It is often claimed that Margaret Cavendish was an anti-experimentalist who was deeply hostile to the activities of the early Royal Society—particularly in relation to Robert Hooke’s experiments with microscopes. Some scholars have argued that her views were odd or even childish, while others have claimed that they were shaped by her gender-based status as a scientific ‘outsider’. In this paper I examine Cavendish’s views in contemporary context, arguing that her relationship with the Royal Society was more nuanced than previous accounts have suggested. This contextualized approach reveals two points: first, that Cavendish’s views were not isolated or odd when compared with those of her contemporaries, and second, that the early Royal Society was less intellectually homogeneous than is sometimes thought. I also show that, although hostile to some aspects of experimentalism, Cavendish nevertheless shared many of the Royal Society’s ambitions for natural philosophy, especially in relation to its usefulness and the importance of plain language as a means to disseminate new ideas.

Keywords: Margaret Cavendish; Royal Society; experimentalism; microscopes

When Margaret Cavendish became the first woman to visit the Royal Society in May 1667, the occasion caused something of a stir. Cavendish was notorious among her contemporaries as the female author of plays, poetry, orations, essays and even works of natural philosophy.1 In one of these ‘scientific’ texts Cavendish had attacked the experimentalists of the Royal Society in general and Robert Hooke in particular.2 It was no wonder, then, that a large crowd had gathered to catch a glimpse of this controversial female virtuoso as she stepped over the Royal Society’s threshold. Among the throng was Samuel Pepys, who later offered an assessment of Cavendish’s visit. Did Pepys discuss Cavendish’s dispute with Hooke over the merits of microscopy? Did he examine her criticisms of experimental philosophy? Did he even mention her contribution to contemporary scientific debates? He did not. Instead, he confided to his diary that Cavendish was possessed of a ‘dress so antic’ and a ‘deportment so unordinary, that I do not like her at all’, although he conceded, with some relish, that she was nevertheless a ‘good comely woman’.3

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Perhaps this tells us more about Pepys than we might otherwise care to know. But it does reveal an important point about critical reactions to Cavendish: from the mid-seventeenth century onwards, commentators have often either ignored or trivialized her contribution to contemporary natural philosophy. Thus, for John Evelyn, Cavendish was a ‘mighty pretender to learning . . . and philosophie’, while his wife, Mary, could barely conceal her contempt for Cavendish’s ‘nonsense’. Writing in the nineteenth century, C. H. Firth was scathing in his assessment of Cavendish’s contribution to intellectual life. He confidently asserted that ‘the ponderous tomes on science and philosophy which . . . [she] published are entirely valueless.’ Samuel Mintz, who offered the first detailed account of Cavendish’s visit to the Royal Society, was sweeping in his criticisms. Cavendish was a ‘figure of fun’ mainly on account of her apparent ‘disregard for the methods and utilitarian aims of science’. A broad consensus began to emerge that Cavendish was an ‘anti-experimentalist’ who failed to understand the true significance of the methods employed by Robert Boyle, Hooke and other Royal Society luminaries. Mintz argued that Cavendish’s scientific works were ‘a plea . . . for less experimentalism in science’; another critic declared: ‘The experimental method she eschewed, spinning her theories from her own fantastic brain.’ A prime example of Cavendish’s apparent folly was her view that Hooke’s microscopes were ‘deluding Glasses’ rather than ‘true Informers’ about the nature of objects under scrutiny. These attacks were seen as wrong-headed, misconceived—even ‘child-like’.

More recently, Cavendish’s reputation has been rehabilitated by feminist historians and scholars of women’s history, who argue that her views have real worth and should be taken seriously. Evelyn Fox Keller has argued that Cavendish’s criticisms of the Royal Society were based not on ignorance but on her keen understanding of the principles involved. And Lisa Sarasohn, who has produced the most recent book-length treatment of Cavendish’s natural philosophy, argues that her views were ‘neither silly nor mad.’ However, it is striking that these recent accounts share the same established view that Cavendish was an anti-experimentalist who was fundamentally opposed to the practices of the Royal Society. Both Keller and Sarasohn argue that the relationship between Cavendish and the Royal Society was a hostile one, and both are convinced that it was shaped by gender. Excluded from the meetings of the Greshamites on account of her sex, Cavendish is said to have spoken with a bold, female voice of opposition to the ‘fathers of science’. Keller argues that Cavendish’s attacks on experimentalism were part of a gendered project to undermine and ‘ridicule’ the ‘masculinist science’ of the Royal Society. Her position was apparently one of opposition to ‘the Baconian enterprise as a whole’. Sarasohn’s account in particular emphasizes Cavendish’s supposed disregard for the Royal Society—an institution she is said to have viewed as ‘dangerous, useless, and deluded’. Cavendish’s physical isolation from the meetings of the Royal Society apparently mirrored her intellectual isolation from contemporary debates. Thus, Sarasohn argues that Cavendish’s critique of experimentalism ‘represents the perspective of the stranger . . . who is outside a community’. Similarly, Keller claims that Cavendish’s hostile assessment of the Greshamites was ‘a stranger’s account’ spoken from the ‘intellectual margins’.

