go in search of any ; the latter stop them, they pull them about, bite them ; and never leave them till they have thrown up, in their favour, all the provision got by them. A Bee who has not been stopp'd by the way, often goes to the work-shop of the labourers ; and offers them honey, to prevent (as one would conclude) their being reduced to the necessity of leaving their work, in order to go in quest of subsistence ; otherwise she goes and lodges what she has got in the store-houses. Such Bees as bring crude wax, sometimes swallow it by the way ; but they generally stay till they are arrived in the hive, there to consign it to the toilers who

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swallow this wax, and lodge it in their stomachs, in order for it to acquire the true quality of wax ; or else they themselves go and depofite it in ftore-houfes, to ufe it on proper occafions. But this deferves a more minute defcription. A Bee who arrives with two pellets of crude wax, no part of which her companions had taken from her, enters an empty cell ; and then, with the extremity of both her middle feet, loofens the two balls from her large hinder legs, and leaves the former at the bottom of the cell. The Bee, the moment ſhe has got rid of her two little burthens, fets out inftantly, either upon ſome new work ; or haftens to thoſe Bees who are recruiting their ftrength, by taking a deferved and neceffary repoſe. But ſcarce are the two balls diſcharged in a cell, when another inſect comes into it immediately, and ſometimes makes a conſiderable ſtay there. We cannot ſee how this Bee is then employ'd ; but after ſhe has left the cell, we may naturally gueſs what has been doing. The two pellets are then kneaded together in one maſs or lump ; and this had been drove to the bottom of the cell ; had been preſs'd or ſqueez'd, and its ſurface ſmooth'd. Whenever we ſpy two balls of crude wax in a cell, it is a certain ſign that it is allotted for a ſmall ſtore-houſe, and is to be fill'd with ſuch materials. Till ſuch time as it is quite full, the Bees come, one after another, and there unload their proviſion of crude wax ; which other Bees knead, ſqueeze, and ſtow up, after having diluted and bound it together

with honey. Sometimes the insect who brings the two pellets undertakes the doing of all this. Whilst these things are performing, other Bees are employ'd in building of cells, others in repairing them; and others again bring the pappy substance for the younglings, against the time that the eggs shall be hatch'd. We have spoke of these several particulars before, and more largely. The stomach of the Bees is the most essential utensil for their domestic concerns, and of the greatest service to them. It is properly, at one and the same time, their kitchen and laboratory. I observed to you before, that there are two of these. In one of them, they transform crude wax, partly into food, and partly into wax properly so called. In the other, the honey'd substance changes, in like manner, either into their own food, or into true honey. It is likewise in this laboratory that they make various kinds of paste or pappy substance, according to the different age of their younglings, and even pursuant to the dignity of persons; such as are made for their queens being very different in taste from those of the ordinary kind. It is not in the nature of our labourers to perform any work slowly: every thing done by them is executed with such prodigious swiftness and elacrity, that one would scarce think it possible for them to go through their toils, if we did not know that they divide it between them, and rest themselves by turns.

CLAR. You shewed me in our first conversation, the manner in which they take this rest. This is done, if my memory fails me not, by suspending themselves in a groop or cluster. I now perceive them in that position in the hive before us.

EUGEN. Would you believe, Clarissa, that I knew some very sensible people, who had taken it into their heads to imagine, that Bees had their working days and holidays alternately? That such as had worked one day, did not toil the next; at least, that the same Bees did not go every day out of the hive?

CLAR. Supposing I should be of the same odd opinion with these people, how could you convince me of the contrary.

EUGEN. Though this opinion is not built on one single proof, I yet will combat it seriously, since you seem to honour it with your protection: and this I will attempt by a calculation, which you may object to as you shall think proper.

CLAR. If you perplex me with calculations, I promise you that our controversy will soon be at an end.

EUGEN. You grow too soon weary of your pleasures. But the ladies have many resources on these occasions. I will now furnish you matter wherewith to exercise your sagacity. There would be some probability in your opinion, if the number of Bees who issue daily from a hive, was less than that of all the Bees contained in it; for we then might suppose, that

part of them continue the whole day at home, whilst the rest are busy in the fields. But, in case the number of those who go abroad, is equal, or greater than that of the total number of subjects who constitute the commonwealth ; it is more natural to conclude, that the Bee who comes loaded from the fields, reposes herself sometime, and returns afterwards to her labour ; than to imagine that she continues the same toils during the whole day. Now, in order to ground my opinion with the greater probability, I thought I needed but enquire, pretty nearly, into the proportion between the number of Bees, who issued daily from the hive, every day that is proper for working ; with the total number of the Bees contained in the hive. To discover this, instead of numbering those who issue from it ; I counted how many returned to it, which amounts to the same, and is easier. I computed, at different hours of the day, and in various hives more or less populous, the number of Bees who returned to their hive during a certain number of minutes. You will suppose that this number was not exactly equal. I have seen an hundred Bees, more or less, enter a hive during the space of a minute ; so that I think this number (an hundred) may be taken as a mean term. You know that there are sixty minutes in an hour. If therefore one hundred Bees issue out every minute, consequently six thousand will go out in an hour. These insects sometimes issue forth, during the long days, at four
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in the morning ; and do this incessantly till about eight in the evening, which make sixteen hours. But as they don't fally out, during some minutes, in such numbers, I will suppose them to go forth fourteen hours only. Now, if six thousand Bees issue out every hour, consequently eighty four thousand will fally forth in fourteen hours. Nevertheless, the hive from which I made this calculation, consisted but of eighteen thousand Bees. Consequently the number of eighty four thousand, which came into the hive, could not be made, except by supposing that every Bee issued out four times a day, at least, and some five times, in order to get provision. By other computations, made on less populous hives, I was convinced that the same Bee might go forth seven times every day. In fine, you know that a great number of these insects are employ'd about other works in the hive. Hence you may infer, that if a great number continue without labour, these are not long composed of the same Bees ; that in proportion as some join the main Body, in order to stand still ; others leave it, and return to their work.

CLAR. You are wonderful, Eugenio, at calculations ; and I know no man but yourself who could have thought of such. Nevertheless, I am not quite clear as to the last. Are they all the Bees, belonging to the same hive, who undertake five, and even seven, journies every Day ? Are not some of them for ever sedentary ? I imagine that the different labours of the Bees are

suiued to their various talents. I suppose, for instance, that such as go into the fields are the most robust, and that these are the peasants of the republic ; that those who are of the class of architects build the cells ; that such officiate, as nurses, who are not qualified for other employments ; and that those who had the greatest politeness, the noblest carriage, and were best skill'd in flattery, compos'd the queen's court.

EUGEN. I have not made experiments and calculations sufficient for clearing up these points ; and therefore will only tell you my opinion which I imagine very probable. I take it for granted, that all the working Bees are born with the same talents ; that these several talents are in the same, or very near the same degree of perfection, in all these insects : that chance, or occasion, distributes the various works ; and that all the Bees labour indifferently upon them, accordingly as things present themselves. We may even suppose, that they unbend or ease themselves, of too-fatiguing toils, by another that is less vigorous ; and continue some hours unactive ; in like manner as men, who frequently proceed to a lighter task, after being engaged in a very laborious one ; and then to sleep. Thus these clusters of Bees which you perceive clinging one to the other, and who are at rest, at the same time that others take so much care and pains ; enjoy, in all probability, a repose which they justly claimed for their past toils ; they recover new strength, in order that they may be enabled to labour afresh ; and to relieve other Bees, who being
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actually employ'd in fatiguing exercises, will want to repose themselves in their turn. We must not forget to rank in the number of the employments and labours of the Bees, the care they have to keep the hive clean ; to carry off their dead and the filth, of every kind ; to drive away insects, to feed their younglings ; to stop the cells, when the season for the worms to change into *nymphæ* is come ; to clean them ; and carry off their leavings, after the *nymphæ* are transformed into Bees ; and to prop up or support such combs as seem to want mending ; and, lastly, to extirpate the males. I expatiated more largely on these several particulars in our former conversations.

CLAR. Shall we rank their feuds and wars in the number of their toils ?

EUGEN. I have formed to myself so noble an idea of what we call labour, that I should be tempted to exclude from the class of toils, all such things as produce nothing but disorder and confusion in the world, as wars for instance. Nevertheless custom, which is the arbiter in languages, having prevailed ; since the words *martial toils* are used, when we speak of the wars carried on among mankind ; let us also rank the combats of Bees as one of their toils. To give you a full idea, though in the most succinct manner possible, of all that is done in a hive ; I must recal to your memory, that the interval of time, between the entrance of one swarm and the issuing out of another, is about six weeks ; that eggs are laid daily during this time ; that, by
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the hatching of these eggs, worms or maggots are produced, all which are fed with the greatest care and affection ; that these worms turn to Bees ; and that this laying, and these perpetual births, multiply the Bees to such a degree, that, becoming too numerous, they, at last, are obliged to separate. To this is owing the issuing forth of the swarms. We are now come to the revolution of that circle which comprehends the whole life of a Bee. You will find me much too prolix, should I begin to entertain you with this fally ; for it is an article which will take up our whole conversation to morrow. But before we part, I will use a precaution which may be of service to us when we return hither : I mean, we will examine the several hives before us ; and see whether some one of them may not be ready to send forth a colony, which we generally term breeding of swarms. The Bees have had an opportunity of preparing themselves for this, since we began our conversations. Put your ear, Clarissa, to this hive — What d'ye hear ?

CLAR. A gentle humming. All things seem to be in agitation. Is the swarm going to issue forth. If so, I beg we may move off as quick as possible ; for should the mother-Bee alight upon my head, or my shoulder, she would draw the whole swarm upon me ; and I should appear as the Bee-woman, and so serve (with father Labbat's Bee-man) to make up the pair. But I am no ways ambitious of such a reputation.

EUGEN.

EUGEN. You have nothing to fear from that quarter. It is late, and the swarms never issue forth at these hours. This humming is only an indication that a swarm will sally forth to-morrow. There are several signs which proclaim the approaching departure of a swarm. I. When we hear such a humming; and this is usually heard the evening before their sally. II. When we perceive drones or males. III. When the hive appears so full of Bees, that part of them hang in clusters; and are heap'd, by thousands, one upon the other, on the outside. But the most certain sign, and which proclaims that event to be the very day, is when the Bees forbear flying into the fields, though the season seems inviting. We will see, on the morrow, whether this won't be the case, with regard to the hive, where a humming is heard.

CLAR. What means this humming, and the clear and acute sounds, to which I listen? Is it a council of war now held by the Bees, to settle matters with regard to the sallying out of the colony?

EUGEN. If we had adher'd to what you say, we should have imagin'd one thing only which can be supposed, though with very great uncertainty. But you are not to doubt but that the romantic spirit, which has prevailed among the writers of Bees (Swammerdam, Maraldi, and the author after whom I write, excepted) inspired them, with regard to these sounds, no less than in other matters. Some of them declare, that then the
new

new queen harangues the band, the company who are to follow her. Others, that this female-leader animates her subjects with a sort of trumpet, to inspire them with the courage to undertake a mighty and dangerous enterprize. The writer who has succeeded best, in publishing agreeable extravagancies with regard to this humming, is *Charles Butler*, in his Book, intitled the *Female Monarchy*. I will conclude our conversation, by giving you the whimsical commentary made by this author with regard to humming, and hope it will divert you. Butler informs us that, by this noise, one may suppose that the Bee who aspires to be queen, beseeches the queen-mother by sighs and lamentations, to let her conduct a colony out of the hive: that it is sometimes two full days, before the queen can be prevailed upon to be moved by these earnest entreaties; that, when she acquiesces, she answers the petitioner in a stronger and fuller tone of voice; that when the queen-mother has been heard to indulge this request, we may expect a swarm the very next day, in case the weather will permit their issuing forth. In a word, he has fixed the several modulations of the petitioning-bees singing; the different keys of these modulations, and the sounds of which they are composed.

CLAR. I heartily wish, for curiosity sake, that he had pricked down this composition.

EUGEN. He was capable of such a frolic, and I think he has really left us such a specimen. But this is not all. He affirms, that the candidate

date for the sovereignty is not permitted to imitate the notes of the reigning queen : Woe to the young female who should presume to do this, which always proceeds from a spirit of rebellion ; the criminal being sentenced to lose her head, and accordingly falls the immediate victim to the monarch's resentment. Had the ingenious author of the language of brutes, the perusal of whose work gave you so much pleasure (though you censured it justly) attempted the explication of this humming, he doubtless would have said something more satisfactory than Butler.

CLAR. I am persuaded of this. Nevertheless, woe to the man who should attempt to explain the language of brutes, for this is the sphinx's riddle.

EUGEN. However this be, the humming I hear informs me, that a swarm will proceed forth to-morrow. I will now go and take measures, in order that you may have due notice of this, lest you should let slip an opportunity which happens so very *à propos* to our conversations. I will post a centinel, who shall give us proper notice.

CLAR. To fill up, usefully, the time which our return home will take, tell me (by the way) what organ it is by which the Bees utter the sounds we just now heard.

EUGEN. And which you will hear again to-morrow, just before the swarm fallies out. These sounds arise from their striking their wings against the air ; the wings being the sole organs
of

of their voice ; for, by moving them more or less forcibly, and swiftly, they beat the air ; and form the varied and confused sounds which we call humming. The Bee who has lost her wings, or had them cut off, is quite dumb.

CLAR. This is decisive. Shall we form the same judgment with regard to the murmuring noise or buzzing, heard by those bees which hum about our ears, when walking in our gardens, or in the fields.

EUGEN. It is exactly the same mechanism: I don't know one flying insect that sends forth sounds, as other creatures do, from their breast.

CLAR. Do you imagine also that the grasshopper (*cicada*) whom *la Fontaine* describes so agreeably, chaunting the whole summer, sings only with her wings ?

EUGEN. The *cicada* is an exception to the general Rule. It is true, indeed, that many have likewise ascribed her melody to the swift fluttering of her wings, accompanied with the friction of the upper against the lower ones. They were induced to suppose this, from what is found in crickets and some other grasshoppers ; but then they were mistaken. Nature has purposely made, for the grasshopper, an organ contriv'd with wonderful Art, on which I may perhaps discourse with you, some day or other. — I will only observe, that the grasshopper is *ventriloqua*, which signifies, that the organ of her voice is in her belly, and not in her breast ; that it is a true drum, whose skin being swiftly raised or
let

let fall, by a muscle which moves like a spring, strikes the air, and forms the sound which we honour with the name of harmony or singing.

CLAR. May we not suppose that nature furnished the kind mother, after she had taken so much pains to produce an insect, with a little drum to amuse it during the whole day ?

EUGEN. We ought, I presume, to think more nobly of that mighty artificer, Nature, by ascribing to her views of a more serious and more important kind. Please to observe, that she has indued the males only with the faculty of making this noise or cry. Now, it is very probable that he hereby gives the female notice of his presence ; calls her to him ; and it is by this means that these insects, who usually are hid under the leaves of trees, are able to meet.

CONVERSATION XV.

Of the Swarms.

CLARISSA.

DO you think, Eugenio, we shall soon see a swarm issue forth, and settle on our bushes?

EUGEN. I make no doubt of that, for I perceivẽ, from hence, our centinel who makes a signal to us, to advance towards the hive.

CLAR. Let's make haste then, and not lose, this lucky Opportunity. Inform me, in the mean time, what are the most proper hours and seasons to prompt the swarms to issue forth.

EUGEN. With regard to the hour, 'tis seldom except when the sun has warm'd the air; that is, from ten or eleven in the morning, till about three in the afternoon. When a hive is over-stock'd with Bees, they cause a considerable heat in it; and if this heat is increas'd by the sun's darting on the hive; or by some hours of hot, sultry weather; the Bees are not able to support it, they grow faint, and so are forced to separate, in order to get air. As to the season, this depends on the too great number of young Bees produced. But various sinister accidents, several of which may arise from cold, from wind, or rain, retard the issuing forth of a swarm. The

swarms, in various countries, sally out in different months ; and, in the same country, they go out sooner or later, according as the season has been more or less favourable. In France, the hives seldom emit swarms (the soonest) but about the middle of May ; and (the latest) a little beyond the middle of June.

CLAR. We are now come, and yet the swarm is not gone forth. Let's hearken whether our Bees make the same humming as yesterday. Yes, 'tis the very same, and, methinks stronger.

EUGEN. 'Twill increase in this manner continually, 'till the instant of their departure.

CLAR. I perceive also the truth of what you told me ; I mean, that during these latter moments, they go very little into the fields, and seem to cease from all their toils.

EUGEN. They have done nothing since morning. Tho' a shining day-break promises the Bees a fine day, and fit for getting in a large harvest of honey, yet very few of them stir out all that day, on which the whole nation is to separate.

CLAR. What is the reason why those Bees who toil'd yesterday with so much vigour, left their work long before their separation ? Were they sensible, before day-break, that they should leave this habitation about three in the afternoon ? Eight or ten hours is a considerable space of time for a Bee. This is supposing them to foresee things from far. Do you think they have so much foresight ?

EUGEN. What particular can we deny or refuse a set of creatures, who foresee and provide for the dearth of winter, so early as the spring?

CLAR. Let us proceed in our survey of, and admiration of them. See what vast multitudes croud about the mouth or door; they are all in motion; the diminutive people seem in great disquietude and agitation. I don't doubt but that they are revolving something of mighty importance.

EUGEN. Nothing can certainly be of greater moment to a people, than the resolution of abandoning their native country, to go and settle in a foreign region, and (the worst circumstance of all) without knowing to what place they are going, or whether they will be able to meet with a commodious abode.

CLAR. Our superintendant of the hives has taken care of this; he having provided an asylum for the swarm.

EUGEN. If our Bees knew that the sole motive of our harbouring them, is to get the better opportunity of seizing upon their labours, they would not doubt of our kindness and benevolence towards them; but being quite in the dark as to this matter, they rely wholly on providence. They always issue forth merely at random, or as chance may direct. However they would never once attempt to dislodge, were they not prompted thereto by their leader, and were not possess'd of a queen duly qualified to perpetuate the empire they are going to establish;
for

for tho' the too large number of Bees in a hive, may be a reason (among others) which prompts one colony to separate from the rest, yet this alone is not cause sufficient. I have several times had hives which were exceedingly full of Bees; so full, that part of them were forced to keep without, crouded together in form of a ball; and yet the hives in question have produced no swarm, for want of their having a queen. Other hives, on the contrary, many parts whereof were empty and unoccupied, have often given me swarms. To conclude, 'tis certain that if there is not, in a hive, a young mother qualified to bring forth, (one day) a numerous posterity; tho' there be ever so great a number of Bees, they yet will all stay there, and die sooner than quit the place.

CLAR. Is it possible, then, that a queen should forget to lay eggs, whence other queens may spring?

EUGEN. 'Tis more probable that this accident should proceed from a natural defect, rather than from forgetfulness; it also may happen, that the female eggs may be destroy'd before they are hatch'd, or the worms before they produced queens. But whatever the cause may be, 'tis certain that sometimes a swarm is in want of a queen. I myself know this by experience. I have drown'd several of these hives, the swarms in which could not be forc'd out by any means; and after examining all the Bees attentively, I ever found that there was but one single mother, and

this the old one ; and that there was no new one to lead forth the colony.

CLAR. See! see! our swarm is winging away. This sight, which I never beheld before, is very pleasing to me. Let's still keep it in view. What a cloud of Bees are there! The air round us is as full of them, as with flakes of snow in some winter days. Whither are all these poor little creatures hurrying? They turn and wind about in the air, doubtless to consider in what place they shall alight. Be so good as to present them a hive, for 'tis a pain to me to see them thus in suspense.

EUGEN. They would not accept of my offer, I assure you. We shall do this with better success, after they have debated upon a place proper for them to assemble in.

CLAR. Is it the queen who makes this choice? Is she at their head?

EUGEN. Chance has a considerable share in all this. Let us follow our swarm in their march ; the Bees themselves will instruct us in what we desire to know.

CLAR. Hey! why does my gardiner drive them away? Is the man out of his senses? Stop him, I beseech you.

EUGEN. Let him alone, he knows his business. When ever the Bees fly too high, as you perceive these do, we oblige them to descend lower, by throwing up handfuls of sand or dust. You see that he succeeds, and that this swarm is alighting.

CLAR.

CLAR. You say true. See yon apple-tree with a bush-head. Part of our Bees are already seated upon it; the rest follow them close, and the assembly grows more numerous every instant.

EUGEN. Let us advance nearer, in order to survey them more accurately. Observe the form in which they lie round the bough in a cluster, and link'd together, as it were, by the legs. Plate X.
Fig. 3.
Lett. B.

CLAR. My curiosity extends particularly to the queen. A queen who possesses qualities so becoming her sex, majesty, mildness and fruitfulness, is an object I would love for ever, and could never gaze upon too much. Let us see whether we can find out the queen here. But how will it be possible to do this, among so prodigious a multitude.

EUGEN. Being acquainted with her practices, I'll soon show her to you.—Look here. You'll perceive her alone, on the same bough, and near the swarm. Ibid.
Lett. A.

CLAR. You spied her very luckily, for she is this instant entering the groop, and will vanish from us. The other Bees who surrounded her majesty the instant she appeared, have taken her from our sight. The swarm is now very quiet. Will the Bees continue thus any time?

EUGEN. So long as your gardiner, who is now preparing a hive for the reception of these new tenants, may think proper. Before he has finished this expedition, and is ready to receive the Bees in the hive prepared for them, we shall

have time enough to observe a great many things with regard to swarms.

CLAR. If this be the case, be so good as to tell me why a brass pan or kettle was not sounded, as I have been told is the practice on these occasions. Hence I expected that our Bees would have been entertained with a morning serenade.

EUGEN. To inform you of this morning serenade, which I look upon as of little use, tho' many persons think it necessary; you are to know that hives are commonly set in gardens, in order that men may have the better opportunity of looking after them; and that the Bees may, at the same time, find flowers, without being forced to fetch them at a great distance. Persons who delight in hives, take great care likewise to plant, in the gardens in question, none but dwarf trees, or those with bushy heads; in order that the swarms may not settle too high, and may be hiv'd with the greater ease. Spite of these precautions, the swarms frequently wing their flight too high; by which means they would go too far away, and be lost, in case there was not an expedient ready at hand to stop them. Two of these are very common. The first, as you have seen, is by throwing up sand or dust.

CLAR. I could never have imagin'd, that roving Bees could have been brought back, by throwing stones at them.

EUGEN. The particles which fall upon and strike them, induce them to descend; and they mistake them, perhaps, for drops of rain.

