This article concerns the use of rhetorical strategies in the natural historical and anatomical works of the seventeenth-century Royal Society. Choosing representative works, it argues that naturalists such as Nehemiah Grew, John Ray and the neuroanatomist Thomas Willis used the rhetorical device known as ‘comparison’ to make their descriptions of natural things vivid. By turning to contemporary works of neurology such as Willis’s *Cerebri Anatome* and contemporary rhetorical works inspired by other such descriptions of the brain and nerves, it is argued that the effects of these strategies were taken to be wide-ranging. Contemporaries understood the effects of rhetoric in terms inflected by anatomical and medical discourse—the brain was physically altered by powerful sense impressions such as those of rhetoric. I suggest that the rhetoric of natural history could have been understood in the same way and that natural history and anatomy might therefore have been understood to cultivate the mind, improving its capacity for moral judgements as well as giving it knowledge of nature.

**Keywords:** rhetoric; neurology; natural history; anatomy; vividness; comparison

In February 1670/1 the naturalist Martin Lister wrote to his colleague John Ray about a set of queries concerning spiders that he had sent to be published in the Royal Society’s *Philosophical Transactions*. There, he complained about the description in Aristotle’s *Historia Animalium* of the manner in which spiders dart their threads. Lister found the description to be accurate, but not vivid enough to enable even an informed reader to form an adequate mental image: ‘Which Text, tho’ very plain in it self, yet it will not easily enter into our Imagination, before we have made the Observation by Sense; witness the Misinterpretation of Redi and Blancanus.’ To circumvent the flatness of Aristotle’s words, Lister (as he confessed to Ray) deliberately mistranslated them: ‘in the Sett of Enquiries I sent to Mr. Oldenburgh, I have purposely given, to incite the Curious, another Interpretation of the Text.’1 Lister hoped to encourage his readers to question the description that they encountered, and to attempt their own observations. This would equip them to see what Aristotle had accurately, but lifelessly, described. Lister and Ray understood, however, that the work of natural history could not be accomplished successfully by resorting to tricking readers into making their own observations every

*awraggemorley@gmail.com
time it became hard to represent something. Instead, as I argue in this essay, they used strategies derived from rhetorical theory and anatomical descriptions of the brain and senses for impressing vivid images into the imaginations of their readers. I also want to suggest that by analysing the vivid style that they used we can come to better appreciate the purposes, both epistemological and moral, that they wanted natural history and anatomy to serve for their readers.

**The Royal Society and Rhetoric**

Since long before Ray and Nehemiah Grew exchanged words about Aristotle, classical rhetoric had prized the power of vivid descriptions to give subjects clarity, and to help listeners and readers to become virtuous. Vividness was particularly important to historians and orators. In fact Carlo Ginzburg has shown that the term ‘evidence’, which in modern history writing is associated with quotation from reliable sources, was understood by classical historians and rhetoricians in a different manner. In Quintilian’s influential treatment it was synonymous with the technical rhetorical terms *enargheia* and *hypotyposis*, both of which indicated a very vivid description that was so powerful as to seem to paint images of things in the mind’s eye. The reasons for making vividness the main quality desired from historical descriptions were twofold. First, strategies such as *enargheia* helped to produce a vivid image of the actions related by the historian in the mind of the reader. Second, those vivid images supposedly ensured that the moral lessons flowing from them had been successfully implanted. Vivid descriptions were valuable because they engendered clarity and because the mental images that they provoked would assist in the ethical or moralizing function of history. Brian Ogilvie, Ian Maclean, Gianna Pomata, Nancy G. Siraisi and others have shown that the natural historians and anatomists of the Renaissance appropriated many of their descriptive practices from those of history writing in the rhetorical mode. Moreover, Ogilvie has forcefully argued that Renaissance natural history had the ‘ethical and theological dimensions’ that had long been seen to flow from the use of powerful rhetoric allied to virtuous subjects.

