

- I. *A Discourse upon the Usefulness of the Silk of Spiders.* By Monsieur Bon, President of the Court of Accounts, Aydes and Finances, and President of the Royal Society of Sciences at Montpellier. Communicated by the Author.

NEXT to the Principal Care which all Men owe to their more necessary and essential Duties, whether they relate to their own Employments, or respect themselves or other People; it is requisite, that they carefully make Choice of such Diversions, as are as well Useful as Entertaining: And as Inquiries into Nature are agreeable to all sorts of Men, of what Degree or Station soever; it is no wonder, that the greatest part of Mankind has prefer'd this kind Study, which has always been look'd on as a Recreation, and a means to Instruct as well as Divert the Mind.

And indeed what Amusements can we find more solid and agreeable; or in what Science can we make so great a Progress with so little Pains? It is not the same in other Parts of Philosophy, where Knowledge is not to be attained without profound Meditation and continual Labour. What a difference is there betwixt this and other Studies? The one requires some few leisure Moments only, but the others a Mans whole Time.

How then can we blame those, who sometimes amuse themselves in unfolding the Secrets of Nature, which costs them so little? Or ought any one to deprive himself of the like Diversions? The least Insect or Plant, or uncommon Stone, may afford us agreeable Reflections

ons in the most Solitary Place. Every thing induces us to admire the Infinite Power and Wisdom of the Creator : And I dare say, that it is undoubtedly this Wonderful Variety, which appears in all his Works, that has most contributed to make the *Pagans* themselves acknowledge a First Being to be the Sole Author of the Universe.

Philosophers of all Ages, and especially the Moderns, have look'd on this part of Knowledge as the Foundation of Natural Philosophy ; and in applying themselves to search carefully into Matters of Fact, it was only from thence to arrive, at last, at the True Knowledge of the Causes. The Industry, with which the Royal Academy of Sciences at *Paris*, and We of *Montpellier*, have cultivated this part of Philosophy, were sufficient to prove the Usefulness of it : But, without alledging here the Example of those Learned Societies, who seem by their Institution to be particularly engaged in this Study ; how many Emperors, Kings, Princes and Magistrates, have we seen apply themselves to it, for their own private Satisfaction.

Alexander made it his common Diversion, in the midst of his Labours in Conquering the World ; and the Famous * *Aristotle* receiv'd of him 480000 Crowns for his History of Animals, which he compos'd by his Order : And *Pliny* was as well rewarded for presenting the Emperor † *Titus* with those Learned and Curious Collections he had made of Inquiries into Nature.

* *Athenæus Deipnosophistarum lib. 9. Arbitratus verò apud doctissimum Aristotelem in opere Talentorum multorum mercede famoso, (nam Stagiritem rumor increbuit ab Alexandro donatum fuisse talentis octingentis ad impensam condendis ijs libris necessariam) ut comperi nihil memoratum fuisse &c.*

† *Pliny's Epistle Dedicatory.*

Not only Prophane History furnishes us with Instances of the Application that has been made to this kind of Learning ; but Ecclesiastical History affords us much greater Examples of the many Popes and Fathers of the Church, who have thought fit to join this with their other Studies. St. *Augustine* may suffice to convince us of this ; who, how watchful soever he was to suppress all growing Errors, and instruct the Faithful in the Duties of Christianity, applied himself nevertheless to this part of Knowledge : And his Treatise *De Civitate Dei* shows us, that we ought not to despise the Knowledge of any thing, which God himself has thought worthy to create.

But we need not go so far for Instances, when we have them here at home, in the Person of the Reverend † *William Pellissier*, Bishop of *Montpellier*. Has not he writ several Books upon this Subject ? Or could the famous *Rondeletius* ever have perfected his Great Work of Fishes and Shells found in our Seas, without the Assistance and Incouragement of this worthy Prelate ? Our Kings themselves have sometimes taken Pleasure in examining Nature ; and the Historians of *France* assure us, that * *Francis I.* made so great a Progress in this kind of Learning, without any other Assistance, than the Conversation of the Learned *James Cholin*, and *Peter Castelan*,