The

The best course they can then take (as it may appear to them) is to fly to the asylum nearest at hand. The second expedient, which is as much used, and of as great antiquity as the other, is to beat on kettles or frying-pans, the moment after the swarm is set out : but this is not done to give them a serenade, nor to congratulate their arrival with a concert. 'Tis affirmed, that this tinkling determines the Bees the sooner to fix and assemble together. Probably what gave rise to this practice, was its being observed that the noise of thunder prompts such Bees as are in the fields to return home. But thunder is always accompanied by rain, or threatens it. Now, you know that rain is one of those calamities or plagues which they know how to foresee and avoid. We therefore may suppose, that 'tis their dread of the storm, rather than the noise, which prompts them to return home when it thunders ; for, though we make ever so great a noise with kettles or pans in calm weather ; we don't perceive that such Bees as are on the flowers are terrified by it, or are more eager to return to their hive. Consequently, the expedient of throwing up sand to them is the best and most certain.

CLAR. Is it possible that the antients should have let the swarms go forth, without embellishing this circumstance with some pleasing fictions ? Methinks I have formerly heard of parties detached ; of quarter-masters, spies, and I know not what.

EUGEN. This is an incident too susceptible of ornaments to have been forgot by them. Such writers as delighted in relating wonders concerning these insects, declared, that before a swarm ventures to leave the hive, some of the Bees who are to form it, set out upon the discovery like so many spies; and return back to the hive, to give a relation of what they saw; and that afterwards, her majesty's quarter-masters go and prepare the new habitation. To exhibit the truth hid beneath this fiction: 'Tis not till after the swarm is come out of the hive, that some of the Bees who compose it determine, (by surveying the objects round) upon a place proper for them to settle in. On this occasion, the sagacity for which the Bees are so famous, seems to fail them on a sudden. They generally settle at first, round the bough of a tree; where, being exposed to the inclemencies of the weather, it would be impossible for them to subsist long.

CLAR. I imagined that they alighted upon a neighbouring tree, merely by way of a half-way-house; during which some really went in search of a more commodious abode.

EUGEN. Unluckily for their honour, we have but too evident a proof, that they consider the place where they thus settle, as a fixed and permanent residence. For, if we leave the Bees five or six hours there, we find a little piece of comb already wrought by them. Perhaps, indeed, they might afterwards leave, spontaneously, a place so unsuitable to them; but then they
would

would not resolve upon this, till after proving, to their cost, that the place is absolutely not fit for their purpose; and this either from their having suffered so much from heat or cold; or their being tormented by wind and rain.

CLAR. Let us seize this favourable opportunity, and examine whether there may not be several queens in our swarm; or a great number of drones.

EUGEN. Your memory, Clarissa, fails you; a thing which happens very seldom. Did I not observe to you before, that when a swarm divides into two bands or companies (though unequal) 'tis a certain sign that there are two mothers at least; but that, when they don't divide, this is not an indication that there is but one mother only. Several may be so constantly hid under this heap of insects, as to be quite taken from our sight. With regard to males, you may see that they are pretty numerous here.

CLAR. I perceive them. To compensate for my defect of memory, by some act of judgment, I'll now propose a thing which came into my head, when you spoke about those orphan-swarms, who chuse to die in their native abode, rather than dislodge from it when there is no mother to head them. Is there no possibility of saving them?

EUGEN. This doubtless would be a most excellent secret, and of the highest advantage to us. The saving of a whole swarm is a thing too
profi-

profitable for us to neglect. But pray now, what is the expedient?

CLAR. I would supply them with one of those supernumerary mothers whom I should meet with in another hive, and was sentenced to die. The saving the life of a queen who has no subjects, and of subjects who have no queen, each whereof would perish separately; and then unite them in one family, in order to perpetuate their kind, appears to me a noble and very laudable action; 'tis a secret I am highly delighted with myself for having found; and I heartily wish it may appear in as favourable a light to you.

EUGEN. I greatly approve your hint; and think it certainly deserves to be attempted more successfully than I have yet been able to do.

CLAR. How! did you think of this before me! Must I always meet with persons in my way, who will bereave me of the honour of being the first who started a thought?

EUGEN. I have not executed this to so much advantage as you propose it. However, I intend to do it the first opportunity; and am persuaded it would be attempted with success, in case the requisite precautions were used. The manner in which I proceeded was this: you are now so well acquainted with every thing of this kind, that you'll easily find out the reason why I failed in my experiment. I took a basket-hive, which had been so populous for several weeks, that part of its Bees were reduced to the necessity of stand-
ing

ing abroad night and day, there exposed to all the rigours of the weather. But notwithstanding this, no swarm appeared, whence I judged that they were in want of a female. I was very curious to enquire what would happen on this occasion, in case I should introduce one that was an alien, and fit to lay ; and accordingly the mother of a hive, whence I had had three swarms, was employed for this purpose. I now plunged the whole hive in question into the water, and thence drew the mother almost motionless and dead. I then painted her corset or breast with a little red varnish, in order to know her again ; and after having dried, warmed, and restored this queen to her former vigour, I carried her one morning and put her under this basket-hive, which could not hold all the Bees, and whence no swarm had yet gone forth. In an instant she was covered by such a multitude of Bees, that I quite lost sight of her ; and I presumed that she was favourably received, since no sensible tumult was occasioned. In the evening, I stooped the basket, to see whether I should find this new-mother, and what sort of figure she would then make. Accordingly I perceived her. She was among a cluster of our Bees, instead of being within the hive ; when taking up a bit of straw, I separated the queen from her cluster, and set her down upon the stand of the hive, but she soon left it, and mixed with other Bees. She then disappeared, and I put the hive in its natural position. Returning next morning, to see the effect of my experiment, I

found

found that the mother whose breast I had painted red, was dead. She had been conveyed, by those Bees who carry off the dead, to some distance, and opposite to the hive. You will enquire, how it came to pass, that so fruitful a mother had not been spared ; especially at a time when one would have concluded that she must be dear and precious to Bees, who waited impatiently for a queen to head them, from an abode, which no ways suited them. Let us be so ingenuous as to confess, that we are not yet sufficiently acquainted with the principles on which the Bees act.

CLAR. True philosophers only can stop their career on the confines of a conjecture ; but we ignorant women, take the liberty to blab our opinions freely. We even have not yet knowledge enough, to be sensible how little we really know. I'll give you then my opinion with regard to your experiment. It might have failed ; first, because you had half-drowned your fruitful mother ; you had perhaps given her too strong a dose of water, a circumstance which might have altered her present constitution ; and disabled her from laying, which the Working-Bees possibly discovered. Secondly, you observed that this Bee had before sent forth three swarms. May we not suppose that the Working-bees, being well skilled in those characteristics which denote fruitful mothers, might have rejected the mother in question, as being too much worn out for her ever to give birth to a numerous colony ? I grant you that she was favourably received, at first ; but I am of

opinion that, upon being better examined, and afterwards searched by the knowing Working-bees, she was put to death as an impostor, who intended to deceive, and promised more than she could perform. Take a young mother who has not laid, (or very little) and your experiment may turn out to greater advantage.

EUGEN. All this may be supposed. We may also imagine, with equal probability, that the death of this alien-mother was occasioned by the reigning-mother, who, for reasons of state, might be induced to resolve the death of her rival. Be this as it will, your conjectures appear so just, that I promise to pay a regard to them, the first time I repeat my experiment. For I am persuaded that Bees, when in want of a fruitful mother, will be ever ready to receive one who should be well qualified for their purpose, whether of their own family or an alien. You'll be as firmly persuaded, as I can be, of the probability of this; after I shall have informed you of another experiment made by me, that had the wished-for success, and which may serve as a supplement to the preceeding one. This will prove to you, that not only the presence of an alien-mother will suffice to orphan Bees, in lieu of a true mother; but even that the hopes (and this alone) of soon seeing a mother born among themselves, will induce them to fall to work again. I one day placed, in a small hive, a piece of a comb taken out of another hive, where the Bees were at high-work. In this piece of comb were royal
cells

cells, shut up, which consequently contained *nymphæ*, who were to become mothers. I afterwards put into this hive, above a thousand or fifteen hundred Working-bees, and twenty males, or thereabouts. These Bees, who would not have done a stroke of work, (in case no mother being among them, they also had been without hopes of obtaining one) were firmly resolved to labour, merely upon seeing a royal cell clos'd up. They, indeed, worked but very slowly during the two or three first days. Among mankind, hope is vigilant and active, and possession flat and languid; but 'tis the very reverse as to Bees. They began slowly, but the succeeding days they proceeded very strenuously in their labours, whence I concluded that a mother was born among them. This being duly enquired into, a mother was discovered, who yet was an alien.

CLAR. Nothing can be more convincing than this experiment. To proceed now to other matters. I see that our swarm must have been formed of a prodigious number of Bees, they dragging down the bough on which they are cluster'd. I should be glad to know how much this assemblage of Bees may weigh.

Plate X.
Fig. 3.
Lett. B.

EUGEN. That I am able to tell you. But as I perceive your gardiner is going to take the swarm, suspend your curiosity a little, till such time as you shall have seen his operation. I'll first inform you of the several preparations he has just now made, to make the hive fit for the reception of his guests. In the first place, he
cleaned

cleaned it with the utmost care. He afterwards rubbed the inward partitions carefully with herbs or flowers, the fragrance of which is grateful to the little tenants. I saw from hence that 'twas balm. Bean-flowers are likewise employed to very good purpose on this occasion. Another thing which I think of use, and of as much benefit as the pleasing their smell, is to gratify their taste ; by rubbing some parts of the insides of the hive, with matter which may be agreeable to them, as honey, cream, &c. Precautions of this kind cannot be of prejudice, but I don't think them essentially necessary. Every thing has succeeded perfectly to my wishes, in the like circumstances, though I did not make use of them. Observe, now, the manner in which your gardiner goes to work, in order to hive the Bees.

CLAR. The old man was very much in the right, in arming his head with a kind of helmet ; in covering his face with a gauze mask, and his hands with a stout pair of gloves.

EUGEN. I yet have seen peasants, in their shirts, perform this operation with their naked hands and face.

CLAR. Those who first attempted this must have been not a little bold. With regard to my gardiner, he is not only of a contrary disposition, but seems to me something clumsy ; he not managing his little broom dexterously, whereby all the Bees don't fall into his basket. I perceive that large clusters of them are fallen to the ground, and many others are flying away.

EUGEN.

EUGEN. 'Tis enough that a considerable part enter it, and stay there; be assured that the rest will soon follow. See, the operation is ended; and the hive is fixed on its stand with the Bees in it.

CLAR. I perceive that those who fell to the ground, take their way towards the hive; and that such as had winged their flight aloft, and were gone astray, hasten to rejoin their companions. Nevertheless, many of them return to the bough whence they were taken, and where they were so disadvantageously settled.

EUGEN. These would do more; they would continue there, and return hither so often as they should be drove away, if care was not taken to oblige them to quit it; by rubbing this bough with leaves whose smell is distasteful to them, such as those of the elder-tree and rue; or else to force them thence, with the smoak of burning linnen.

CLAR. Of what use are those four stakes which old James fixes about the hive?

EUGEN. This is a precaution absolutely necessary. When a hive has been filled with new Bees, the basket is not carried away immediately, and set in its place with the rest; but 'tis left, till the evening, in the same place where the swarm was hived; when, in case the tree at whose foot they were taken in does not project shade enough; and the sun-beams are exceedingly hot, as at this instant; then make, with four stakes and a cloth, a kind of tent which screens the Bees from the
excessive

excessive heat ; or else employ tufted boughs of trees. The hive is served in this manner till after sun-set, when it is conveyed gently to a stand allotted for it, and on which it is to be fixed.

CLAR. I would gladly know what my gardiner would have done, had our swarm, instead of fixing on yon dwarf-tree with a bushy head, flown and alighted on one of those lofty trees, standing at the end of my kitchen-garden.

EUGEN. This is an inconveniency to which the industry of man must apply the best remedy in his power. Some swarms fly and settle on little boughs of very lofty trees ; and this is the worst situation they could possibly be in with regard to us. Different expedients must be used, according to the shape or figure of the tree, the disposition of its boughs, and its height. The good sense of the person who would willingly save his swarm, must suggest to him methods for doing this. If the tree upon which they are settled is not vastly high, a man may go up a ladder set against the trunk of the tree ; when holding the hive turned topsy-turvy under the swarm ; another person, who had climbed up the same tree, may drive the Bees, with a broom of a proper length, into the hive. In case the swarm is too near the extremity of the boughs, and in such a manner that the ladder cannot be fixed against it ; the hive (turned as above) must be lifted up by means of a long, stout pole, till it be pretty near to the swarm ; after which the Bees must be drove into it with a long broom.

Several other expedients may be used, as circumstances may require : but there is one which seemed to me the simplest and most commodious on many such occasions : and this is, to wait till the sun is set, and the Bees are, by the cool of the evening, become less animated and furious. In this case, the bough of the tree is sawed off gently ; when being let down carefully, and the swarm upon it, they are easily hived by this means.

CLAR. Does it never happen that the Bees tremble, the instant of their departure, at the boldness of their enterprize ? do they never shudder at the sight of the wide extended ocean of air in which they plunge ? and are their bosoms never fired with a desire to return to their native country, as did the companions of Christopher Columbus ?

EUGEN. We frequently perceive emotions of fear and dread, but none of repentance, in animals. Their resolutions are fixed, carried on, and never checked by after-reflexions ; and they never draw back, except when they meet with such obstacles as appear to them insurmountable. We sometimes find that Bees, after leaving the hive in a swarm ; and their being dispersed in the air, or assembled on a tree, return to their first abode ; but this never happens, except when the young queen, who stood at the door, and was ready to accompany them, did not follow ; and this for want of strength, or perhaps boldness enough to trust to her wings for the

the first time. Possibly too a young mother may perceive that she is come forth unimpregnated; a circumstance which will prompt her to return to the hive; and the several Working-Bees, her dependants, to go back with her.

CLAR. I must put you in mind of the promise you made me, I mean to tell me how much a swarm weighs.

EUGEN. I am now able to gratify your curiosity in that particular. All you need do, for this purpose, is to listen patiently, whilst I acquaint you with the particulars of an experiment which informed me of what you desire to know. A hive of mine produced me, on a certain day, one of the largest swarms I had ever then seen. This swarm went and settled so very seasonably on the extremity of a bough of one of the trees in my garden, that I took the opportunity I then had, to weigh it with ease. All the Bees were assembled in such a manner, that their whole mass was shaped like a long pyramid, two foot high; and that hid every part of the bough round which they were cluster'd. The Bees were so very numerous, that I was afraid the bough would break; for which reason I propped it with a forked pole, in the same manner as boughs over-loaded with fruit; notwithstanding which, it bowed so low, that it was within two inches of the ground. To find out the weight of them, I bound the bough pretty near the upper-part of the swarm; and the packthread employed for this purpose terminated in a bow or loop-hole. Our matters be-

ing thus prepared, I ordered a man to come forward, who thrust his steel-yards (for weighing) into the loop-hole of the packthread ; and whilst he raised a little the bough, by drawing the steel-yards upwards, others cut it above the place where the ligature had been made ; but all this gently, and without disturbing the swarm ; by which means the bough and the swarm being thus separated from the tree, remained suspended to the steel-yards. I then easily found, that my swarm weighed eight pounds.

CLAR. You mean, branch and all.

EUGEN. You are very accurate, and won't let the most minute thing escape you. I'll now answer you. After having hived all these Bees, I weighed the bough separately, and found it to be six ounces. However, I won't subtract these from the eight pounds ; I having wherewithal (and over and above) to compensate for this. Though the swarm in question was very large, yet all the Bees belonging to it were not yet settled upon the bough. Several little clusters of them lay upon the ground, whilst others were in the air ; and none of these would join the great cluster or assemblage, though I had given them time to do it. These several parts dispersed were equal, at least, to the weight of the bough. We thence may conclude (and that without overrating) that the Bees weighed eight pounds. But, unluckily for us, all swarms are not so ponderous. They usually are of all weights under
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the above-mentioned; and I have met with a swarm which did not weigh above a pound.

CLAR. Since you thus calculate and weigh every thing in nature, you doubtless will be able to inform me, how many Bees are contain'd in eight pounds of these insects.

EUGEN. You smile in putting this question to me, as though you imagin'd you had desired me to count the number of sands in the ocean.

CLAR. I really concluded, that such a calculation would take up a long time.

EUGEN. This may be discovered by a very short method, which I employ'd. I put, into a scale, a half-ounce weight; and, in the other scale, as many Bees as made the *equilibrium*. You will suppose that I was obliged to employ dead Bees for this purpose. I must observe, by the way, that these were Bees who had been killed in a dreadful battle; occasioned by a band of aliens, who endeavoured to seize upon a peopled hive. One hundred and sixty eight of these dead Bees weighed but half an ounce. There consequently are twice an hundred and sixty eight Bees in an ounce, that is, three hundred and thirty six. Now, if three hundred and thirty six Bees weigh an ounce, there must be five thousand three hundred and sixty six in sixteen ounces or a pound; and consequently forty three thousand eight hundred Bees to weigh eight pounds. To avoid all suspicion of error in our calculation, we'll reduce the number of our Bees to forty thousand. This still will be a good

handsome quantity ; and more considerable than that of the inhabitants of many great cities. I must nevertheless confess, with regard to this hive of eight pounds, that many more Bees seemed to have gone forth from it, compar'd to the number who continued in it ; that they were not all of the new brood, but that many of them were of the former one.

CLAR. Do you think this sort of swarms better than the less numerous ones ?

EUGEN. I don't look upon them as the best. The swarm I am speaking of did not do me the service I expected. There were so great a number of drones among them, that they could not be all destroy'd during the summer. Some remained, who survived the whole winter ; and these, in all probability, perplex'd the working Bees to such a degree, that this hive was abandon'd in spring. I should rather chuse a swarm weighing five or six pounds. Butler, who does not always give into romance, informs us that an excellent swarm weighs six pounds English, a good one five pounds, and a tolerable good one, four.

CLAR. What ! did Butler also weigh swarms ?

EUGEN. He does not tell us how he weighed them ; but there is a very easy method which I will teach your gardiner, in order that he, being well skill'd in swarms, may be able to distinguish between such as are fit for coupling, or mixing together ; and those which ought to be weaken'd.

CLAR.

CLAR. Teach me this method likewise, for I would not willingly have my gardiner more knowing than myself.

EUGEN. Emulation is a laudable principle. You know that we usually leave, at the top of the basket, a small wooden pin or peg, or a tuft of straw, by which we take or hold up the hives. Now, if a ring, either of iron or cord, was added, this would give us an opportunity of weighing the several swarms which these baskets were to lodge, before we introduc'd a new one into them. But when every thing is prepared for this purpose, we must weigh the empty hive, and afterwards turn the Bees into it. In the evening, when they are all come back from the fields, and benumm'd as it were with cold, we must weigh it a second time. You conceive that the surplus of its then weight, will be that of the Bees which were introduc'd into it ; and hence you'll estimate the swarm, and know what must be done with it.

CLAR. I frequently observe, and perceive with pleasure, that your weights, your measures, and calculations, are not mere useless curiosities.

EUGEN. Some continue to be such, which yet will be otherwise to our successors, who will make them of service.

CLAR. I don't perceive that any of our Bees newly lodg'd go forth from the hive, and wing their way into the fields. Is this repose and

tranquillity an indication that they are going to abandon it?

EUGEN. When a swarm of Bees are pleased with a new tenanted-hive, they are not long unactive. Though all the Bees in it seem to be at rest and idle, and not one of them leaves it and flies into the fields, yet some are working at combs. We often don't perceive, till after the Bees have made pieces half a foot or a foot long, and several inches broad, that many of these insects which were supposed quite idle, had toil'd very hard ; or rather, that they all work'd in their turns ; a circumstance which proves that, at their quitting the former hive, they carried a provision of prepared wax in their stomachs. One sign that Bees are pleased with the hive they are put into is, when they ascend as high therein as they can, which is an indication that they design to fix there ; this being the part where they usually build their first cells, and lay the foundations of their edifices,

CLAR. Will the swarm we have now seen hiv'd, produce another swarm this year ?

EUGEN. Sometimes the swarms which appear early produce a second generation. However, they commonly don't give birth to a new swarm till the ensuing year.

CLAR. I beg my questions may not tire you. How many swarms proceed from a good hive in one year ?

EUGEN. Three, four, and sometimes five swarms issue from the same hive, one after the other ;

other ; in the interval of five, six, and sometimes ten or twelve days.

CLAR. What do you mean by coupling or mixing swarms ? What precautions must be used, in order to make them prosper ?

EUGEN. The clearing up of these matters depends on the knowledge of several previous circumstances ; and these will be the subject of our future conversations, in which I shall treat of the enemies to the Bees, their sicknesses ; and the expedients that must be used, as well to remove whatever may annoy them, as to procure them the several necessities.

CLAR. The particulars of this knowledge, relating to the practice, will be more agreeable to me than the theory, or what relates only to the history of the Bees.

CONVERSATION XVI.

Of the enemies to the Bees, and such insects as devour the wax.

CLARISSA.

I Am not surprized that Bees should have enemies. As they possess riches, this circumstance alone must be motive sufficient. Are not we ourselves their enemies, though concealed beneath the mask of friendship? In case we could not possess ourselves of their treasures, any other-wise than by killing them, should we scruple an instant to do this?

EUGEN. We are so far from scrupling it, that we daily put them to death very inhumanly, and without any manner of necessity. I cannot forbear reproaching, for this cruel treatment, the persons who breed Bees.

CLAR. I am not surpriz'd at it. These little creatures are laborious; they perform such works as it is not in our power to execute, but which are for our purpose. This is enough for us: whether dead or alive, we must plunder their works. We treat them just as we use one another. The husbandman sows, reaps and gathers in; at the last mentioned season, what numbers

numbers of idle people come and share with him in the fruits of his toil !

EUGEN. On which side soever we cast our eyes, we shall see nothing but wolves and sheep. The Bees have more than one enemy. Among the many that might be named, man is, indeed, the most barbarous. I will not particularize, in this day's conversation, his cruelty with regard to our ingenious insects ; we will now discourse on those creatures only, whom a power, unknown to themselves, forces to be enemies to the Bees.

CLAR. I will know them, whoever they be ; and, if possible, make the life of Bees (my favourites) more easy and comfortable, and less exposed to persecution. I now am ready to defend them against all opposers, and shall look upon their enemies as mine. Point them out to me, let me get acquainted with them, and I will pursue them for ever.

EUGEN. D'ye see the sparrow on yon plumb-tree ? He is one of their enemies. This wretch laughs at your threats ; and is preparing to devour the little creatures, to whom you indulge your protection, and are so fond of ?

CLAR. Ha ! that is an enemy I shan't run after, but must desire you to rid me of him.

