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Arthur Dobbs Esq

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IV. *A Letter from* Arthur Dobbs *Esq; to* Charles Stanhope *Esq; F. R. S. concerning* Bees, *and their Method of gathering* Wax *and* Honey.

SIR, *Castle-Dobbs, Oct.* 22, 1750.

Read Nov. 8. 1750. SINCE my View of doing Good, by making Discoveries of the Great World has been disappointed, upon my Retirement into this little Corner of it, [*Ireland*] amongst other rural Amusements I have been contemplating the Inhabitants of the Little World; particularly that most useful and industrious Society of Bees; and have had Time to revise the curious, ingenious, and entertaining Account given by M. *Reaumur*, of that inimitable Insect, with his curious Remarks and Reasoning about them; since he has been indefatigable in his Experiments and Observations about them, as well as of most other Insects, I think it the Duty of every Person, who has had Time to make any Observations, which may contribute to come at the Truth, and complete his Natural History of Insects, to throw in his Mite towards it.

I had Leisure and Opportunities many Years ago, to make some Observations about Bees; and all that I made confirm his general Theory, as well from his microscopical Observations, as those made by means of glass Hives; in which he had much greater and better Opportunities to make Observations than I have had: However, as there are two Things, in which my Observations are different from his, I think

think it but Juſtice to the curious and learned World to mention them; that M. *Reaumur*, in caſe he be alive, and ſtill able to follow his Obſervations, or, if he is not, that ſome other curious Perſon may make future Remarks, to know whether thoſe I have made are true: As I muſt own myſelf diffident of my own Obſervations, when they differ from ſo accurate, minute, and careful an Obſerver, as he has ſhewn himſelf to be throughout his whole Theory of Inſects in general, and more particularly of the Society of our Garden-Bee.

I therefore beg Leave to lay the few Remarks I have made before you, Sir; that if you think there is any thing in them worth communicating, you may lay them before the *Royal Society*, of which you are a worthy Member; or communicate them to M. *Reaumur*, if he be ſtill alive, and follows his Obſervations; that, in caſe my Obſervations are found true, he may ſo far alter his Remarks; and if they are not confirm'd, I ſhall willingly ſubmit to his future Obſervations.

The only two things in which I differ from M. *Reaumur*, are, that I apprehend he ſays, the Bees range from Flowers of one Species to thoſe of another Species, whilſt they are gathering one Load; ſo that the *Farina*, or crude Wax, loaded upon their Legs, is from different Species of Flowers; which is contrary to what I have obſerved. The other thing that I differ with him in is, that he ſays the Wax is formed in the Bee, from the crude Wax, or *Farina* (ſo far I agree with him): But by his Obſervations, he ſays, after Digeſtion it is diſcharged upwards by the Mouth; whereas, by my Obſervations,

is

it is the *Fæces*, Husks, or Shells of the *Farina* or crude Wax, after Digeſtion, diſcharg'd by the *Anus*.

As to the firſt, I have frequently follow'd a Bee loading the *Farina*, Bee-Bread, or crude Wax, upon its Legs, through a Part of a great Field in Flower; and upon whatſoever Flower I ſaw it firſt alight and gather the *Farina*, it continued gathering from that kind of Flower; and has paſs'd over many other Species of Flowers, tho' very numerous in the Field, without alighting upon or loading from them; tho' the Flower it choſe was much ſcarcer in the Field than the others: So that if it began to load from a Daiſy, it continued loading from them, neglecting Clover, Honeyſuckles, Violets, *&c.*; and if it began with any of the others, it continued loading from the ſame Kind, paſſing over the Daiſy. So in a Garden upon my Wall-Trees, I have ſeen it load from a Peach, and paſs over Apricots, Plums, Cherries, *&c.* yet made no Diſtinction betwixt a Peach and an Almond.

Now M. *Reaumur*, in his Memoir upon the Bee's making Honey, mentions *Ariſtotle*'s Obſervation of the Bee's loading or gathering from one Species of Flower without changing; not quitting a Violet to gather from a Cowſlip; which he ſays is not juſtly founded; for he has obſerved frequently a Bee on a large Border gathering from Flowers of different Species. If M. *Reaumur* only means, that, when the Bee gathers Honey, it takes it indifferently from any Flower, I can ſay nothing againſt it; but, if he intends it to mean the Bee's loading the *Farina* upon its Legs, then my Obſervation directly contradicts it.

