Margaret Cavendish and the Rhetoric and Aesthetics of the Microscopic Image in Seventeenth-Century England

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> There is, it would seem, in the dimensional scale of the world a kind of delicate meeting place between imagination and knowledge, a point, arrived at by diminishing large things and enlarging small ones, that is intrinsically artistic (Vladimir Nabakov).[1]

In his 1989 article "Rhetoric and Graphics in *Micrographia*," John T. Harwood argued that in presenting his microscopic findings to the public Robert Hooke employed a "rhetoric of graphics," that is to say, a range of "strategies for linking not only text and image but larger segments of texts and images to make a broader argument about mechanical philosophy."[2] In this paper I consider how Hooke and Henry Power sought to rhetorically establish the truthfulness of the visual images produced by their instruments, and how a *counter-rhetoric* of visuality was established by Margaret Cavendish in her critique, *Observations upon Experimental Philosophy*, using a very different set of strategies, aimed at discrediting and undermining the mechanical philosophy whilst simultaneously establishing the authority of her own method of philosophising. Although Cavendish's attitudes towards the use of the microscope and experimental philosophy have already received

[1] Vladimir Nabokov, *Speak, Memory: An Autobiography Revisited* (London: Weidenfield and Nicolson, 1967, reprint (Harmondsworth: Penguin Books, 1969), pp. 130–131.

[2] Robert T. Harwood, "Rhetoric and Graphics in *Micrographia*" in Michael Hunter and Simon Schaffer (eds.), *Robert Hooke: New Studies* (Bury St Edmunds: The Boydell Press, 1989), pp. 119-147 at p. 123.

a fair amount of critical attention,[3] up to now critical accounts have tended to focus on her contestation of male-dominated scientific practices rather than on the epistemological issues surrounding the status of the visual image in the natural philosophy of the period.[4] In what follows I shall examine the ways in which the micrographic texts of Hooke and Power sought to lend credibility to the microscopic enterprise by emphasising the image as the appearance of the truth of nature itself, and how Cavendish sought to overturn this through an attack on the new "visual technology" of the microscope and the visual images which it produced.

Cavendish's objections to the microscopic project and its truths claims is both epistemological and methodological. The microscopists belief that magnification revealed the truth of nature ran counter to Cavendish's belief that no individual could possibly grasp the infinite truth of nature. "Nature being infinite,' she argued, 'cannot be pictured or patterned by any finite particular Creature."[5] Microscopy did not reveal

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[3] On Cavendish and the micrography see Stanton J. Linden, "Margaret Cavendish and Robert Hooke: Optics and Scientific Fantasy in *The Blazing World*" in Richard Caron, Jocelyn Godwin, Wouter J. Hanegraff and Jean-Louis Viellard-Baron (eds.), *Esoterisme, Gnoses et Imaginaire Symbolique: Melanges offerts à Antoine Faivre* (Louvain: Peeters, 2001), pp. 611–23. Jo Wallwork, "Old Worlds and New: Margaret Cavendish's Response to Robert Hooke's *Micrographia*" in Jo Wallwork and Paul Salzman (eds.), *Women Writing, 1550-1750* (Bundoora: Meridian, 2001), Anna Battigelli, "Between the Glass and the Hand: The Eye in Margaret Cavendish's Blazing World," *1650-1815: Ideas, Aesthetics, and Inquiries in the Early Modern Era*, 2 (1996), 25-38.

[4] Keller, for example, sees Cavendish's *Observations* as "a proto-feminist critique of the rational bases of mechanical science" (Keller, "Producing Petty Gods," p. 451), while Lisa Sarasohn sees Cavendish's critique of the Royal Society as an attack "on the authority of a male-dominated science, and, by implication, an attack on male authoritarianism." See Lisa T. Sarasohn, *The Natural Philosophy of Margaret Cavendish: The Natural Philosophy of Margaret Cavendish* (Baltimore: Johns Hopkins University Press, 2010), p. 294. The most sustained study of the epistemological status of microscopic observations is Catherine Wilson, *The Invisible World. Early Modern Philosophy and the Invention of the Microscope* (Princeton University Press, 1995), although she does not discuss Cavendish's critique of microscopy.

[5] Margaret Cavendish, *Observations upon Experimental Philosophy* (London: A. Maxwell, 1666), p. 75.

the "Truth of Nature," but made the microscopist blind to anything but the images produced by their devices.[6] Another obstacle to knowledge was the fact that microscopes only delivered images of the exterior parts of the objects under scrutiny. Her own natural philosophy consisted in finding probable reasons for the phenomena of nature based on motions which were not visible to the eye, but were conceivable by the 'eyes' of speculative reason. While the microscopists criticised speculative philosophy and championed a new natural philosophy based on observations made by instruments, Cavendish favoured a combination of 'natural' or 'regular' perceptions (i.e., those made with the unaided aid eye) and the speculative powers of reasoning. "[O]ur exterior senses," she insisted, cannot give a "true information" of an object's "interior parts" and motions. "The truth is, or exterior senses can go no further then the exterior Figures of Creatures, and their exterior actions, but our reason may pierce deeper, and consider their inherent natures and interior actions," or at least give a plausible account of them (for "there can be no perfect or universal knowledg in a finite part").[7] Cavendish's critique of the microscopic project then, defends her own "Contemplative-Philosophy"[8] against the new methodology of the experimentalists who sought to disparage speculation, but also defends a measured probablism from the unbridled epistemological optimism of the Royal Society.

1. Robert Hooke and the rhetoric of magnification.

In his preface to the *Micrographia* (1665) Hooke argued that microscopes and other "*artificiall Instruments* and *methods*" represented the means of a "reparation

[6] Cavendish, *Observations*, p. 72.
[7] Cavendish, *Observations,* pp. 92–3.
[8] Cavendish, Observations, p. 87.