† *Gariel. Series Prasulum Magalonensium, in vita Guillelmi Pellissierij. Et Thuan. lib. 138. Histor. sui temporis, ubi de obitu Guillelmi Rondeletii.*

* *Thuan. Hist. sui temporis lib. 2. Præcipueque naturalis historia narratione delectabatur, in qua tantum audiendo profecerat, ut quamvis à pueritia nullis literis imbutus, quidquid de Animalibus, Insectis, Plantis, Metallis, Gemmis, ab antiquis et recentibus Scriptoribus memoria proditum est, et meminisset, et aptè edissereret. Usus ad hoc fuerat operâ Jac. Cholini primùm, dein Petri Castellani viri probitate et morum gravitate et doctrinâ præstantissimi, quem Episcopatu Matisconensi, magnique Eleemosiarii dignitate propterea remuneravit, ac Magistrum Bibliothecæ post Budaï obitum constituit.*

Mezeray edit. in fol. Paris 1685. tom. 2. pag. 1045.

that he was ignorant of nothing treated of, by either Antient or Modern Authors, upon the Subject of Animals, Insects, Plants, Metals, or precious Stones,

The Liberality of this Prince towards Men of Learning, drew into his Kingdom so many Famous Learned Men, that he was justly called the Father of the Muses. But if he deserved this glorious Title, with how much greater reason is it due to *Lewis* the Great? Who tho' continually possess'd with a Thousand different Cares, and is obliged at once to sustain the Efforts of all *Europe* in Arms against him; yet in the midst of so many Labours, nothing can divert him from the generous Design he always had, of making Arts and Sciences flourish: An undeniable Proof of which we have in his Establishing this Society, of which he has been pleased to declare himself Protector.

And what better Acknowledgment can we make, than by prosecuting his Intentions; and that You, Sirs, who are appointed to make the Natural History of this Province, would redouble, if possible, Your Care and Studies, to render your Inquiries as well profitable as pleasant. As for my self, who have a very different Employment, and ought to give my self up entirely to the Study of the Laws; yet I am perswaded, that to answer in some measure the Favour the King has done me, in Nominating me an Honorary Member, together with Persons so Illustrious in themselves, as well for their Birth as the Dignity of their Professions, I ought to employ all my leisure Hours in endeavouring to assist You, as far as I am capable, in searching into Nature. The advantage I have, in being one of Your Number, ought to inspire me with these Thoughts, as You have been always pleased to acknowledge, and I hope will continue to do, if my chief Employment would permit me to spend more time among You, and to Merit the Place I here enjoy.

The Observation I have now the Honour to present You is entirely New, and perhaps may one Day be as profitable. The Approbation You gave the bare Relation of the Experiments I designed to make on this Subject, engaged me to put them in execution ; and it is to Your Encouragement that is owing what I am going to relate.

You will be surpriz'd to hear, that Spiders make a Silk, as beautiful, strong and glossy, as common Silk : The prejudice that is entertained against so common and dispicable an Insect, is the reason why the Publick has been hitherto ignorant of the Usefulness of it. And indeed who would ever have imagin'd it? When that of common Silk, as considerable as it is, lay so long a time unknown and neglected after its Discovery. It was in the Island of † *Cous*, that *Pamphila*, Daughter of *Platis*, first found out the Invention of working it. This Discovery was soon after known to the *Romans*, who brought their Silk from the Country of the * *Seres*, where Silk-Worms naturally breed : But far from making any advantage of so useful a Discovery, they could never imagine these Worms should produce so beautiful and valuable a Thread, and made a Thousand Chymical Conjectures about it. So that their Ignorance and Idleness together, made Silk for several Ages so extraordinary scarce and valuable, that it was sold for its

† *Aristotelis Hist. Animal. lib. 5. cap. 19. Prima texisse in Co insula Pamphila Platis filia dicitur.*

Plinij Hist. Natural. lib. 11. cap. 22.

* The *Seres* are a People of *Asian Scythia* near the Mountain *Imaus*.
Vide Plinij Hist. Natural. lib. 6. cap. 17. et lib. 16. cap. 17.