What

What further confirms my Obſervation is this, that each Load upon the Legs of a Bee is of one uniform Colour throughout, as a light Red, an Orange, a Yellow, a White, or a Green, and is not upon different Parts of the Load of a different Colour; ſo that as the *Farina* of each Species of Flowers, when collected together, is of one uniform Colour, the Preſumption is, that it is gather'd from one Species. For, if from different Kinds, Part of the Load might be of one Colour, and Part of another.

Another Obſervation to confirm the ſame Fact is, that Bees, in the Height of the Seaſon, return to their Hives with Loads of very different Magnitudes, ſome having Loads as great as ſmall Shot, whilſt others have very ſmall Loads; it cannot be conceiv'd that this Difference is from the Inactivity or Sloth of the Bee in collecting its Load, but rather from the Scarcity of the Flowers, upon which it firſt began to load.

Now, if the Facts are ſo, and my Obſervations true, I think that Providence has appointed the Bee to be very inſtrumental in promoting the Increaſe of Vegetables; but otherwiſe, might be very detrimental to their Propagation; and at the ſame time they contribute to the Health and Life of their own Species.

From the late Improvement made by Glaſſes, and Experiments made, in obſerving the Works of Nature, it is almoſt demonſtrable, that the *Farina* upon the *Apices* of Flowers is the Male Seed; which entering the *Piſtillum* or *Matrix* in the Flower, impregnates the *Ovum*, and makes it prolific. It is often neceſſary to have Wind and dry Weather to

waft this *Farina* to the *Piſtillum*, and from Flower to Flower, to make the Seed prolific: And we find in wet Seaſons, that Grain, Nuts, and Fruit, are leſs prolific, by the *Farina*'s not being properly convey'd to the *Piſtillum*; and alſo in very hot dry Weather, from clammy Honey-Dews, or, more properly ſweet Exſudations from the Plants themſelves, which clogs the *Farina*, and cauſes Blaſts and Mildews. Now, if the *Farina* of ſpecifically different Flowers ſhould take the Place of its own proper *Farina* in the *Piſtillum*, like an unnatural Coition in the animal World, either no Generation would happen, or a monſtrous one, or an Individual not capable of further Generation.

Now if the Bee is appointed by Providence to go only, at each Loading, to Flowers of the ſame Species, as the abundant *Farina* often covers the whole Bee, as well as what it loads upon its Legs, it carries the *Farina* from Flower to Flower, and by its walking upon the *Piſtillum* and Agitation of its Wings, it contributes greatly to the *Farina*'s entering into the *Piſtillum*, and at the ſame time prevents the heterogeneous Mixture of the *Farina* of different Flowers with it; which, if it ſtray'd from Flower to Flower at random, it would carry to Flowers of a different Species.

Beſides theſe viſible Advantages, it may be of great Benefit to their own Species and Society; for, as this *Farina* is the natural and conſtant Food of the Bees, during one Half of the Year, and from this digeſted, as it is accurately obſerved by M. *Reaumur*, is the *Bouillée* and Jelly formed; which is lodg'd for the Food of the young Bees, until they become *Nymphæ:*

Nymphæ: It is alſo neceſſary that Stores of it ſhould be lodg'd in the Cells adjoining to the Honey, for their Winter Proviſion; without which Mr. *Reaumur* obſerves they would be in Danger of dying of a Looſeneſs, their moſt dangerous Malady.

It ſeems therefore highly reaſonable to believe, that different Kinds of *Farina* may have different phyſical Qualities: So that, by making Collections of the ſame kind in each Cell, they may have proper Remedies for themſelves againſt Ailments we have no Knowlege of, which otherwiſe they would not have, if they were filled at random from all Kinds of Flowers. Theſe further Advantages, directed to them by Providence, ſeem to add Weight to my Obſervations, and are a preſumptive Proof that they are true.

The only thing, beſides the former, wherein my Obſervations differ from Mr. *Reaumur*, is in the Manner the Wax is made and emitted by the Bee. I abſolutely concur with him, that the Wax is formed by Digeſtion in the Bodies of the Bees, and is emitted by them, and then becomes Wax; and that it is almoſt impracticable to form Wax any other Way, unleſs the Wax extracted from the Myrtle-berries in *America* by boiling be an Exception from it.