[…] for the mischiefs, and imperfection, mankind has drawn upon it self, by negligence, and intemperance, and a wilful and superstitious deserting [of] the Prescripts and Rules of Nature [...]."[9] The biblical fall, Hooke argues, has rendered the senses "far short of the perfection they seem capable of." These "infirmities" he ascribes to a "double cause": the "*disproportion of the Object to the Organ*" or the incorrect presentation of the object when perceptions are "not received in a right manner."[10] The "several defects" of the senses, he says, can find "assistances" which may "*inlarge* their power."[11] Thus magnification is mediated through a discourse which suggests that the magnified image is *remedial* – effecting an improvement of sight which is at once ethical and truthful. The first thing to be undertaken in this "weighty work," Hooke insisted, was "a *watchfulness over the failings* and an *inlargement of the dominion*, of the Senses." Instruments such as the microscope were to be considered prosthetic, "supplying […] infirmities […] and, as it were, the adding of *artificial Organs* to the *natural*."[12]

This prosthesis is not only an improvement of the senses, but also of the intellect, creating a "new visible World discovered to the understanding,"[13] for "not having a full sensation of the Object, we must be very lame and imperfect in our conceptions about it."[14] Magnification is thus presented as a plenitude: the partial (because partially seen) object of intellection becomes "full" when we overcome the scalar disproportion between the eye and the visible object. The "misguided apprehensions" of unaided sight are seen as taking "the *shadow* of things for the *substance*," "small *appearances*" being mistaken for "good *similitudes*." The magnified image, by

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[9] Robert Hooke, *Micrographia* (London, 1665), "The Preface," sig. a^{r}.
[10] Hooke, *Micrographia*, sig. a^{v}.
[11] Hooke, Micrographia, sig. a^{r}.
[12] Hooke, *Micrographia*, sig. [a2]^{r}.
[13] Hooke, *Micrographia*, sig. [a2]^{v}.
[14] Hooke, *Micrographia*, sig. a^{v}.

implication, overcomes the deceptive veil of phenomenal appearances to reveal essences: "the true nature of the things themselves."[15]

These claims for the revelatory intensity of the micro-image are rhetorically assisted by the spectacular engravings which adorned Hooke's *Micrographia*, which were intended to visually demonstrate the verbal claims and to persuade the reader through the forceful immediacy of the image. In presenting "new Worlds and *Terra-Incognita's*"[16] to the reader's view, Hooke needed to convince them that what they saw was indeed what they had perceived. Thus, he assures the reader that the "delineated Subjects" are fully explicated by the "descriptions annext" to them, and that the engravers had "pretty well follow'd" his "directions and draughts." These engravings he emphasises are designed not to delight but "to discover the true appearance, and next to make a plain representation of it."[17] The need to affirm the reliability of his illustrations (after he has warned his readers against the dangers of "*mistaken Images*")[18] is particularly important because with

> these kind of Objects there is much more difficulty to discover the true shape, then of those visible to the naked eye, the same Object seeming quite differing, in one position to the Light, from what it really is [...].[19]

He seeks to alleviate this problem by beginning his drawings only after "many examinations in several lights and in several positions" until he had "discover'd the

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[15] Hooke, *Micrographia*, sig. a^{v}.
[16] Hooke, *Micrographia*, sig. [d2]^{v}.
[17] Hooke, *Micrographia*, sig. [f2]^{v}.
[18] Hooke, *Micrographia*, sig. [b2]^{r}.
[19] Hooke, *Micrographia*, sig. [f2]^{v}.

true form" of what he was observing.[20] By insisting upon the pains which he took with his initial observations and his graphic recording of them, and his emphasis on the preservation of the "true form" in the transition from draught to engraving, Hooke legitimates his printed observations as valid and truthful. Despite his protestations, however, it was clear that Hooke was not entirely confident that he had resolved the issue of the unstable image, and his description of the process only makes the potential for departing from the original observational data apparent to the critical reader. However much he might claim to have supervised and monitored the engraving process, the final image was the responsibility of the individual engraver and his facility with the burin.

Hooke ends his preface on a rhetorical flourish, in which he tries to establish the aesthetic as well as the intellectual importance of the microscopic image, by striving to undermine potentially disparaging comparisons:

> [I]t is my *hope*, as well as *belief*, that these my *Labours* will be no more comparable to the *Productions* of many other *Natural Philosophers*, who are now every where busie about *greater* things; then my *little Objects* are to be compar'd to the greater and more beautiful *Works of Nature*, A Flea, a Mite, a Gnat, to an Horse, an Elephant, or a Lyon.[21]

Hooke falters here, as he seems unsure himself that the "little" objects he has chosen might be unworthy of the trouble and expense which has been lavished upon them. The insistence on "belief" as well as "hope" seems defensive, and he seems to fear

[20] Hooke, *Micrographia*, sig. [f2]^{v}.
[21] Hooke, *Micrographia*, sig. [g2]^{v}.

that his efforts might appear trivial to his colleagues working on the "noble" animals which inhabit the more familiar macroscopic world.

2. Henry Power and the aesthetics of the magnified image.

It was precisely the perceived weaknesses which opponents of microscopy capitalised on, stressing the trivial nature of the microscopic object by dwelling on the disproportion between the size of the objects and the efforts expended upon them, and by exaggerating the imperfection, ugliness and monstrosity of some of its subjects. But the disproportion between macro- and microscopic scales was also a potential source of positive rhetoric. Hooke himself suggested that the microscopic imperfections revealed in products of human art were matched by a corresponding increase in beauty in microscopic nature: "in all [… art's] productions, even in those which seem most neat […] the more we see of their *shape*, the less appearance will there be of their *beauty*: whereas in the works of *Nature*, the deepest Discoveries shew us the greatest Excellencies."[22] In Henry Power's *Experimental Philosophy* (1664), this aestheticising of the microscopic object is achieved by creating pleasing analogies between the microscopic object and the familiar domestic environment of his bourgeois readers.[23] While Power's "design" was – as Hooke suggests – "only to print Observations without Pictures,"[24] it makes extensive use of a visual rhetoric which presents the images described before the mind's eye of the reader in an appealing fashion, as a kind of "microscopic ekphrasis."

[22] Hooke, *Micrographia*, p. 2.
[23] On Power's aesthetic exploitation of analogies between the micro- and macro-world and his "archness of style" see Wilson, *The Invisible World*, pp. 85–6.
[24] Hooke, *Micrographia*, p. 2.