Isidor. Originum lib. 19. cap. 23. Sericum dictum, quia id Seres primi miserunt, vermiculi enim ibi nasci perhibentur, a quibus hac circum arbores fila ducuntur.

weight in Gold: And * *Vopiscus* relates, that for this reason the Emperor *Aurelian* refused his Empress a Suit of Cloaths of Silk, notwithstanding she earnestly desired it. Its scarcity continued a long time; and it was to the Monks at last that we owe the Manner of breeding Silk-Worms, who brought their Eggs from Greece, under the Reign of the Emperor *Justinian*, as we learn from † *Godefridus* in his Notes upon the Code; and *Ulpian* assures us, that the Price of Silk was equal to that of Pearls.

It was late before *France* made any advantage of this Discovery; when *Henry II.* brought to the Marriages of his Daughter and Sister the || first Silk Stockings that were seen in his Kingdom. To him and his Successors it is we owe the Establishment of this Manufacture at *Tours* and *Lions*, which has made Silk so common, and so greatly increased the Magnificence of Furniture and Cloaths.

So many Examples ought to shew us of what Importance it is to neglect nothing in the Study of Nature: What at first seems of no use, or almost impossible to

* *Vopiscus sub finem vite Aureliani. Vestem holosericam neque ipse in vestiario habuit, neque alteri utendam dedit, & cum ab eo uxor sua peteret, ut unico pallio blateo serico uteretur, Ille respondit, abst, ut auro fila pensentur; libra enim auri tunc libra Serici fuit.*

† *Putat Seres vermiculos fuisse, quorum semen ovis piscium simile in Graciam fuerit allatum a Monachis ex Serindia India civitate sub Justiniano, ut tradit Procopius. — Temporibus Gratiani ignorabatur in Imperio Romano Serici conficiendi ratio. l. 1. Cod. Quæ res venire non possunt. Vestis Serica inter res pretiosissimas computabatur ab Ulpiano L. 37. §. 1. ff. de evictionibus & L. 1. & temperent. Cod. de vestibus Holoberis lib. 11. soli principi licebat gestare vestes sericas aut saltem holosericas, et in solis Gynæciis principis confici poterant; & lege Rhodiâ Holoserica auro æqualia.*

|| *Mezeray edit. Paris. in Fol. tom. 3: sub finem vite Henrici IV. Pag. 1254.*

be put in execution, oftentimes turns to the greatest advantage, and becomes easy by Care and Industry. This is the Fate of all new Discoveries; and I dare promise my self, that I what I now propose, will be favourably received. The Ingenious Fable of * *Arachne* shows us, that it is to the Spider we owe the first Hints of weaving Cloath and laying Nets for Animals: So the constant advantage, which I am satisfy'd may arise from this Insect, will undoubtedly make it hereafter esteem'd as highly as Silk-Worms and Bees, which of all Insects are the most necessary, as well as wonderful in their Works.

Tho' the History of Spiders be very large, an account of the great Number of Species, which are observable in each different kind; I think it notwithstanding absolutely necessary in a few Words to give a General and Cursory Account of this Insect, before I enter upon the Description of its Silk. I shall therefore reduce all the different sorts of Spiders to two principal kinds, *viz.* such as have long Legs, and such as have short ones: The latter of which furnishes the Silk I am now speaking of. In respect of their particular differences, they are distinguish'd by their Colour, some being Black, others Brown, Yellow, Green, White, and others of all these several Colours mixt together.

They differ likewise in the Number and Position of their Eyes; some having six, others eight, and others ten, differently placed upon the top of the Head, as may easily be seen by the naked Eye, but much better, by the help of a Glass. These are the principal Differences, they being alike in other respects as their Body, which Nature has divided into two parts: The fore-

* *Plinij Hist. Natural. lib. 7. Cap. 56. Qua quis invenerit in rina. Fusos in lanificio Closter filius Arachnes, Linum & reia Arachne invenit.*

part is covered with a Shell or hard Scale set with Hairs; it contains the Head and Breast, to which are fix'd its eight Legs, each of them consisting of six Joints. They have likewise two other Legs, which may be call'd their Arms; and two Claws, armed with two crook'd Nails, and joyned by Articulations to the Extremity of the Head: With these Claws they kill the Insects they feed on, their Mouth being immediately underneath them. They have likewise two small Nails at the End of each Leg, and a spongy Substance between them, which undoubtedly is of Service to them when they go upon smooth Bodies.