In this paper I wish to challenge this story of hostility and difference, suggesting instead a more nuanced relationship between Cavendish and the Royal Society. Although some aspects of Cavendish’s work are undoubtedly anti-experimentalist—especially in relation to sensory experiments conducted with microscopes—I wish to
ask whether it is safe to make a connection between her hostility and her gender. In short, if Cavendish spoke up against the ‘fathers of science’, how significant was it that her voice was female? One way to answer this question is to examine Cavendish’s views in contemporary context. Did any other thinkers share her views? And if so, was their opposition to experimentalism shaped by gender—or were other factors at play? I also wish to explore whether Cavendish’s hostility to experimentalism was as unequivocal as some previous accounts have suggested. By examining her contributions to a series of contemporary debates in natural philosophy, I shall show the ways in which Cavendish shared, rather than deplored, some important parts of the Royal Society’s ethos and programme.

MICROSCOPES

Cavendish’s reputation for hostility towards the Royal Society rests largely on her critical assessment of microscopy, published in her 1666 text Observations upon Experimental Philosophy. To which is added, The Description of a New Blazing World. This volume was (at least in part) a response to the work of two pioneers in English microscopy, Henry Power and Robert Hooke, who had published their works in 1664 and 1665, respectively. The first point to make is that Cavendish’s early critics were wrong to claim that her assessment of microscopes was based on ignorance or childish folly. Not only was she particularly well read on the subject (in fact, she was one of the earliest readers in England of Power’s work) but she also had practical experience with the new scientific equipment. Her marriage to the Marquis of Newcastle—a man of immense wealth and a keen virtuoso—meant that Cavendish enjoyed greater opportunities than most when it came to experimenting with the latest instruments. During their exile in Paris during the 1640s, the couple acquired an impressive collection of microscopes and telescopes, two of which were made by Torricelli, the famous Italian experimentalist, and four by Eustachio Divino, of which the largest, the ‘Great Glass’, was 29 feet long. Cavendish owned her own microscope—‘my Lady’s multiplying glass’—which was 18 inches long, focused with a screw of 10 threads.

Cavendish’s familiarity with microscopes really did breed contempt. Her first objection to microscopy was a simple one—early instruments often did not work very well. Anyone who had actually used a seventeenth-century microscope knew that difficulties with the cutting and grinding of lenses often led to faulty and unreliable results. Cavendish pointed out that ‘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.’ The lighting of specimens presented further difficulties. Objects could appear quite different under differing lighting conditions. Indeed, Hooke himself confronted the problem in relation to the eyes of a fly. Thus:

in one kind of light [they] appear almost like a Lattice, drill’d through with [an] abundance of small holes . . . In 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 . . .

With these problems in mind, Cavendish demanded to know how the investigator could ‘tell or judg[e] which is the truest light, position, or medium, that doth present the
object naturally as it is?’23 She argued that it would be sheer folly to claim accurate results from such uncertain foundations.

The problems of lenses and lighting were, if you like, the known unknowns about the reliability of microscopes. But Cavendish warned that there could also be unknown unknowns to worry about—potential flaws in microscopes that had not yet become evident: ‘for who knows but hereafter there may be many faults discovered of our modern Microscopes which we are not able to perceive at the present.’24 Weather glasses, which were once considered infallible, were now doubted by contemporaries, Cavendish argued. Consequently, it would be unsafe to base claims of experimental truth on such ‘brittle, inconstant and uncertain ground’ as the untested microscope.25

Cavendish had further objections. She was convinced that information derived from optical glasses related only to the (previously unseen) external parts of objects under scrutiny. Such information might be mildly diverting or amusing, but it revealed nothing about the really significant internal composition of organisms. For example, she argued: ‘of this I am confident, that this same Art, [microscopy] with all its Instruments, is not able to discover the interior natural motions of any part or creature of Nature’.26 This failure on the part of microscopes was partly due to the complexity of the ‘interior motions’ within organisms; ‘for there are numerous corporeal figures or figurative motions of one particular Creature, which lie one within another, and most commonly the interior are quite different from the exterior; as for example, the outward parts of a mans body are not like his inward parts’.27

It was ‘improbable’ that man’s exterior senses (such as his eyes or ears) could perceive any of these complex ‘interior corporeal figurative motions of the parts of an animal body’, she argued.28 Unless or until investigators could use microscopes to reveal this internal information, they were simply wasting their time: ‘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’.29 It was this failure of microscopes on utilitarian grounds that Cavendish so deplored. Thus:

the inspection of the exterior parts of Vegetables, doth not give us any knowledge how to Sow, Set, Plant, and Graft; so that a Gardener or Husbandman will gain no advantage at all by this Art: The inspection of a Bee, through a Microscope, will bring him [i.e. the experimenter] no more Honey, nor the inspection of a grain more Corn . . . .30

Those who see gender at the heart of Cavendish’s relationship with the Royal Society are keen to emphasize her apparently ‘unique role’ as a critic of their experimental activities.31 Sarasohn in particular claims that ‘it was perhaps a woman who was best able to challenge the pretensions and power of the new science.’32 But how unique were Cavendish’s objections to microscopes?