By M. *Reaumur's* Obſervations, he forms his Opinion, that after the Bee has fed upon the *Farina*, or Bee-Bread, and it has paſs'd through the firſt Stomach (which is the Reſervoir where the Honey is lodg'd, from whence it is diſcharg'd upwards by its Mouth into the Cells) it is convey'd into the ſecond Stomach; and yet, when there, great Part of it continues in its ſpherical or oval Form, ſtill undigeſted,

as view'd by him with his Glaſſes; and conſequently muſt be convey'd further, before it be thoroughly digeſted, and the Particles broke; yet this he ſuppoſes is reconvey'd upwards through both the Stomachs, and is emitted by its Mouth; and forms his Judgment from his Obſervation, that the Bee, when working, and finiſhing the Cells, nips with its Teeth the Wax, where it is too thick, or wrong laid; and has obſerved a Motion of its Tongue as it were ſmoothing or laying on more Materials, which he thinks muſt be then diſcharg'd from the Stomach by its Mouth.

What makes me diſagree with him in his Opinion and Obſervations, is from the Remarks I have made, that the *Fæces* of the Bee diſcharg'd by the *Anus*, after the *Farina* is digeſted, is the true Wax. We may with Truth believe, that the *Farina*, which is the male Seed of all Vegetables, conſiſts of a Spirit or moving Principle, floating in a ſweet Oil, ſurrounded by an exterior Coat or Shell, in which is that *Monade* that impregnates the Grain or Fruit, and makes it prolific; that, upon Separation or Digeſtion, this Spirit and Sweet Oil becomes the Nouriſhment of the Bee; which Spirit is of the ſame Nature with the Animalcules *in ſemine maſculino* of Animals, and becomes the animal Spirits in the Bee and other Animals; and perhaps the true Honey is the ſweet Oil included in the *Farina:* And as all Vegetables abound with theſe vegetable vivifying Atoms, ſince, from many, every Bud is capable of increaſing each Species, ſo the true Honey breaking through its Shell by great Heat, occaſions thoſe Honey-Dews obſerv'd in hot Weather upon the Leaves and Flowers

Flowers of moſt Vegetables; which is no more than an Exſudation from the Leaves and Bloſſoms of theſe Veſſels that break with the Heat; beſides thoſe that appear on the *Apices* of Flowers, which afterwards impregnates the Fruit.

Of this inward Subſtance of the *Farina*, diluted with Water, after Digeſtion, is formed the *Bouillée* and Jelly, which the Bees diſcharge upwards by the Mouth, into the Cells, to nouriſh the young Bees until they become *Nymphæ*; whilſt the Husk or outer Coat is diſcharg'd by the *Anus*, and becomes the genuine Wax.

I have frequently, when Bees have been ſwarming, had them alight upon my Hands and Cloaths; and many, at different times, have diſcharged their *Fæces* thereupon: This I have taken off, and found it of the Conſiſtence of warm Wax, with the ſame glutinous adhering Quality, not crumbling like the *Farina*. I have alſo diſtinguiſh'd it by the Smell to be Wax; but it had a heavier ſtronger Smell, as it was freſh and warm from the Bee.

What further confirmed me in this Fact, was from my Obſervation of the Bees when working up their Comb in a glaſs Hive; where I have conſtantly ſeen (and muſt believe it impoſſible not to be obſerved by ſo accurate an Obſerver as M. *Reaumur*) that ſeveral Bees, ſoon after one another, have by haſty Steps, walk'd along a Comb then forming, for the Length of two or three Cells, bending their Tails to the Comb, and ſtriking it with a wriggling Motion from Side to Side, in a zigzag Way; which I was convinced was diſcharging their *Fæces*, or the Wax, againſt the Border of the Cells, as they

they ran along, and repeated it as long as they had any to discharge, and then quit it; which is the Reason why the outward Border of the Cells is so thick and strong: And immediately afterwards, other Bees came along the Cells, and with their fore Feet rais'd up the Borders like Paste, and thinning it, whilst other Bees were ripping off with their Teeth, and pruning away any irregular Excrescences, so as to make the Divisions of the Cells vastly thinner than the Borders or Edges, which were always thick and strong, from the discharging the *Fæces* or Wax upon them.