EUGEN. Had we but one sparrow to oppose, our hive would soon be very secure : but there are such prodigious multitudes of these devourers of Bees ; (not to mention the many enemies, of other kinds, who infest them) that we had better pass this day in enquiring who they

are, and try whether we can't lessen their number ; for, as to the destroying of them all, that would be impossible. The enemies to the Bees are of three sorts. The first are weak, heedless insects, who creep into a hive without knowing whither they are going ; and only raise disturbances and confusion therein. The second endeavours to destroy the Bees, and eat up their honey ; and the malice of the third kind is levell'd only at their wax. In the first class we may rank such slugs and snails as creep heavily into hives ; beetles, foreign or wild Bees, who go in quest of works ready form'd to their hands. These kinds of enemies are easily destroy'd.

CLAR. I imagine that we need not be under any concern about them ; and that our Bees have weapons sufficient to defend themselves against their attacks.

EUGEN. The second class includes the sparrow you just now observed, and all such as resemble him. I have often seen, with the utmost uneasiness, a parcel of sparrows flock round my hives, and who, spite of my presence, peck'd and gobbled down the Bees, as tho' they had been so many ears of corn. No bird makes such dreadful havock among our insects as the sparrow, he destroying greater numbers of them than all the other birds put together.

CLAR. I imagine that swallows must likewise be terrible devourers of Bees.

EUGEN. Tho' they are said to feed greedily upon our insects, I yet am of opinion that they
take

take them but seldom, any more than toads, lizzards, or frogs ; tho' some writers, among the antients, advise their being drove from the hive. But 'tis otherwise with regard to another kind of insects, which, tho' of a species related to our Bees, are yet vastly formidable to them : I mean hornets and wasps ; and even wasps of the most common sort, such as are scarce larger in size, than our insects. I have often seen some of these wind round and round a hive ; watching for a favourable opportunity to attack a laborious Bee, when returning from the fields tir'd, and loaded with wax. The Bee, tho' arm'd with a sting so fatal to man, endeavour'd, but in vain, to defend herself against a wasp, who kill'd her in a moment. I have sometimes seen a wasp fly off with her prey ; sometimes she, immediately after butchering her enemy, tore open her belly, and suck'd the whole contents of it. I have even seen Bees, whilst busied in sipping the nectar on flowers, or winging their way to them, carried off instantly by hornets or wasps ; in like manner as an innocent turtle-dove is seiz'd by a hawk or other rapacious bird.

CLAR. This is dreadful. How is it possible that even one of our insects should be left in the world ? For I imagine that there are as great numbers, at least, of hornets and wasps, as of Bees. Should a whole class devour the other, the entire race of one or other of them must soon be extinct.

EUGEN.

EUGEN. Nature, at the same time that she permitted such massacres, has prescribed limits to them. Studious to preserve the particular kinds form'd by her, she has prevented their entire annihilation, as well as their too great increase. Were the hornets and wasps to come armed, in a body, and attack a hive, the tenants of it would doubtless be destroy'd in a moment ; but they never do this. Wasps, like all other thieves and murderers, are errant cowards ; and knowing that the Bees are able to defend themselves, they never attack them except when they have an advantageous opportunity for so doing. The war wag'd against them is wholly by surprise, and merely, what we term plundering, or making incursions. And, indeed, this is of no very fatal consequence ; and my opinion is, that it would not be worth while for us to endeavour to destroy all the wasps nests in a country, as some authors, who were fond of Bees, have taught us.

CLAR. Thus I find that hornets and wasps are, with regard to Bees, what lions and tygers are to men. They now and then happen to seize and devour one of our species ; but this is done so seldom, that there is no occasion that the whole world should take up arms, merely to extirpate the race of them. Men must make the best defence they can. Let us return, and enquire upon what principle it is, that wasps make war upon our hives. Is it from a passion for slaughter ? Is it

It from a jealousy with regard to merit, or the labours in which they are respectively concern'd?

EUGEN. From none of these, but from those principles which, among mankind, give rise to cut-throat thieves, I mean gluttony and idleness. The wasp, as well as the hornet, is very sensible that the Bee carries in her body, a portion of wrought honey. Now whenever the ruffian finds an opportunity of seizing, without any hazard to himself, a Bee, he rushes upon her, rips up her belly instantly, and sucks her bowels for a dainty he otherwise would have been forced to go in quest of at a distance, at the bottom of the cups of flowers.

CLAR. Let us talk no more of these enemies; they make my blood run cold. I'll certainly destroy all that ever come in my way. What think you of spiders?

EUGEN. I fancy that these make but very little destruction among our Bees. The spider is, in general, a creature whose chief occupation is to spread her nets; and who subsists entirely on what fortune happens to throw in her way. She does not go forth in quest of prey, which must come to her; besides, so great is her temperance, that she is contented with a little. Her only food is a few gnats, or other diminutive game, which fall into her snares. But for prey of a considerable size, (such as a Bee) this she rarely meets with, and therefore is to be very little regarded. We likewise must not rank ants among the enemies to our insects; tho' some authors declare
them

them to be vastly bad neighbours to hives. But so far from this, I'll presently show you that Bees and ants live very friendly as neighbours, and are well enough pleas'd with one another. The ant, tho' so fond of sweet things, can better restrain her appetite than man ; and will inhabit close by the forbidden fruit without once touching it. I had a glass hive, whose shutters I did not open for some time. During this interval, certain ants observed that there was a void space between the shutters, and the panes of glass of my hive ; and presently concluded that this would be a very good abode for themselves, and much more healthy and commodious than any other they could make choice of ; since they would always have a constant degree of heat there, such as was not to be met with in any other part of the garden. Accordingly they instantly convey'd thither their eggs, their *nympha*, and their worms, and fixed upon this as their residence. Ants were without the hive, and Bees within ; a single glass only separating two nations, so different in manners, in customs and genius. The Bees were abundantly provided with a dainty of which ants are exceedingly fond, I mean honey. The ants had just reason to be apprehensive that the Bees would be uneasy, and jealous to preserve so precious a treasure. Nevertheless, the utmost harmony and concord prevail'd between the two nations. Not a single ant was tempted to enter the hive, how strongly soever she might be invited by the fragrancy of the honey ; nor did any Bee disturb

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the ants, tho' infinitely superior to them in power, the several individuals, on each side, went in and out peaceably : they would meet in the way, without fearing or molesting one another : respect on one side, and complacency on the other, were the foundation of this peace.

CLAR. How delightful is such an union ! Why do not men live in as friendly a manner ? But is not this double hive a singular case, a kind of transient phænomenon which has never appeared since ?

EUGEN. This is not a phænomenon, 'tis a real thing, which I myself have often seen and admired. We may, indeed, ascribe the modesty and prudence of the ants to fear. They seem sensible of the danger to which they would expose themselves, should they be tempted to plunder the honey of a very populous hive. After leaving, during some hours, hives whose Bees were dead ; I observ'd that then the ants, having nothing to dread, went and fed upon the honey left in it.

CLAR. The same thing is seen among mankind. More of these are made wise, through fear and weakness, than from reason. Thus I find that you exclude, from the number of enemies to Bees, the spider and the ant. This pleases me, and my fears for my darling insects are lessen'd in proportion. Do any other creatures endeavour to massacre them ?

EUGEN. I know three, the most formidable whereof is man himself, who, from a very in-

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judicious

judicious interest, is often the greatest destroyer of them. I'll treat more largely of this, when we come to discourse concerning the best manner of managing hives. The second enemy is the field-mouse, concerning whom I shall speak no farther at present ; because, as this enemy to the Bees never appears except in winter ; I'll postpone what I have to say with regard to this animal, 'till I observe how Bees are to be managed during the rigorous season of the year. I proceed to the third enemy, who is a little insect that settles upon the Bee, and lives by sucking her. This is properly the vermin (fleas or lice) of the Bees. 'Tis a sort of reddish louse, about the size of a very small pin's head. Its body is shining and scaly, as likewise its six legs. It has not any part shap'd like a true head, the foremost end of this seeming to be cut square-wise. 'Tis almost always found sticking to the Bee's breast. However, I have frequently met with it near the Bees neck ; in that part where the wings begin, and sometimes near that of one of the legs. This insect has a trunk, which, I believe, cannot pierce through the scales wherewith the Bee's breast is arm'd ; but then she may thrust it into the joints, which being necessarily flexible, consequently no scales could be in that part. The young Bees are never incommoded by these vermin, which prey upon none but the old Bees, all of whom have never more than one upon them.

Plate XI.
Fig. 5.

Plate XI.
Fig. 6.

CLAR. In what manner does this vermin prejudice hives ?

EUGEN.

EUGEN. The hives whose Bees are pester'd with them, are not thought so well of as others, and perhaps with reason ; because these lice are oftner found upon the Bees that inhabit old hives, (where they have had time to multiply) than upon the tenants of new ones. But I am not able to say, whether they really do great injury to Bees. However, I am almost sure that they don't put them to much pain, and incommode them but very little ; the Bees scarce ever endeavouring to shake them off from certain parts of their body, on which they fix themselves ; and whence they might easily dislodge them with their legs. We are told of various remedies to destroy this sort of vermin ; but I give little credit to them. As therefore I take this disease to be of little consequence, and the cure of it very doubtful, I'll wave all further enquiry concerning it. I'll now discourse upon a much more dangerous enemy ; his malice being levell'd not only against the Bees, (he endeavouring to destroy, devour and overthrow all their works) but likewise against mankind ; he bereaving us of the hopes of dividing, with the Bees, a delicious food which we consider as common between them and us. This enemy, singly, composes the third class ; and 'tis he who plunders the wax. Was I to inform you of the several particulars I know concerning him, you might think me very tedious. You surely would not have me suspend the principal history for the sake of entertaining you, a long time, with a subject that was merely the accessory ?

CLAR. 'Tis still the history of nature. On what subjects soever its wonders are exhibited, I shall be greatly delighted to see and hear them.

EUGEN. Since you are so disposed, the conclusion of this day's conversation, shall be the history of this last enemy (at least that I am acquainted with) to the Bees. I mean those worms or moths who feed upon wax. Would you be apt to give credit to a person who should affirm, that there is a country where ten or twelve sheep, can hunt and drive away more than eighteen thousand wolves, and force them to quit the place?

CLAR. This would seem quite a paradox.

EUGEN. And yet this country, where so extraordinary a circumstance is found, is now under your eye: 'tis a hive. If we substitute Bees instead of wolves; and a sort of small caterpillar, (which I will show you) in the place of sheep, 'twill be no longer a paradox, and my assertion will be found literally true. The insect, term'd the *wax-worm* or *wax-moth*, because of the havock made by her in wax, is a diminutive caterpillar; tender and delicate in its frame, unarm'd and defenceless; an insect who can subsist itself in the midst, and at the cost, of the most populous hive; a tiny creature, who feeds upon the labours of above eighteen thousand Bees, defended with breast-plates, and arm'd with murdering weapons; which they are ever ready to employ against all who annoy, or attempt to annoy them; and who guard perpetually their treasure.

treasure. You, possibly, may discover too soon, and with the greatest regret, that ten or twelve, and often a less number of these little catapillars, have bor'd through, destroy'd, and broke to pieces, the honey-combs of one of your hives ; and that, on the ruins of the cells, (spite of the formidable army surrounding them) those weak enemies shall have thrown up new edifices for lodging themselves ; shall have built them with the ruins of the cells ; and will, at last, force the Bees to quit the place, in order for them to reside in it.

CLAR. This shows evidently, that there is no such thing as an impotent enemy ; and that those persons are very weak who cry, what prejudice can such a man do me ? Industry will find out many more methods to hurt, than strength can suggest. The insect you speak of, must be endued with a very surprizing talent ; in being able to compensate (by industry) for this weakness, and to overcome such mighty obstacles. The particulars you now relate, make me exceedingly desirous of getting acquainted with so singular a creature.

EUGEN. We call, by the general term *Moth*, all those little worms, most of which are caterpillars, who prey upon our clothes, furniture, hangings, wood, books, &c. Among these creatures, some cut themselves out clothes, which they put on, walk with them, and live under them, the whole time that they continue in the state of worms or caterpillars. Others, whom

nature has not taught to make portable dresses, have the art to make themselves galleries, which serve them, at one and the same time, for clothes and houses. The former are call'd by authors, *Moths*, and the others, *false Moths*. Both of them owe their existence to *Papilios* or butter-flies. Our wax-eater is of the species of false moths. Its *Papilio* is of the tribe call'd *Phalænæ*, who fly only in the night, and burn themselves in the candle. Let us trace the history of these from the egg. The egg whence it issues having been laid by the female *Papilio*, in some corner of a honey-comb; there arises from it, some days after, a small caterpillar, which may justly boast that 'twas born in the midst of the greatest dangers. Being surrounded, on every side, with enemies who are active, vigilant, and quick in their revenge; they escape a certain death merely by their extremely small size, which, during the first moments after their birth, prevents their being perceived by the inspectors or overseers; and by the swiftness with which they spin instantly, and enwrap themselves with this little sheath or covering of silk, which is then sufficient to secure them from all harms. This caterpillar is of the tribe of those with sixteen legs. 'Tis smooth, has a whitish skin, and a brown, scaly head. There are two sorts of these caterpillars who devour wax: but as I know no other disparity between them, than that they vary in size, and that there is some difference in their *papilios*; and farther, that their manner of living, working,

ing, and eating wax are the same ; I shall speak only of the most common of the two ; of that which, when full grown, is about the bigness of a caterpillar of an ordinary size. I just now observed, that our little caterpillar or false moth, spun itself, the instant after its birth, a sheath or tube proportionable to its size. These tubes are fix'd and glued to the wax ; and may be term'd more properly galleries, as the insect expatiates, and is at large, and moves up and down them with great ease ; and by this name I shall distinguish them afterwards. The first care therefore of our false moth, at its birth, was to secure its life from external dangers ; the next must be, to preserve and prolong it by sustenance. She finds very little difficulty on this occasion ; the wax on which she builds her gallery serving her, at the same time, for food. 'Tis enough that she thrusts her head out of her house, she finding sustenance all round her door. So long as she meets with wax within her reach, she is not sparing of it ; but feeds thereon, grows, and her gallery soon becomes too narrow and too short for her. As she liv'd upon the flooring which stood opposite to the entrance of her gallery, she is obliged to thrust her self forward, in order to find another floor to gnaw ; but then it is incumbent upon her to do this, without being expos'd to the vengeance of the Bees.

CLAR. I now perceive such an insect at work. She is going to lengthen her gallery, in

order that she may always be under covert, as she walks.

EUGEN. But this would not be sufficient. She is more sensible than we can be, of the several dangers to which she is going to expose herself. The false moth being grown larger, and advancing still farther into the enemy's country, will thereby be less conceal'd, and consequently more expos'd to the insults of the Bees. To remedy this, she makes this second part of her gallery thicker, stronger, and more capable of defending her than the first, which was only a covering or barrier of silk.

CLAR. Foresight and precautions should increase, in proportion with dangers.

EUGEN. I am no ways surpriz'd, that reason should suggest judicious reflections to you; but am greatly so to find them practis'd by insects. That in question, in order to strengthen the partitions of her gallery, works her silk covering or barrier with fragments of wax which she cuts neatly, and in the shape of a ball; and in order to forward her work, she joins to it her own excrements, which, for colour and shape, are like small grains of gunpowder. As mankind have their arts, the insects have theirs also. The Bee is an excellent architect. Our false moth is a silk-weaver, who does not work at random, as you will see presently. The inward partition of her gallery, is a close texture of white silk; and so very smooth, that her delicate tender body cannot be any ways hurt by the friction. But the small
particles

particles of wax and the excrements are fix'd on the exterior surface of her gallery : they are join'd so close together, that they quite hide the silk into which they are introduced ; and probably screen the moth who inhabits them, so very effectually, that the Bees cannot perceive them, no more than we. Probably these grains or particles may have this farther important use ; I mean, they may form a wall almost impenetrable to the stings of the Bees.

CLAR. I am vastly surpriz'd that creatures, so bold and courageous as our Bees ; one of whom is not afraid of attacking a giant of prodigious bulk, a monster in strength and size (for such, methinks, a man must appear to the eye of a Bee ;) I am greatly surpriz'd, I say, that these haughty creatures, tho' strongly arm'd with talons, with jaw-bones, and a tremendous dart, should yet not rush upon the galleries in question, and tear them into a thousand pieces. Bees can easily tear paper, and even sometimes cut wood ; how comes it then that they show a regard, to artificers and to works, which seem to me so very crazy and weak ; and at the same time, threaten them with sudden destruction ?

EUGEN. A thousand conjectures might be started on this occasion, all which (tho' specious) would, perhaps, be false. What appears to me most probable is, that the small hooks wherewith their feet are arm'd, tangle in the silk which binds together the little particles ; and that the Bees finding themselves catch'd in it, in the same manner

as they would be in a spider's web, relinquish this sort of fortification, which is spread as a kind of net to them.

CLAR. Our Bees must surely be excessively stupid. Since the demolishing these galleries would be so very difficult an attempt, why don't they, with their virgin-wax, seal and stop up the door of these false moths, in the same manner as they stick or fasten a snail against a wall.

EUGEN. This shows, that the understanding of Bees is confin'd to pretty narrow limits; since they have not the skill to apply, in one case, an expedient which succeeds so happily to them in another very like it. Here nature leaves them to the mercy of the weakest of all their enemies. The latter, indeed, act with the utmost prudence. The false moth does not quit its gallery, so long as it exists as a moth. As this insect began its gallery in proportion to its size at that time, this gallery increases always in diameter, in proportion as the creature itself grows; so that the portion or part which was built first, does not seem larger than a thread when the insect has left it; but it increases in bulk, and at last its diameter is equal to that of a quill. These galleries begin commonly near the upper edge of a cell, and are carried on towards the bottom of the same. The end where the gallery begins is clos'd; but the extremity towards which it will be lengthned, is always kept open. When a false moth is full grown, its length exceeds that of the depth of a cell; and, for this reason, the galleries in question are carried

ried directly through the bottom of a cell ; and force quite through it, in order to pass into the next cell ; and return, thence, to a third, a fourth, &c. so long as the insect's life lasts, till the instant that its sheath or case is to be form'd. Hence it is that these galleries are carried on in a multitude of crooked directions ; they passing through every one of the cells, at whose expence they were fram'd.

CLAR. Though I have very little concern for the lives of these false moths, whose race I would gladly see extirpated ; I yet should be glad to know, what contrivance they use, in order to extend their gallery, and take their food ; for it is not possible for them, to do either without thrusting out their heads ; and thus hazard their being seen by our Bees, and consequently of being exposed to their vindictive shafts.

EUGEN. I before observed, that their head is scaly ; I mean, that it is cover'd with a stout helmet, which would blunt all the stings in a hive, were they levell'd against it. But this is not all. The first ring plac'd next to the head, is cover'd likewise with a large piece of scale, no less hard than the other. All this part of the insect's body may be exposed abroad, and in open day-light, without any danger ; and the false-moth, in order to procure sustenance and perform its work, need not thrust forth a greater portion of its body, than that just mentioned. In fine, when the moth is grown, at the expence

of the wax made by the Bees, and is increased to its greatest size ; it then must make a sheath or case, in order to transform itself into a *chrysalis*. This I have not had an opportunity of observing in hives ; but then, I am able to judge of their manner of proceeding, from what I have seen them do in little glasses ; wherein I put a considerable number of these moths, with honey-combs, to give me the better opportunity of viewing them at work. There they framed their sheaths against the wax. These sheaths, which are of the size, and in the shape of an olive-stone, were composed of the same materials with the galleries above-mentioned ; the outside of them consisted of a thick lay of particles of wax, and their excrements work'd up with, or intwin'd in their silk ; and the inside was a texture of white silk, close, smooth, and so very strong, that the sheath resisted, in some measure, to the finger which pressed upon it. It is commonly about the end of June, or beginning of July, that the caterpillar we are speaking of transforms itself into a *papilio* or butterfly.

CLAR. How do you think it possible for our moth, when grown to the size of a middling caterpillar, to leave its gallery, in order to frame itself a case or sheath ; and that, when naked, and destitute of this rampart impenetrable to the stings of the Bees, these will permit it to work or labour, undisturbed, at its own preservation ; and not revenge the injuries they had met with from these insects ?

EUGEN.

EUGEN. Its sheath is only its gallery lengthened. The sheath begins where the gallery terminates ; but the greatest difficulty does not lie here. 'Tis this. It is necessary that our moth issue, in a butterfly-form, out of that very sheath in which it passed its *chrysalis*-state. Nay, several butterflies must come forth, at the same time, from different sheaths ; among which there must be males and females who engender, and the latter must lay eggs. All this takes up a pretty considerable time ; and yet the whole passes in an enemy's camp, in every part whereof are guards ; centinels, who never sleep ; enemies ever ready to destroy ; and no gallery for security.

CLAR. Our moths seem to be here involved in the greatest difficulties, for which reason I am the more desirous of knowing, in what manner they will extricate themselves.

EUGEN. I cannot say whether our moths escape unpunished. Probably great numbers of them may lose their lives on these occasions, and very few may escape. However, if only a single female avoids the several dangers, and has had time to lay her eggs ; she is so exceedingly prolific, that this second laying may, alone, quite overspread the hive ; and give birth, at once, to so great a number of false-moths ; that the honey-combs, are, in a very short time, undermin'd and devour'd ; so that the Bees, inconsolable for the havock made in their hive, abandon it, and seek an asylum elsewhere. I have observed, by
means

means of false-moths kept by me in sand-glasses, &c. that some of these butterflies slide in between two honey-combs (in those parts where the combs almost touched one another) and whence it would be scarce possible for the Bees to drive them. In these places they used to lay their eggs ; and, in all probability, they do the very same in the hives. This operation being performed, they are forced to go in search of subsistence elsewhere, the butterfly not feeding upon wax. They then escape as well as they can. These *papilios* are indued with a peculiar talent, and which seems to have been indulged them merely for this purpose ; I mean, that they are swift racers. I don't know any creature of this kind, who is so nimble-footed ; it runs rather than walks, and walks rather than flies ; even when endeavouring to escape the hand which pursues it. I once saw, in the lower part of a hive, two or three Bees run after a butterfly like that I am speaking of. The *papilio* was chased by the Bees ; and play'd its part so well, that, after many windings, our favourite insects grew tir'd, and the butterfly escap'd.