It is well known that some of the texts associated with the early Royal Society, most notoriously Thomas Sprat’s *History of the Royal Society* (1667), contain sharp attacks on just this sort of rhetorical writing. Equally famous are the efforts of some of the Society’s Fellows, such as John Wilkins, to replace conventional language with newly contrived universal languages, systems of signs that stood in fixed relation to the things that they signified, abolishing the ambiguities of metaphorical speech. The argument conventionally derived from this evidence asserts that the early Royal Society rejected rhetoric in favour of a plain style that was better suited to its attempts to make knowledge of nature objective and useful, rather than beautiful and pleasurable. Yet the evidence, including even works such as Sprat’s *History* and Wilkins’s universal language scheme, does not favour such a clear division of objectivity from subjectivity, of utility from pleasure. Take Sprat’s *History*, for example. Early on, the author poured scorn on rhetoric not just because of the ambiguities inherent in its extravagant metaphors but also because of the capacity of those metaphors to cause pleasure, regardless of the worth of the subject that they ornamented. Later, however, he suggested that the pleasures of rhetoric might be put to good use if allied to a good cause and that natural philosophy might even supply beautiful metaphors for other subjects. It had, by way of example, afforded Francis
Bacon a ‘vast Treasure of admirable Imaginations ... wherewith to express and adorn his thoughts about other matters.’

Equivocation of this sort typifies the attitude of Society Fellows to the powers of rhetoric, powers that they attributed to its capacity to make discourses pleasurable. In his Essay Concerning Human Understanding (1690), Locke wrote that rhetoric could be deceptive because it presented ‘pleasant Pictures’ that struck hard in the imagination, ‘requir[ing] no labour of Thought’ to become clear. Yet, as Peter Walmsley has shown, Locke filled his Essay with just the sorts of metaphors that he had apparently rejected, using them to make his arguments clear and persuasive to his readers. The same has been shown by Quentin Skinner for Thomas Hobbes, who turned away from his own earlier rejection of rhetoric to pack his Leviathan with rhetorical devices to make his arguments clearer, and to persuade people who might not all have been capable of rational persuasion to accept and act on his proposals. In spite of the dangers posed to truthfulness, neither Locke nor most of his contemporaries sought to remove metaphors from philosophical speech and writing. Instead, they wanted to ally rhetoric to their philosophical enterprises, using its capacity for producing pleasurable and vivid images to make their arguments clear. As William T. Lynch concludes, their goal ‘was not to eliminate metaphor but to find a means of controlling the effects of metaphor.’ They did not object to the fact that rhetoric could cause pleasure but rather, as Sprat pointed out, to the moral and epistemological perils of rhetoric allied to deceptive or corrupting subjects. Allied to truly virtuous subjects, the pleasures of rhetoric could be regulated and afforded legitimacy.

Given the intellectual proximity of Ray and others to these philosophers and the obvious derivation of their writing practices from those of rhetorically motivated history, it is strange that very little has been said about the written style of their natural historical and anatomical works. Perhaps this is because the style of natural historical works such as Ray’s Historia Piscium (‘History of Fish’) (1686) and Historia Plantarum (‘History of Plants’) (3 volumes, 1686–1704) and anatomical ones such as Nehemiah Grew’s Anatomy of Plants (1682) and Thomas Willis’s Cerebri Anatome (‘Anatomy of the Brain’) (1664) is relatively plain in comparison with that prevalent earlier in the century. This does not mean, however, that the descriptions in these works transparently signified the things that they stood for. Peter Walmsley reminds us that ‘for a generation educated on Quintilian, the plain style was a style—not a claim to transparent meaning or an endorsement of some linguistic purity, but a literary mode with its own appropriate purposes and strategies.’ This essay comprises an attempt to appraise the literary mode used by Ray, Grew and Willis in the work of describing nature to their readers.

I shall consider only one of the stylistic strategies used by Ray, Grew and Willis. This is the ‘comparison’, understood as a figure or trope of rhetoric. This is simply because the comparison is a basic metaphor, meaning that the overall stylistic register of a piece of early modern writing may be discerned by a survey of the style of its comparisons. The next part of this essay consists of a stylistic analysis of some of the comparisons employed by Ray, Grew and Willis, identifying a vivid style. I do this with the aid of contemporary rhetorical and stylistic works with known connections to the Royal Society, such as Bernard Lamy’s (1640–1715) De l’art de Parler, published in Paris in 1675 and in English translations as The Art of Speaking in 1676 and Robert Boyle’s Some Considerations Touching the Style of the H.[oly] Scriptures (1661), a defence of the Bible’s stylistic qualities. Both of these works rely heavily on contemporary accounts of the workings of the brain and senses to explain the causes of the pleasures provoked by
rhetoric, which they construed in bodily terms directly comparable with the medical discourse of the day. For this reason much of my focus is on Willis’s *Cerebri Anatomica*, a work that purported to explain exactly how rhetoric affected the brain and nerves, and one that also stands as an example of the sort of rhetoric that was, according to this model, best accommodated to provoke the brain and nerves into forming vivid images.