M. *Reaumur* has very justly observed, that, besides the three transparent smooth Eyes, which the Bee has placed in a Triangle betwixt the *Antennæ* on the Top of its Head, the Bee has also on each Side of its Head an Eye, or rather a Multitude of Eyes, form'd by a Number of distinct *Lens's* surrounded each with short Hairs, which are confirm'd to be Eyes, both from *Swammerdam*, and his own Experiments to determine it; and that, notwithstanding these *Lens's* are lin'd with a dark opaque Substance, yet they assist so much their Vision, that, when darkened by Paint laid over them, the Bees could not find their Way to their Hive, tho' at a small Distance, but soar'd directly upwards; nor could they find their Way when the three smooth Eyes were darkened.

But there is one Observation, which I don't find he has made, which may have determined the Garden Bees to make almost all their Cells imperfect Hexagons. The Observation is this; that these opaque Eyes on each Side of the Head, consist of many *Lens's*, each of which is a perfect Hexagon; and the whole

whole Eye, when view'd in a Microſcope, appears exactly like a Honeycomb: Now, as the Eyes compos'd of theſe hexagonal *Lens's*, are in full View to the other Bees, does it not ſeem that Providence has directed them ſo as to be a Pattern ſet before them, for the Bees to follow in forming their Combs? Is it not alſo reaſonable to believe, from the Diſproportion of the Convexity betwixt the three ſmooth tranſparent Eyes, and the *Lens's* of the dark rough Eyes, that they are appointed for different Purpoſes? why may it not be thought that the *Lens's* are great Magnifiers, to view things nigh at hand, and by many Reflexions to convey Light into the dark Hives, where Light is ſtill neceſſary; and that the three other Eyes are to obſerve Objects at a great Diſtance, ſo as to conduct them abroad to Fields at a Diſtance, and back again to their Hives?

I agree with M. *Reaumur* in the Form and Uſe of the Fang or Tromp of the working Bee, and of the Uſe of the Mouth within the Teeth of the Bee; ſo that it does not ſuck, but laps or licks with its rough Fang or Tromp, like a Dog. But I have never obſerved the Bee nipping or breaking open the *Apices* of Flowers, to let out the *Farina*, when it is not fully blown or open; but have often with Pleaſure obſerved the Bee gathering the *Farina* upon its Fang, by licking it off the *Apices*, and laying it upon the firſt Pair of Legs, which convey it to the ſecond Pair, and theſe lodge it upon the Pallet of the third Pair, with ſurpriſing Briskneſs; ſo that, by the time the ſecond Pair has lodg'd it upon the third Pair, the Bee has gather'd more, and lodg'd it on the fore Legs; ſo that all are in conſtant Motion.

From

From the curious Obſervations made by M. *Reaumur*, upon the Structure and Behaviour of the Queen or Mother-Bee, the Drone or Male Bee, and the working or Mule Bee, which is of neither Sex; from the Queen Bee's being ſo exceedingly prolific, as to lay from 30 to 40000 Eggs of working Bees in a Seaſon; beſides the Eggs of 800 Male Bees, and of eight or ten Queen or Mother Bees; and from the Coldneſs of the Male Bee, who ſo long reſiſts the Careſſes of the Queen or Female Bee; and alſo from the indefatigable Labour and Oeconomy of the working Bee, to nouriſh the young Bees, make up the Combs, and lay in Stores of *Farina* and Honey for Winter. I think very good Reaſons may be given why the Queen ſhould have a Seraglio of ſome Hundreds of Male Bees; and why the working Bee ſhould deſtroy the Males, when no longer neceſſary to impregnate the Eggs of the Mother Bee.

It is evident, from the Oeconomy of the Garden Bee, that Providence has appointed that they ſhould ſhare their Store with Mankind, by making them ſo induſtrious in every Climate, as to provide, in tolerable Seaſons, a Store of Honey and Wax, double of what is neceſſary for their Subſiſtence during the Winter, and of Combs for the Queen's laying her Eggs in Spring, before new Work can be made. From the vaſt Number of Eggs which the Queen lays in a Seaſon, it is abſolutely neceſſary that ſhe ſhould have a great Store of Male Sperm, to impregnate her Eggs; and as the Eggs are not ſenſibly large in her Body for 6 Months after her Coition with the Males, who die, or are killed, in *Auguſt*, and ſhe does not begin to lay from that time till *February*