CLAR. I now conceive that the butterflies, arising from false moths, may engender, lay, and increase their race in hives ; and issue there from false moths, hid in corners, whence the Bees were not able to dislodge them. Their whole life, though past in toils and persecution, may yet be comprehended. Creatures who are not afraid of life, may engage in attempts though ever so hazardous. But a circumstance which

which I can scarce conceive is, how it was possible for the eggs we are speaking of, to be convey'd into these close, remote places. In order for the effecting this, you must suppose that a female butterfly came from without ; had crossed the whole hive ; passed in the midst of eighteen thousand enemies ; and also conclude that this army, ever careful to drive away all creatures of a different species from their own, must have been asleep all the time ; otherwise you must return to the opinion of my good old nurse ; and think that the first false moths rose from putrefaction.

EUGEN. Without having recourse to an opinion that clashes directly with reason ; we are furnished with facts, which may persuade us that a supposition, though scarce admitted by you, is yet very possible. I am certain that a prolific, female false moth, when driven from one hive, may get access to another ; and winding into the most secret recesses of it, may lay its eggs there. I observed to you, that our butterfly was a bold racer. 'Tis enough for her purpose, if she gets into a hive suddenly and unawares. She runs with so swift a pace, that she is able to pass through the enemy's camp almost unperceived ; at least, without allowing time for her being attack'd ; and then slides into some narrow place between the honey-combs, there to lay her eggs in security. Having done this, she makes her way out as well as she can. She is so fond of her posterity, that, for their sakes, she will run any hazard.

hazard, provided she can but secure them: Whether she escapes afterwards, or is punished for her boldness, is little or nothing to the purpose : the evil is done, and this is what we were afraid of.

CLAR. What madness can thus urge this creature to attempt, at the hazard of her life, to carry her eggs, and lay them, at the bottom of a hive? Is this the only place in the world where she could get rid of the eggs which burthen her?

EUGEN. Perhaps it may. You give me occasion to take notice of a wonderful providence of Nature, with regard to the several species formed by it, and which may serve to clear up your difficulty. The Creator, in sentencing animated creatures to a very limited course of life ; determin'd that, by a continual, uninterrupted succession of children to their mothers, the revolution of ages, given to the duration of the world, should be accomplished ; and, in order to force these Beings to multiply their kind, he indued them with two very strong, and almost invincible passions. The first is the union of sexes, and the second maternal love. The one preserves what the other has form'd. Maternal love is felt when the female is inspir'd merely with the hopes of becoming a mother. The bare reflexion on the near approach of this, rouses, disturbs, and makes her take proper cautions for preserving the life of a future object. She is struck with love for a Being, though yet wholly unacquainted with it.

it. I appeal to you, Clarissa, who are a mother, for the truth of this.

CLAR. I have been sensible to what you are speaking of.

EUGEN. This passion is stronger in some creatures than in others. Nature seems to have proportioned it to the difficulty of meeting with food suitable to the younglings. 'Tis especially in insects that this ardent love for posterity is predominant ; and which prompts the females to expose themselves, for their sakes, to the most evident dangers. This exceedingly strong passion is accompanied likewise, in them, with a knowledge of a very singular kind ; I mean, their being able to discover, among a million of objects, the kind of food suitable to their young. Of this I could furnish many examples which would surprize, in case you don't know them. That a butterfly who, as such, lived merely on the juice of flowers ; should be sensible that, from the eggs she carries, worms will arise, which can subsist only on certain plants ; and should chuse, without being able to mistake, that very one in which it is proper for her to lay her eggs ; in order that her younglings, at their birth, may instantly find the food proper for them ; such a knowledge must be wonderful. But what will you say of that of certain flies, some of whom know that the sustenance, suitable to the young they are going to bring forth, is found only in the brain of a sheep ; others in the neck of a stag ; and others again in the entrails of a horse ; and that the fe-

males in question have the courage to force into places so very remote, and which seem so well defended, to deposite their issue in a place where they may easily get food ?

CLAR. You have exhibited to me (Eugenio) and demonstrated so many wonders, that I now can contest no longer ; but must implicitly believe, at once, whatever you may please to tell me. The only objection I can make is their being too concise. Be so good, therefore, as to enter into a greater detail, with regard to the three species of flies, who lodge their eggs in so singular a manner.

EUGEN. I will do this ; but will mention such circumstances only, as relate to the subject concerning which you desire to be inform'd ; I mean, to shew that there are creatures, who are forc'd, by nature, to lodge their posterity in one place, and in that only. A fly, something larger than those which wing up and down our rooms ; that has a sluggish, sleepy air ; that seldom uses its legs and wings : is yet able to rouse itself, and can find both wings and legs, when, after having been impregnated, the time is come for her to deposite her eggs in a proper place. She is taught that the only food which her younglings can eat, is a certain slime ; a mucous substance, found only in a cavity, lying at the top of the snout of sheep, called *sinus frontalis*. Maternal tenderness renders the female, on these occasions, diligent, active, and industrious ; makes her find out sheep ; and, spite of the snuffing, and the

the perpetual agitations of the beast in question; our fly finds an opportunity of gliding into its nostrils, where she gets to the *sinus frontalis*. It was there; and no where else, that the egg was to hatch; and accordingly a worm is brought forth, who lives in that place, and subsists at the expence of the sheep; passes its whole infancy in this retirement; issues afterwards from thence, by falling on the earth; and, hiding itself there, becomes a fly like to the parent whence it sprung.

CLAR. Is not the distraction, which sometimes seizes my sheep, owing to these worms or maggots?

EUGEN. Nothing can be more probable. These worms are prickly about the belly; and have two scaly, and very sharp-pointed hooks, with which they walk. Now, if they happen not to lie still, in the *sinus frontalis* of a sheep, but shift their place; their thorns and hooks must necessarily put the sheep to excessive pain; which, probably, may cause those sort of fits of vertigo on frenzy, to which a creature, naturally so mild and pacific as the sheep, is subject. 'Tis doubtless on these occasions that we see them leap, fly, and dash their heads several times together against the hardest bodies, such as trees and stones. Another fly which I am acquainted with no otherwise than by the maggots, whence they spring; is sensible (like the fly just mentioned) that the food proper for her young is deposited in two fleshy vesicles or bags, lying at the entrance of

the throat, and on the root of the tongue of stags; she also knows the way to these vesicles. Accordingly she takes her opportunity; glides into the stag's nose, and creeps up its nostrils. Did this fly go merely at random on these occasions, she might stop by the way; or proceed, like the sheep-fly, into the *sinus frontalis*: on the contrary, she is not at a loss, but knows perfectly the course she is to take, though 'tis the first time she ever attempted it. She pierces, at once and without hesitation, through the most pitchy gloom; and shapes her way through all the winding passages leading from the entrance of the nose to the root of the tongue, where the two vesicles in question lie. Being arrived at the desired recess, she lays her eggs, and returns back quite satisfied, since her family is lodged in safety.

CLAR. I must confess that the particulars you now tell me are exceedingly singular. The most fruitful, romantic genius, does not suggest fictions equally wonderful with those presented by nature, when duly enquired into.

EUGEN. I must likewise take notice of the horse-fly, who is no less wonderful than the two former ones. The particulars I shall here relate, are from one of our naturalists, who studied this insect attentively, and traced all its motions. This fly dwells only in the fields, it never coming near our houses, at least in those of cities; and, indeed, such horses only as live in pasture ground, are infested by them. The naturalist

turalist I now hinted at, had the good luck to get a sight of a fly of this kind, in one of those instants (so seldom met with) when they creep into the intestines of a horse or mare. As the gentleman in question was one day looking in the fields, at his mares, which were feeding peaceably; he perceived them, on a sudden, grow uneasy; leap, caper, prance about and shake their tails. He did not doubt but that these sudden motions, were owing to the humming of a fly, which hovered round them; and endeavour'd to force its way through the *anus* of one of these beasts. The fly missing its opportunity, winged its way, with less noise, towards a mare, who fed at a distance from the rest. On this occasion the fly was more successful; she getting under the tail, and gliding till she reached the *anus*. Probably the insect, at first, excited only an itching, which prompted the mare to force outward the border or edge of its intestine; to open it, and widen its aperture. Our fly made a proper advantage of this disposition, she advancing farther, and concealing herself in the foldings of the *anus*. 'Twas then, in all probability, that she finished her operation, and was enabled to lay her eggs. Soon after this, the mare seemed quite distracted; she beginning to run caper and prance; and, at last, threw herself on the ground; and 'twas a quarter of an hour before she was easy, and fell to feeding again. The instances I have here given, in these flies and the butterfly arising from a false moth,

suffice to show, that if the author of nature has thought proper to allot, for the food of certain embryos, certain substances which seem so remote from them; he, at the same time, has taught the females in question how to know these substances; the places in which they are lodged; the way of arriving at them; in fine, all the industry and fortitude requisite, in order for surmounting the various obstacles which oppose the discovery of them. The Creator even required that this should be done at the hazard of their lives: for the life of every individual is less precious than the preservation of the whole species. I shall here conclude all I had to say with regard to the enemies of Bees. I might have added the ill treatment they meet with from men; the diseases they are subject to; and the multitudes of them who perish by cold and hunger. But these articles will furnish matter sufficient to compose entirely our next conversation.

CONVERSATION XVII.

Concerning the best manner of taking the honey, and the wax, out of hives, without destroying the Bees. Of the necessity of securing these, during winter and spring, from cold and hunger.

CLARISSA.

OUR last conversation put me in mind of a reflexion I have often revolved, *viz.* that there are few creatures, upon earth, but have their antagonists among other species of animals; and that man is the general opponent of them all. He looks upon himself as their king, and accordingly exercises a tyrannic sway over them. He imagines that the whole earth, with all things contained therein, was made for his use only; that he has an incontrollable right of life and death over all things who breathe. Methinks 'tis whimsical enough that man, when he eats his ox or sheep, should imagine he possesses himself of a thing to which he had a just and lawful title.

EUGEN. The lion may, with equal justice, fancy himself impowered to feed upon man, and the wolf on sheep. But 'tis my opinion, that neither the one nor the other could find any

other original title, of their sovereignty, than force or cunning. But let us engage no farther in a question, as this would raise up a multitude of gainfayers, whose interest it would be to differ from us in opinion. I shall only observe, that, if our ancestors were usurpers of the empire they obtained over brutes; long possession has given us a sort of title to this sovereignty; but yet, this will not permit us to exercise such a power, any otherwise than with oeconomy, prudence, temperance and discretion. Besides the right which we claim over their persons; we have others, (and these seem better founded) on the things belonging to them. Some creatures have such a superfluity as would be utterly lost; wherefore then should we not make advantage of it? This is seconding the views of nature, who seems to offer them us. Hens lay a greater number of eggs than are necessary for the propagation of their species. Cows gives milk with such a profusion, as plainly shows that all was not destin'd as sustenance for their calves. Sheep let us shear their wool, which afterwards grows again. Bees have the art of renewing their wax, whenever they are dispossessed of it. Let us therefore divide those several things with them; but then let us imitate, on these occasions, good kings, who exact no more contributions from their subjects, than what may enable such monarchs to compensate for those, by administering justice to their subjects; by indulging them protection, and procuring them plenty. We behave thus towards
such

such creatures as are kept in our yards: why then should Bees only feel the effects of our cruelty? We destroy every year, in several provinces of the kingdom, and especially about Paris, a great number of hives; and this merely for destruction sake. In the places I am speaking of, a custom, equally ridiculous and cruel, prevails. The persons hinted at, employ no other method, in order to get the honey and wax out of the hive, than to kill all the Bees who inhabit it. For this purpose they make a hole in the ground, large enough to receive the bottom of the hive. In the bottom of this hole, rags smeared with brimstone, and set on fire, are thrown. The hive is set on the vapour; when immediately so much earth is drawn round it as may suffice to prevent the Bees, and even the smoak from getting away. The stench of the brimstone, with which the hive is instantly filled, soon stifles all the ill-fated Bees. There are other kinds of death, the invention whereof various authors thought meritorious; but which I shall think it a merit to conceal. In the places where this practice, equally unskilful and barbarous, is used; people apologize for themselves by declaring, that, they destroy, on these occasions, none but the old Bees, from whom no farther harvest can be expected; Bees who would furnish no more swarms; but would eat, during the winter-season, a considerable quantity of the honey stor'd up by them. In this manner would a tyrant argue, who, after he had cut to pieces all the inhabitants of one of his cities, merely for
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the fake of plundering their gold and silver ; should endeavour to justify his monstrous cruelty, by declaring, that all the inhabitants were very antient, and incapable of furnishing posterity next year.

CLAR. This is a perfect picture of the avarice with which man is fired. All his arguments, as well as his conduct, are big with horror. Whenever I see injustice and cruelty go hand in hand, I conclude from thence that they are led on by avarice ; and I am seldom or never mistaken in my conjectures.

EUGEN. Your reflexion, Clarissa, is exceedingly just. Who told the persons hinted as above, that all the Bees in a hive are old ? We ourselves have seen, when a swarm was issuing forth, that it consisted of old and young Bees ; and that many, of both sorts, remained in the abandoned hive. When the Goths and Saxons sent colonies into Gaul, did they leave, in their own country, none except old men, who were unable to get successors ? Hives recruit themselves perpetually like cities and governments. Tho' the Bees of a hive happen to be destroyed by some accident, yet many exist eight or ten years. I knew a peasant who preserved a hive above thirty years. The murderers above-mentioned add, that Bees would devour, during winter, all the honey stored up by them. But this is another argument dictated by avarice, which ever mistakes its true interest. It must be confessed, that our insects would eat the greatest part of
such

such honey, and perhaps all ; since they hoard it up merely as provision for themselves. But does it not argue more wisdom in us, to be contented with taking away a portion at different years, and in various seasons of the same year, as is the practice in many countries ; than to carry off the whole at once ? By what name would you call a peasant, who should kill his goat, merely that he might, at once, take all the milk contained in the bladders of the animal ?

CLAR. How delighted am I to hear you confound covetousness ; and undertake the defence of innocence, in opposition to oppression and tyranny ! Would I could enact laws, a dreadful proclamation should then be published instantly against Bee-cide.

EUGEN. There is really such a one. Alexander de Montfort, whom I before mentioned, cites a law, enacted by a grand duke of Tuscany ; forbidding all persons to put Bees to death, upon pain of being punished arbitrarily.

CLAR. Delightful prince ! how justly did he deserve to command over others ! Why was not this laudable example imitated by all the monarchs upon earth ? Myself will make such an injunction, and cause it to be published throughout the whole extent of my little territories.

EUGEN. This will be well ; but then you, at the same time, must restore another practice ; I mean, the gentler method of taking away the wax and honey.

CLAR.

CLAR. 'Tis from you that I expect to be taught this.

EUGEN. When a person has used his utmost endeavours to preserve Bees, and to multiply, and produce large harvests from them ; such a one may justly expect to share the fruits of their labours with these insects ; I say divide with them, and not seize upon the whole, and butcher them at the same time. This sharing or dividing with the Bees, is performed by only cutting off some portions from every hive. Such is the custom in several countries, where they are cut in different seasons ; in some this is done at the end of February, or in the month of March. We then may, without injuring the Bees, take away a considerable quantity of their wax ; and at the same time, of the honey remaining of their winter-hoard. There need no more be left them, than what may be necessary for their support, during the inclement days, between the end of winter and May. We also may take out several of their combs, which are empty of honey ; particularly those, the wax whereof is grown too black. What is thus taken away from Bees, at a time when they have an opportunity of recruiting it soon, is a superfluity which, so far from injuring, gives them more room, and an opportunity of making new work. However, as the time, for this operation, differs in many places ; it must vary according to the different provinces or countries ; and according to the more or less clemency of the seasons. Our harvests are
not

not all gathered in the same month. In proportion as the flowers spring forth, or are kept back, the labours of the Bees are either forwarded or retarded. In some provinces the honey-combs are not cut till July or August.

CLAR. This article, of cutting the honey-combs, seems to me a very bold attempt. D'ye know, Eugenio, that, ever since I have kept Bees, I never had the courage to be present on such occasions?

EUGEN. D'ye think you'l dare to listen to the description of it? 'Tis a military expedition, (and one of the boldest) to carry off, from the inside of a hive, honey-combs which thousand of Bees, strongly armed, are always prepared to defend. And, indeed, he who engages in this enterprize, should be armed cap-a-pee; he must use the same precautions observed by your gardiner, when he took a swarm from a tree, in order to remove it into a hive; I mean that he must well cover his face, his hands and legs. Nevertheless, some peasants, as I observed before, use none of these precautions. With regard to the time of day fit for this operation, some conclude noon to be the best; from a supposition that the greatest part of the Bees are then in the fields. However, I would not advise any person to trust to this. About twelve at noon, during the hot days, the least work is done by the Bees; and consequently most of these insects are then in the hives. In case the noon, of temperate days, is chosen; the more Bees there are abroad,

abroad, the greater number will be returning home every instant. All these little inhabitants, exasperated to find, at their return, their city demolished, and their possessions plundered, will haste to vengeance; and the enraged squadron will not give quarter to the common enemy. Others are of opinion, (which is also mine) that the best time is the morning; as our insects are then still pinched by the cold of the preceding night. To quiet the Bees the more, and make them less furious, the smoaking them will render these insects yet more senseless. To effect this, the hive must be lifted up a little, when the smoak of a rag, held in one's hand, being introduced; this makes the Bees giddy, and forces them to move towards the summit of the honey-combs. We then seize the instant, and turning the hive sideways, lay it on a chair or bench; of such a height as may facilitate the intended operation. And now, a single glance directed to the hive, shows at once what combs are fit for cutting. Then with a knife, whose blade bends like that used for cutting vines, we pare away whatever may be thought proper. The survey of such combs as are full of honey, and those which are very old, determine the operator where to cut; and either to take whole combs away, or only parts. In a word, 'tis allowed to be just in some measure, and even necessary, to leave the Bees about half their honey. 'Tis proper to keep the rag burning during the whole operation; and to let its smoke descend in the hive, in order to keep the Bees in.

CLAR. All these precautions are extremely seasonable. But do not the persons who thus take away honey and wax, run the hazard of carrying off, and destroying at the same time, a great number of little worms or maggots, which might soon have turn'd to Bees; and consequently incur the penalties hinted at in the duke's edict?

EUGEN. Your observation is quite right; this being an error which many, through carelessness, often commit. However, a little experience in honey-combs; in distinguishing those whose cells are shut; and, among these, the being able to discern such as are store-houses of honey, from those which contain *nymphæ*, will prevent our committing any mistakes on this occasion. By first breaking off a little piece from the honey-comb, and examining its cells, we easily discover whether any worms, *nymphæ* and eggs, are inclosed in them; in which case we must not touch them. Some authors advise us to cut such combs only as are towards the back of the hive; but this rule is too general. The best is, to pitch upon such combs as are fullest of honey. After having taken what we think proper from a hive, we then set it in its place again. That side, whence the largest quantities have been taken, ought to be set forward; that is, be most exposed to the sun; the Bees chusing rather to work on this side. Some persons have thought upon an expedient on these occasions; and which is judged by them as a medium, between the desire of taking the produce

of a whole hive, and the cruelty of putting all its inhabitants to death. The expedient I here mean is, the removing the Bees of a full hive into an empty one. However, this practice is not convenient except in spring; and during seasons when the fields may abundantly furnish Bees wherewithal to repair, with speed, the losses they thus sustain. Nevertheless, by this practice, the eggs are destroyed; which is always a considerable loss, and consequently should be prevented as much as possible. I know but one case in which this is absolutely requisite, and that is; when the false moths above-mentioned are multiplied to such a degree in the hive, that the safest course the Bees can take is to abandon it to them.

CLAR. You have made me quite easy, by thus teaching me to reconcile our interests with the lives of our diminutive subjects. I must now intreat you to inform me, what methods must be employed, in order to enable the Bees to pay us their contributions, without oppressing them; or giving them the least cause of complaint against us.

EUGEN. To effect this, we must protect our insects to the best of our power, against all such baleful accidents as we only can make them escape. Besides the living creatures who make war upon Bees, there also are, in the frame of the universe, various scourges or calamities, which it is scarce possible for them to shun. 'Tis enough that they themselves furnish the admirable

ble industry and contrivances of which we have taken a view ; and join diligence and assiduity to a toil, the fruits whereof we desire to share with them. 'Tis therefore just that we, on the other hand, endeavour to make their lives commodious and easy ; and remove from them whatever may annoy. The two scourges which prove most fatal to Bees, and sometimes destroy more than half our hives, in one year, are cold and hunger. If therefore you are desirous of preserving your Bees, you must guard, as much as possible, against these.

CLAR. Is it so very difficult to secure Bees from cold and hunger ?

EUGEN. Much more so than is commonly imagined. Frequently, by an endeavour to screen them from cold, we expose them to die with hunger. This happens in manner following. They, like all insects, pass the winter ; are sensible to its inclemencies, and do not take any food.

CLAR. What use then will they make of those closed store-houses, in which they had laid up their provision of honey ? Hitherto I supposed, that this was to subsist themselves, after the season of flowers was ended.