Finally, I shall suggest that Ray and his contemporaries might have seen their natural historical and anatomical works as conducive to making their readers virtuous. This was because of the directness with which they thought vivid rhetoric was capable of changing the fabric of the brain and nerves. They saw natural history as a contribution to a sort of cultivation of the mind, construed in the terms of what Sorana Corneanu has termed an ‘integrated approach to the mind’s distempers and virtues’. The sense impressions left by works of natural history might have been capable of curing the brain—and, by extension, the mind—of the bodily distempers that clouded its capacity to know things well and to make good judgements about them. This argument militates against the too-easily made distinctions between the characteristics of objective and subjective speech that probably motivate the often excessive focus on the Royal Society’s anti-rhetorical pronouncements. For sociologists of knowledge at least, the making of knowledge cannot be separated from its communication. Rather, as Steven Shapin has pointed out, ‘speech about natural reality is a means of generating knowledge about reality.’ If we draw out the full consequences of this observation, we must accept that the style of descriptions of nature that are normally characterized as ‘objective’ must be constitutive of those descriptions, not external to their real meaning. Moreover, as Shapin also points out, we must accept that a range of social judgements normally perceived to be subjective, including judgements about style and taste, conspire in the social production of knowledge, in so far as they form or govern the social relations on which knowledge is founded.

**The style of comparisons**

Lamy, who in *The Art of Speaking* explained the well-known powers of rhetoric in physiological terms, retained the classical tripartite division of styles into ‘plain’, ‘middle’ and ‘lofty’. Using the works of Virgil as a template, he explained how to form metaphors appropriate to each style. In a work written in the plain style, such as Virgil’s pastoral *Eclogues*, the comparisons ought to be simple and devoid of poetic amplification. The lofty style, meanwhile, was appropriate to heroic actions such as those in the *Aeneid* and required elaborate metaphors to convey the grandeur of its subjects. The middle style, exemplified by Virgil’s *Georgics*, was suitable to works seeking to educate or instruct readers in a pleasant fashion and needed comparisons that amplified their subject enough to make them interesting, or diminished them enough to make them intelligible.

To achieve decorum, the appropriateness of a style to its subject, the writer had to consider the fitness of comparisons to the things that they stood for and their likely effect on readers and listeners. This is a part of rhetoric called ‘accommodation’, and the discourse of accommodation has been used for, among other things, justifying the apparent differences between the Old and New Testaments as stylistic differences clothing the same message for various audiences. In his essay on Virgil’s *Georgics*, John Dryden (1631–1700) reminded his readers that its middle style was the result of an effort to make the precepts of husbandry palatable by means of rhetorical amplification. Virgil’s florid
comparisons were authorized by the need to keep his readers interested in an otherwise dull subject. Writers also needed to ensure that their comparisons were similar enough to their objects to be believable. The effects of pleasure and vividness associated with comparisons would be lost if they stretched credulity too far, or were too incoherent with the overall metaphorical pitch of the work. There was no place for lofty metaphors, for example, in a work written in the low style.

Grew, Ray and Willis generally used comparisons to make vivid images of the forms of plants and animals. Mostly they executed them in a plain style, paying scrupulous attention to the degree of likeness that they saw between the comparison and the thing itself. Consider two examples from Grew’s *Anatomy of Plants*, the first being his description of what happens to the skin of a bean when dried: ‘When’ tis dry, they cleave so closely together, that the Eye not before instructed, will judge them but one; the inner Coat . . . so far shrinking up, as to seem only the roughness of the outer, somewhat resembling Wafers under Maquaroons.’ Later, in his description of the pores of the pith of plant roots, he took care to explain that their structure was only ‘somewhat answerable to the Cells of an Hony-Comb.’ The style of these descriptions was ‘low’ because the objects used for comparison were commonplace, medium-sized and easily visible.