For Power the microscopic image presents itself as a striking aesthetic object – a "glorious spectacle to behold."[25] The eye of a flea, he says, is "beset round with a greenish glistering circle, which is the Iris, (as vibrissant and glorious as a Cats eye) most admirable to behold." This "admirable" beauty seems to him striking enough to suggest the hand of a skilful craftsman or artist, who lavishes careful attention on even the smallest of details: "How critical is Nature in all her works!" he exclaims, "that to so small and contemptible an Animal hath given such an exquisite fabrick of the eye [...]."[26] The objects of microscopy might – as Hooke feared – seem "contemptible", but the ingenuity of the craftsmanship involved in their creation argued otherwise. Of the butterfly he notes:

> This Animal might well deserve our Observation without the assistance of a *Microscope*; for who does not admire the variegated diversity of colours in her expansed wings? Which do not onely out-vye the Peacock in all his pride, but does [...] far out-go the strip'd bravery of the Tulip […]? But view them in the *Microscope*, and you may see the very streaks of the Coelestial pencil that drew them.[27]

The microscopic spectacle hyperbolically exceeds the larger-scale beauties and represents an intensified, pleasurable acknowledgement of the divine wisdom – and divine draughtsmanship – in nature.

As he struggles to find a descriptive language commensurate to the task of expressing the unfamiliar surfaces and textures of the micro-world, Power draws

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[25] Henry Power, *Experimental Philosophy* (London, 1664), p. 13.
[26] Power, *Experimental Philosophy*, pp. 1–2.
[27] Power, *Experimental Philosophy*, p. 7.

partly on the familiar domestic environment and partly on more exotic visual narratives. The "diaphanous and transparent" body of the louse, for example, is said to be made up of "Escallop'd protuberances" and "Gauntlet-work" (terms taken from costumery),[28] the eye of a butterfly is "white like Alabaster, diced or bespeck'd here and there with black spots (like checker'd Marble)," the body of a woodlouse is "like polish'd silver," while the eye of a horse-fly is said to be "an incomparable pleasant spectacle […] black and waved, or rather indented all over with a pure Emerauld-green so that it looks like green silk Irish-stitch, drawn upon a black ground, and all latticed or chequered with dimples," while the body "looks like silver in frost-work, onely fring'd all over with white silk [...]."[29]

This tendency to make analogies with expensive fineries has the effect of commodifying the micro-image, presenting the reader-purchaser with a composite of attractive vendables. The analogies can be more quotidian, however. The eye of a "common fly," for example, is "neatly dimpled with innumerable little cavities like a small grater or thimble," and the sting of a bee is said to be "hollow and tubulous (like a Shoomaker's-punch)."[30] Other images oscillate between the exotic and the familiar: the eyes of a house spider are "like a Locket of Diamonds, or a Sett of round Crystal-Beads," the eggs of a field spider are "like your counterfeit pearl" or "just like white Poppy seed," its body is "like white Amber imboss'd all over with black Knobs, out of […] which grows bristles […] like whin-pricks [i.e., the thorns of a gorse bush]."[31]

Power's first observation – that of the flea – is interesting in that it develops an extended analogy with military finery. His "head, body and limbs" are "all of blackish

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[28] Power, *Experimental Philosophy*, p. 9
[29] Power, *Experimental Philosophy*, pp. 6–7, 10.
[30] Power, *Experimental Philosophy*, pp. 4–5. On the use of everyday imagery to describe the "new world" revealed by the microscope see Wilson, *The Invisible World*, p. 62.
[31] Power, *Experimental Philosophy*, pp. 12–13, 15.

armour-work, shining and polished with jemmar's," covered with hairs "like so many Turnpikes as if [… it was] palysado'd about by them." Nature has "armed him […] *Cap-a-pe* like a Curiazier in warr, that he might not be hurt by the great leaps he takes."[32]

Many of the images, because of their unfamiliar components and juxtapositions, result in compound analogies which can usefully be compared with the rococo excesses of the "material portraits" of Giuseppe Arcimboldo (1527-1593) or the artificially-constructed composite animals of the curiosity cabinet.[33] Thus the fly is:

> as it were from head to tayl studded with silver and black Armour, stuck all over with great black Bristles, like Porcupine quills, set all in parallel order […] her wings look like a Sea-fan with black thick ribs […] which are webb'd between with a thin membrane or film like a slice of Muscovy-glasse.[34]

While Power's book is not able to avail itself of the graphic rhetoric of Hooke's engravings, it is able to vend its commodified images in intensely visual narratives. A disturbing aspect of these aesthetic narratives (an aspect which it shares with comparative anatomy performed on living animals in this period)[35] is the frequency with which his "glorious spectacles" end in the death of the specimens – a fact rendered more unsettling by the persistent gendering of the insect-subject as female.

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[32] Power, *Experimental Philosophy*, p. 2
[33] On "natural metamorphes" in the curiosity cabinet see Stephanie Bowry, "Before Museums: The Curiosity Cabinet as Metamorphe," *Museological Review*, 18 (2018), 30– 42 (33-4).
[34] Power, *Experimental Philosophy*, pp. 4–5.
[35] On experiments involving living animals in the seventeenth century see Jole Shackelford,*William Harvey and the Mechanics of the Heart* (New York: Oxford University Press, 2003), pp. 32–3, 70–71, 113–114, 132–3 and "Animal Experiments in Biomedical Research: A Historical Perspective," *Animals* 3:1 (2013), 238–273.

Take the field spider, for example: "This Spider was a very pleasant spectacle: having cutt off her legs, and layd her flat with her belly upon the object-plate, I perceived a round knob […] which proved to be her head."[36] Likewise, after admiring the "frost work" of the fly, Power proceeds to tell us that "After her head is cut off you shall most fairly see (just at the setting on of her neck) a pulsing particle (which certainly is the heart) to beat for half an hour most orderly and neatly through the skin."[37] Each experiment seems to conclude in an act of violence against the "glorious spectacle." The heart of a louse is "prick'd" and observed until Power "could not perceive any life or motion after," while the tongue of a butterfly is "cut out and laid on the object-plate."[38] A house fly is "prick[ed with] a pin through the eye," and Power notes "you shall finde more blood there, then in all the rest of her body."[39]