EUGEN. That's very true ; but not in so great a latitude as you imagine. Let us resume matters a little higher, in order to acquire a just idea of this. Among the infinite variety of creatures formed by nature, some of them, especially insects, cannot find food necessary for the sup-

port of their lives, except during part of the year. These, for instance, who subsist on the leaves of trees, plants and fruits, are reduced to the necessity of existing without food during the other part of the year, when there are neither leaves, plants or fruits. 'Tis not difficult to conceive, the possibility of their undergoing so long a fast. The only reason of our taking sustenance, is to repair the losses we sustain perpetually by motion and perspiration. Was it in our power to stop, in ourselves, all motion and dissipation of our parts; there is no doubt but we then might subsist without food, during the whole time that we should continue in such a state. The insects do what it is not in our power to effect. They are able to keep their bodies in perfect rest during the whole winter-season; in all probability they do not waste many animal spirits in thinking; as to their perspiration, which is during the very hot season, 'tis stopped by the cold; hence there is no farther dissipation of them; they have no farther occasion to recruit, or consequently to eat. The case is therefore the same with Bees, as with other insects, in some few particulars excepted. Most insects are able to resist cold weather, though exceedingly rigorous. You are but too well acquainted with the species of caterpillars, who make such cruel havock in your orchards and woods; spin webs, and pass the whole winter at the extremity of the boughs of trees. This insect can resist such a degree of cold, as is four or five degrees stronger than

than that of 1709. Others would perish in so rigorous a season; but all, or most of them, (be the cold ever so sharp) are able to wait, abstemiously and in repose, till the season comes round again, during which the earth will produce the sustenance fit for them. But the Bees are not indued with this talent; they being able to resist only a certain degree of cold, and this not over severe. That which stops vegetation, and the springing of flowers, reduces them to a state in which sustenance seems not necessary; it keeps the Bees in a sort of lethargic state, during which they don't perspire; at least on such small quantities, that their bodies suffer very little from it. Were the winters always equally cold; in such a degree as would only throw them into a kind of lethargy, till such time as the springing forth of flowers, they then would have no occasion for the honey stored up by them; but, during the season we are speaking of, the days are far from being like one another. I will suppose Bees cramped or benumb'd by the degree of cold above-mention'd: now should the frost break, or the air soften; should the beams of a resplendent sun play on the hive and warm it, our insects would rouse instantly from their drouziness. This sudden heat revives, and draws them out of their lethargic state; they flutter their wings, and are in motion; they are restored to their former activity, and at the same time to their appetite. 'Tis then they are reduced to the necessity of taking sustenance. As the fields will

not supply them with food, they open their magazines, and have recourse to the honey and crude wax which had been laid up in them. They begin by opening the lower cells; they not touching the upper ones till afterwards, though these were first filled by them. They certainly must have good reasons, for feeding upon that honey first which was gathered in last. I imagine that the summer or autumn honey is not thought by them so fit for keeping, as that of the spring; and that it perhaps thickens sooner. In a word, whenever the cold increases, they revert to their lethargic state; and when it softens, their craving for food returns. Thus, the softer the air continues during winter, the more honey the Bees consume; the larger consumption is daily made of the quantity stor'd up by them; and consequently, they run the greater hazard of consuming their whole stock, before the flower-season comes round again. Thus they are in danger of being starved. On the other hand, if they are not numerous enough in the hive, or if the winter is too inclement, they very probably may be killed by the cold. A certain degree of cold is therefore favourable to Bees; that which only pinches or benumbs them, secures them from the danger of starving; that which does not pinch them, may occasion their being famished; and that which pinches or benumbs them too much, is mortal. Hence 'tis plain that Bees, during severe winters, are exposed to perish through cold; and, in soft winters, to be starved to death. Our Bees
know

know perfectly well, that they are exposed to these two calamities; and for this reason they exert their utmost to secure themselves from them. They love to be exceedingly numerous in their hives; they, doubtless, knowing that the more populous they are, the warmer their inward air will be; and by this means they preserve themselves from the severity of the winter. They likewise secure themselves from the famine to which a too mild winter would expose them, by laying up stores of honey and crude wax.

CLAR. Since these little creatures are so vigilant with regard to their own interests, what need we concern ourselves about them?

EUGEN. Tho' nature has endued Bees with so much knowledge, as to be sensible of their own wants, it yet has not thought proper to give them powers sufficient to guard enough against them. Nature, very probably, thought it requisite that we should lend a helping hand on these occasions; and partake in their toils, in case we desired to share in the fruits of them. For this reason, if we are willing to preserve our Bees during the winter-season, we must attend especially to two things; I mean, to preserve them from perishing through cold; and to take care that they may not be in want of sustenance, when the winter is mild, or continues too long so. I'll now inform you, with respect to these two articles, of all the particulars which experience has taught us.

CLAR. I shall listen to you with pleasure. My Bees may depend upon being tenderly us'd,

the instant I shall be told, how to fix upon such a degree of cold as is necessary for their preservation.

EUGEN. Every Bee is not able singly to resist, for a long time, a degree of cold much softer than that which can congeal water. I don't know any insect to whom heat is so necessary. Bees die with cold in an air, the temperature of which would be found soft enough, by all the other insects of our climate.

CLAR. How is it possible then for them to live in gardens, during very severe winters? For, tho' great numbers of them die, you yet must own that some survive; nay, that multitudes of them resist this rigorous season, and are alive in spring.

EUGEN. This is because the air of a hive is not the same with that of a garden. 'Tis ever hotter; and this heat is greater or less, according as the hive is more or less populous. Figure to yourself that a hive resembles a play-house, on the occasion we are speaking of. Was such an edifice to be in the middle of the fields, during a fine winter's day; when the severity of a frost was excessive, and there was but a single person in this theatre; you'll naturally conceive that such a person must be almost as sensible to cold, as others who should stand on the outside of it. But should a thousand persons come into it, the cold would begin to lessen. After this, should benches be fixed sufficient for ten or twelve thousand persons to seat themselves; as every individual

dual would furnish his quota of natural heat, the air within this play-house might then change to an agreeable temperature; whilst the air out of the theatre, would be ten or twelve degrees colder than that which can freeze water. But how great would be the alteration, should the ten or twelve thousand persons we are speaking of, take it into their heads to rouse all together, run up and down, and exert the most vigorous motions? There is no doubt but these would at last work themselves into a sweat; and communicate to the air in the theatre, a degree of heat equal to that of the hottest summers. In applying this comparison to our hives, you'll easily conceive that, accordingly as they are more or less populous, the better they'll be enabled to bear up against the extremest cold. Thus you perceive how easy it is for us to secure our insects from this calamity. Our only business is to take care, at the approach of winter, that such hives as we are desirous of preserving during this season, may be well stock'd with Bees. Hence arises a maxim of great importance to the preservation of these insects, which is, that when some of our hives are thinly peopled, we need only make one hive of two; I mean, remove all the Bees of one hive into the other, and this we term coupling or marrying them. By this means our insects will be so populous, as may enable them to pass the winter, less liable to disastrous accidents.

CLAR. I had been told of this practice before, but was unacquainted with the reason why

it was done. However, I can scarce imagine that Bees, who, when I touch them, don't make a sensible impression of heat upon my finger; should yet be able to communicate to the air with which they are surrounded, a heat like to that you would have me suppose, by your comparison of twelve thousand persons in a play-house. Mankind may be endued with such a natural heat as is not found in Bees. You know much better than myself, that comparisons are no proofs.

EUGEN. I therefore must convince you by experiments. One day in January, I had placed in my garden, and at the side of a glass hive, a thermometer. It stood at three degrees below frost; that is, the air was three degrees colder, than was necessary to freeze standing water. A pane of glass was broke in one of the corners of my hive; when, taking away what I had put to stop this opening, I thrust my thermometer into the hole of the hive, after taking it from its wooden frame. Notwithstanding that the honey-combs, on which the ball of the thermometer stood, were at a pretty considerable distance from the center, and from the place whither the Bees had retired for shelter; the fluid rose nevertheless quickly, and ascended to ten degrees above frost. These ten degrees denote that of the temperature of cellars. Had it been possible for me to advance the ball of my thermometer, among the group of Bees in the center of the hive; possibly the fluid would have rose as high, and perhaps higher,

higher, than it does in many of our hot summer-days.

CLAR. Methinks this experiment must be unanswerable.

EUGEN. But I don't intend that you shall be satisfied barely with a single experiment. Here follows another of the same kind, made by me in the month of May. I let down the ball of a thermometer through a hole left by me purposely at the top of the hive. On this occasion the ball was in the center of the cluster of Bees who were at rest ; and the fluid rose to thirty-one degrees above frost, which must have been done by a heat stronger than that of our most sultry days in summer.

CLAR. What you tell me is surprizing.

EUGEN. And yet this is nothing ; the Bees procuring themselves a much greater heat, when they are in motion. I had kept, during winter, Bees in a hive, into which they had been removed, without being allowed the least portion of honey-comb : in short, they were quite destitute, in some measure, of necessaries. At the time I am speaking of, the external air was very little above frost. The glass panes of my hive were cold to my finger. But whenever I disturbed these Bees, either purposely or undesignedly ; whenever they dispersed themselves, and that they began to move tumultuously up and down ; to flutter their wings, and to make a strong humming ; the hive grew, on a sudden, so very hot, that when I touch'd the very same panes of glass which I before found cold ; they now felt as hot
as

as if I had held them near the fire ; and in such a degree of heat as is scarce supportable.

CLAR. Here we have an image of the ten thousand men sweating in the theatre you were speaking of ; at the same time that the frost without, was as violent as possible.

EUGEN. This proves to you, that the more Bees there are in a hive, the less we need to fear that the air should grow cold enough to destroy them. Where these are very numerous, they have heat enough among themselves to keep one another warm.

CLAR. I yet have heard my gardiner say, that the Bees of some hives, after resisting the winter, died with cold in the spring.

EUGEN. The same has happened to my Bees, the cause of which I found, and also a remedy for it. The cause is, when the Bees, at the closing of winter, take their flight too soon. As they go from an excessively hot air, to another that is too cold for them to bear, they are struck with it and die. If these too impatient Bees happen to be very numerous, the hive is depopulated by so many ; for then the hive we are speaking of, which, by its being so numerous, could resist the rigours of the winter ; is not able to bear up, against the cold days still felt in March and April. However, this might be remedied, by not letting them out too soon. As 'tis we who are acquainted with the state of the weather out of the hive ; it consequently is our business to regulate the time when it will be proper

proper for the Bees to fall forth. I'll soon inform you how this is to be done. But let us not quit the measure or degree of cold which our insects are able to sustain; 'till we have particulariz'd every thing which experience may have taught us on these occasions. I before observed, that a degree of cold which would be slightly felt by mankind, and the generality of insects, is too violent for Bees. Farther, an air which is pretty soft with regard to us, is too cold to them; I mean of every Bee in particular; of such of our insects as are alone, at a distance from their body; or where they are but very few in number. Here follows a proof of this. I shut up about the end of November, two dozen of Bees in a sand-glass. I then placed it in a closet, whose air, during the whole day, was between four and five degrees above frost. In less than an hour they appear'd dead. Being desirous, in the evening, to know whether they were really dead, I caus'd them to be warm'd, when they reviv'd with the heat, and all gave signs of life. I then carried them instantly into the same closet whence I had taken them; and immediately they seem'd to fall dead again. The next morning I warm'd them anew, and they again rose to life. I made them undergo, for three days alternately, this cold and heat; but at last my experiment prov'd fatal to them, they rising no more to life after the third day. Another experiment made by me (if I remember well) was on the first of December. I then put a dozen and half of very sprightly
Bees

Bees into another sand-glass, which I set in my closet, and in a much softer air than the above-mentioned. The fluid in the thermometer stood, in the day time, at fifteen degrees; and eleven at night. Nevertheless this air, tho' gentle like that of a soft spring, reduced them in three hours to a lethargic state. I left them in it three days; after which I endeavoured, but in vain, to restore them to life.

CLAR. How shall we reconcile this with their going abroad in spring, during a season when the same air, so far from killing, revives and invites them to work?

EUGEN. This is easily reconciled. The preceeding experiment related to Bees confined in a sand-glass; Bees who were very few in number, and at rest: But such as issue from the hives during the first fine days, come from a place that was very hot; and acquire, by labour and motion, the requisite heat. An air which, were they few in number and unactive, would be too cold; would be found supportable when they are in motion. 'Tis just the same when Men, during winter, preserve, by swift walking, the heat they had got by setting before a good fire.

CLAR. I understand you. In what position are they, in the hive, when it freezes; and that they find themselves falling into their lethargic state? Do they haste and hide themselves in the cells? Do they take up their station between the honey-combs?

EUGEN.

EUGEN. This you yourself may easily see, and without any danger to your person, next winter. You shall make choice of a day when it freezes ; shall then order one of your hives to be laid on one side, and even turn'd upside down, if you will : you then will see the Bees between honey-combs, cluster'd and fix'd quite close one to the other ; they'll take up but little space, and this towards the lower part of the hive ; at most, towards the middle of its height. They'll appear so benumb'd to your eye, that you'll imagine them dead : such is the posture and condition in which they pass a great part of the winter. I will observe on this occasion, that one of the duties we owe our Bees is, to visit their hives every morning, not only during winter, but especially after the cold nights of the spring ; for, in case the degree of heat they procur'd to themselves, is not strong enough to resist the violence of the cold, their lives will be in danger. To enable you to guard against this, 'twill be enough to observe, that the first effect which cold has upon Bees is to benumb them ; and that in proportion as the severe weather increases, it has so strong an influence upon them, that they appear as dead ; and their strength is enfeebled to such a degree, that the muscles of their legs lose the contraction necessary for keeping them hook'd one in the other. Little clusters of them will break away, and fall to the bottom of the hive ; here they will seem as dead, on which occasion we may handle and take them up by heaps,
without

without fearing their stings. However, tho' they are found in this condition, you yet need not be alarm'd ; for in case they have not been too long so, you may easily extricate them from the danger with which they are menac'd : only set them by the fire, and they'll recover. This secret was not unknown to the antients. Varro and Columella, two writers on rural affairs, who, agreeably to the opinion entertain'd in their time, thought this lethargic state a real death ; declare, that the way to recall these Bees to life, is to lay them on hot ashes. I fancy that you have no manner of notion of this sort of resurrection, for which reason I shall not trifle away time, in pointing out to you the absurdity of that word. I proceed therefore to the remedy. That of hot ashes is good ; but that of laying them upon dryers is better ; or to put them in large boxes or glasses, and bring them near to a gentle fire, is best of all. I have sometimes had hives, all the Bees in which appear'd lifeless, tho' they had laid between the honey-combs. Then, to revive them, without causing any havock ; I plac'd, under the hive, a small earthen pot, in which were a few burning coals, cover'd with a large quantity of hot ashes. This expedient is the simplest and most easy ; however, as I observed above, we must not leave the Bees too long in this lethargic state ; for, should it be suffer'd to continue many days, the remedy I am speaking of would be attempted without success.

CLAR. The particulars I have now heard are exceedingly curious ; however, I don't yet know how to find the exact degree of cold necessary for keeping my Bees in a lethargic state ; and this I am impatient to be taught.

EUGEN. I should first give you a compleat idea of the theory, on which the practice I design to instruct you in is grounded. The degree of cold requisite for Bees, during the winter-season, is not a fix'd point, nor easy to be prov'd. The disposition of the place in which they are kept during this season ; the situation, the greater or less number of Bees in a hive ; all these cause different degrees of cold to be required. A very populous hive will live in a place, the air of which will be cold enough to kill one that is more thinly inhabited. One hive shall be thrown into that useful lethargic state, by the same degree of cold, which would be a degree of heat for another. Whilst the Bees, in one hive, shall be consuming their provisions, the Bees in another shall be expiring. Should we enter into such a detail, as might teach us to preserve every individual Bee from the severities of winter and hunger, we should be obliged to have recourse to expedients which would perhaps, be found impracticable, at least by country people ; such expedients as would require time and expences, which the profits made by hives could never pay. The methods or expedients, for our purpose, are general ones ; such as may be easily put in execution, and whose tendency is most beneficial.

'Tis

'Tis on these I now intend to treat. 'Tis certain that if hives, instead of being left during the whole winter in gardens; there expos'd to all the rigours of cold, were remov'd, under covert; they, by this means, would not be in so much danger of perishing by the cold, as when expos'd to the open air. One practice of very great antiquity, and used in several provinces or countries, is, to stop all the apertures of the hives about the beginning of November; and then remove them to a green-house, or some place equivalent to it. However, this practice, so far from being sufficient, is expos'd to many inconveniencies. Such hives as are strong and very populous, will resist the extremes of cold; but these rigours will destroy the weaker hives: for we cannot compose our hives of an equal number of Bees, nor even in such a proportion as may be pretty near one another; and some of our hives will always be found weak, with regard to excess of cold. In fine, that method which proposes the stopping up every opening or cranny of the hives, and even the doors, in order to keep out the cold, make the Bees subject to many fatal diseases. A too close air corrupts daily, it being infected by the smell of the Bees. Their perspiration moistens it very much; and moist air kills, and even rots them in the hive. From these considerations, several persons (spite of the great risk to which such hives, as are left in the open air during the whole winter, are expos'd) think it safer to let them stay abroad.

CLAR.

CLAR. Methinks such a medium might very easily be found on these occasions, as would remedy all these inconveniencies: for this purpose we need but leave our strong or populous hives in the garden, and remove all the weak ones into the green-house.

EUGEN. Your observation is very just; and therefore I shall not compare it with another most trifling one, which some of the antients have taught us, and this is, to lay some dried carcasses of birds into our hives; they asserting that these secure them from the cold: As I am persuaded you will not lose time in repeating this experiment; I shall consider only the division of the hives just now mentioned. This would be the most expeditious for such persons as are thrifty of their time; but far from being the most salutary with regard to Bees. If you remember how very difficult it is to secure Bees from cold, you will conclude that the warming of your green-houses will not be sufficient to preserve the weak hives. Though these places be ever so well shut, the extreme rigours of cold will yet pierce into them. To make them, therefore, fit for our purpose, a fire should be kept all the winter, in these green-houses; in like manner as in those where foreign plants are nursed: but as this would be an over-great expence for country people, and take up too much of their time, it consequently cannot be of use to them. To remedy this, I hit upon a method, which, after several trials, was found very successful. To prevent any mistake

in this experiment, I made it on hives of every kind ; some of them being very weak or thinly inhabited, and composed of only a handful, as it were, of Bees. I proposed, on these occasions, to unite together the three views, which all persons who desire to preserve their Bees, must attend to. First, to secure my insects from the most violent extremes of cold : secondly, not to stop the door of their hives, but leave them the liberty of fallying forth on fine days, and thus make the air capable of being renew'd ; thirdly, to let them meet with food in their hive, in order that they might not be forced to go and seek it abroad ; and consequently prevent their being exposed to such severities of cold as would prove fatal to them. There cannot be a greater simplicity than in this method, and is so well suited to peasants, who commonly have plenty enough of the utensils employ'd by me on this occasion. I took an old cask, whose head was knocked off ; when setting it upright, I threw, at the bottom of my cask, a lay or bed of dry and very close earth, about four or five inches thick. After placing boards on this lay, I set my hive on this flooring. I then filled all the void spaces between the sides of the cask and the hive, with the same kind of dry, close earth, quite to the top of the cask. You will naturally suppose, that, by means of such a clothing, which is neither dear, nor difficult to be come at, my Bees were well secured from the severity of the winter.

CLAR.

CLAR. This I can easily imagine, and I even suppose that they were quite stifled; an infallible secret to prevent their dying with cold.

EUGEN. You don't do honour to my industry and contrivance, &c. I will now inform you that I made a door which stood always open, in order that the air might have a free passage; as also the provisions, at such times as my Bees were not in their lethargic state; for, being buried in the earth, as I observ'd, they will be oftner hot than cold; and consequently be frequently in want of food. In the first place, before I put them into the cask, I laid, on the flooring of the hive, an earthen pan fill'd with honey; and, over this honey, a sheet of paper prick'd full of little holes, in order that the Bees might eat the food just mention'd, without any of its sticking to their legs. By this means they will be secured from famine. And now to show you how I furnished them with air, I must observe, that a hole was made about the bottom of my cask, exactly of the same height with, and opposite to the door of my hive. Before I surrounded my hive with earth, I had introduc'd, by the hole in question, a wooden trough, of such a length that it projected a few inches out of the cask; and extended inward, to the door of the hive. By means of this trough or gallery, my insects had an opportunity of going in and out, at pleasure, and their air was renew'd perpetually.

CLAR. This method of preserving hives seems to me a very happy contrivance, and

easily executed. Nevertheless, a man who was possessed of an hundred, or twice that number of hives, would have a considerable deal of business upon his hands, should he be obliged to provide so many casks.

EUGEN. 'Tis really very hard to please you. Old casks are not so dear a commodity as you may imagine. However, to content you, I will make the thing still easier. If you happen to be one day possess'd of a great number of hives, and only a few old casks, you shall keep these for what use you please, and employ long boards in their stead ; or, to be still more frugal (for I perceive that is what you aim at) you shall have hurdles, the holes of which must be narrow ; these must be a little higher than the hives ; and set in form of a partition, of a length proportionable to the number of your hives ; you need only set up a few stakes to support them. There must be left, between the two rows of hurdles or boards, a distance a little greater than the diameter of the hives. Here a flooring must be laid like to that in the cask ; and you must place, on this flooring, all your hives one after another ; with each its earthen-pan and trough or gallery of communication ; which must extend, from the door of the hive, without the partition : after this, the whole void space, between the partitions, to the height of the hives, must be fill'd with very dry earth. By this means, the greatest cold, with regard to Bees, will be found but moderate ; such as a degree will throw our
insects

infects into the gentle lethargic state, which is of advantage to them. A moderate cold will, in their hives, be of such a warmth as to invite them to take their food ; and the provision of honey you will supply them with, will compensate for the want of honey in their store-houses, which will soon be emptied. The aperture I propose to be left in the hives, will give them an opportunity of issuing forth during fine days ; a circumstance that must necessarily contribute greatly to their health ; and preserve them from the diseases to which they are subject, when too long shut up. You likewise will not be obliged to visit them so often, as I observed would be necessary during winter, in order to examine whether their lethargy is not of a deadly kind. In fine, you likewise may defend them very easily, by this method, from an enemy who is extremely formidable in the cold season. This is the sort of field-mouse, concerning whom I before promised to treat ; and who, whenever he has got into a hive, makes dreadful havock. This creature does not dare to attack our Bees in another season, as knowing that he would be made to pay dear for such an attempt. He stays till the Bees are benumb'd with cold ; on which occasion he rushes into the hive, and devours all the inhabitants of it, who are then unable to make the least resistance. I have seen some very populous hives destroy'd by them in one night. The manner of his eating them is likewise worthy of our observation. The belly and intrails

of animals are usually the parts which excite the voraciousness of those creatures who feed upon them ; but these very parts are not regarded by the field-mouse ; he preferring the head and breast, though these parts are drier, and much more scaly.

CLAR. I am less struck with the singularity of this creature's taste, than desirous of knowing how I must drive him from my Bees.

EUGEN. The common way is to put up mouse-traps, near the hives : but then these traps don't destroy all the mice, some of them never failing to get clear off. The shortest way is to prevent any of them from being able to reach the Bees ; and this may be done, in our casks or hurdles, by fixing little plates of tin round the holes which serve them for doors ; in like manner as at the windows of dove-houses, to prevent pole-cats from creeping into them.

CLAR. I give you my word that my hives shall be well buried, all winter, between two partitions of hurdles. Whatever my gardiner may say to the contrary ; what respect soever may be due to antient customs, I will give no credit to them ; and buried they shall be in earth, tho' I myself should be forc'd to do this.

EUGEN. You say well. The best method for instructing country people, is to set examples before them. They are commonly very dull with regard to argumentations ; but proportionably skilful in imitating whatever may produce profit.

CLAR.

CLAR. I will enable them to imitate. However, before I endeavour at this, some illustrations will be proper. Is it absolutely necessary that the earth, with which I surround my hives, and wherewith I shall make the flooring to support them, be dry ?

EUGEN. It ought to be thoroughly so, and for this reason. The fluid emitted by the Bees in perspiration, would overflow their hive ; it would form a thick cloud which must incommodate them greatly, since they would be thus kept, continually, in a sort of drown'd state ; their door would not suffice to give a free passage to the vapour or fluid we are speaking of. But if the earth employ'd on this occasion is dry, it will imbibe this fluid like a sponge ; and the heat of the Bees, driving it out of the hive, thro' the earth, will cause it to evaporate.