In fact, what is striking about Cavendish’s criticisms is how similar they are to the views of two important contemporary thinkers, Thomas Sydenham and John Locke, who collaborated on an essay on microscopic anatomy just two years after Cavendish’s Observations appeared in print. In this essay, Sydenham and Locke echoed Cavendish’s view that microscopes failed to reveal the internal workings of organisms. Thus, Locke argued:
Now it is certaine and beyond controversie that nature performs all her operations on the body by parts so minute and insensible that I thinke noe body will ever hope or pretend, even by the assistance of glasses... to come to a sight of them... and though we cut into these inside, we see but the outside of things and make but a new superficies for ourselves to stare at.33

Sydenham was of the same mind, arguing that knowledge derived from microscopes was limited to 'the outer husk of the things that we would know.'34 No microscope, ‘however exquisitely elaborate’, could possibly penetrate the internal mysteries of organisms, he argued.35

Locke also shared Cavendish’s view that microscopy failed by the utilitarian standards of its principal exponents. Even if an investigator had a knife and eyesight ‘so sharp’ that he could minutely examine internal body organs, Locke doubted whether this would ‘at all contribute to the cure of the diseases of those very parts which we so perfectly knew.’36 Arguing that anatomy (or dissection) was no more useful than simple, practical cures, Locke claimed that

after all our porings and mangling the parts of animals[,] we know noething but the grosse parts, [and] see not the tools and contrivances by which nature works, and are as far off from the discoverys we aime at as ever.37

Thus it is clear that Cavendish’s supposedly ‘unique’ role was also being played out by Locke and Sydenham—an important point that emerges only by considering Cavendish’s views in context rather than in isolation from her intellectual milieu.38 This contextualized approach can have surprisingly positive results for scholars of Cavendish—her views may not have been unique, but it is surely significant that her objections appeared in print two years ahead of those of Locke and Sydenham.

So much for the content of Cavendish’s critique, but what about her style? Sarasohn makes much of Cavendish’s use of ridicule in her assaults on the Royal Society, arguing that she sought to turn ‘the pursuits of experimental philosophy into a game’ in order to ‘challenge male hegemony in natural philosophy.’39 It is true that Cavendish used ridicule as an effective strategy of criticism, seeking to infantilize members of the experimental community by comparing them to children. Thus Cavendish likened microscopists to ‘Boys that play with watry Bubbles, or fling Dust into each others Eyes, or make a Hobby-horse of Snow’.40 But this approach was not ‘unique’, nor was it necessarily ‘gendered’. In fact, Cavendish’s strategy was shared by Hobbes, who derided Boyle’s air pump, scoffing that it was ‘of the nature of a pop-gun which children use, but great, costly and more ingenious.’41

Cavendish, Locke, Sydenham and Hobbes may have been wrong about microscopes, but it is inappropriate to single out Cavendish’s objections as ‘silly’ or ‘childish’.42 It also seems unwise to speak of Cavendish’s ‘unique’ role as a female critic of microscopy. Indeed, it may be that the introduction of gender into the debate over mid-seventeenth-century microscopy is as deluding as one of Hooke’s cracked lenses.

‘Art’ versus ‘Nature’

Cavendish’s critique of microscopes should be seen in terms of a wider contemporary debate over the roles of ‘Art’ and ‘Nature’ in scientific enquiry. Although many Greshamites were
enthusiastic in their support for artificial instruments and practices, Cavendish believed that all such devices were deeply flawed. Indeed, she claimed that the very artificiality of microscopes counted against them as reliable truth-tellers—regardless of whether the lenses were well cut or the lighting conditions were acceptable. Thus: ‘all such Arts [as microscopy] prove rather ignorant Follies, than wise Considerations; Art being so weak and defective, that it cannot so much assist, as doth hinder Nature’.

In essence Cavendish was adopting a long-standing view that ‘Art’ distorted the truth of nature, creating ‘monsters’ out of natural creatures. After the publication of Hooke’s illustrations, Cavendish was able to see these ‘artificial Monsters’ displayed in dazzling detail on the printed page. For example, under magnification, the tiny louse appeared like a ‘lobster’—she asked where the scientific truth could lie in such a representation.

Artificial instruments seemed to distort the very reality they were designed to reveal, which meant that ‘those Arts are the best and surest Informers, that alter Nature least, and they the greatest deluders that alter Nature most’.

Cavendish’s motivation is important here: she was not arguing against scientific enquiry per se; rather, she was deeply troubled by the uncritical enthusiasm for enquiry based on artifice. Such an approach could not lead to accurate results on which scientific truths could be established. Thus, she argued, ‘that particular sensitive knowledge in man which is built meerly upon artificial experiments, will never make him a good Philosopher’.