Ray used comparisons in the same way as Grew, deploying an array of common, medium-sized objects. Take this description of a flower called by Ray *Serpentaria Virginiana*, a species in the modern genus of snakeroot (*Ageratina*) named by Linnaeus *Aristolochia serpentaria*, and its difference from another flower:

Near the ground grow one or two hollow flowers . . . different in form from the *Pytolochia retica*, or any other yet known; all whose flowers . . . resemble a cow’s horn, the top growing to the rudiment of the seed-vessel, and the open end cut slanting like a drenching-horn, whereas this of ours terminates with a heel, which supports a broad round galericulated [as if covered with a cap or hat] lip, the centre of which opens into the hollow of the flower . . . . The seed-vessel is hexagonal, shaped like a pear, when full-grown nearly half an inch in diameter.

The comparisons in Ray’s Latin works, such as his *Historia Piscium*, have the same character. He described the mouth of a type of ray, the *Raia clavata*, in the following terms: ‘The mouth is without teeth, in truth the jawbones are criss-crossed with rude rhomboidal protuberances, resembling carpenters’ files.’ If we extract these comparisons from their context and place them alongside each other, we are confronted by a row of simple, medium-sized objects that are easy to imagine: ‘cow’s horn’, ‘drenching-horn’, ‘heel’, ‘lip’, ‘pear’, ‘carpenters’ files’. It seems that Ray did not systematically refer to any individual thing or sets of things when he made comparisons. Neither did he use things that formally resembled plants and animals in any way other than in their shapes. If there is consistency in his metaphorical tone, it is in his use of medium-sized, commonplace objects to provoke vivid images of the shapes of things.

When a systematic analysis of the comparisons in one work is conducted, their mixed character is thrown into sharper relief. I have chosen to make an extended example of the comparisons used by Willis in his *Cerebri Anatome* because of the work’s fundamental importance in explaining how Willis and his contemporaries expected those comparisons to work on the mind. The only part of the work in a lofty style is the dedication, which makes a sustained comparison of the then Archbishop of Canterbury, Gilbert Sheldon, to the high priest of the Temple of Solomon. When Willis came to describe the brain and
nervous system, he deployed the same mixture of comparisons to commonplace, medium-sized bodies as had Grew and Ray. He also took care, like those naturalists, to clearly mark out the status of his comparisons as metaphorical helps to the imagination, almost always introducing them with the words quasi or velut. His translator, Samuel Pordage, always used the expression ‘as it were’ as the substitute for these two words in the English edition.

A full-text search of the electronic transcription of Pordage’s translation hosted by Early English Books Online for the expression ‘as it were’ therefore makes it possible to catalogue nearly all of the comparisons, exposing the work’s stylistic tenor somewhat. They appear throughout the text, although they are most thickly deployed to describe points of particular difficulty or importance. Typical examples are: ‘a net admirably variegated or flourished’, ‘Chambers or Vaults’, ‘two stems’, ‘two out-stretched wings’, ‘a Flood-gate’, ‘a bubble’, ‘transverse strings or cords’, ‘the serpentine chanels of an Alembick’, a ‘Balneo Maria’ (a bain-marie), a body patterned ‘as it were with furrows’, ‘the bill of a Pelican’, ‘a Cylinder rolled about into an Orb’, ‘four Mole-hills’, ‘the Kings High-way’, a ‘Machine or Clock’, ‘distinct Store-houses’, ‘little Tad-stoles or Puffe’, ‘so many little holes in a Honey-comb’ and ‘the Chest . . . of a musical Organ’.27

Again, we encounter an array of commonplace, medium-sized objects. Willis’s metaphors are decidedly mixed. Even when describing individual components or systems of the brain and nervous system, he resorted to a variety of comparisons. His style was not, however, entirely lacking in the sorts of amplification and ingenuity indicating a slightly elevated style. Consistently he employed comparisons that were much larger than the things they illustrated, relying on their size and familiarity, rather than much formal resemblance, to make the shapes and textures that he described vivid.