CLAR. I comprehend this perfectly. In what manner must I prevent my Bees from issuing forth unseasonably ; at a time that their hatred of winter, and their tedious captivity, shall excite them to launch, imprudently, and sooner than they ought to do, into the expanse of outward air ? How shall I be able to know that the season proper for this is not yet come ?

EUGEN. I before observ'd, that these precautions relate especially to the first days in spring ; when sudden frosts are unexpectedly succeeded by gentle weather ; when the Bees are cheated by a beautiful day-break, which seems to invite them to go forth early, and enjoy a delicious Zephyr ; instead

whereof they meet with a cold, northern blast, that quite freezes them. 'Tis our business, who are abroad ; and consequently may know the state of the weather ; either to confine them, or let them out, accordingly as the weather is colder or warmer. We, in order to be informed of this, need have recourse to our senses only ; but here our senses are frequently very unfaithful in this particular. The sensation of Bees, on these occasions, is infinitely more delicate than ours. If you desire to be very accurate, employ the late invented thermometers, for these are of admirable use for our purpose. Since you are possessed of one which you consult daily as an oracle, you know that this instrument has an exquisite sensation with regard to heat and cold ; and points out, with surprizing exactness, the state of the air at the time desired. Place one of these thermometers in your' hive ; and it will inform you, every morning, whether your Bees may go forth from their habitation without danger. If the thermometer points to frost, you must not suffer, upon any account, your insects to go into the fields : but when it points to the temperature of cellars, it is then you may begin to open their doors. I have not yet told you, how doors may be made to hives, without intercepting the passage of the air. This is done by fixing, to the trough or gallery of every hive, a small grate made (crosswise) of iron-wire, whose holes must be too small for the Bees to pass through. Now, if this iron-work is fixed in such a manner, as

to open and shut like a window ; it will be easy for you, in the visits you must make every morning to the hives, during this doubtful season, to regulate by this thermometer, the issuing forth, or staying at home of your Bees.

CLAR. This is an excellent contrivance. How much honey is necessary for subsisting a hive during the winter ?

EUGEN. That is according to the populousness of the hive. A pound is sufficient for such an one as is most numerous. The surest way is to put more rather than less.

CLAR. I could ask another question, but will forbear, I having so good an opinion of myself, as to believe that I am able to answer it, without your assistance. The hives we have been speaking of, which are to be buried in the middle of my garden, either between two partitions, or in casks ; would be exposed to rain and snow, which would wet and moisten the earth ; the water would soak through, and consequently drown my darling insects ; but I will make them a little thatch'd roof, like to that with which the country-people cover the stalls for their cattle. I imagine that nothing more need be done.

EUGEN. This would be sufficient, provided that the roof in question projected a few inches beyond the hives, in order that the rain might be carried off at a considerable distance from them. You must own that I have furnished you, and all who are desirous of putting this experiment

experiment in execution, with a very cheap method to preserve your hives during winter, and in the beginning of spring. This is the most essential point with regard to their increase ; by this means you may save above half, and perhaps two thirds, of your Bees. The first care of every wise government is to be watchful over the lives and health of the inhabitants. We will consider, at our next meeting, of the duties we owe our insects, during the other seasons of the year.

CONVERSATION XVIII.

Of the methods for increasing considerably the traffic of wax. Of the produce of kives. Of the journies which Bees are made to undertake.

CLARISSA.

SINCE we are drawing towards the close of our discourses on Bees, I intreat you, Eugenio, not to let me be a stranger to any particular which may add to the perfection of this art ; an art I intend to make one of the pillars of the state, and which will save a great number of its inhabitants.

EUGEN. This is a project, Clarissa, worthy of yourself ; and must necessarily be the effect of a generous heart, and an enlightened understanding. In return for the instructions I have given you, with regard to Bees ; let me know in what manner you propose to reap such valuable advantages from them.

CLAR. I will oblige our Bees to pay a great part of the duties which the government draws from our provinces. These insects, if my scheme takes place, shall henceforwards pay a considerable part of our taxes. This project, which no doubt surprizes you, was suggested by my reflecting

reflecting on the prodigious quantity of wax consumed in France ; on the price it bears ; on the money sent abroad to procure it from foreign countries ; and on the vast advantages that would accrue, from the making it as common as the fat of cattle, of which candles are made. By revolving all these things in my mind, I fancy I, at last, have hit upon an easy expedient, for procuring to my native country a very valuable commodity, in one branch of trade ; as well by multiplying this commodity prodigiously ; as by making it an occasion for easing the common people, and introducing a greater oeconomy in families.

EUGEN. This declaration of yours seems to promise mighty things.

CLAR. And be assured that I'll make good all my assertions. My scheme is founded wholly on the instructions I received from you, and still expect to receive, concerning the best manner of treating Bees. My first step will be, to oblige every one of the inhabitants of my hamlet to get themselves two hives. Not a single family shall be exempt from this injunction. I afterwards will teach them the ingenious methods you have so obligingly communicated to me, in order to preserve our insects during winter, and increase them from year to year. I myself will first set them the example. In a word, I am resolved that, in less than four or five years, my village shall have the reputation, of being the finest wax-manufacture in Europe ; and that
every

every one of my peasants shall be in the happy condition, to which we are told our excellent Henry IV would have raised every individual in his kingdom. I am determined that they, merely by the produce of their hives, shall be able to procure themselves the several sweets of life ; and furnish, without difficulty or regret, the taxes laid upon them. I will bring matters so well to bear, that their felicity shall excite the emulation of their neighbours ; and as this emulation must spread from town to town, the whole kingdom will consequently be affected by it. My head is so full of my project, that I can't possibly defer, (till another opportunity) acquainting you with my little system. 'Tis impossible for me to hold any longer, and I must disburthen myself of it. I remember you told me, that a hive produced four or five swarms annually. At this rate, a person who should have two hives this year, would have ten the next, fifty the year following, and two hundred the fourth year.

EUGEN. Not so fast, good Clarissa. Have you forgot the fable of *the woman and her pail of milk* * ; or the Asiatic who sold glasses †. In the first place, I did not tell you that every hive produced exactly four swarms annually ; but only, that they sometimes did this. Secondly, such hives, how numerous soever they may be, as have already produced one or two great swarms, soon become thinly inhabited. For, not to mention

* See la Fontaine's fables.

† See the Persian tales.

the losses sustained by the perpetual diminution which death (common to all living creatures) makes among them; other losses arise also from the mixture of old Bees, of which no swarms are without: and, if there comes forth a third or fourth swarm, they are usually too weak; and the only method to preserve these last swarms is, to mix them, or join two in one. When a hive produces several swarms in a year, the swarm which issues first is the most valuable; for, besides its being the most numerous, it falls to work in a more favourable season. The succeeding swarms always lessen in value; consequently, a considerable subtraction must be made from your calculation.

CLAR. You quite ruin me. Be so good then as to inform me, exactly, how many swarms I may depend upon in a year?

EUGEN. If your hives are well looked after; and you take care to couple or join together the weak swarms, you may be assured that, (one with the other) every hive will produce two swarms.

CLAR. Two good swarms! That is something. Well, if this be the case, I'll proceed in my project. 'Twill, indeed, not advance quite so fast as I imagined; but it perhaps will be more successful in the end. I say then, if every hive produces two good swarms annually; a man who is now possessed of two good hives, will have six next year, eighteen the following, fifty-four
the

the fourth, and one hundred and sixty-two the fifth, and so on.

EUGEN. Your calculation is certainly just, bating hazards which, now and then, may make some diminution in your computation ; however, the more care is taken of hives, the decreases we are speaking of, will be less in proportion.

CLAR. Your allowing me this, will very much contribute to the success of my project. However, it is necessary that you inform me of one particular, as my ignorance in it might expose me to the ill fate of the woman with her pail of milk, hinted at above. What profit may a hive, when well looked after, produce its owner annually ?

EUGEN. This profit varies exceedingly, according to the different places ; and 'tis impossible for it to be the same, every year, in the same country. Bees have their years of barrenness as well as of abundance ; farther, as the queens, in all hives, are not alike prolific ; they are not all equally furnished with artificers ; consequently, much more work is done (I mean wax made) in some hives than in others. However, to give you a certain standard, from which you may calculate exactly ; I will inform you what is the general computation, in such parts of the kingdom as are not most favourable to Bees. In the places I am speaking of, every hive is supposed to produce two pounds of wax, and twenty pounds of honey.

CLAR.

CLAR. I'll keep to this calculation. This shall be the common standard, from which I'll reckon the profits I intend that my tenants shall make. I believe you'll own that my lands are vastly favourable to Bees. The beautiful meads which lie round my park; the shining rivulets that lave my plants; my flower and kitchen-gardens; my wood; all these furnish so vast a profusion of flowers, that my Bees may here riot upon dainties of every kind. If Bees yield two pounds of wax in other places, they ought to produce four upon my estate. However, I'll ground my scheme only on the foot of the least profit, in order that all persons may find their account in it. For this purpose, I'll not take the honey into the supposed gains. I'll imagine that the peasant shall make no other use of it than to support his family; this will be an addition to his domestic food; an addition which will give joy to a way of life which, generally speaking, is too frugal. In a word, I am resolved that my estate shall, to borrow an expression from the scriptures, be *a land flowing with milk and honey*. As to the pecuniary profits, I propose that these shall arise merely from the sale of the wax, which I settle at ten-pence *per* pound *. Methinks I cannot impose upon any one, in fixing it at so low a price.

* This answers to about five-pence farthing, sterling money.

EUGEN.

EUGEN. So far from it, that you wrong yourself. Your estimating the value of a hive at only * twenty-pence, will take off every objection that can be made to your project; especially as there are many provinces, in which three or four times † that gain is made.

CLAR. I don't desire that my hamlet should grow so rich. As poverty forces the peasants to abandon the tillage of the earth; such an abundance or plenty, (from a contrary reason) as should arise solely from these products, would cause husbandry to be neglected; and we ourselves would be the first, who should feel the bad effects of ill-placed generosity. At only twenty-pence a hive, the peasants (those worthy, industrious creatures) would not have an opportunity of growing idle. Nevertheless, five years hence, every family who, by their industry, should become possessors of an hundred and fifty hives, would enjoy a yearly income of above one hundred and fifty livres ‡. In case this little fortune amazes you, I'll subtract half from it (seventy-five livres) to obviate all cavils at my calculation. 'Tis usual for projectors to magnify, in their computations; whereas I'll diminish mine. Nevertheless, most of the peasants who live upon my estate, pay much less than seventy livres, in taxes. Farther, they likewise will have, an-

* Ten-pence half-penny sterling.

† The original is, *On en tire un écu, & même quatre francs*; "whence a crown, or even four livres, are gained."

‡ Six pounds, eleven shillings, and three-pence.

nually, three thousand pound weight of honey, as well for the sustenance of their Bees in winter, as for the support of every family during the whole year round, and even for other occasions ; for although this sort of fruit of the earth, is far less valuable than wax, it yet has an intrinsic value : the government will thereby find a vast increase of wax, which must necessarily lessen the price of tapers ; a circumstance that will be of advantage to my family. These several benefits will arise solely from my Bees ; and thus I have compleated my project.

EUGEN. I think your scheme an admirable one. Give me leave to add the following reflexion. A distant profit commonly makes but a faint impression on the minds of the common people. The hopes of a future benefit, of which they have no example, will not be strong enough to prevail over the fears they entertain, with regard to the fatigues (how slight soever) they must go through, in order to see those hopes crowned with success. 'Twould be even difficult for you to rouse your tenants on this occasion, unless they were animated by some present advantage, which may be as a surety, (to them) with regard to futurity ; as if you, for instance, could obtain from court (where you have some credit) a diminution of the taxes, in proportion to the number of the hives, kept by all persons subject to taxes.

CLAR.

CLAR. You are certainly in the right ; and nothing would excite their industry so much as this. We may be persuaded, that the ministry will give their utmost attention to any project calculated for the advantage of trade. Till this favour is obtained, I myself will supply this defect, and endeavour to excite an emulation in my tenants. By the way, will it not be of infinite advantage to poor peasants, to be freed for ever from the malice of an envious, revengeful collector ; and the prosecution of a merciless civil officer ? To be enabled to satisfy the collector, by giving him some pounds of a commodity, which the owner of it possessed, without being obliged to manufacture it ; a commodity that will not cost him any money ; and which he may procure with little pains ?

EUGEN. I understand you perfectly, and will have my share in the good work. I am resolved not to leave you, till we shall have carried this useful and salutary scheme to its greatest perfection. To affect this, I will continue to tell you all such particulars as may conduce to it. We attended, in our last conversation, to the preservation and sustenance of the Bees during winter ; let us now consider what is to be done for them in the other seasons. The spring which, with regard to us, is merely a season of hopes ; during which we are still consuming the fruits gathered by us in the preceding autumn, is, with respect to Bees, the season wherein the most plentiful harvests are made. Nature, at this time,

diffusing a new heat, revives all such living creatures as the rigours of winter had benumb'd. The gentle breath of Zephyrus purifies the air. Flora discloses her treasures. The shepherds and Bees are rivals with regard to flowers; and 'tis not till after our little artificers have seized their first sweets and their fragrancy, that Cupid culls them, therewith to adorn the bosoms of our fair shepherdesses.

CLAR. Methinks you are making a pastoral.

EUGEN. You really draw me from a poetical delirium into which I was plunging. All I mean to say, in plain terms, was, that during spring and summer, the Bees have no need of our care. In those two seasons they can easily supply themselves. They then have a profusion of honey, virgin-wax, crude-wax, in short, of every thing necessary. The only circumstance we then need attend to, is, not to let them want water. I am of opinion, that the neighbourhood of rivers, of large water-streams, of basons or reservoirs whose margins are high, are disadvantageous to them. Our insects are very liable to be drowned in them. Winds and storms whirl them into these: not to mention that 'tis with difficulty they can keep themselves steady on the margins or banks; some of which are too steep, and others too much buffeted by the waves. I would rather there should be set, opposite to the hive, water in plates or dishes; which, when not full, will leave a slope, whereon a Bee may, when drinking,

drinking, stand conveniently dry. This, as I observed, is the only office these insects want from us, with regard to food, during the two first seasons ; but about the end, and sometimes in the middle of summer, they must be treated variously, according to the different countries. The plenty dispensed by your meads, and their cool shades, will support your Bees till winter ; but nature has not been so lavish of her favours to all countries, as to your happy spot. The spacious and wealthy plains of Beauce, of the Sossionnois, of the island of France, which are so fruitful in corn, are fruitful only to men ; they being, with regard to Bees, an ungrateful soil. These places could not support so great a number of Bees, as many others. 'Tis a custom with the country people I am speaking of, immediately after harvest, to grub up all the stubble, and at the same time all the grass and plants growing among it : so that, after the hay is mowed ; at least, by that time the corn is ripe, every thing is dry and parched in those parts. There, when 'tis a dry summer, the Bees rove about the fields in vain ; they don't meet with any flowers ; or at least so few, that such Bees as are most fortunate in their progresses, scarce get a few pellets of crude-wax ; or provisions enough, in the fields, and out of their hives, to sustain themselves. In how different a situation are these Bees from yours ? 'Tis not therefore sufficient that persons, who may be extremely desirous of multiplying their hives, endeavour at this ; they must

first consider whether the places inhabited by them are fit for their purpose ; they must proportion the number of little tenants to the quantity of food which these spots can furnish ; and not attempt, for instance, to keep an hundred hives, where only ten can be supported.

CLAR. Methinks all the particulars you now tell me, diminish very much the benefits I propos'd to reap from my scheme.

EUGEN. Very true ; but then 'tis of advantage to its success, as it will prevent persons from making an ill use of it, by pointing out its proper limits and extent. Tho', by putting your project in execution, you should ease only half the country-people, still the attempt would be highly worthy of you ; and I am persuaded you would be satisfied with it. There are in France as many lands (at least) that continue a long time fresh and green, as others which dry up presently, and become barren with regard to Bees ; but the defects in some (among the latter) may, by certain expedients, be made of service to our insects. The defects here hinted at are, that some flourish too early, and others cease too soon to be in flower ; by which means, a long interval is left, during which the Bees would be quite deprived of sustenance. Now a method has been found, in some countries, to remove the hives, with their inhabitants, elsewhere, and afterwards bring them back again. This is done in manner following, as related in Mr. Maillet's curious description of Egypt. You have heard of the famous inundations

tions of the Nile, which cover regularly, every year, the dry, burning sands of Egypt ; where, leaving a most prolific slime, they convert the spots so overflow'd, into one of the most beautiful, and most fruitful countries in the world. I am of opinion that this country would be the most delightful upon our globe ; if the indolence of its inhabitants, the mixture of numberless ignorant nations, who all are enemies one to the other ; and the avarice of conquerors did not oppose perpetually its natural advantages. Spite of the ignorance and rusticity which have got possession of Egypt, there yet remain in it several foot-steps of the industry and skill of the antient Egyptians. One of their most admirable contrivances is, their sending, annually, the Bees into distant countries, in order to get sustenance, at a time when they could not find any at home ; and afterwards, to bring them back, as shepherds who should travel with their sheep, and make them feed as they went along. The inhabitants of lower Egypt observed antiently, that all the fruits of the earth ripen'd sooner in upper Egypt, than in their parts ; which made a difference, of above six weeks, between the two countries. Hence they were prompted to make their Bees, if possible, reap an advantage from this interval ; or, in other words, to procure them food six weeks sooner than they would have done in their native place. The expedient made use of by them, for the purpose we are speaking of, is employ'd in this age. About the end of October, all such

inhabitants of lower Egypt as possess hives, embark them on the Nile, and convey them upon that river, quite to upper Egypt ; they observing to arrive thither, at the time when the inundation withdrawing, the lands have been sow'd, and the flowers begin to bud. “ The hives being
 “ come to this part of Egypt, are there placed
 “ pyramidically in boats prepared for that purpose ; after being mark'd and number'd by
 “ the several owners who set them there. In
 “ this place the Bees feed, in the fields, during
 “ some days. Afterwards, when 'tis suppos'd
 “ that they have got in all the honey and wax
 “ that could be met with within two or three
 “ leagues round ; their conductors convey them,
 “ in the same boats, two or three leagues lower ;
 “ and there leave the laborious insects so long
 “ time as is necessary for them to collect all the
 “ riches of the spot in question.” Thus, the nearer they come to the place of their abode, the earth forwards its productions, and the plants flourish in proportion : so that we may then say of the Bees, with something more truth than we observe with regard to the ladies, ; that flowers spring up under their feet. “ In fine, about the
 “ beginning of February, after having travell'd
 “ through the whole length of Egypt (gathering
 “ all the rich produce of those delightful banks of
 “ the Nile) they arrive at the mouth of that river
 “ towards the ocean ; whence they set out, and return to their respective habitations. For care is
 “ taken, to set down exactly, in a roll or register,
 “ every

“ every district whence the hives set out in the
 “ beginning of the season ; their number ; and
 “ the names of the particular persons who sent
 “ them ; as likewise the mark or number of the
 “ boats, in which they were placed, according
 “ to their several habitations.” *

CLAR. It must be a singular spectacle to a traveller, to view whole fleets of Bees, sailing pompously on this noble river. Cleopatra's fleet which went to meet Mark Anthony, was more gaudy indeed ; but then it did not reflect so much honour on the understanding of the Egyptians. But I have heard of something still more ingenious, with regard to our insects ; if we may credit what we are told in *Speſtacle de la Nature*.† 'Tis there declar'd, that the Egyptians had found the secret of giving an education to Bees, such a one as few animals are capable of acquiring. That they had shepherds, who led them to pasture, in the same manner as a shepherd leads his flock ; that the Bees, more tractable than the last-mentioned animals, were prompted, merely by a whistle, to leave their hives, or return to them ; to go from one meadow to another ; to fly to the banks of a rivulet ; in short, to follow their leader, from village to village, whither-soever he might think proper.

EUGEN. I also have read this relation, or rather little romance ; and I remember that the

* Description of Egypt, tom. II. p. 24.

† Tom. III. p. 37. In our English translation of this excellent work, 'tis Tom. III. p. 23, 24, of the 8vo edition.

author quotes, to prove his assertion, a passage from the prophet Isaiah,* and another from St. Cyril. However, notwithstanding these venerable authorities, I believe we may doubt the truth of this assertion; and apply this whistle to sailors concerned in the management of boats; I mean, that it was used about sailing; and to otherwise direct the Egyptian mariners, rather than govern the Bees.

CLAR. But, Eugenio, if Isaiah declares the very words mentioned in *Speſtacle de la Nature*, methinks we cannot but give credit to them. Do you conſider that 'tis a ſacred Writer who ſpeaks?

EUGEN. I bear no leſs reverence to this divine book than St. Jerom did; and will obſerve to you (after him) that many things are told in the ſcripture, conformably to the opinion which prevail'd in that age, and not to the moſt exact truth.† The ſacred Writers expreſs themſelves, ſometimes, ſuitably to the notions of the vulgar, rather than agreeably to the accuracy of phyſics; and for this reaſon, becauſe human ſciences are of little conſequence with regard to the knowledge of ſalvation and ſanctification; which is the only end propoſed by the Almighty, in giving us the ſcriptures. Bees, in our age, would not be capable of receiving ſuch an education; and it is more than probable, that thoſe

* See Iſaiah V. 26, and VII. 18.

† *Juxta opinionem illius temporis, & non juxta quod rei veritas continebat.* S. Hieron in c. 28.

of past times were not better qualified to learn, than our present insects. But to resume our subject. Egypt is not the only country in which our insects are made to travel. Alexander de Montfort tells us, that the Italians who live near the banks of the Po, treat their Bees in much the same manner as the Egyptians; that they load boats with hives, and convey them to the neighbourhood of the mountains of Piedmont; that, in proportion as the Bees gather in their harvest, the boats, by growing heavier, sink deeper into the water; and that the watermen determine from hence, when their vessels are loaded sufficiently; and that 'tis time to carry them back to the place whence they came.

CLAR. This proves to me, how exceedingly advantageous it is for persons to live in the neighbourhood of a great river, when their fields are not very abundant in flowers, or sufficient to support our insects during every season. I conceive that Bees, (by taking a little voyage upon a river) and enjoying the spring of a dry country, with the autumn of a fat, shady soil, may thus be supported the year round. But in order to do this, the owners of hives must live near a navigable river, otherwise what I just now observed would be defeated; and you know that many places have not such an advantage.