3. Margaret Cavendish: False Informations of the Optick Sense

In her critique of the newly-founded Royal Society, *Observations upon Experimental Philosophy*, published in 1666, Margaret Cavendish produces a counter-experimental observational narrative. As Emma Wilkins has argued, this critique was part of a broader dissatisfaction with experiment and particular observations as a foundation for natural knowledge.[40] One of the most original aspects of her critique, however, was her criticism of microscopy as a kind of violation of nature.. In a chapter criticising Hooke's beliefs "concerning the Generation of Butter-flies […] by the way of Eggs," Cavendish counters his visual narratives with an observational

[36] Power, *Experimental Philosophy*, p. 14.
[37] Power, *Experimental Philosophy*, p. 7.
[38] Power, *Experimental Philosophy*, pp. 8–9.
[39] Power, *Experimental Philosophy*, p. 5.
[40] Emma Wilkins, "Margaret Cavendish and the Royal Society," *Notes and Records of the Royal Society of London*, 68.3 (2014), 245–260, esp. 248–251.

narrative of her own ("a short account of what I myself have observed.") Replacing a rhetoric of "artificial Sense" with an observational rhetoric of a "perfect natural Eye," which speculates benignly rather than destroying the object of study. A maid having brought her what seems to have been a chrysalis, Cavendish records her speculations:

> [I]t was about the length of half an inch or less, the tail was short and square, and seemed to be Vegetable, for it was as green as a green small stalk, growing out of the aforesaid piece of stone or wood; the part next the tail was like a thin skin, wherein one might perceive a perfect pulsation, and was big in proportion to the rest of the parts; The part next to that, was less in compass, and harder, but of such a substance as it was like Pewter or Tin: The last and extreme part opposite to the first mentioned green tail […] seem'd like a head, round, onely it had two little points or horns before, which head seem'd to the eye and touch, like a stone, so that this Creature appeared partly a Vegetable, Animal and Mineral; But what is more, it was in a continual motion […] But I cutting and dividing its tail from the said piece, it ceased to move, and I did not regard it further.[41]

After a space of time she returns to the closed room and notices two butterflies. "[F]inding the insect all empty," she says, "I supposed [the butterflies] had been bred out of it," comparing the chrysalis husk to "the skin of a Snake when it is cast."[42]

She refuses to "certainly affirm" the truth of her statement because she "could not discern them with [… her] eyes," because she was unwilling to dissect the creature:

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[41] Cavendish, *Observations*, pp. 26–7. See Brandie Siegfried, "Anecdotal and Cabalistic Forms in *Observations Upon Experimental Philosophy*" in Line Cottegnies and Nancy Weitz (eds.) *Authorial Conquests: Essays on Genre in the Writings of Margaret Cavendish* (London: Associated University Presses, 2003), pp. 59–79, at 73-4.

[42] Cavendish, *Observations*, pp. 27–8.

"had I opened this insect," she says, "it might perhaps have given those Butter-flies an untimely death, or rather hinder'd their production." Although she does not explicitly criticise the practice of microscopic dissection there does seem to be an implicit ethical critique of the taking of animal life.[43] Her researches were brought to a halt, she says, "except I had had some Microscope, but a thousand and one I might have been also deceived by it."[44] Rather than destroying an animal life in the pursuit of knowledge, she preferred to speculate on the 'exterior figures of Creatures', even though she could only 'probably guess' at the causes of them.[45]

This critique is part of a much larger project to discredit the experimental philosophy which found an important crux in the critique of the truth claims of the "brittle Art" of microscopy.[46] Whilst not explicitly identifying its opponents the *Observations* engages point-by-point with passages in the works of Hooke and Power. The primary function of the *Observations* (as with many of Cavendish's works written after her *Philosophical and Physical Opinions*) is to legitimate her own philosophical system by discrediting those of her perceived opponents. She argues, for example, that "I have but little faith […] in Telescopical, Microscopical, and the like inspections," she says in her prefatory epistle to her husband William, preferring her own "rational and judicious Observations," to the "deluding Glasses and

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[43] In the "Further Observations Upon Experimental Philosophy," however, Cavendish does criticise the practice of anatomy, and anatomy on living creatures in particular. Her criticism is more epistemological, than ethical: "the dissecting of a living Creature can no more inform one of the natural motions of the figure, then once can by the observing of an egg, be it never so exact, perceive the corporeal figurative motions that produce or make the figure of a Chicken." See "Further Observations," p. 54.
[44] Cavendish, *Observations*, pp. 27–8.
[45] Cavendish, Observations, p. 93.
[46] Cavendish, *Observations*, sig. A3^{r-v}.

Experiments" of Hooke, Power and other experimental philosophers.[47] While this sounds like a very general remark, the stress on "rational" – as opposed to the empirical or experimental – is extremely value-laden in Cavendish's philosophical discourse, and is central to her concept of natural philosophy as a product of the autonomous operations of the "wit" or "fancy" of the philosopher, which makes plausible speculations based on observations made with the naked eye.[48] The *Observations*, then, strives to undermine and negate the bases of observational experimentalism and in particular its instruments.

Against the experimental philosophers' optimistic claims that the microscope and telescope were effecting a restoration of "fallen" perception, Cavendish insists on the limited capabilities of artificial aids and stresses the partial and relative viewpoints of individual experimenters:

> Some are of the opinion, *That by Art there can be a reparation made of the Mischiefs and Imperfections mankind has drawn upon it self* […] But the all-powerful God, and his servant Nature, know, that Art, which is but a particular

[47] Cavendish, *Observations*, "To His Grace the Duke of Newcastle," sig. b^{v}. It should be remembered, however, that Cavendish's objections to the experimental philosophy was strategic rather than absolute. In a passage which seems to concede most to the experimentalists Cavendish wrote: "[A]lthough Experimental Phylosophy is not to be rejected, yet the Speculative is much better, by reason it guides, directs and governs the Experimental; but as knowledg and understanding is more clear, where both the rational and sensitive perception do join; so Experimental and Speculative Philosophy do give the surest informations, when they are joined and united together." See Cavendish, *Further Observations*, p. 82. NB the *Further Observations* is in the same volume as the *Observations*, but numerated separately.

[48] On "Wit" and "Fancy" in Cavendish's philosophy, see Sarasohn, *Margaret Cavendish*.