In Lamy’s Art of Speaking there are surprisingly direct authorizations for Willis’s way of using comparisons. Where comparisons were intended for purely ornamental purposes, Lamy argued that they should have a strict and proportional relation to the things that they stood for.28 However, the sorts of disproportionate metaphors employed by Willis were allowable if they could help listeners and readers picture things that they would otherwise be unable to without much difficulty. Lamy turned to examples from Virgil’s Æneid to make his point, arguing that apparent breaches of decorum in the great work were justified by the need to accommodate the actions to the capacities of the audience. Virgil’s mixed metaphors, for example, were justified by the need to help readers to imagine heroic scenes that lay out of the bounds of normal experience. They served to ‘make a more sensible description’ where the imaginative faculties of readers were likely to fail. The use of comparisons that did not fit with the overall stylistic register was also permissible if their purpose was to aid intelligibility. Again using the Æneid as his template, Lamy argued that comparisons to commonplace things, normally indecorous in a piece written in the ‘lofty’ style, could be justified on these grounds. They worked by relaxing the minds of readers who might otherwise have felt bombarded by too much lofty imagery: ‘He does it to ease and relax the Mind of the Reader, whom the Grandeur and Dignity of his Matter had held in too strong an intention.’29

The comparisons employed by Grew, Ray and Willis may be understood as having a slightly elevated pitch, delivered with the aim of provoking readers into imagining vivid images of the things described. They replace small things with larger ones, thereby amplifying them in the most literal sense, and familiarizing unfamiliar things through the substitution of common ones. A georgic note is detectable in this style; it at once
amplifies and diminishes the subject so as to make it palatable to readers and listeners. As Lamy explained, such moves worked by provoking changes in the affective state of those listeners and readers, in this case by ‘easing and relaxing’ minds that might otherwise have grown resistant to such difficult material. Ray’s letters show that he and his colleagues viewed the ‘ease’ with which their descriptions provoked images as an important criterion of their success or failure. Lister, as we saw above, rejected a description by Aristotle not because of its inaccuracy but because it would ‘not easily enter into our Imagination’. On two other occasions, Ray had cause to remind his correspondents that engraved plates could sometimes more powerfully represent things than words, not because words were wholly deficient but because images did so with ‘ease and pleasure’, sparing readers the difficult task of forming images for themselves.³⁰

The fact that Ray and his contemporaries self-consciously aimed at provoking pleasure with their representations suggests that perhaps they sought to use them in the service of the persuasive goals associated with rhetoric. It is surely significant in this regard that in his so-called ‘physico-theological’ books, moralizing works of natural theology that used examples of supposed design in nature to infer God’s existence and qualities, pleasure had an important role. Indeed, Ray and his contemporaries claimed pleasure as an effect of the study of natural things, as well as one of the incentives that was supposed to make their preferred variety of natural theology more effective than those not inspired by the contemplation of nature. In *The Wisdom of God Manifested in the Works of Creation*, for example, Ray stated that pleasure followed from the sight of natural bodies as if it were a simple bodily reflex.³¹

The weakness of Ray’s bland claim about the pleasures of contemplating nature is revealed by his difficulties when trying to account for the fact that some people did not feel this pleasure. For Ray, there were two possible explanations. Either they had minds that simply did not function properly, or they were so morally corrupted by the sinful use of their senses that they could no longer take pleasure in the contemplation of God’s execution of his designs in nature.³² Because it was so important to his argument that pleasure was a natural response, Ray heaped opprobrium on those unfortunate enough not to feel it, claiming that they must be ‘sunk into so forlorn a pitch of degeneracy’ that they had become ‘as stupid to these things as the basest of Beasts’.³³ The pleasures that Ray attributed to the contemplation of nature were normative in character. Yet this is an observation that can be made about the rhetorical strategies used by Ray and his contemporaries to persuade readers that the contemplation of natural things was as pleasurable as they averred. How could they resolve the tension between their claim that pleasure necessarily followed from the sight of natural things, as a consequence of the operations of the brain and nervous system, and the unavoidable fact that different people have different perceptions of pleasure? By answering this question we can, I suggest, better appreciate the affective and moral qualities attributed to anatomy and natural history by Ray in the *The Wisdom of God*.