The hinder Part of the Body of this Insect is joyned to the fore-part only by a small Thread, and cover'd with a thin Skin, on which are Hairs of divers Colours: It contains the Back, Belly, Parts of Generations, and the *Anus*. I shall apply my self more particularly to the Description of the *Anus*, as being the Part from whence the Spiders draw their Silk; it not being my design to give a General Description of this Insect, but only to speak of their Silk, and the Usefulness of it.

It is certain, that all Spiders spin their Thread from the *Anus*; about which there are five *Papille*, or small Nipples, which at first sight one would take for so many Spindles, that serve to form the Thread: I have found these *Papille* to be Muscular, and furnished with a Sphincter. A little within these I have observ'd two others, from the middle of which issue several Threads, in a pretty large quantity, sometimes more, and sometimes less, which the Spiders make use of after a very Mechanical manner, when they have a mind to go from one place to another. They hang themselves perpendicular by a Thread, and turning their Head towards the Wind, they shoot several others from their *Anus*, like so many Darts: And if by chance the Wind, which spreads them abroad, fastens them to any solid Body,

(which

(which they perceive by the resistance they find in drawing them in from time to time with their Feet) they then make use of this kind of Bridge to pass to the place where their Threads are fixt. But if these Threads meet with nothing to fix on, the Spiders continue to let them out further, until their great length, and the force with which the Wind drives them, surpassing the weight of their Bodies, they find themselves to be strongly drawn; and then breaking the first Thread, which they hung by, they let themselves loose to be driven by the Wind, and flutter on their Backs in the Air with their Legs stretch'd out. And by these two ways it is, that they pass over Roads, Streets, and the largest Rivers.

One may himself wind up these Threads, which by reason of their being united together, seem to be but one when they are about a Foot in length; but I have distinguish'd them into 15 or 20 at their issuing from the *Anus*. What is further remarkable, is the easiness with which this Insect moves its *Anus* every way, by means of the many Rings that border upon it. This is absolutely necessary for 'em, in order to wind up their Threads or Silk, which in the Female Spider is of two sorts. However, I believe this Insect to be Androgynous, having always found the Signs of a Male in such Spiders as lay Eggs: But it being of no Service to discuss this particular, I shall return to my Subject.

The first Thread that they wind is weak, and serves them for no other use than to make that sort of Web, in which they catch Flies: The second is much stronger than the first; in this they wrap up their Eggs, and by this means preserve them from the Cold, and secure them from such Insects as would destroy them. These last Threads are wrapt very loosely about their Eggs, and resemble in form the Bags of Silk-Worms, that have been prepar'd and loosen'd between the Fingers in order
to

to be put upon the Distaff. These Spiders Bags (if I may so call them) are of a Grey Colour when they are new, but turn blackish when they have been long exposed to the Air. It is true, one may find several other Spiders Bags of different Colours, and that afford a better Silk, especially those of the *Tarantula*; but the scarcity of them would render it very difficult to make Experiments upon them; so that we must confine ourselves to the Bags of such Spiders as are most common, which are the short Leg'd ones. These always find out some Place, secure from the Wind and Rain, to make their Bags in; as hollow Trees, the Corners of Windows or Vaults, or under the Eaves of Houses. And by getting together a great many of these Bags, it was that I made this new Silk, which is no ways inferior in Beauty to common Silk. It easily takes all sorts of Colours; and one may as well make large pieces of it, as the Stockings and Gloves which I here present you. I shall next proceed to show the manner how I prepared the Bags, to make the Silk that is now before You.