Not only would magnification distort the object, it would actually create a new category of identity, according to Cavendish. In her view, the subjects of Hooke’s investigations existed in some kind of categorical limbo between Art and Nature. Thus she claimed that ‘Art is not onely gross in comparison to Nature, but, for the most part, deformed and defective, and at best produces mixt or hermaphroditical figures, that is, a third figure between Nature and Art’. Such was the enthusiasm for microscopes that her contemporaries had abandoned critical thinking and failed to consider this new category of identity. Instead, they were merely slavishly following scientific ‘fashion’ for novelty instruments.

Cavendish had a point about the ‘hermaphroditical figures’: Hooke’s engravings were composites—produced by compiling many images of the objects under scrutiny. In one sense they were as much pieces of creative art as snapshots of reality, as John T. Harwood and others have argued.

On the face of it, Cavendish’s support for ‘Nature’ against ‘Art’ looks like good evidence of hostility at the heart of her relationship with the Royal Society. However, it is important not to oversimplify the Greshamites’ views. There is evidence that even the most enthusiastic supporters of artificial instruments also welcomed the role of natural observation in the scientific process. For example, Hooke sought the best of both worlds, explaining that his methodological intention was to alternate between ‘Artificial Improvements’ and ‘Observations of Nature’. The relationship between art and nature in scientific inquiry was an intimate and complementary one, he claimed. ‘I design alwayes to make them follow each other by turns, and as twere to interweave them, being apart but like the Warp or Woof before contexture, unfit either to Cloth, or adorn the Body of Philosophy.’

Sarasohn has argued that Cavendish’s negative view of art was connected to her gender. She argues that ‘Cavendish spoke for many silenced voices... for nature against art/experimentation... for women against male arrogance and power.’ However, there are problems with this view, which fails to take into account the many male natural philosophers who shared Cavendish’s positive endorsement of natural over artificial
enquiry. For example, Sydenham rejected microscopic anatomy as a ‘violation of nature’, and deplored what he saw as contemporary contempt for

those causes that ought to be, and which can be understood; which lie before our feet; which require no rotten supports; which appeal to the understanding at once; which are revealed by either the testimony of our senses, or by anatomical observations of long standing [i.e. without microscopes].

Although it is true that Cavendish’s disdain for ‘Art’ was broadly at odds with the experimental programme of the Royal Society, it is important to recognize that the picture is more complex than some previous accounts have suggested. Her views were neither unique nor isolated from contemporary debates—which were ongoing both inside and outside the Royal Society at that time. Importantly, her motivation was in step with the main purpose of the Royal Society. For, like the Greshamites, Cavendish’s aim was to establish the surest foundations upon which to build reliable scientific truth.

‘Sense’ and ‘Reason’

Cavendish’s objections to microscopes should also be seen in terms of a wider debate surrounding the relationship between ‘Sense’ and ‘Reason’ in mid-seventeenth century natural philosophy. Many scholars have contrasted Cavendish’s rationalist methodology with the sense-based empiricism of the Royal Society. If Cavendish supported ‘Reason’ whereas the Royal Society stood for ‘Sense’ in scientific enquiry, is this not strong evidence of hostility at the heart of the relationship?

It is true that many experimentalists at the Royal Society were deeply hostile to what they saw as an over-reliance on ‘Reason’—or rational methodology—in science. Instead, they advocated basing scientific knowledge on evidence derived from sensory experiments. For example, Hooke claimed that the Royal Society was conducting a programme of sensory correction, owing to the faulty reasoning which had afflicted all previous natural philosophy:

For the Members of the Assembly having before their ey[e]s so many fatal Instances of the errors and fals[e]hoods, in which the greatest part of mankind has so long wandred, because they rely’d upon the strength of humane Reason alone, [they] have begun anew to correct all Hypotheses by sense, as Seamen do their dead Reckonings by Coelestial Observations . . .

This negative view of ‘Reason’ was shared by Henry Power, who approvingly quoted Boyle’s views on the practical problems of faulty reasoning. ‘When a Writer . . . acquaints me onely with his own thoughts or conjectures, without inriching his discourse with any real Experiment or Observation, if he be mistaken in his Ratiotination, I am in some danger of erring with him’.