EUGEN. This defect may be supplied by land-carriage. Columella informs us, that the Greeks constantly convey'd every year Bees, from Achaia into Attica; and this because that, at the
time

time that the flowers in Achaia are gone, those of Attica began to blow. Montfort relates, that the people of the country of Juliers us'd the same practice; and that, at a certain season of the year, they carried Bees to the foot of mountains cover'd with thyme, and that of the wild kind. I, indeed, borrow these instances from remote times, and foreign countries; but as people are commonly apt to subtract many things from these relations; I must give you an example of what is done among ourselves, in the center of France, and of which you yourself may be eye-witness. One of those men, born for the improvement of the arts, and whose name deserves to be transmitted to posterity, (Mr. Proutaut) makes his Bees travel like those of the Greeks of Achaia. This ingenious artist has set up a manufacture, for whitening wax, † near Pétiviers, in the diocese of Orleans; and there keeps a great number of hives. This spot is one of those in which flowers become rare or scarce very soon, and where few or none are seen after the corn is ripen'd. He then sends his Bees into Beauce, or le Gâtinois, in case it has rain'd in those parts. This is a journey of about twenty miles * which he makes them take. But, if he concludes that the Bees could not meet, in either of these countries, wherewith to employ themselves advantageously, he then has them carried into Sologne, about the beginning of August; as knowing

† At Yèvre-la-ville.

* The original is, *six à sept lieues*, "six or seven leagues."

that they there will meet with a great many fields of buck-wheat in flower, which will continue so till about the end of September.

CLAR. I easily conceive, that hives may be carried to a great distance in boats. This carriage is gentle, and can hurt Bees very little. But then, methinks the conveying them by land, must be attended with many difficulties. In what manner does your industrious artist act on this occasion? I presume that he is not so polite as to convey our insects in a coach or a litter.

EUGEN. The ancient historians had not acquainted him with the method by which the Greeks us'd to send away their Bees by land: but here follows his contrivance, which he practices with success. The first care is, to examine those hives, some of whose honey-combs might be broken or separated, by the jolting of the vehicle; they are made fast one to the other, and against the partitions of the hive, by means of small sticks which may be disposed differently, as occasion will show. This being done, every hive is set upon a packing-cloth, or something like it, the threads of which are very wide: they then turn up the sides of this cloth, and lay them on the outside of each hive; and tie them together with a piece of small pack-thread, observing to wind it several times round. They afterwards place in a cart, built for that purpose, as many hives as it will hold. The hives are set two and two, the whole length of the cart. Over these, others are placed, which make, as it were, a
second

second lay or bed of hives. These must be always put topsy-turvy ; 'tis for the sake of their honey-combs, and to fix them the better, that the hives are disposed after this manner ; for such as have no honey-combs, or very small ones, are placed in their natural situation. Care is taken in this stowage, not to let one hive stop up another ; it being essentially necessary for the Bees to have air ; and 'tis for this reason they are wrapped up in a coarse cloth, the threads of which were wove very wide, in order that the air may have a free passage, and qualify the violent heat which these insects raise in their hives ; especially when they move about very tumultuously, as often happens in these carts. Those used for this purpose in Yèvre, hold from thirty to forty-eight hives. As soon as all are thus stow'd, the caravans set out. If the season is sultry, they travel only in the night ; but, in cool days, they make a proper advantage of them. You'll imagine that they don't ride post. The horses must not be permitted even to trot ; they are led slowly, and through the smoothest roads. If any hives are void of honey-combs ; or have not sufficient to support the Bees during their journey, which is more than of one day, they are made to stay in the place where they happen to be. The sort of hives we are speaking of, are taken out of the cart ; are set upon the ground ; and after removing the packing-cloth, an aperture is made at the bottom of every hive ; by which the Bees issue forth in order to procure themselves provisions

abroad. The first field they come to serves as an inn to them. In the evening, as soon as they are all returned, the hives are shut up; and being placed again in the cart, they proceed in their journey. When the caravan is arrived at the journey's end, the baskets are set up and down in the gardens; or in fields adjacent to the houses of different peasants, who, for a very small reward, undertake to look after them. 'Tis thus that, in such spots as are not very abundant in flowers, means are found to supply the wants of Bees during the whole year. Your lands want none of these contrivances; for which reason let us proceed in enumerating such precautions as are necessary, in all countries, for the prosperity of those insects, and their labours. But I perceive that I have employ'd your attention a long time; and yet I have enough to furnish another compleat conversation, for which reason we'll break off here.

CONVERSATION XIX.

Of the precautions necessary for making Bees thrive. Of the diseases to which they are subject, and their natural death.

EUGENIO.

I Must finish to day, what I had to observe, concerning the care we must take of Bees, in order to reap all the advantages possible from their hives ; and pay ourselves for the services they receive from us. One of the first objects of our care, in spring, is the looking after the swarms. We must watch their going forth, to prevent our losing any. You have seen the manner in which they are taken ; the endeavours used to make the hive, offer'd to them, agreeable. The Bees must not be put, at random, into the first that comes to hand. 'Twill be proper to have hives of different sizes ; and proportion, as near as we can, these little mansions to the populousness of the swarms. Bees don't love to reside in too wide-extended habitations ; and that because they would be too cold in them. Seasons which would not be hurtful to our insects in narrow hives, would incommode them in spacious ones. They likewise would not be satisfied with too narrow hives ; for, besides that such would be too hot ; they would soon want room for
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building a number of cells suitable to their populousness. However, after we may have taken the utmost care (which experience will soon teach) for this purpose ; yet Bees often want room. This happens especially to good hives ; to such as have a very prolific queen ; and in a favourable season. For the sudden increase of this little people ; their love of labour join'd to an easy and abundant harvest, soon enable them to fill the hive with honey-combs. This we perceive by the honey-combs themselves, which descend to the bottom, and almost touch the flooring. This defect, which is merely an excess of abundance, is easily repair'd ; by putting under these baskets, a *Raiser* or *Stand*,* if I may so term it. These stands are circles made of the same materials, and of a like diameter with the basket or pannier ; and are as so many broken pieces of hives, with which those too short are lifted up. By thus enlarging the hives, we give the Bees an opportunity of continuing and lengthning their honey-combs.

CLAR. I am of opinion, that this must likewise contribute to the multiplication of the swarms.

EUGEN. The observation you now make, shows that you do not yet sufficiently understand my meaning here. I here speak concerning lodging the swarms to advantage. Now swarms very seldom produce other swarms the same year. The

* In French, *Hausse*.

business therefore here, is not concerning the producing new swarms; but only how to contrive matters, so as that they may make a considerable quantity of wax and honey; and to people them well, in order that they may live warmer in the winter. None but the swarms of the preceding year; those which have gone through a winter, give birth to three, four, and sometimes five swarms; and this from the middle of May (at soonest) to the middle of June, at latest. I know not whether I observed to you, that one of the signs by which we know that a hive is going to produce a swarm, (the first time in the year) is, when we see a great number of males or drones appear.

CLAR. I remember your remarking this; but you did not then acquaint me with the reason of it. I will tell you that which is now suggested by myself, tho' at the hazard of a correction, which I possibly may justly deserve again. Since there is a time when the Bees dispatch all their males; murder them without remorse; and that none of them are suffered to remain in hives the Bees of which are to pass the winter: whenever we perceive any of these in the spring, they must necessarily have been newly hatch'd; and consequently a certain indication that a swarm will soon come forth.

EUGEN. Your argument is so very just, that no part of it can be objected to. I have but one farther observation to make with regard to these swarms. It may, and no doubt often happens,

pens, that Bees are scarce settled in the new hive, but the weather changes, turns to cold or rain, and continues so many days. Now for Bees to leave their habitation, at these times, would be hazarding their lives. Nevertheless, they have not yet got any provision of crude wax or honey, and nothing to subsist upon at home. Consequently our insects, whether they go abroad or continue in their hives, are equally threatned with death.

CLAR. This is a horrid situation. It gives us an image of a city block'd up, and quite unfurnished with provisions: a city which hunger will reduce to the extremes of misery, if your humanity does not prompt you to throw provisions into it immediately.

EUGEN. I have taken care of the Bees in this particular. When they happen to be in the situation here spoken of, they must not be left so; small plates of honey must be set in the hive, which yet must be taken away again, as soon as the weather becomes fine, and will permit the Bees to sally forth. I proceed now to weak or thin hives; to those, the Bees in which are not numerous enough to people a small hive. When a hive has produced two or three swarms, 'tis often adviseable to prevent its producing a third or a fourth, since this would only weaken the hive whence they should issue. The applying the *Raisers* or sands just now spoke of, are commonly sufficient to prevent these sallies. As our insects, by this means, find themselves more at large, and

less incommoded by heat, they don't think of changing their situation. But if endeavours were used, to no purpose, to stop them ; we then must have recourse to an expedient mentioned before, I mean, the joining two in one ; an operation which I must explain to you a little farther. Such hives as have already given birth to one or two great swarms ; tho' these hives were ever so populous before, they now are greatly thinn'd or weakned ; and if a third or fourth swarm comes from them, the latter are usually too weak to be brought up separately. The most effectual method for preserving these swarms, as I observed above, is to join two in one ; and this is most easily done in manner following. We take the hive which is to be emptied, and bring it near that to which we intend to join the Bees contain'd in it. You'll observe that such an operation, which must necessarily confuse the Bees, should always be perform'd in the morning or the evening ; as the Bees are less vigorous at those times. The two hives in question being brought near to one another, the first must be shook strongly against the earth, or on a table, when the Bees will fall out in clusters ; tho' the small honey-combs contained in them should fall also, very little harm would ensue, as they are yet very small and light. Immediately the second hive is set over the group or body of Bees that were shaken out ; a little after which the latter rise up into it, and mix with the new companions before settled in it : and this they do at once, provided there is a queen in both swarms.

CLAR. A much greater simplicity appears, in this operation, than I at first imagin'd. Is the same method used, for driving out the Bees from a hive we want to destroy, and to remove the insects into another hive?

EUGEN. We must first know the circumstances in which such a destruction will be necessary. I am acquainted with only three. First, when the body of the hive is grown too crazy, and almost worn out : secondly, when the false moths have got such strong footing in a hive, that the true owners will soon be forced to abandon it to them : thirdly, when a person is determined not to increase the number of his hives. The most common way, of shifting Bees from one habitation to another, is in manner following. The hive, whence the Bees are to be dislodged, must be turned upside down. A thousand ways may be found, for holding a hive topsy turvy. The hive thus reversed, being set firm, must be covered with another empty hive, plac'd upon it, bottom against bottom. But as it is scarce possible that two hives, when thus disposed, should match or tally exactly at their lower brims ; and as several holes or apertures would be left, throughout the whole circumference where they join, by which apertures the Bees would escape ; the circumference above-mentioned must be instantly closed or surrounded with earth, mix'd with cow-dung ; and to secure this still better, the circle of earth and cow-dung must be compassed (two or three times) with

a cloth ; and wrought so close that all the Bees may be kept in. Matters being thus prepared, we strike, with two small sticks, held in each hand, against the opposite sides of the lower hive ; when this noise disturbing the Bees, they immediately are put in motion ; they humm ; and this humming increases, till such time as many determine to quit an inverted habitation, where they are so much disturbed, and pass into the upper hive. When the mother-Bee is determin'd to ascend into it, she is soon followed by the major part of the Bees ; but then she is too frequently indolent ; or so strongly attached to her antient abode, that we sometimes might beat whole hours upon the hive, and yet not make the Bees dislodge. This is discovered by approaching our ear to the upper hive. When a great noise is heard in the latter, it is a certain sign that a considerable number of Bees are got into it, and the mother-Bee likewise. We then may separate the two hives. However, if the mother-Bee does not abandon the hive willingly, but should persist to continue in her first abode, I have discovered a speedy way to finish this contest. We need only shake the two hives with our arms, as strongly as we can, but without severing or parting them. This violent agitation determines many of our insects to pass into the empty hive. How inconsiderable soever their number may be, they will be sufficient to cause the empty hive to be tenanted by all the rest ; especially if we sever the two hives, and instantly carry the hive

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we want to fill, to the place where stood that which we intend to empty. This is a very essential point. As soon as the former is set in its place (as I observed) a sheet or cloth must be spread on the ground ; then a little board must be taken, one end of which must lie on the sheet, and the other on the prop, and opposite to the door of the hive that is to be fill'd. This being done, the old hive must be strongly shaken over the sheet, in order to force out, upon it, all the obstinate Bees. The Bees in question falling in heaps, and being near to the place of their abode, know it again, and always direct themselves towards it. We see them advance, in companies, that way ; walking upon the board, which serves them as a bridge. However if, spite of these precautions, some Bees should stick fast, (how strongly soever the hives may be shaken) the honey-combs must then be cut ; must be swept (as it were) with the feather of a quill ; by which means the obstinate Bees will be forc'd down upon the sheet, and thus be obliged to go and join their companions. Another method employ'd in country-places, for dislodging Bees, is to smoak them as we do foxes. But this is executed in such a manner, as generally proves fatal to a great number of our insects ; they running the hazard of being burnt to death, either by the unskilfulness of the persons who direct the smoak ; or by the confusion into which this throws the Bees, many of them rushing then into the flames. Nevertheless, as this is the plain-

est and easiest method that can be used, I have endeavoured to correct such things as may be amiss in it, and that in manner following. I first get a board, a little broader than the bottom of a hive ; and in this board a great number of little holes must be bored, so small that the Bees cannot pass through them. I then lay this board over a sort of pail ; and, over the board, the hive whence I want to drive out the Bees ; taking care to stop all the holes through which the Bees might escape, and leaving none open except those of the board. Every thing being ready, I make, at the top of the hive in question, a hole about one or two inches broad ; and immediately place, at the opening of this hole, the hive into which I want to drive the Bees. I now lay, at the bottom of my pail, burning pieces of old linnen rags that emit thick smoak. The smoak now rising, and passing through the holes of the board, spreads into the hive, and there forms a thick cloud, which disturbs and tortures the Bees ; who, in order to avoid being stifled, ascend to the top ; where meeting with an opening, they thereby secure themselves from the smoak, and take sanctuary in the empty hive, which is ready to receive them, and where they are easily detain'd.

CLAR. I have much more esteem for those who improve arts, than for the inventors of them ; and have been told, that the invention of arts was generally the effect of chance ; but that the improvement of them, was the result of study,

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application, and genius ; hence I infer, that you merit many encomiums, and these I will entertain you with, whenever you think proper.

EUGEN. Praise is a smোক with which most human brains are delighted, and take it in even to intoxication. But I beseech you to spare mine, which the faintest vapour would overpower ; and force it to seek for some hole to glide through, in like manner as the Bees when fumigated.

CLAR. I promise not to offend you in this particular, provided you will inform me what materials are fittest to make hives with, and the form or shape most proper for them ?

EUGEN. The materials are neither rare nor valuable. Osier-twigs, those of the wild-vine, straw, boards, and the trunk of a hollow-tree, are the materials commonly employ'd ; and some of these are used, preferable to ours, in different countries.

CLAR. I know a country where much more valuable materials are employ'd. I read the other day, that the English have, in Barbadoes, above four hundred pieces of cannon *, most of which are employ'd as Bee-hives. This is what we may justly call raising solid works.

EUGEN. I don't think it will be necessary to make such solid hives here. I take those to be the best, which are raised with wreathes of rye-

* *Political State of Europe*, Tom. V. Part II.

straw ; like to yours, and most of those in Brabant and Beauce.

CLAR. Why are they made of this straw, preferable to the other materials you spoke of ?

EUGEN. The Bees are better secur'd, by these hives, from extreme cold in winter, and violent heat in summer ; these heating and cooling more slowly than the others. This forms a sufficient objection against hives made of brick, which are used in some places, they being the very worst of all. But the best, in my opinion, are such as are made of the barks of cork-tree, in countries abounding with them, Palladius, an antient writer on rural affairs, prefers them to any other. Thus much for the materials. I now come to the figure most suitable to hives, and this I take to be such a one as is nearly conical.

CLAR. You perhaps imagine that I understand foreign Languages ?

EUGEN. I own my fault : I mean that they must be shap'd like a sugar-loaf, but not sharp-pointed at the top. The inside must terminate in an arch, in order that several honey-combs may be the more easily fixed in it. If the hives are made of wreathes of straw, or such like, whose parts are not wove close ; it will be proper to plaister the outside, or do something equivalent to this ; to prevent the air and water from penetrating, and to spare the Bees the trouble of stopping those apertures with virgin-wax.

CLAR. I am highly delighted with this last precaution ; nothing being more agreeable to me than to save the labour of such as serve me.

EUGEN.

EUGEN. People generally find their account in observing this maxim ; and, in the present case, the profit is visible, since the time which the Bees would spend in stopping the crannies of their hives, will be employ'd in making wax for you. Another circumstance, likewise of the greatest importance, is to place your hives in the most favourable situation you can. They must never be set towards the north. The south is best ; in order that the Bees may enjoy the rising sun as soon, and the setting sun as late, as possible. However, if necessity should oblige us to dispose of them otherwise, either from the disposition of the particular spot, or that of the place itself ; we then must be contented with the rising or setting sun. But particular care must be taken, that such a roof be raised as may shelter the hives from rain and the scorching rays of the sun ; for some days, in summer, are so excessively hot, that the sun would melt the wax, and make the honey-combs fall. Such persons as are not possessed of hives enough, or are not able to build one common roof, must make each of them a very thick covering of straw. Our obligations to Bees are so great, that we cannot take too much care of them.

CLAR. I am of your opinion, and think that we should endeavour to make their habitations as commodious as possible. However, an article no less essential, is their food : let us speak concerning it, and I must intreat you to free me from a perplexity with which I have been

been long troubled, as well with regard to my Bees, as for myself. I don't doubt but that some flowers are hurtful to them ; and that they have their hemlock as well as mankind. There are other plants (you nam'd one of them to me) which produce a honey that is very unwholesome to us. By the rule of contraries, some flowers must be more salutary, with respect to Bees, than others ; and certain flowers which produce a honey more salubrious with regard to man, and more pleasing to his palate. I therefore expect, from you, a dictionary of simples for the use of Bees. You perceive that my health is concerned in this ; and you perhaps will think me, at the same time, something of an epicure.

EUGEN. I should be exceedingly glad, from the respect I bear to your taste, and the regard I have for your health, was it in my power to draw up such a dictionary as you mention. It would be of use to you, and do me great honour, I imagining that it would be the first in its kind ; but then I don't care to advance any assertions at random. Our knowledge, in the subject we are speaking of, is exceedingly imperfect. The only flowers I know which our insects refuse, are those of elder and rue ; and I am not acquainted with any which poison them. Experience indeed shews, that certain kinds of honey agree with us better than others ; and some are found vastly prejudicial. But, to pretend to fix the degrees, with regard to the wholesomeness, or malignity of every flower, would, I believe,
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be a very idle attempt. I am of opinion, that such places as abound with thyme, wild thyme, jessamine, rosemary, broom, and other odorous plants, must produce a good-tasted balsamic honey ; such as that of *mons Hymettus*, which the Greeks so highly priz'd ; such as our Narbonne honey. I fancy that the flowers of our corn of every kind, of our pulse, of our fruit-trees, produce a honey less agreeable to the smell ; but this honey may probably contribute as much, or more, to procure as good nourishment. As to plants which may produce a honey of a noxious quality, I have not made any experiment with regard to such. However, I am apt to think that hen-bane, milk-thistle, hemlock, and such like, whose juice is known to be hurtful, may very possibly communicate their malignity to the honey that should be extracted from them. For this reason, I would make no difficulty to grub up all such pernicious weeds, in the places adjacent to my hives.

CLAR. You have now pronounc'd their doom ; for not one of them shall be seen throughout the whole extent of my demesnes. After having thus provided our little tenants with suitable lodging and food, let us now consider their diseases, for they are liable to some : my gardiner has often told me, of the great havock made among our Bees by the meazles, and by purgings both upwards and downwards.

EUGEN.

EUGEN. I don't doubt but that you'll be gladly told, that the meazles are only an imaginary distemper. Abbé de la Ferrière, who has given excellent precepts with regard to the management of Bees, mistakes (as many others, have done) in supposing the meazles to be a distemper of vastly fatal consequence to Bees. He says this disease *arises from a sort of wild honey ; a red, thick substance, which does not fill above half the cells ; that it is more bitter than sweet, grows yellowish, and breeds worms or maggots which destroy the Bees.*

CLAR. Let me answer Abbé de la Ferrère, for methinks I have been taught so much, that I myself shall be able to confute his arguments. As he supposes that the meazles are a substance which engender worms, I deny his whole system ; it not being possible for inanimate matter to engender or procreate.

EUGEN. Your answer is quite conformable both to reason and experience. But this is not the only circumstance in this writer that merits censure. What he calls wild honey is not honey ; it is crude wax ; a substance exceedingly necessary for the support, as well as for the works, of Bees. I observed to you, some time since, that crude-wax retained the colour of the *stamina of flowers*, of which it was form'd ; it being yellow, yellowish, white ; sometimes green, and sometimes red. Thus what he calls the *meazles*, was merely red crude-wax ; a substance fit to nourish Bees, and not make them sick. - But it is different with respect
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to the purgings hinted at above, these being a real disease ; which some ascribe to the new honey they feed upon during the spring, and on cold days. But methinks it is more probable to suppose, that this distemper arises from the Bees being forced, for a long time together, to live upon honey only, and without a supply of crude-wax. I have frequently experienc'd, that such Bees as I fed with nothing but honey, were troubled with purging downwards. *Vandergroen*, or the *gardiner of the low-countries*, affirms that such of our insects are troubled with purgings of this kind, as are in want of bread ; for thus he terms, and properly enough, crude-wax.

CLAR. How do you reconcile this, with the pots or plates of pure honey, which you leave in the hives, to support the tenants of it during winter ?

EUGEN. This does not clash in any manner with that practice. Call to mind that our insects make a provision of crude-wax, as well as of honey ; and have store-houses of each ; and since experience has taught us, that we need only furnish them with pure honey, sufficient to make up for the scarcity of it during long winters ; we thence may infer, that the quantity of crude-wax hoarded by the Bees, is sufficient to serve them, during the longest winters ; but that their provision of honey is soon consumed. Hence we may suppose, that, during the season in question, their consumption of bread is infinitely less than that of honey ; though the contrary happens during

ing summer. But we likewise may take it for granted, that as pure honey incommodes them ; some of this bread, tho' in ever such little quantities, is absolutely necessary to them ; and the want of it attended with fatal consequences.

CLAR. Be so good as to inform me of the symptoms and effects of this disease, as well as the method to cure it.