After I had got together 12 or 13 Ounces of these Spiders Bags, I beat them well for some time with the Hand and a small Stick, to free them from Dust. Then I washed them in warm Water, 'till the Water that came from them was clear. After this, I let them steep in a large Pot, with Soap, Saltpetre, and some pieces of Gum-Arabick; and let the whole boyle 2 or 3 hours over a gentle Fire. Then I washed them again with warm Water, to free them from the Soap: And having let them dry for some Days, I loosen'd them a little between the Fingers, that they might be more easily carded by the common Silk Carders, excepting that I caused them to use much finer Cards. By this means I had a Silk of a very particular Ash-colour, which is easy to be spun, and (as you here see) affords a Thread
 much

much stronger and finer than that of common Silk. Which shows, that all other sorts of Work may be made of it: And there is no reason to fear but that it will endure any Tryals of the Loom, after having passed that of the Stocking-Weavers.

Having already shown the Usefulness and Possibility of making this Silk, the only difficulty now lies in procuring a sufficient quantity of Spiders Bags to make any considerable Work of it. And this would be no difficult matter, if we could breed Spiders as they do Silk-Worms; for they multiply much more, and every Spider lays 6 or 700 Eggs; whereas the *Papilio's*, or Flyes, of Silk-Worms, lay but 100, or thereabouts: And of this Number we must abate at least half, on account of their being subject to several Diseases, and are so tender, that the least matter hinders them from making their Bags. Whereas on the contrary, the Eggs of Spiders hatch of themselves, without any Care, in the Months of *August* and *September*, in 15 or 16 Days after they are laid; and the Spiders that laid them Die sometime after. As for the Young Spiders that are bred from these Eggs, they live 10 or 11 Months without Eating; and continue in their Bags, without growing either bigger or less, till the hot Weather forces them to come forth and seek Food. The Reason of this is plain and natural: For all Insects, and a great many other Animals, as Bears, Serpents, Mountain Rats, &c. that lye hid during the Winter, abound with a Viscid Matter, which is not easily put in motion: So that it is not strange, that Young Spiders should live in the Cold Weather upon their own Substance, without any loss of Spirits. But as soon as the warm Weather comes, it put in motion this Matter, and forces them to Spin, and run from place to place in search of Food: And as soon as they begin to Eat, one may perceive them to grow bigger and bigger every Day. From whence we may cer-

certainly conclude, that if we could find out a way of breeding Young Spiders in Rooms, they would furnish us with a much greater quantity of Bags than Silk-Worms do: For I have always found, that of 7 or 800 Young Spiders, there scarce died one in the Year; and on the contrary, of a hundred Young Silk-Worms, not Forty liv'd to make their Bags.

So great and considerable a Difference as this, will undoubtedly move the Curiosity of such as are Lovers of Arts and Sciences, to endeavour to find out a way of Breeding these Insects. In hopes that some lucky Chance, or my own Industry, might favour me with so Useful a Secret, I made use of the following Expedient to furnish my self with a large quantity of these Bags, which I now propose to the Curious, who may make the same Tryal of it as my self.

I ordered to be brought to me all the large short-leg'd Spiders, that could be found in the Months of *August* and *September*. These I shut up in Papers, and put them into Pots, and covered the Pots with a Paper prick'd full of Holes with a Pin, as were likewise the several Papers that were in it, that the Spiders might have Air. I fed them with Flies; and some time after found, that the greatest part of them had made their Bags, of which these are some.

But I more easily procured a great quantity of them, by promising to pay the same price for them by the Pound as for common Silk. This Advantage furnished me in a short time with a large quantity: And they assured me, they found no difficulty in getting them; and that if they were permitted to go into every House, where they saw these Spiders Bags in the Windows, they could furnish me with what I pleased. So that we may easily conclude, that there are Spiders Bags enough in the Kingdom to make large pieces of Work; and that this New Silk which I propose, is not so scarce or dear

as common Silk was at first. And so much the more, by reason Spiders Bags, in respect of their lightness, afford much more Silk than the others; as a Proof of which, 13 Ounces yield near 4 Ounces of clean Silk; 3 Ounces of which will make a Pair of Stockings for the largest siz'd Man. These here weigh but two Ounces and a Quarter, and the Gloves about three Quarters of an Ounce; whereas Stockings of common Silk weigh 7 or 8 Ounces.