**The Cure of the Body**

So far we have learned about the pointed, purposeful character of the style employed by Ray and his contemporaries in natural history and anatomy. Far from neutrally or transparently signifying the things that they stood for, their verbal descriptions tended towards the
production of affective states. These, Ray and his colleagues hoped, would help their readers to more easily imagine the shapes and textures that they had sought out and described. Less palatable to modern sensibilities is Ray’s attitude towards those who did not feel the emotions and sensations that he thought should accompany the contemplation of nature. In Ray’s appraisal they were either stupid or immoral. This is to say that he linked the production of an effect or sensation in the body to the moral state of the soul that, in his view, inhabited it. The connection that he drew can be seen even more clearly if we consider the precise effects on the brain that Willis and the writers of neurologically informed rhetorical works, Boyle and Lamy, attributed to rhetoric.

In England the most influential anatomical description of the brain and nerves was Willis’s *Cerebri Anatome*. According to his description and hypothesis, mental ideas were caused by the impression of external things on the sense organs. These impressions were sometimes transmitted through spirits in the brain’s passages to an organ—called the corpus callosum—that could somehow turn them into ideas for the mind to work on. Willis argued that only some impressions are forceful enough to provoke ideas. Weaker ones, he supposed, might only travel as far as the medulla oblongata, provoking only the involuntary responses for which that organ was responsible. Stronger impressions, he claimed, provoked the spirits in the brain to travel as far as the corpus callosum, causing images to form in the imagination, or even to his supposed seat of memory, the cortex, for later use. The imagination depended on the impressions of undulating spirits striking the corpus callosum for all of the ideas or images that it produced. As he wrote in a later work, *De Anima Brutorum* (‘On the Souls of Brutes’) (1672), ‘the Rational soul... depends very much, as to its Operation, on the Phantasie [the imagination], without the help of which, it can know or understand nothing.’

Ray and Grew disagreed with Willis about the extent to which the operations of the ‘sensitive soul’, responsible for such functions as the heartbeat and reflexes, could be accounted for mechanically, and Hooke hypothesized his own mechanisms for the impression of ideas in the imagination and memory. Yet they all agreed with his fundamental claim that most of our ideas (with perhaps the exception of some ideas about God) came from impressions made on the brain and senses, and that it was not in the imagination’s capacity to form absolutely new ideas, but only to compare and reorder images laid up in the memory, thereby producing new combinations. The ‘thinkable’ was therefore determined by the capacity of the senses to receive impressions from external things, and by the extent to which those impressions could be transmitted to the parts of the brain fit to receive impressions and render them as images to the mind. As Catherine Wilson has explained, this meant that many seventeenth-century philosophers considered explanations intelligible only if they could be made susceptible to the senses. Because most of them saw vision as the most important of the senses, they tended to associate the intelligibility of an explanation ‘with its visualizability, or with the analogical similarity of the process to a visualizable process.’

The vividness of the comparisons employed by Grew, Ray and Willis may therefore be explained in physiological terms, as the consequence of inscriptions made in the brain’s fabric and the capacity of the brain itself to receive or otherwise store them. Comparisons to ‘drenching-horns’, ‘carpenters’ files’ and the ‘little holes in a Honey-comb’ functioned by provoking the mind in recalling and rearranging simple images that had once been forcefully inscribed in the memory. We can surmise that the comparisons derived their effect in part because the medium-sized objects that they referred to were of a scale...
proportionate to the senses themselves, and consequently that they had been inscribed easily, forcefully, and quite often. Certainly, things that were too small or too large could have little or no effect on the senses and had to be made sensible by means of analogies or comparisons to visible things, in the hope that those things were similar enough to the imperceptible ones to produce useful inferences. This was the principle behind many of the hypotheses that Boyle framed in his famous chemical experiments: sensible changes in the constitution of bodies, such as colour, texture, or smell, could leave the philosopher with some reliable knowledge about their invisible causes. Ray used one of these experiments in another physico-theological work, *Three Physico-Theological Discourses* (1693), to show that it was possible to present phenomena to the senses from which the presence of countless invisible, microscopic particles could be inferred. Boyle’s experiment was, as Ray put it, ‘a sensible demonstration of the unconceivable’. The things described by Grew, Ray and Willis were, of course, not absolutely unconceivable. However, they were rendered much more conceivable by the use of comparisons that brought them to a medium scale, most appropriate to work on the human senses.