> Creature, cannot inform us of the Truth of the Infinite parts of Nature, being but finite it self.[49]

Hooke insisted on the ability of enhanced perceptions to improve intellectual conception, claiming that "The Science of Nature has been already too long made only a work of the *Brain* and the *Fancy*: It is now high time that it should return to the plainness and soundness of *Observations* on *material* and *obvious* things," and that philosophers should leave "*invisible Notions*" to follow "*sensible paths*."[50] Cavendish was vigorously opposed to this philosophy on the grounds that "Sense […] is more apt to be deluded then Reason, [and so] cannot be the ground of Reason […]. Wherefore discourse shall sooner find or trace Natures corporeal figurative motions, then deluding Arts can inform the Senses."[51] In her philosophical discourses Cavendish champions precisely the "work of Brain and Fancy" which Hooke condemns. While Hooke claimed that it was:

> not improbable, but that by these helps [i.e., microscopes] the subtility of the composition of Bodies, the structure of their parts […] and [the] manner of their inward motions […] may come to be more fully discovered.[52]

While both Hooke and Cavendish want to gain access to the hidden truth of nature, Cavendish denied that these 'inward motions' were accessible to microscopic

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[49] Cavendish, *Observations*, p. 5. Cf. on the same page: "every Creature has a double perception, rational and sensitive, yet each creature […] has not an Infinite perception." On early modern microscopy and the reparation of fallen nature see Wilson, *The Invisible World*, pp. 65–7.
[50] Hooke, *Micrographia*, sig. b^{r}.
[51] Cavendish, *Observations*, p. 6.
[52] Hooke, *Micrographia*, sig. [a2]^{v}.

investigation. For Cavendish the 'subtility' of nature's workings was invisible to the eye, with or without the aid of a microscope. The 'interior motions of natural Creatures' are below the threshold of perception, and 'how these actions are performed inwardly, no Microscope is able to give us a true information thereof.'[53]

In the third chapter of the *Observations* ("Of Micrography and of magnifying and Multiplying Glasses") Cavendish declares herself "confident" that "this ... Art, with all its Instruments, is not able to discover the interior natural motions of any part or creature of Nature," even though she confesses that she has "neither studied nor practised that Art."[54] Not only does she question whether microscopes can reveal the hidden substructures of nature, she begins by questioning whether microscopes can even "represent ... the exterior shapes and motions [of nature] so exactly, as naturally they are."[55] Her primary objection is that optical instruments are, by their very nature, delusive artificial distortions of nature:

> Art makes Cylinders, Concave and Convex-glasses, and the like, which represent the figure of an object in no part exactly and truly, but very deformed and misshaped: also a Glass that is flaw'd, crack'd, or broke, or cut into the figure of Lozanges, Triangles, Squares, or the like, will present numerous pictures of one object. Besides, there are so many alterations made by several lights, their shadows, refractions, reflexions […] as the truth of an object will hardly be known; for the perception of sight […] goes no further then the exterior Parts of the object

[53] Cavendish, *Observations*, p. 149.
[54] Cavendish, *Observations*, p. 7.
[55] Cavendish, *Observations*, p. 7.

> presented; and although the Perception may be true, when the object is truly presented, yet when the presentation is false, the information must be false also.[56]

Microscopes, Cavendish maintained, present not heightened and intensified images of the natural objects, but rather "hermaphroditical […] mixt figures" which are "partly Artificial, and partly Natural."[57] She rhetorically emphasises the unnaturalness of the microscopic image by associating it with monstrosity: here through the contemporary figure of sexual monstrosity, the hermaphrodite. While Hooke and Power presented microscopic vision as revelatory – an engagement with the hidden real – Cavendish plays on the well-known properties of optical glasses to distort the visual image and deceive the eye.[58] Here magnification is a recognisable distortion and not an intensification of the real, reversing the polarities of Power's aestheticised image-composites to yield a monster:

> [P]ut the case they can present the natural figure of an object, yet that natural figure may be presented in as monstrous a shape, as it may appear mis-shapen rather then natural: For example; a Lowse by the help of a Magnifying-glass, appears like a Lobster, where the Microscope enlarging and magnifying each part of it, makes them bigger and rounder then naturally they are.[59]

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[56] Cavendish, *Observations*, pp. 7-8.
[57] Cavendish, *Observations*, p. 8.
[58] See esp., Stuart Clark, *Vanities of the Eye: Vision in Early Modern European Culture* (Oxford University Press, 2007). See also Wilson, *The Invisible World*, pp. 215-216.
[59] Cavendish, *Observations*, p. 8.

In this monstrous image, "each joynt will appear as a diseased, swell'd and tumid body, ready and ripe for incision."[60] She thus further undermines the magnified image by an unpleasant analogy with the diseased body.

Cavendish's counter-aesthetics of the microscopic image

While Power and Hooke legitimate their microscope images partly by adopting the terms of the aesthetic discourse of the visual arts (stressing the "glorious spectacle," the "pleasing," "handsome" or "curious" aspects of the natural image sketched by the "coelestiall pencil"), Cavendish uses the same discourse to undermine the status of the same images. "[N]o Glass presents the true picture of an object," she claims, but "oftentimes present[s] falsly the picture of an exterior object; I say, the Picture, because it is not the real body of the object which the Glass presents [...]."[61] The image is *the copy of a copy*, she says, "and there may easily mistakes be committed in taking Copies from Copies."[62] Not only does she invoke contemporary aesthetic prejudices against the reproduction of originals,[63] she also capitalises on naturalistic tastes in contemporary social portraiture in discrediting the microscopic image.[64] "[I]f

[60] Cavendish, *Observations*, p. 9.
[61] Cavendish, *Observations*, p. 9.
[62] Cavendish, *Observations*, p. 9.
[63] On the complex relationship between "original" and "copy" in the early-modern European art market see Charlotte Guichard, "What is Authenticity? New Insights in the History of Original and Autographic Painting in Early Modern Europe," *Annales. Histoire, Sciences Sociales*, 6 (2010), 1387–1401.
[64] On the significance of "likeness" in seventeenth-century European portraiture see P. T. A. Swillens, *Johannes Vermeer, Painter of Delft, 1632-1675* (Utrecht and Brussels: Spectrum Publishers, 1950), pp. 106–7, and Robert T. Petersson *Bernini and the Excesses of Art* (Florence: M & M Maschietto, 2002), p. 73: "portraiture always revolves around the question of likeness and seventeenth-century artists seriously pursued personal likeness."