It is certain a great Advantage may be made of this Insect, which the Publick has always look'd on as troublesome and dangerous, on account of its Venom: But I can assure You, notwithstanding, that Spiders are not Venomous, having been very often bit by them my self, without any ill Consequence. And as for their Silk, it is so far from having any Venom, that every body makes use of it to stop Bleeding and heal Cuts; and indeed its Natural *Gluten* is a kind of Balsam, that cures small Wounds, by defending them from the Air.

These Reasons ought to be sufficient to take away the Fear and Prejudice, that some People might have against making use of the Silk of Spiders: But is is necessary before I end this Discourse, to add others, so strong and solid, that the most obstinate must needs be convinced, that of all Insects, Spiders least deserve the Contempt of the Publick.

Their Silk is Useful, not only in respect of the Manufacture it produces; but its Usefulness is much greater, and more essential, on account of the Specifick Medicines, that may be drawn from it. It yields by Distillation a large quantity of Spirit and Volatile Salt; and I have found by comparing, that it affords at least as much as common Silk, which of all mixt Bodies yields the most. This Salt and Volatile Spirit, which is drawn from Spiders Bags, is very active; as may be judged by the following Experiments. It changes the Tincture
of

of the Flowers of *Turnsole* into a beautiful Green Emerald Colour. It congeles, and reduces to a sort of Snow, the Dissolution of Corrosive Sublimate; whereas the Volatile Alcalies, drawn from Human Scull, Hartshorn, and divers other mixt Bodies, only render it white or milky. So that this New Alkali which I propose, being prepared after the same manner as that which is drawn from the Bags of Silk-Worms, in making the *English Drops*, so famous over all *Europe*, may serve to make other New Drops, which may deservedly be called *Drops of Montpellier*; which we need not scruple to make use of, with much greater Success than the old ones, in Apoplexies, Lethargies, and all Soporose Diseases, by reason of their great Activity: And they will be taken with less regret, because their smell is not so fetid and disagreeable. I shall not enlarge further on this Subject, but recommend to the Physicians and Chymists of this Society, the Care of Inquiring into the other Uses, which Spiders Bags, and the Principles that are to be drawn from them by a Chymical *Analysis*, may afford in Physick.

Explication of the TABLES.

Tab. 1. A. Shows the Belly of a Spider, with the Anus and five Papillæ, from whence the Threads issue.

B. C. The Side, and Fore-part of the Penis of a Spider, as magnify'd by a Microscope.

D. The Follicle or Bag of a Field-Spider with a harder Shell, at the breaking of which the Young Spiders come out mixt with the Silk.

E. The Follicle or Bag of an House-Spider with a softer Shell, in which the Young ones are inclosed.

Tab. 2. F. *A Spider hanging on the Branch of a Tree, with its Head turned against the Wind, and spinning out its Thread, 'till it finds that it adheres to some Body, (as to the Wall here represented) by which kind of Bridge it passes over Rivers, &c.*

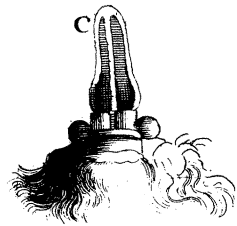
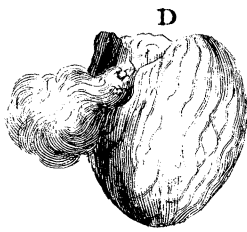
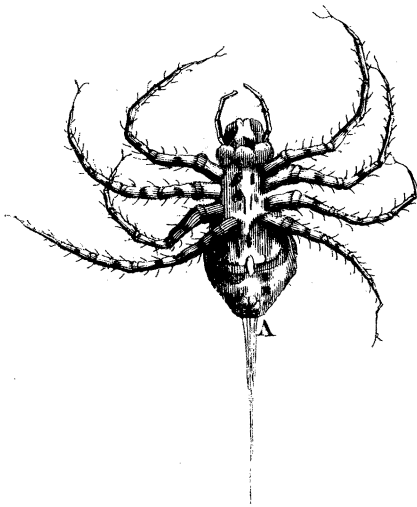
G. *A Spider having broke the first Thread, by which it hung, and let out several others, is carried by the Wind, and floats in the Air with its Legs extended.*