EUGEN. Don't expect, from me, a consultation in form. The physicians of Bees procure their licences so very cheap, that the only thing we can require at their hands is experience. All I know concerning the distemper we are speaking of is this. Bees, when most in health, evacuate the dregs of their food in a liquid form. When groop'd or cluster'd in the hives, they fix themselves in such a manner, as not to incommode their neighbours therewith ; all of it falling to the bottom of the hive. But as pure honey does not form a food sufficiently substantial for them ; whenever they feed too long upon it, without having any bread, they grow weaker daily ; and this weakness increases to such a degree, that they, at last, are unable to quit their hives, or even to disengage themselves one from the other. 'Tis on these occasions that, not having strength enough to move ever so little ; those fix'd above drop, on the others beneath them, a clammy, liquid substance ; which wets them, spoils their wings, and stops up the canals through which they perspire. Such as should yet be quite free from this distemper, lose their lives merely by
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fig. 1.



fig. 2.



fig. 3.



fig. 5.



fig. 4.



fig. 6.

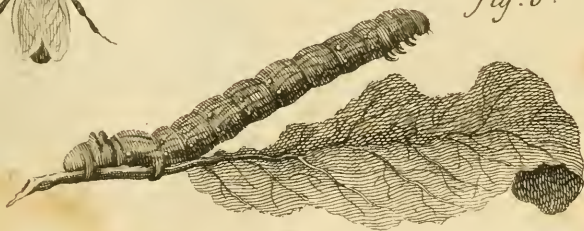




fig. 1.

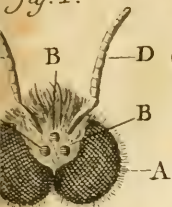


fig. 2.

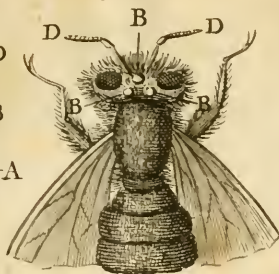


fig. 3.



fig. 4.



fig. 5.



fig. 7.

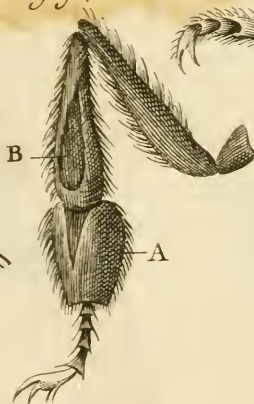


fig. 8.



fig. 6.





fig. 1.



fig. 2.



fig. 3.



fig. 4.

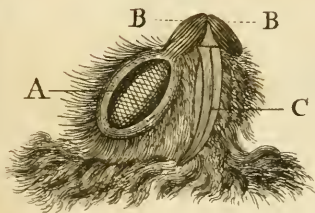
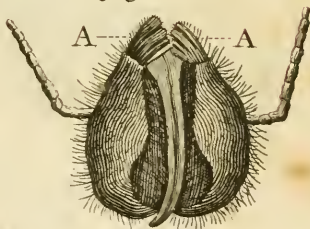


fig. 5.





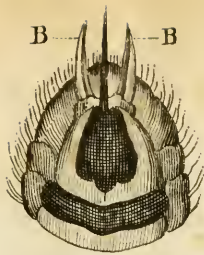


fig. 3.

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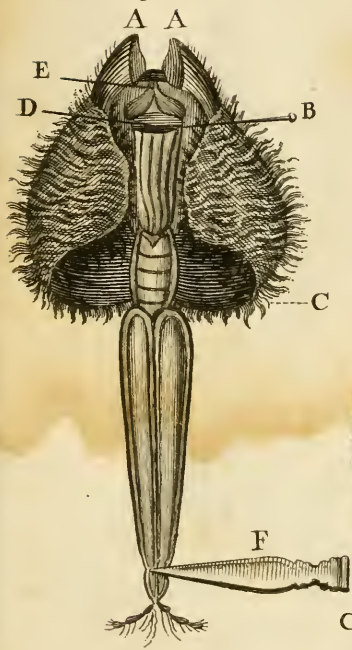




fig. 1.

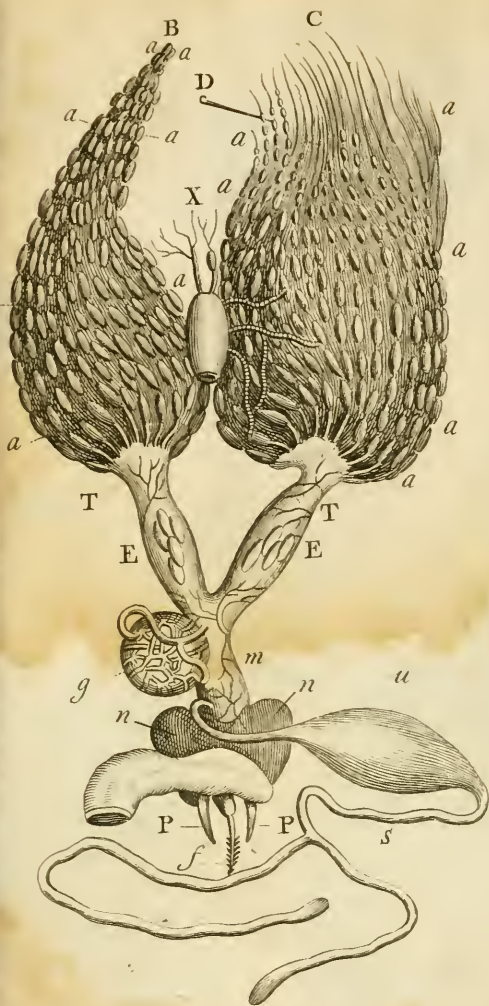


fig. 2.

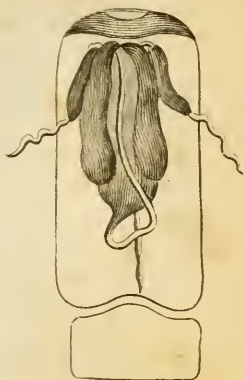


fig. 3.





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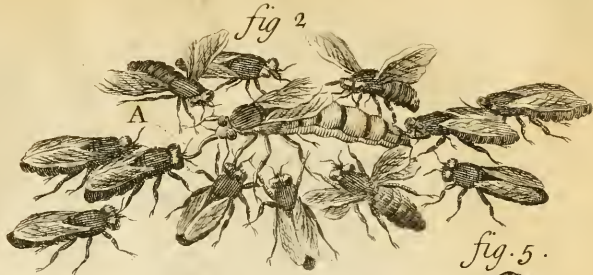


fig. 3.

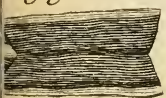


fig. 4.

fig. 5.



fig. 6.

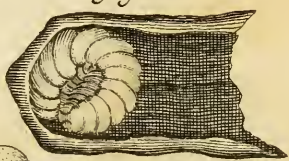


fig. 10.

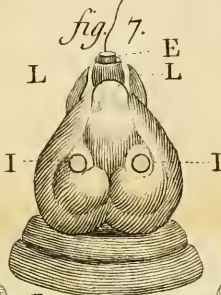


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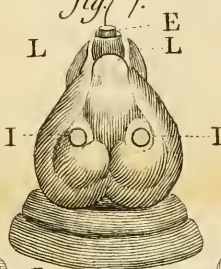


fig. 8.

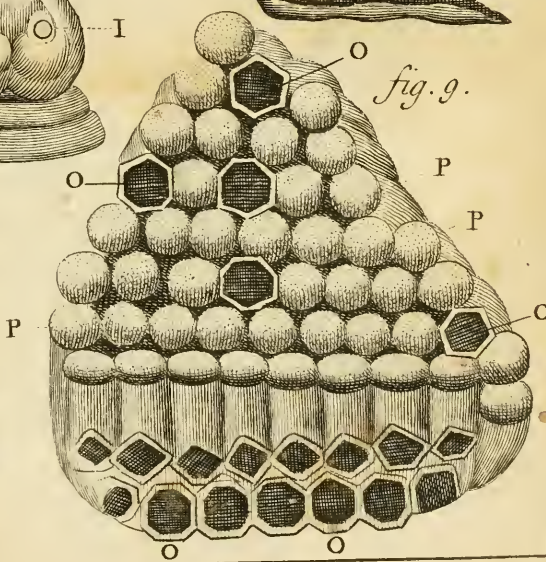
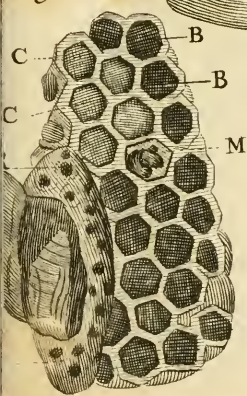


fig. 9.



the contact of the sick. An experiment I made on this occasion, will give you a much better idea of this distemper, its symptoms and effects. I had fix'd some Bees in a hive, without leaving them any honey-combs ; or even the liberty of seeking their food abroad. However, to compensate for this, I supplied them with pure honey. At first I let them feed but sparingly, and kept them alive above three weeks : however, I afterwards was too bountiful ; they eating so much, that they soon had purgings ; they wetted one another ; and, some days after, they all died ; and were as wet, on this occasion, as if they had been dipp'd in water thickned with honey.

CLAR. This really is a distemper of extreme bad consequence : I therefore must desire you to inform me, as soon as possible, how it may be cur'd ?

EUGEN. Abbé de la Ferrière, above-mentioned, speaks much better with regard to this disease, than concerning the measles. He gives us a recipe which is very like several others, that had been prescribed before him ; and is as follows : take half a pound of sugar, the same quantity of good honey, a pint of * red wine, and about a quarter of a pound of fine bean-meal or flower : mix all these together, and set the mixture, on a plate, for the Bees. This, very probably, may be a good prescription, but I know one that is much safer, and less compli-

* The French is *chopine*.

cated, *viz.* to take from another hive, a honeycomb, whose cells are fill'd with crude-honey, and give this to the sick Bees.

CLAR. I am for your prescription. As the sole cause of the weakness and infirmity of these Bees, is from their wanting such sustenance as may strengthen them ; it would be needless to use compositions, the doses or qualities of which are always arbitrary ; when we ourselves have, within our reach, the very sustenance on which they naturally feed. Let us now proceed to some other disease ; and since we are on this topic, we will even go through our whole course of physic.

EUGEN. This will be soon done. The distemper I just now treated of, is the only one (at least that I know of) to which Bees are subject. Perhaps they may have certain maladies which are unknown to us, but then these must attack our insects very rarely ; and we may affirm, that they don't proceed from any irregularity or excess in the Bees. Most of the diseases which attack man's life, are the consequences of, and the punishment for, the ill use he makes of the things given him to preserve it. But the Bees, faithful to the laws of nature, and keeping within the limits prescribed to them, suffer no other defect in their constitution, than such as are owing to the general laws of the universe. They never die except through old age, or from such accidents as are unavoidable.

CLAR.

CLAR. The words old age remind me of a question I often intended to ask you. How long is the life of a Bee, that has escap'd all the hazards which might otherwise have shortned its course ?

EUGEN. Some authors affirm that they live ten years, others seven ; and Abbé de la Ferrière, one of the most knowing among these writers, is of opinion, that they don't live above a year. I made an experiment, which inclines me to this Abbé's opinion. However, as my experiment was not accurate enough, for me to pronounce affirmatively on this occasion ; I fancy that all we are told concerning the duration of a Bee's life, is hitherto very uncertain. Was it possible for us to keep a Bee in a cage, as we do birds, we then might satisfy ourselves fully in this particular ; but a Bee does not live apart from her companions. Hives are like cities, which should have fresh inhabitants every year ; and whose houses should exist much longer than the several tenants of them. In fine, I will not scruple to close the history of the life of the Bees, with confessing my ignorance concerning the limits which nature has prescribed to it. I imagine, Clarissa, that you, by this time, know enough to establish on your estate, the noblest manufacture of wax in the kingdom. I could have mentioned several little operations ; many practices used in the management of hives ; but what you want to be instructed in farther, is known to the meanest peasant ; and the superintendant of your Bees, who has so long had the

direction of them, will inform you sufficiently concerning these matters ; not to mention, that you will meet with several things, for your purpose, in books. I promised you nothing but the natural history of Bees; and have told you all I know on this subject. To the instructions I have here given, do you add your own sagacity, your understanding, and your zeal for the public good ; you then will be enabled to carry the art, of prospering and multiplying Bees, to its highest perfection.

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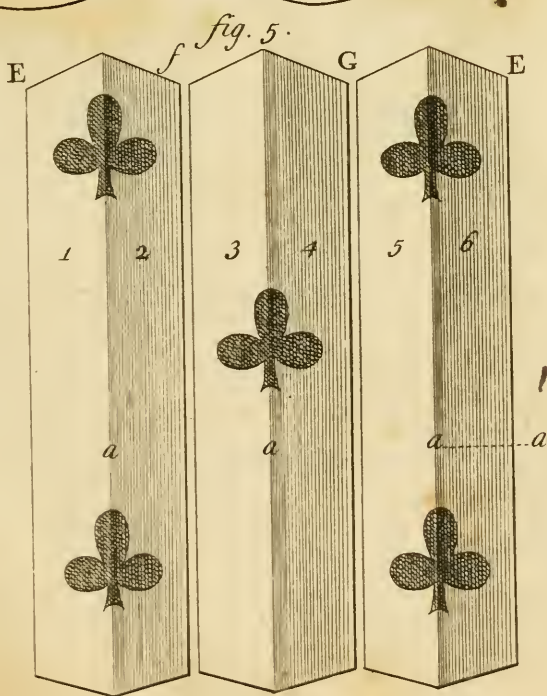
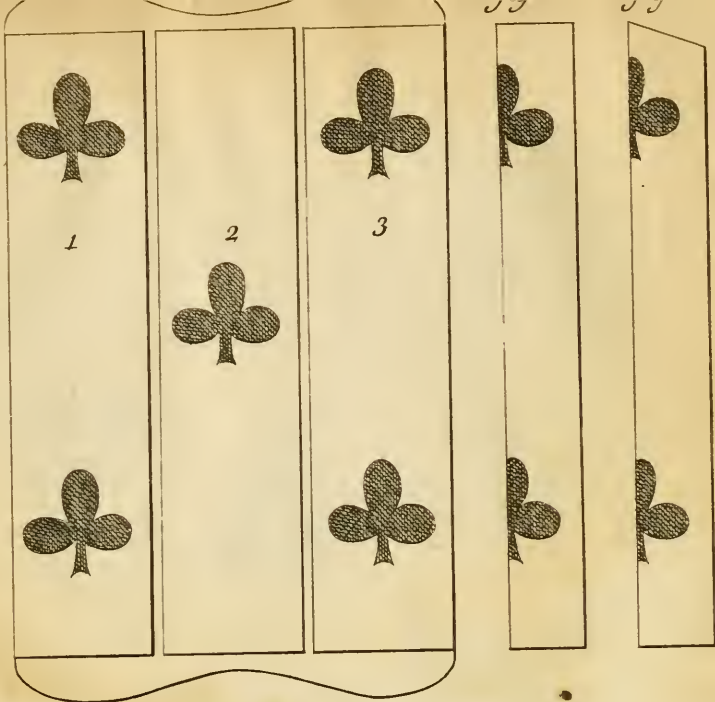




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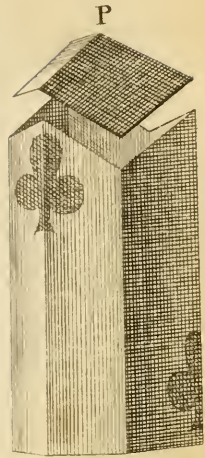


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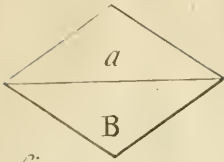


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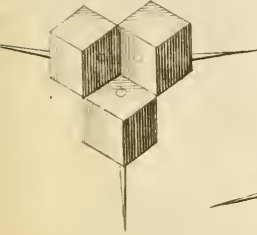


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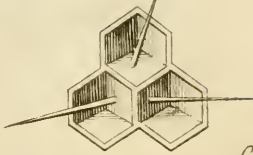
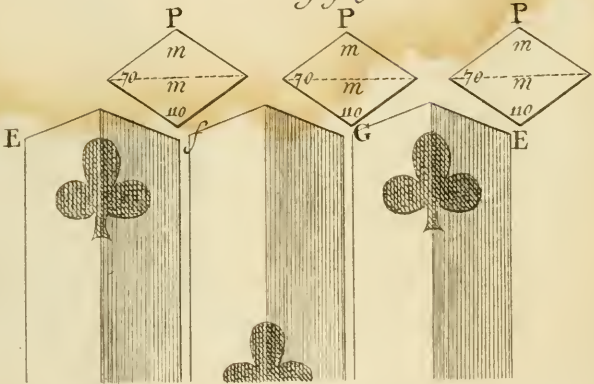


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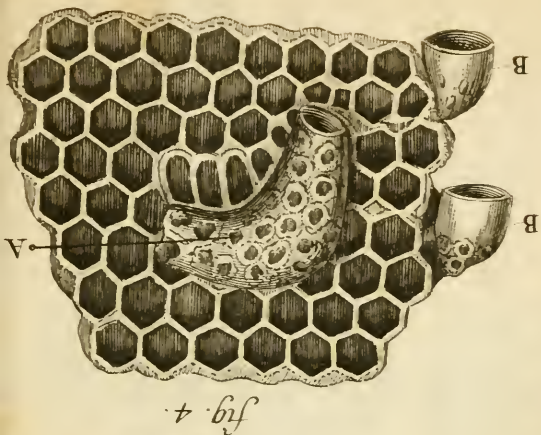
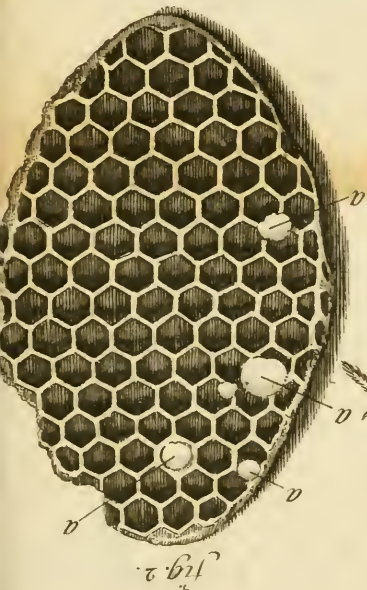
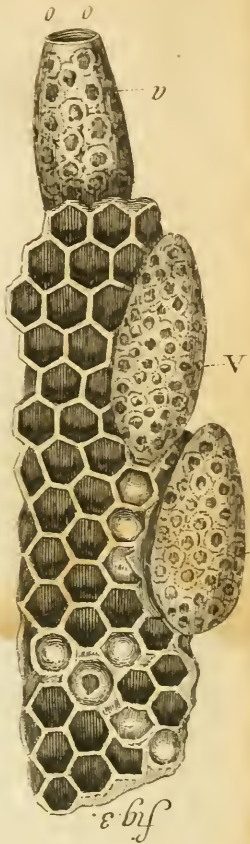


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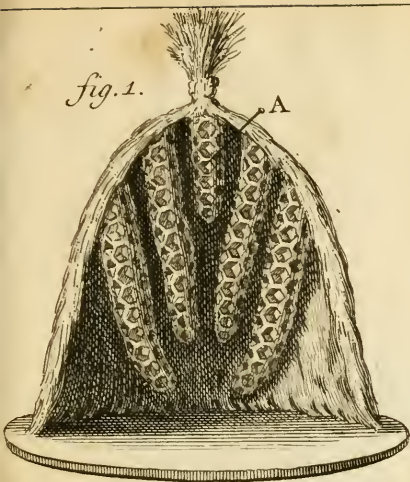


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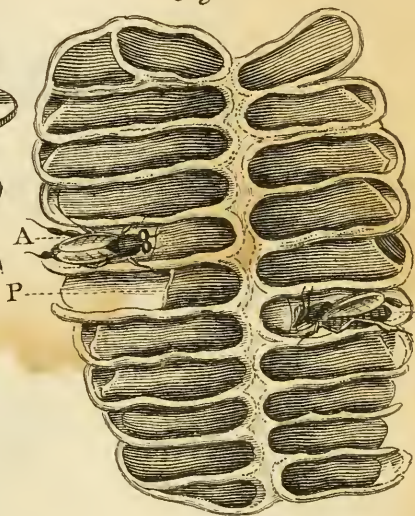


fig. 3.



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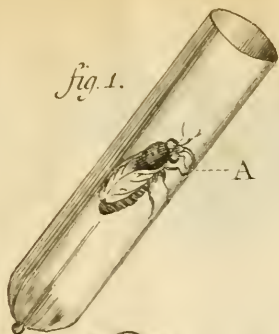


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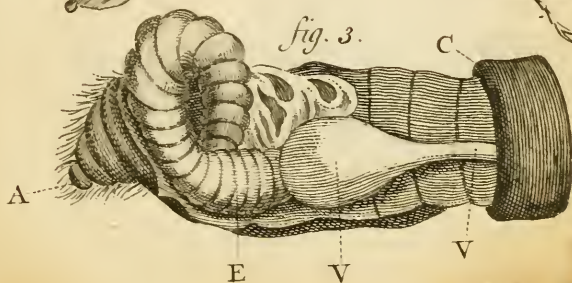


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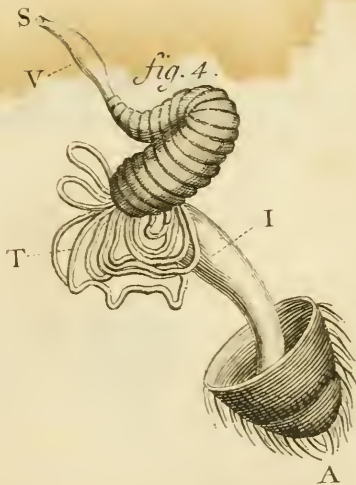


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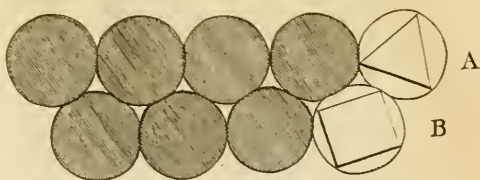


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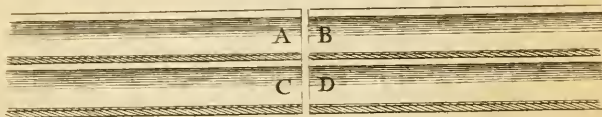


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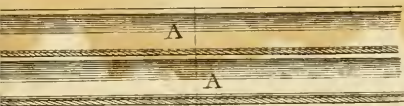


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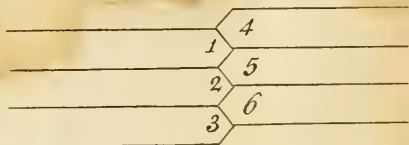


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