A reliance on human senses produced both opportunities and problems for experimental philosophers. In Micrographia, Hooke had shown that natural senses were fallible—for example, the point of a needle was not sharp but blunt, and a ‘dot’ in printed type was really a smudge. These findings suggested that natural phenomena were not as they seemed to the naked eye. Many experimentalists believed that the best way to correct these flaws in natural sense was to use the newly available scientific instruments. For example, Hooke argued that the ‘principal indeavour’ of the Royal Society was ‘to
enlarge & strengthen the Senses by Medicine, and by such outward Instruments as are proper for their particular works.56

Cavendish, who was familiar with these views through her reading of Hooke and Power, claimed with some justification that 'sense is more in fashion than reason'—a state of affairs to which she had strong objections.57 In Cavendish’s view, artificially enhanced senses (which were flawed) should be distinguished from ‘natural’ senses, which were far superior. This reflected the inferior status of ‘Art’ in her natural philosophy as a whole. The superiority of natural senses meant that, for example, ‘the best Optick is a perfect natural Eye’.58 But Cavendish was not entirely consistent on this subject. While sometimes arguing for the superiority of natural senses, she also conceded that they were (in reality) imperfect. In her view, all senses—natural and artificial—were capable only of perceiving the exterior parts of organisms. As we have just seen, Cavendish was certain that the major task of the natural philosopher was to understand the interior nature of phenomena, and for this she needed to apply not a microscope or natural sense, but human reason. Thus she argued that ‘The truth is, our exterior senses can go no further than the exterior figures of Creatures, and their exterior actions, but our reason may pierce deeper, and consider their inherent natures and interior actions’.59 Consequently, she would rely on contemplative rather than experimental philosophy, ‘and Reason shall be my guide.’60

Cavendish’s preference for ‘Reason’ over ‘Sense’ was not necessarily linked to her gender. Indeed, her views were shared by other contemporary thinkers who were also questioning the fashion for sense among the experimental community. For example, John Worthington was alarmed by Thomas Sprat’s enthusiasm for sense, claiming that he was obsessed by ‘what gratifies externall sense, or what sense doth reach.’61 Perhaps the best known of all the rationalist thinkers was Hobbes, who famously preferred his own ‘meditation’ to sense-based experimenting.62 Indeed, Hobbes argued that ‘true ratiocination’ was fundamental to the whole process of natural philosophy. Hobbes had further objections to experimentalists: those who abandoned reason in favour of the popular ‘sense’ were not only bad philosophers; they were also ignoble, he argued. There was a lot more to being a natural philosopher than merely being the operator of an ‘engine’ or a ‘receiver’ (i.e. an Air-Pump), he claimed, declaring that experimentalists can get Engines made, and apply them to the Stars; Recipients made, and try Conclusions; but they are never the more Philosophers for all this . . . not every one that brings from beyond Seas a new Gin, or other jaunty device, is therefore a philosopher. For if you reckon that way, not only Apothecaries and Gardeners, but many other sorts of Workmen, will put in for, and get the Prize.63

Cavendish also introduced class into the debate over experimentalism, which she regarded as a hierarchy in which ‘artists’ were at the bottom of the social heap. Artists were like servants, who should rely on rationalist thinkers for instructions in how to pursue natural philosophy. ‘the Contemplator is the Designer, and the Artist the Workman, or Labourer, who ought to acknowledge him his Master’.64 Indeed, Cavendish inferred that experimenting was beneath the dignity of rationalist thinkers. Thus: ‘Neither doth it always belong to the studious Conceiver to make trials or experiments, but he leaves that work to others, whose time is not so much employed with thoughts or speculations, as with actions’.65

Cavendish argued that, if the hierarchy of experimentalism were reversed, scientific knowledge would be halted in its tracks. For if Hooke and Power had their way, then
‘Reason must stoop to Sense, and the Conceptor to the Artist, which will be the way to bring in Ignorance, instead of advancing knowledge; for when the light of Reason begins to be Eclipsed, darkness of Understanding must needs follow.’ In this way, Cavendish linked the advancement of experimentalism with the triumph of ‘servants’ over their ‘masters’. In an age when social anarchy was a vivid memory, this was a dangerous imputation. It was also particularly unwelcome among the Fellows of the Royal Society, who continuously stressed the ‘nobility’ of their programme in order to attract patronage and funds.

Cavendish and Hobbes were both ‘outsiders’ in the sense that neither was a member of the Royal Society. But there is evidence that their views on the menial nature of experimenting had at least some resonance within the Royal Society. Although Boyle was an enthusiast for the apparatus of experimentation, he rarely got his hands dirty—employing Robert Hooke and a team of technicians to make machines and conduct experiments for him. Furthermore, Boyle never believed that artisans or mechanics were better philosophers than gentlemen.

There is one further point: although it is true that Cavendish privileged ‘reason’ as her guide in the conduct of natural philosophy, she also believed that there was an important role for ‘sense’, or sense-based techniques. Indeed, she claimed that natural philosophy should be built on a synthesis of rational contemplation and sense-based observation. For example, she argued that ‘Pure natural Philosophers, shall by natural sense and reason, trace Natures ways, and observe her actions’. Furthermore, ‘the best study is Rational Contemplation joyned with the observations of regular sense’. This is of a piece with Bacon’s view that knowledge would only be advanced ‘if contemplation and action may be more nearly and strictly conjoined and united’. It may therefore be unwise to characterize Cavendish’s approach to experimentalism as ‘wholly’ anti-Baconian.