II. *An Account of the Moon's Eclipse, February 2. 170^o₁. observed at Streatham near London, and compared with the Calculation. By the Rev. Mr H. Cressener, M. A. Fellow of the Royal Society.*

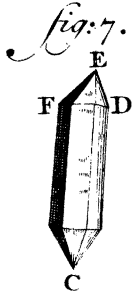
IN the last Lunar Eclipse, on the second of *February* 1709-10. the time of the end (which was what alone the want of a proper *Apparatus* and a favourable *Skie* would give me leave exactly to determine) I found to be the same (with but a very inconsiderable Difference) which the Calculation, according to our most Learned *Presidents* admirable Theory, promis'd me to expect.

There being therefore no Examples of any Calculation (that I know of) according to that Theory, nor of the Theory's Agreement with Observation yet made Publick; I thought it proper to offer this one to this Learned Society's Perusal, that the exact consent with Observation in this, may prompt some of them to try the like in others. I have added the Calculation from the famous Mr. *Flamsteed's* Tables, according to *Horrox's* Theory,

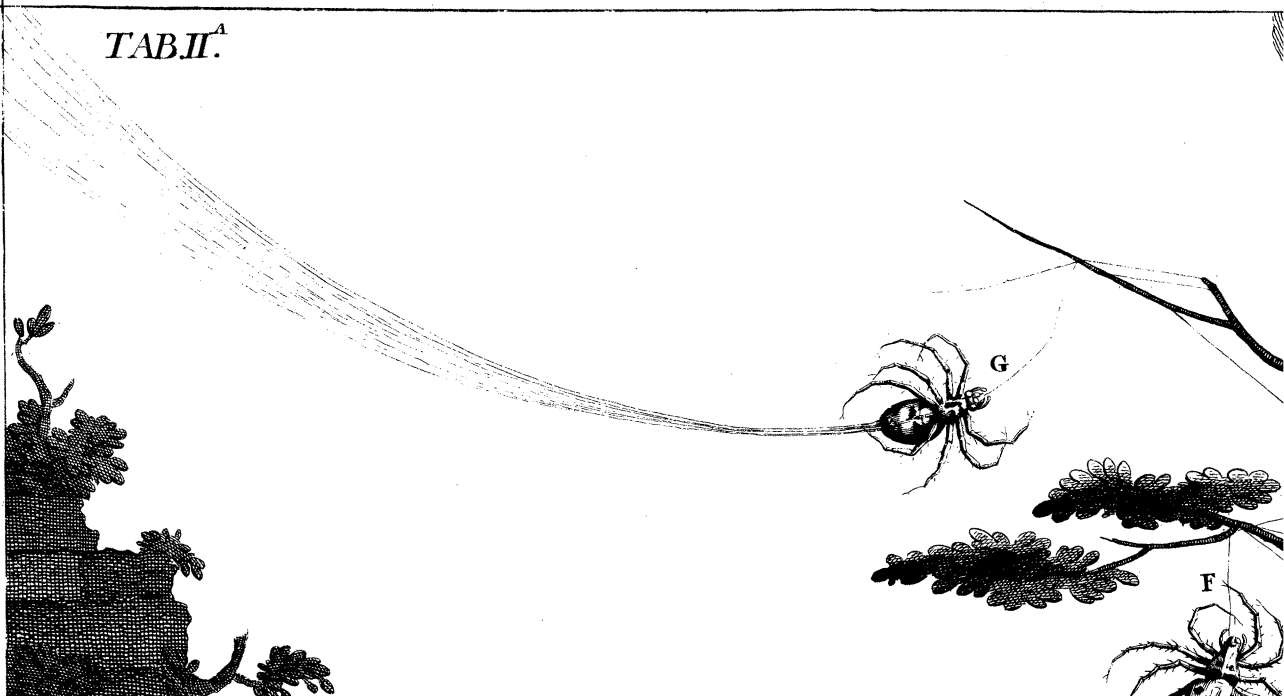
TAB. I.^A *Philos. Transact. N. 325.*



TAB. III.^A



TAB. II.^A



B.III.^A

fig: 3.