the Picture of a young beautiful Lady should be drawn according to the representation of the Microscope," she argues, "it would be so far from being like her, as it would be like a humane face, but rather a Monster, then a picture of Nature."[65] As Duchess of Newcastle, Cavendish was, of course, extremely familiar with the current conventions of portrait painting, and a number of significant portraits of her survive, including a full-length portrait with her husband William Duke of Newcastle attributed to the Flemish painter Gonzales Coques (1614-1684) in 1662,[66] a portrait miniature,[67] and two full-length portraits (painted in 1665) attributed to the fashionable society portraitist Peter Lely (1618-1680).[68] Engraved portraits of her also featured prominently in her published writings, such as this one by Pieter Louis van Schuppen, after Abraham Diepenbeeck (see fig. 1).[69] However, as we can see from the poem by William Cavendish which accompanies the engraving, Cavendish was sceptical about the epistemic claims of portraiture. Cavendish's "beauty" – her mind – is, the poem

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[65] Cavendish, *Observations*, pp. 9–10.

[66] Now in the Staatliche Museen zu Berlin, Gemäldegalerie, Berlin. On Coques, see Marion Lisken-Pruss, *Gonzales Coques (1614-1684): Der kleine Van Dyck* (Turnhout: Brepols 2013).

[67] On the portrait miniature (painted c. 1645) see James Fitzmaurice, "The Intellectual and Literary Courtship of Margaret Cavendish," *Early Modern Literary Studies*, 14 (2004), https://extra.shu.ac.uk/emls/si-14/fitzinte.html, paragraph 3 of 16). Fitzmaurice notes Cavendish's enduring interest in the visual arts, and her tendency to describe microscopic images as "pictures" in the *Observations* (see paragraph 11 of 16).

[68] On Lely see C. H. Collins-Baker, *Lely & the Stuart Portrait Painters: A Study of English Portraiture before & after Van Dyck*, 3 vols. (London: Philip Lee Warner, Publisher to the Medici Society, 1912), vol. 1, Ch. XVI "Peter Lely (1618-1680)," pp. 138-176. For the two 1665 portraits of Cavendish (National Portrait Gallery, Ex. 1866, no. 862 and Welbeck) see the chronological list of Lely's portraits, vol. 2, p. 127 (Appendix I, items 128 and 129).

[69] Line engraving, c. 1653-1658, see National Portrait Gallery, NPG D11111. This engraving features as a frontispiece to Cavendish's *Poems, and Fancies* (1653 and 1668), *The Worlds Olio* (1655) *Playes* (1661 and 1668) and the second edition of *Natures picture drawn by fancies pencil to the life* (1671).

reminds us, "beyond the Skill/Of the best Paynter," and can only be "read" in her works, "By Phancy's Pencill drawne alone."[70]

The analogy between micrographic images and portrait painting allows Cavendish to mobilise three powerful rhetorical oppositions: good/bad likeness, beauty/monster, and falsehood/truth. These oppositions are powerfully fused in the following bizarre speculation, which pre-empts some of the stranger Lilliputian episodes in *Gulliver's Travels* by over sixty years:

> [P]erchance if a Lowse or Flea, or such like insect, should look through a Microscope, it would be as much affrighted with its own exterior figure as a young beautiful Lady when she appears ill-favoured by Art. I do not say this, as if Optick Glasses could not present the true figure of an Original; for if they do not exceed the compass of natural dimensions, they may; but when they endeavour to go beyond them, and do more then Nature has done, they rather present monstrous, then truly natural figures. Wherefore those, in my opinion, are the best Artists, that keep nearest to Natures Rules [...].[71]

While Cavendish here concedes here that the a microscope might be able to present a "true figure", she insists that in order to do so it would have to present the object at the same scale as it is perceived by the naked eye (not exceeding the object's "natural dimensions"). Cavendish here is invoking what might be called 'scalar decorum', a concept which is both aesthetic and epistemological. The unmagnified object is

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[70] In *Natures Pictures* (1656), Cavendish compared her "Romancicall Tales" to the artistry of Anthony van Dyck. Margaret Cavendish, *Natures pictures* (London: J. Martin, and J. Allestrye).
[71] Cavendish, *Further Observations upon Experimental Philosophy*, p. 13.

beautiful, natural and true, the magnified object ugly ('monstrous'), unnatural and false.

Not only does Cavendish exploit the aesthetic discourse of the micrographers to discredit microscopic images, she also uses their discussions of the variability and indeterminacy of the microscopic object to undermine the truth-status of their images. Micrographers, she says:

> [D]o confess themselves, that Flies, and the like, will appear of several figures or shapes, according to their several reflections, refractions, mediums and positions of several lights; which if so, how can they tell or judg which is the truest light, position, or medium, that doth present the object naturally as it is?[72]

Hooke himself noted the deficiencies of English microscopes which had apertures "so very small, that very few Rays are admitted, and even of those few there are so many false, that the Object appears *dark* and *indistinct*,"[73] and also concedes that with some objects "it is exceeding difficult […] to distinguish between a *prominency* and a *depression*, between a *shadow* and a *black stain*, or a *reflection* and a *whiteness* in the colour."[74] Hence the elaborate precautions he took in recording his observations which we discussed above. Although Hooke was able to convince himself that his microscope and his observational practice overcame the ambiguity and variability of

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[72] Cavendish, *Observations*, p. 9. Cf. pp. 24–5: "if the Reflections and Positious [*sic*] of Light be so various and different as Experimental Philosophers confess themselves ... how shall the object be truly known?"
[73] Hooke, *Micrographia*, sig. [d2]^{v}. On the deficiencies of contemporary microscopes see Wilkins, "Margaret Cavendish and the Royal Society," pp. 247–8 and Wilson, *The Invisible World*, pp. 81–4.
[74] Hooke, *Micrographia*, sig. [f2]^{v}.

the microscopic image, Cavendish capitalises on Hooke's candour and emphasises his own reflections on the instability of the image and builds it into a powerful counter-rhetorical tool.[75]

In the *Micrographia* Hooke expressed doubts about Henry Power's observations of the compound eye of the fly, noting that:

> The Eyes of a Fly in one kind of light appear almost like a Lattice, drill'd through with abundance of small holes; which probably may be the Reason, why the Ingenious *Dr. Power* seems to suppose them such. In the Sunshine they look like a Surface cover'd with golden Nails; in another posture, like a Surface cover'd with Pyramids; in another with Cones; and in other postures of quite other shapes.[76]

Cavendish builds upon this equivocal account in order to emphasise the weakness of its observational claims and to advance other possible explanations of the visual phenomena:

> I Cannot wonder enough at the strange discovery made by the help of the Microscope concerning the great number of eyes observed in Flies; as that, for example in a gray Drone-flie should be found clusters which contain about 14000 eyes […]. [I]t may be, perhaps, that those little pearls or globes, which were taken for eyes in the mentioned Flie, are onely transparent knobs, or glossie shining spherical parts of its body, making refractions of the rayes of light, and reflecting

[75] Wilson notes that the doubts and criticisms of microscopic observations expressed within the microscopical community "did not seriously challenge the assumption that the microscope was a truth-revealing instrument." Wilson, *The Invisible World*, p. 225.
[76] Hooke, *Micrographia*, sig. [f2]^{v}.

> the pictures of exterior objects, there being many Creatures, that have such shining protuberances and globular parts, and those full of quick motion, which yet are not eyes [… these] glossy and shining globular protuberances [… may be] Bubbles of Water, Ice, as also Blisters and watry Pimples, and hundreds the like, [which] are shining and transparent Hemispheres, reflecting light, but yet not eyes.[77]

Whereas Hooke re-invests in the truthfulness of the microscopic image by suggesting a number of practical "Remedies" to overcome the variability of the visual appearances, Cavendish uses what Hooke calls the "Inconveniences" of the microscope image to completely discredit it.[78] "Truly, my reason can hardly be perswaded to believe," she says, "that this Artificial Informer (I mean the Microscope) should be so true as it is generally thought; for in my opinion it more deludes, then informs [...]."[79] Cavendish re-interprets what Hooke calls the "fullness" of the visual image in magnification as an artificially produced and unnatural distortion of the "natural" figure in the macroscopic world:

> It is well known, that if a figure be longer, broader and bigger then its nature requires, it is not its natural figure, and therefore those Creatures, or Parts of Creatures, which by Art appear bigger then naturally they are, cannot be judged according to their natural figure, since they do not appear in their natural shape; but in an artificial one, that is, in a shape or figure magnified by Art.[80]

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[77] Cavendish, *Observations*, pp. 23–5.
[78] Hooke, *Micrographia*, sig. [d2]^{v}.
[79] Cavendish, *Observations*, p. 24.
[80] Cavendish, *Observations*, p. 24.

Once again the microscopic image is seen as a breach of scalar decorum, the magnified 'figure' cannot be a reliable guide to reason because it is unnaturally large and artificial. What is worse, their perusal of these artificial figures leads micrographers to make peremptory decisions about the causes of natural processes, and encourages an over-reliance on a limited range of explanatory concepts: "[They] stick so close to some particular opinions, and particular sorts of Motions or Parts, as if there were no more Motions, Parts or Creatures in Nature, then what they see and find out by their Artificial Experiments."[81] Cavendish's own natural philosophy insists upon an almost infinite variety of natural causes (albeit all reducible to various kinds of "corporeal figurative motion"), and she baulks at this explanatory parsimony.

Taking up Hooke's complaints about the technological inadequacy of the microscopes available at the time (but ignoring the technological optimism which he shared with Power), Cavendish emphasises the unreliability of the knowledge produced by such instruments: "[If] the instrument [is] not very exact (for who knows but hereafter there may be many faults discovered in our modern Microscopes which we are not able to perceive at the present) how shall the object be truly known?"[82]

Against Hooke's claims for the instrumental prosthesis or augmentation of the senses, Cavendish argues for the primacy of unaided natural vision supported by reason: "[T]he best optick is a perfect natural Eye, and a regular sensitive perception, and the best judg is Reason, and the best study is Rational Contemplation […] but not deluding Arts [...]."[83] In sum, she argues, "natural Reason is above artificial Sense" (and hence her own rationalist account of internal figurative motions is superior to the

[81] Cavendish, *Observations*, p. 86. Cf. p. 88.
[82] Cavendish, *Observations*, pp. 24-5.
[83] Cavendish, *Observations*, p. 12.

new scientific empiricism).[84] Natural reason has access to the interior forms to which the microscope (despite Hooke's and Power's corpuscularian claims) cannot have access. Microscopes, she claimed, can no more represent "interior form" than "Telescopes can [represent] the interior essence and nature of the Sun [...]."[85] The microscope could only deal with the externals and superficies of things, which can tell us nothing about their inner natures or hidden causes:

> [I]t is impossible that the exterior shape and structure of bodies can afford us sure and excellent instructions to the knowledg of their natures and interior motions, as some do conceive; for how shall a feather inform us of the interior nature of a Bird?[86]

No microscope, for example, is able to "present to our view [the] inward points" of "hot and burning" vegetables (i.e., spices) "by the inspection of the[ir] exterior figure and shape [...]."[87] Micrographers might be able to make images of animals, vegetables and minerals but they cannot make images of the elements.[88] In arguing for her philosophy of 'Fancy' (or 'Regular Reason'),[89] Cavendish manipulates the old Platonic prejudice that "Sense deludes more then it gives a true Information": an "exterior inspection through an Optick glass" must inevitably be "deceiving" and

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[84] Cavendish, *Observations*, pp. 12-13.
[85] Cavendish, *Observations*, p. 12.
[86] Cavendish, *Observations*, p. 42.
[87] Cavendish, *Observations*, p. 43.
[88] Cavendish, *Observations*, p. 45.
[89] In Cavendish's philosophy, the difference between "Fancy" (and imagination) and Reason is often collapsed. In her *Observations Upon the Opinions of some Ancient Philosophers*, Cavendish defined "Fancy, or Imagination" as "a voluntary action of Reason" (*Ancient Philosophers*, p. 39). "Regular reason" or "rational perception" is the "best informer and reformer of all sensitive Perception" (*Observations*, p. 3).