**SPECULATIVE HYPOTHEZISING**

Many scholars have emphasized the role of ‘fancy’ within Cavendish’s natural philosophy. This is said to contrast with the approach of the Royal Society, where Fellows apparently avoided speculative thinking. Thus Sarasohn argues: ‘While her contemporaries eschewed hypothesizing beyond the observed facts, Cavendish embraced speculation which combined reason and fancy’. It is certainly true that Cavendish favoured speculation as an important part of the process of natural philosophy. Thus: ‘Experimental and Mechanick Philosophy cannot be above the Speculative part, by reason most Experiments have their rise from the Speculative, so that the Artist or Mechanick is but a servant to the Student.’

Many Greshamites took the opposite view. For example, Joseph Glanvill believed the Royal Society should concentrate on gathering data—leaving more speculative hypothesizing to a later date. Thus, in a letter to Cavendish, he argued:

all that we can hope for, as yet, is but the History of things as they are, but to say how they are, to raise general Axioms, and to make Hypotheses, must, I think, be the happy priviledge of succeeding Ages; when they shall have gained a larger account of the Phaenomena, which yet are too scant and defective to raise Theories upon . . . .

However, not all Fellows of the Royal Society shared Glanvill’s views. Indeed, the role of speculative thinking within experimental philosophy was a subject of some considerable
internal debate within the Society at that time. One area that illustrates the tensions particularly well is the ‘official’ response to Hooke’s *Micrographia*, which appeared under the Society’s imprimatur in 1665. Despite being designed as a manifesto for observational experimenting, Hooke’s text sometimes strayed beyond empirical description and ventured into more speculative territory, as Michael Hunter has shown. For example, when discussing lunar gravitation, Hooke rejected Cartesian explanations and argued that ‘some other principle must be thought of, that will agree with all the secundary as well as the primary Planets’. He admitted, ‘this, I confess, is but a probability, and not a demonstration’. This tendency in Hooke drew a sharply worded instruction from the Society:

That Mr Hooke give notice in the dedication of that work to the society, that though they have licensed it, yet they own no theory, nor will be thought to do so: and that the several hypotheses and theories laid down by him therein, are not delivered as certainties, but as conjectures; and that he intends not at all to obtrude or expose them to the world as the opinion of the society.

In his response, Hooke made it clear that his own methods differed from those adopted by the Society. While acknowledging the excellence of its rules against hypothesizing, Hooke conceded that this was exactly what he had sometimes done in *Micrographia*. Thus: ‘I may seem to condemn my own course in this treatise, in which there may perhaps be some expressions, which may seem more positive than your prescriptions will permit.’

Thus is it clear that commitment to ‘the observed facts’ stripped of hypotheses was not as uniform within the Royal Society as Sarasohn has suggested. When it came to speculative theorizing within natural philosophy, Cavendish and Hooke shared some important common ground.

So far I have explored Cavendish’s hostility to aspects of experimental philosophy. Her suspicion of microscopes, her mistrust of ‘Art’ and her preference for ‘Reason’ over ‘Sense’ as a methodological principle seemed to be at odds with the programme favoured by many (if not all) Fellows of the Royal Society. However, there are some important positive endorsements of experimentalism to be found within Cavendish’s works, and it is to these that I now turn.

**CAVENDISH’S SUPPORT FOR EXPERIMENTALISM**

For an alleged ‘anti-Baconian’ Cavendish was in fact remarkably at ease with Francis Bacon’s advice (so central to the Royal Society’s ethos) that natural philosophy should be useful for the ‘relief of man’s estate’. For example, Cavendish argued that natural philosophers should investigate nature so that ‘we [shall] know how to Increase our Breed of Animals, and our Stores of Vegetables, and to find out the Minerals for our Use’. Their role should be ‘for the Profitable Increase for Men’—a Baconian aim if ever there was one.

These views were indistinguishable from those of many members of the Royal Society. Indeed, Boyle used similar terms to argue that ‘I shall not dare to think my self a true naturalist till my skill can make my garden yield better herbs and flowers, or my orchard better fruit, or my field better corn, or my dairy better cheese, then theirs that are strangers to physiology.’
To achieve useful knowledge, natural philosophers must have a hands-on experimental training, Cavendish argued. They should have ‘Experience by Practice, and Judgement by Observation’. Elsewhere, Cavendish made the rather Baconian point that ‘certainly experiments are very beneficial to man.’

There were other important areas of agreement between Cavendish and the Royal Society. Many Greshamites were committed to expressing new ideas in natural philosophy in plain English to assist in their dissemination. For example, William Petty disclosed that ‘tis the Profession of the [Royal] Society, to make Mysterious things plain; to explode and disuse all insignificant and puzzling words.

Cavendish shared this view. Her own works (all of which were written in English rather than Latin) would be widely understood because they were ‘Plain and Vulgarly Express’d, as having not so much learning as to Puzle the Reader with Logistical, Metaphysical, Mathematical, or the like terms.’ Therefore, ‘the Truth, or at least the Probability thereof, might not be Lost in the Labyrinth of Sophistry, produced from the Corruption of Logick and the Mixture of several Languages.’