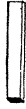


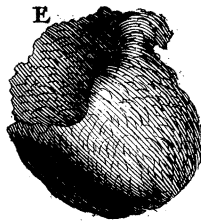
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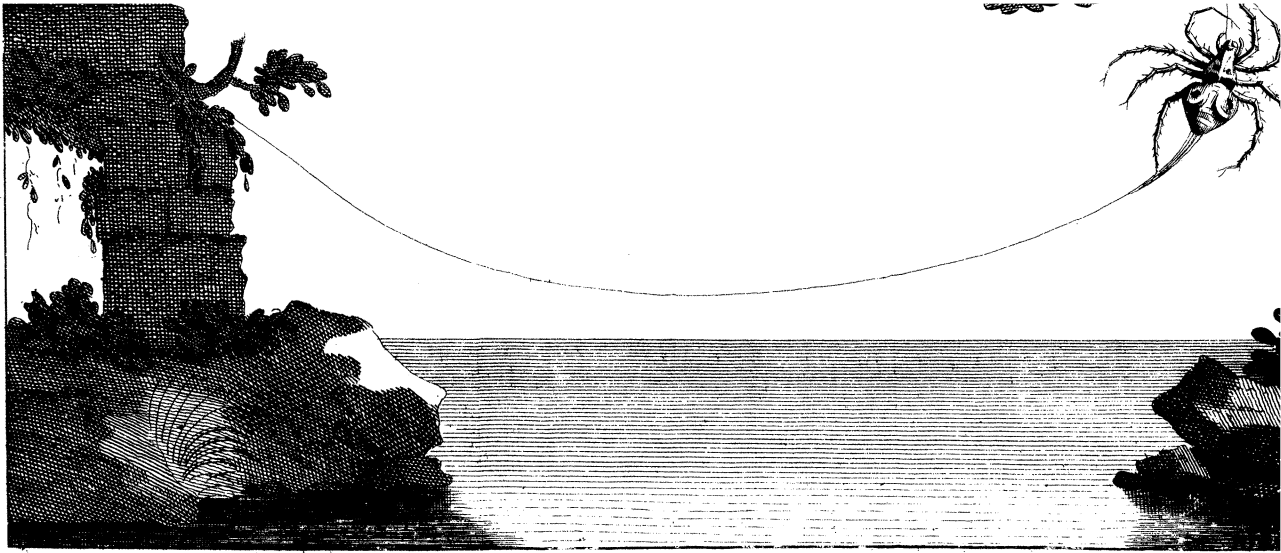


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fig: 8.





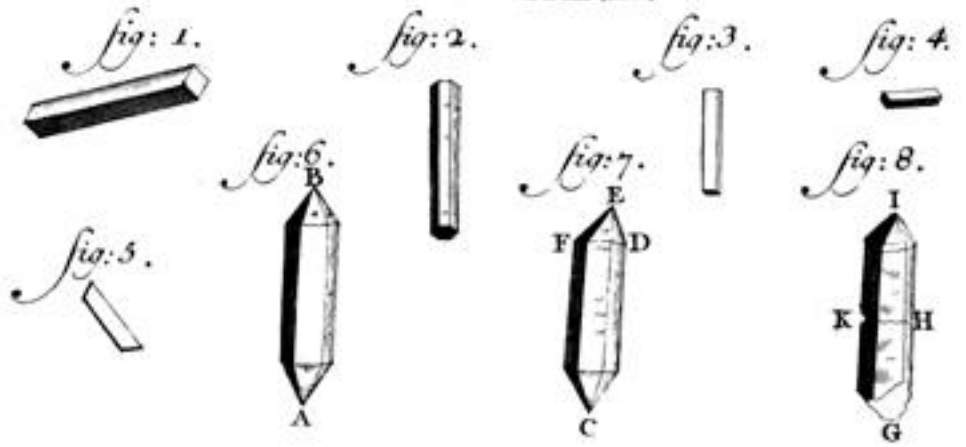


N. 1. 6. Fuchs-Spide

TAB. I. *Philos. Transact. N. 325.*



TAB. III.



TAB. II.