"cannot be relied upon."[90] It is only rational 'discourse' that can 'trace Natures corporeal figurative motions', speculating on the inward motions implied by the exterior figures of natural forms.[91] Cavendish undermines the status of visible evidence by stressing the phenomenal complexity of the act of perception itself. "[E]ven in one and the same animal sense," she argued, "as for example, of seeing, there are numerous perceptions; for every motion of the Eye, were it no more then a hairs breadth, causes a several perception [...]."[92] Believing as she did in the infinite mobility of the parts of matter, and the material constitution of intellection and perception, Cavendish sees acts of sensation as infinitely dissimilar to their objects:

> [I]t is not onely the five organs in an animal, but every part and particle of his body that has a peculiar knowledge and perception […]. Which if so, then a Looking-glass that patterns out the face of a Man, and a Mans Eye that patterns again the copy from the Glass, cannot be said to have the same perception, by reason a Glass, and an animal, are different sorts of Creatures.[93]

For Cavendish the coincidence between perception and object is a fortuitous one (relying on a similitude in the "patterning," or arrangement of independent aggregations of sentient parts of matter).[94] Eschewing both intromissive and

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[90] Cavendish, *Observations*, sig. d[r]. Cf. Plato *Phaedo*, 74–6. Cavendish might also have been aware of Descartes's insistence on the unreliability of the senses in *Meditations*, II.
[91] Cavendish, *Observations*, p. 6.
[92] Cavendish, *Observations*, p. 161.
[93] Cavendish, *Observations*, p. 161.
[94] On Cavendish and "patterning" see David Cunning, *Margaret Cavendish* (Abingdon and New York: Routledge, 2016), pp. 42–3, 160–161 and 189–190; Deborah Boyle, *The Well-Ordered Universe: The Philosophy of Margaret Cavendish* (Oxford: Oxford University Press, 2018), pp. 101–2, 105; Marcus P. Adams, "Visual

extromissive models of human perception, Cavendish argues that perceptions are 'not made by receiving either the figures of the exterior objects into the sensitive Organs, or by sending forth some invisible rayes from the Organ to the Object.' Nor is it (as it is in the natural philosophy of Hobbes) a merely mechanical operation 'by pressure and reaction'. Rather it results from the independent and autonomous activity of 'innate figurative motions' in the perceiving mind which chooses to imitate the objects around it.[95] Cavendish rejects the idea that objects 'cause' sensations in the sentient creature, but refers instead to "occasioned perception" (where the existence of objects in the world are merely 'occasions' for the patterning motions, which can occur without the presence of objects, as in the minds of a dreamer).[96] The independence of these patterning motions means that the microscopic image is "not the real body of the object" – but is simply the glass itself which "figures or patterns out the picture" of the body.[97]

In Cavendish's philosophy, then, instruments are disabled by their very material constitution from presenting a true image of reality. The unreliability of the perceptions of experimental philosophers is used by Cavendish to argue, paradoxically, for the utility of speculative philosophy:

> [O]ur age being more for deluding Experiments then rational arguments, which some cal a *tedious babble*, doth prefer Sense before Reason, and trusts more to the deceiving sight of their eyes, and deluding glasses, then to the perception of clear and regular Reason […] Thus reason must stoop to Sense, and the Conceptor to the

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Perception as Patterning: Cavendish against Hobbes on Sensation," *History of Philosophy Quarterly*, 33 (2016), 193–214.

[95] Cavendish, *Observations*, sig. [f2] recto. On the 'absurdity' of the mechanical account of reason cf. p. 161.

[96] Cavendish, *Observations*, sig. [g3] verso.

[97] Cavendish, *Observations*, p. 9.

> Artist, which will be the way to bring in Ignorance, instead of advancing knowledg [...].[98]

Whereas Power and Hooke both situate their micrographic discourses within a wider polemic on the usefulness of the experimental philosophy, Cavendish emphasises the lack of practical utility and triviality of microscopy as a scientific endeavour. Microscopes, she says, do the world "more injury then benefit," because they cause men to be "intoxicated" with the "exterior figures of objects," rather than inquiring into their true causes.[99] This obsession with images, she insists, is more "unprofitable" than the scholasticism which they criticise:

> [I]f Microscopes do truly represent the exterior parts and superficies of some minute Creatures, what advantages it our knowledg? For unless they could discover their interior, corporeal, figurative motions, and the obscure actions of Nature, or the causes which make such or such Creatures, I see no great benefit or advantage they yield to Man […]. [T]he inspection of a Bee, through a Microscope, will bring him no more Honey, nor [...] the inspection of dusty Atomes, and reflections of light, teach Painters how to make and mix Colours.[100]

Again Cavendish insists that the problem with microscopy is the focus on *exterior* figures, whereas nature can only be understand by reflecting on interior figurative motions which are "obscure" or invisible to the eye with our without the aid of an instrument.

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[98] Cavendish, *Further Observations*, p. 4.
[99] Cavendish, *Observations*, p. 10.
[100] Cavendish, *Observations*, sig. [c2]^{v}-d^{r}.

Micrographies are "superficial wonders," a vain and fruitless activity neither "advancing […] trade and traffick" (as Sprat had promised in his *History of the Royal Society*), nor decreasing "nice distinctions and sophistical disputes in Churches, Schools and Courts [...]."[101] In short:

> Magnifying-glasses are like a high heel to a short legg, which if it be made too high, it is apt to make the wearer fall, and at best, can do no more then represent exterior figures in a bigger, and so in a more deformed shape and posture then naturally they are.[102]

Margaret Cavendish defended her philosophy of "natural reason" with its emphasis on producing probable accounts of the infinite figurative motions of nature against the unqualified veridical claims of the new experimental philosophy, which claimed authority on the grounds of the "soundness of Observations on material and obvious things" by rhetorically contesting the visual narratives of microscopy, which was seen as a flagship of the experimental philosophy by the members of the Royal Society. Cavendish does this by adopting strategies developed out of the anxieties of the micrographers themselves regarding the reliability of their observations. By criticising perception as a basis of natural philosophical truth-claims, by the subversive handling of negative analogies and contemporary aesthetic values, Cavendish constructed a counter-meaning for magnification which excluded it definitively from the real.

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[101] Cavendish, *Observations*, p. 10.
[102] Cavendish, *Observations*, p. 12