Cavendish and Boyle were united in their condemnation of the iatrochemist Johannes Baptista van Helmont for his use of unnecessarily complex language, as Stephen Clucas has shown. Thus Cavendish complained that Van Helmont had ‘such strange terms and unusual expressions as may puzle any body to apprehend the sense and meaning of them.’ Similarly, Boyle deplored the ‘dark or empty Words’ used in Helmontian chemistry. Cavendish praised Boyle for his clarity of expression, for ‘he doth neither puzle Nature, nor darken truth with hard words and compounded languages, or nice distinctions.’

Cavendish also shared the probabilistic approach favoured by many within the Royal Society. Thus she argued that her aim was ‘to find out a Truth, at least a Probability in Natural Philosophy’. This approach was similar to that of Boyle, who claimed that his works were no more than a ‘heap of bare Probabilities’. Walter Charleton similarly described his scientific enquiries as ‘at most but ingenious Conjecture’ and ‘in the latitude of Probability only’. In line with this approach, Cavendish was a committed anti-dogmatist. Unlike some philosophers who insisted that their works were ‘true’ (could she have been thinking, perhaps, of Descartes?), Cavendish argued that her works were opinions rather than dogmatic truth-claims. Thus, for example, ‘I will not declare my Opinions for an infallible Truth.’ Cavendish shared her anti-dogmatism with many Fellows. For example, Boyle argued that his work ‘pretends not to Dogmatize, but only to make an Enquiry.’ And Glanvill composed an entire work against ‘The Vanity of Dogmatizing’.

One of the most appealing aspects of probabilism was that it allowed freedom of discussion among natural philosophers. Opinions were not ‘right’ or ‘wrong’ they were merely more or less ‘probable’. Cavendish ‘took the liberty to declare my own opinions as other Philosophers do’ because ‘Opinion is free, and may pass without a pass-port’. Indeed, she invited her contemporaries to contradict her opinions—as long as theirs were more rational and probable. Cavendish was not alone in adopting this position. Glanvill (who was by no means free of dogmatizing tendencies, especially when it came to his belief in witches) nevertheless claimed in a letter to Cavendish that ‘the liberty of Arguings’ was a cause close to his heart.

Thus it is clear that Cavendish shared some important aspects of the early Royal Society’s programme: her commitment to plain English, her desire for discursive liberty free from
dogmatism, and her Baconian emphasis on the usefulness of natural philosophy were all views with which many Fellows concurred. Rather than regarding the early Royal Society as ‘dangerous, deluded and useless’, it now seems that Cavendish was in fact remarkably at ease with many of its aims and ambitions.

CONCLUSION

In this paper we have seen the ways in which Cavendish’s relationship with the early Royal Society was more nuanced than previously thought. Although opposed to some aspects of experimentalism, she nevertheless supported some important aspects of the Society’s programme. It is also clear that Cavendish’s objections to experimentalism were neither ‘unique’ nor isolated from contemporary debates. When seen in the context of her intellectual milieu, Cavendish’s views emerge as a coherent response to some of the most pressing intellectual challenges of her day. It is only by examining the connections between her views and those of other mid-seventeenth-century natural philosophers that we can begin to properly assess Cavendish’s contribution to contemporary thought. In doing so, we can better understand the complexities of these ongoing debates over the nature and role of experimentalism in natural philosophy.

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NOTES


2. M. Cavendish, Observations upon Experimental Philosophy. To which is added, The Description of a New Blazing World (A. Maxwell, London, 1666) (hereafter OEP and NBW, respectively). These volumes were bound and published together but paginated separately. I am using the terms ‘science’ and ‘scientific’ here as useful shorthands in place of the more cumbersome (but historically accurate) ‘natural philosophy’ and ‘natural philosophical’. Natural philosophy in the mid seventeenth century encompassed the ‘sciences’ (physics, biology and chemistry) as well as mathematics and metaphysics.

3. The Diary of Samuel Pepys, A new and complete transcription edited by Robert Latham and William Matthews (London: G. Bell & Sons, 1970–83), vol. 8, pp. 243–244. For an account of this visit and the experiments that Cavendish was shown, see Whitaker, op. cit. (note 1), pp. 302–304.

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8 OEP, sig. b1v; OEP, p. 90 wrongly paginated as 86.


13 Ibid., p. 466, p. 452.


15 Ibid., p. 13.


17 Henry Power, Experimental Philosophy, in Three Books: Containing New Experiments Microscopical, Mercurial, Magnetical (London, 1664); Robert Hooke, Micrographia, or Some Physiological Descriptions of Minute Bodies made By Magnifying Glasses (hereafter Micrographia) (Jo. Martyn & Ja. Allestrey, London, 1665). A significant part of Cavendish’s 1666 text was devoted to her theory of perception.