Accounts of the brain and senses such as the *Cerebri Anatome* also implied that the effects of rhetoric, like those of any sensory stimuli, depended to an extent on the fitness of the brain to receive impressions, and that the brain was actually physically changed by its exposure to rhetoric. Lamy, influenced by the works of Descartes, made this ‘medicalization’ of rhetoric very explicit in a section of *The Art of Speaking* with the title ‘The Qualities of the Substance of the Brain, and the Animal Spirits, are necessary to make a good Imagination.’ He wanted to show that the successful impression of ideas in the brain depended on the consistency of its fibres:

> Figures drawn upon the Surface of the Water leave no prints, because they are immediately filled up. Figures ingrav’d upon Marble are seldom perfect, because the hardness of the Matter gives too much resistance to the Chissel. This gives us to understand that the substance of the Brain ought to have certain Qualities, without which it cannot receive exactly the Images of such things as the Soul imagines. If the Brain be too moist, and the little Threads and Fibers which compose it too feeble and lax, they cannot retain the Foldings and Impressions given them by the Animal Spirits, and by consequence the things drawn there are confused, and like those we endeavour to draw upon Mud: If the Brain be too dry, and the Fibers too hard, ‘tis impossible all the strokes of the Objects should leave their Impressions, which makes every thing seem dry and meagre to men of that Temper.

With this description (and take note of the vivid comparisons to water, marble and mud), Lamy accounted in bodily terms for the fact that some people responded to the impressions of rhetoric in different ways. His use of the word ‘Temper’ is telling. It shows us that Lamy was thinking about the matter in medical terms, linking the humoral temperaments of medical theory (bilious, melancholic, phlegmatic and sanguine) to the makeup of individual brains.

It followed that sufficiently powerful rhetoric could alter the fabric of the brain somewhat, changing the manner in which it perceived, stored and ranged ideas. Lamy made this clear in an admonition to his readers about the consequences of delivering discourses in a poor style. Even if the subject of the discourse were itself wholesome, it would exercise a damaging effect on the mind if it were clothed with badly chosen words. Lamy made this clear by
comparing the actions of stimuli on the senses, and their remaining impressions in the memory, to those of mechanical type on paper:

An excellent Person has resembled the Memory to a Printing-Press; a Printer who has none but Gothick Characters, prints nothing but in Gothick Characters, let the Treatise be never so good. The same may be said of those whose Memories are full of nothing but improper words; having nothing in their minds but Gothick Molds, and their thoughts clothing themselves with Expressions from thence, no wonder if they always assume a Gothick aire and fashion.41

Lamy’s worry was not with incorrect words, but with ‘improper’ ones. The difficulty did not concern the subjects impressed in the memory, but their stylistic clothing. The comparison to typography shows that by failing to clothe a discourse in the appropriate style, a writer could end up producing effects other than those intended. Even if the words were good, either poor typography or a poor style would render them less forceful, and more confusing. Even worse, that style might muddle the very fabric of the brains of those people that it was intended to help. Robert Boyle and Thomas Willis are known to have shared Lamy’s concern. Adrian Johns has shown that cases of long-lasting cerebral damage brought on by dangerous reading practices littered the casebooks of physicians such as Thomas Willis and affected even Robert Boyle, who attributed a bout of ‘raving’ to the reading of romances.42 Importantly, Boyle and his contemporaries also took seriously the possibility that disorders of the mind could be cured by exposing it to the ‘right’ sorts of material—those bringing with them pleasures that really corresponded to the truth. Boyle’s distemper was cured, for example, by a regimen of regular mathematical exercises.43

During the 1650s, Boyle composed a book in defence of the Bible’s rhetorical style, published first in 1661 as Some Considerations Touching the Style of the Holy Scriptures. It is a work that more directly reckons with the difficulty that Ray tried to overcome in The Wisdom of God by resort to ad hominem arguments. It was self-evident to Boyle himself that the style and content of the Christian scriptures should combine to deliver the best of truths in the most beautiful way imaginable. Yet there were, as Boyle remarked, ‘diverse witty men’ who nevertheless found its style unpleasant.44 How could this be? Boyle responded by admitting the possibility that the Bible could seem unpleasant to those who were ‘Faultily indispos’d to receive Impressions from it.’45 This misapprehension was caused, Boyle hinted, by the corruption of those faculties such as the imagination, memory and understanding that enabled people to discern between mere appearances and the reality of things.