February or *March*; it is therefore neceſſary that ſhe ſhould have a great Store of Male Sperm within her, to impregnate all the Eggs ſhe lays from that time, until *June* or *July*, when young Drones or Males are hatch'd, who are not deſigned for her Uſe, but for the young Queens, who go off with the Swarms, or for the young Queen who ſucceeds the old one in the old Hive; ſince the Drones are great Feeders, and no Workers; and are of no Uſe, but to give a ſufficient Store of Sperm to the Mother-Bee; as the working Bees have ſo many Enemies to deprive them of their Store, they can't be maintain'd during the Winter, even if their Life ſhould laſt ſo long; and as it is probable each Male has but one Act of Coition with the Queen, as they are ſo cold, and take ſo much careſſing before they act, and, by M. *Reaumur*'s Obſervation, die ſoon after the Act is over, when, probably, their whole Store of Sperm is exhauſted in that Act, as ſoon as the Queen has got as much Sperm lodg'd in the proper Reſervoir, as is ſufficient to impregnate all her future Eggs, the Males are no longer of Uſe; and if thoſe who have acted, die, thoſe who have not, being of no further Uſe, are killed by the working Bee, out of Oeconomy to ſave their Winter Store, when, probably, by Nature they could live but few Days more; as we find the Silk-worm Moth dies ſoon after the Eggs are laid, as well Males as Females. It ſeems therefore neceſſary that the Queen ſhould breed ſo many Males, as, by one Act of Coition from each, may impregnate all her Eggs, and that the working Bee ſhould diſpatch them, as ſoon as that is over, and a Store is lodg'd.

There are two Veſſels deſcrib'd by *Swammerdam* in the Mother-Bee, whoſe Plate M. *Reaumur* has given in his Memoirs; one of which is placed betwixt the two Lobes of the *Ovarium*, which he ſuppoſes to be a Bladder to contain Air; the other is a ſpherical Veſſel, ſeated cloſe by the common Duct, in which the Eggs fall from the Lobes of the *Ovarium*, which he ſuppoſes is to ooze out a Juice to moiſten the Eggs in their Paſſage. I take one of theſe, but moſt probably the laſt, to be the Reſervoir and Repoſitory of the Male Sperm, wherein it is lodg'd from the Act of Coition, until the Eggs are inlarg'd, and paſs thro' the adjoining Duct from the two Lobes of the *Ovarium*.

Since the Preſervation and Increaſe of Bees are evidently beneficial to the Public, I approve very much of M. *Reaumur*'s Inſtructions in driving Bees from a full Hive into an empty one, in caſe it can be done time enough to have new Work, ſufficient for the Queen to lay her Eggs in in Spring; ſince they can be fed at very little Expence, if Care be taken to keep them in a middle State of Stupefaction, neither too hot nor cold, during the Winter: But I approve much more of his caſtrating or ſharing the Combs with the Bees, by taking the Combs beſt ſtor'd with Honey, and leaving thoſe wherein are the *Nymphæ* and Bee-bread; but think in taking the Combs a ſafer and eaſier Way may be taken, than he directs: His Method is to ſtupefy the Bees with Smoke, to oblige them to croud together in the Crown of the Hive, and then turning up the Hive, and cutting out the Combs fill'd with Honey. Now I think, that turning up the full Hive, and ſetting an empty Hive upon it,

it, and driving the Bees into it, is preferable to ſmoking: For then a very few Bees will remain in the full Hive; and thoſe few may be ſtupefied, and the Bees in the empty Hive being put on a Table, the Combs may be taken out and ſelected at leiſure, without Hazard; and afterwards the empty Hive may be turn'd up, and their old Hive ſet over them, ſo that they will go up without Scruple into their former Hive, and repair their Work, by making new Combs: And if the Queen had not quitted the old Hive, as is often the Caſe, then they would return to their Queen, and the Society would not be loſt, as is ſometimes the Caſe, in driving into an empty Hive.

Theſe, Sir, are the few Remarks I have made on reviſing M. *Reaumur*'s curious Obſervations on Bees, which I thought incumbent upon me to ſend you, to lay before your Learned *Society*, if it may contribute towards finiſhing the Natural Hiſtory of Bees. I ſhall take up no more of your Time, than to aſſure you, that I am, with the greateſt Regard,

SIR,

Your moſt obedient, and moſt humble Servant,

Arthur Dobbs.