18 William Cavendish, Earl, Marquis, and eventually Duke of Newcastle. Both William and Margaret were Royalists who fled from England during the 1640s, met in Paris and married in 1645.


20 Whitaker, op. cit. (note 1), p. 103.


22 Micrographia, sig. f2v.

23 OEP, p. 9.


25 OEP, p. 90 wrongly paginated as 86.

26 OEP, p. 7.

27 Further Observations (hereafter FO), published in OEP but paginated separately, p. 54.

28 FO, p. 54.

29 OEP, sig. c2v.

30 OEP, sig. d1r.


32 Ibid., p. 197.


34 The Works of Thomas Sydenham (transl. & ed. R. G. Latham) (Sydenham Society, London, 1848–50), vol. 2, p. 171. Sydenham’s objections were partly based on his view that God had shaped man’s faculties to observe only the outer superficies of bodies and to attempt to

35 Latham, *op. cit.* (note 34), p. 171.
36 Dewhurst, *op. cit.* (note 33), p. 4.
37 Ibid., p. 5.
38 See, for example, E. Wilkins, *The natural philosophy of Margaret Cavendish, Duchess of Newcastle, in contemporary context* (PhD thesis, University College London, 2013).
40 *OEP*, p. 11. The references—as Cavendish helpfully lists in the marginalia—are to those who ‘play’ with glass tubes, atoms and exterior figures.
42 On the dangers of handling ‘rejected knowledge’ see *LAP*, pp. 11–13.
45 *Letters*, p. 281; *OEP*, p. 8.
46 *OEP*, p. 13.
47 *OEP*, p. 92.
48 *OEP*, p. 12.
49 *OEP*, p. 91 wrongly paginated as 87, p. 92. Miniature microscopes were worn as bracelet charms at this time. See Marjorie Hope Nicolson and David Stuart Rodes (eds), *Shadwell: the virtuoso* (Edward Arnold, London, 1966), p. xx.
53 Latham, *op cit.* (note 34), vol. 1, p. 20. Sydenham differentiated between longstanding basic anatomy—knowledge of the structure of the kidneys, the skeleton, and so on—and more speculative knowledge derived from microscopic anatomization.
54 *Micrographia*, sig. g1r.
56 *Micrographia*, sig. g1r.
57 *OEP*, p. 91 wrongly paginated as 87.
58 *OEP*, p. 12.
59 *OEP*, p. 93.
60 *OEP*, p. 91 wrongly paginated as 87.


64 Letters, p. 502. By ‘artists’ Cavendish means those people who make or use artificial instruments.


66 FO, p. 4.


69 LAP, p. 131. See also Shapin, op. cit. (note 68), p. 557, who argues that ‘very few’ of Boyle’s experiments involved ‘the laying of his hands upon experimental apparatus or materials.’ Instead, a ‘very substantial proportion’ of his work was done by paid assistants who were ‘invisible’ to Boyle and remain unchronicled in the historical record.

70 Letters, p. 281.

71 OEP, p. 12.


75 Sarasohn, op. cit. (note 11), p. 196.

76 OEP, p. 7.

77 Glanvill to Cavendish [13 October 1667], in Letters and Poems in honour of the Incomparable Princess, Margaret, Duchess of Newcastle (hereafter LP) (Thomas Newcome, London, 1676), pp. 24–25. Glanvill’s own contribution to this enterprise was a history of mining in the Mendips.

78 M. Hunter, ‘Hooke the natural philosopher’, in Bennett et al. (eds), op. cit. (note 51), pp. 130–131.

79 Micrographia, p. 246.


81 Ibid.

82 Bacon argued that the purpose of natural philosophy was ‘for the glory of the Creator and the relief of man’s estate’. See Warhaft, op. cit. (note 72), p. 235.

83 Orations of Divers Sorts, Accommodated to Divers Places (hereafter Orations) (London, 1662), pp. 244–245. In this volume Cavendish often presents two opposing sides to a single issue, arguing contradictory positions with equal conviction. In this case there is no counter-oration.


85 Orations, p. 245.

86 Letters, p. 496. Cavendish was not prepared to convert her positive endorsement of experimentalism into financial support. When the Fellows appealed to her for a donation in 1668, she declined to help. See M. Hunter, Establishing the new science: the experience of the early Royal Society (Boydell Press, Woodbridge, 1989), p. 167.

M. Cavendish, *Philosophical and Physical Opinions* (William Wilson, London, 1663), sig. b4r–4v. Cavendish was making a virtue of necessity: she was ignorant of both Latin and Greek.


*Letters*, p. 234.

R. Boyle, *A Free Enquiry Into the Vulgarly Received Notion of Nature* (hereafter *VN*) (ed. Edward B. Davis and Michael Hunter) (Cambridge University Press, 1996), p. 6. Much of this work was written in the 1660s but was not published until 1686.


*VN*, p. 7.


*Letters*, sig. b1r.

*Letters*, sig. b1r–1v.

*LP*, pp. 104–105.