Unlike Ray, Boyle prescribed a cure for the scoffers who were unwilling or unable to take pleasure in sense impressions that really corresponded to and promoted virtue. He framed his diagnosis, and his cure, in the terms of a highly literal and medical discourse describing the loss and acquisition of good taste. Boyle’s cure for the distemper that caused people not to enjoy the scriptures was nothing more than the disciplined practice of reading ‘orderly some set Portion or Chapters of the Bible’.46 He recognized that Bible study might feel unpleasant at first, all the while producing no noticeable impressions of pleasure. By comparing it to a course of conventional medicine, Boyle gave his readers a vivid impression of the manner in which he expected the prescribed course to make the faculties again fit to take pleasure in what they ought to:
For in Diseases (Bodily or Spiritual) though the Mouth be out of Tast, and cannot Rellish what is taken in, yet wholesome Aliments must be eaten, and do effectively Nourish and strengthen, though they be then Insipid, (perhaps Bitter) to the distemper’d Palate.  

We can only guess how literally Boyle wanted this gustatory and medical metaphor to be understood. I have shown, however, that there is considerable evidence to suggest that Boyle understood the impressions made by reading on the mind in entirely bodily terms, and that he understood that the mind could be distempered as well as cured by exposing it to different sorts of reading matter. It is safe to at least suggest that Boyle, and such of his colleagues in the Society as agreed broadly with the cerebral and neurological models proffered by Willis and Descartes, thought that the capacity of the brain to receive ‘good’ ideas could be improved by regulating its exposure to powerful rhetoric.

This attitude to reading bespeaks an ‘integrated’ approach to the mind that gave the mechanics of the body influence over the mind’s capacity to think well and to make good moral judgements, and suggested equally mechanical cures for both intellectual and moral difficulties. The methods of inquiry into nature proposed by the Royal Society’s members were not, therefore, guides in the mechanical production of objective truths but, as Sorana Corneanu has shown, methods of cultivating the whole mind to improve its capacity to make a range of sound judgements. This is strongly suggested by Robert Hooke’s proposed ‘method’ for guiding philosophical inquiries, which appeared in slightly different forms preaced to his Micrographia (1665) and in his Posthumous Works (1705). According to Hooke’s own suggestion, the causes of the human inability to reckon well with nature were moral, stemming from a ‘deriv’d corruption’ innate in humanity since the fall from grace and from the corruptions acquired by individuals. The remedies with which he hoped to partly reverse this were largely habitual or technological, intended to furnish philosophers with simple methods of making sense impressions large enough to actually sense and to order ideas in such ways as might make them useful. I want to suggest that the vivid images provoked by the works of anatomy and natural history that we have encountered had an analogous salutary purpose, curing distempered brains by making them associate pleasure with ideas corresponding to the truth—at least as Ray and his colleagues saw it.

VIVIDNESS AND MORAL IMPROVEMENT

How was this cultivation effected? The evidence presented here suggests that many of the natural historians and anatomists thought of powerful rhetoric as having the capacity to change the very fabric of the brain and nerves. It was this capacity that gave rhetoric its power to deceive and encourage vices, as well as to clarify the truth and to promote virtues. In his essay entitled ‘The epistemology of metaphor’ (1978), Paul de Man drew attention to the line drawn by Locke in his Essay between the deception that could be caused by misplaced words, and the moral consequences that flowed from allowing oneself to be so deceived. De Man reported Locke’s arguments faithfully, but he imputed to Locke a false idea of his own—that Locke’s response to the threat of deception was to attempt unsuccessfully to abolish metaphoric speech from language. In fact, as Walmsley has shown, Locke used rhetoric, including vivid comparisons, to try to make his arguments powerful. We therefore need to run Locke’s argument in the other direction. If misappropriated metaphors harmed the capacity of the mind to know things,
leading to various forms of immorality, did not metaphors that garnished the truth in a pleasant fashion have the opposite effect, improving the mind and its capacity for virtue?

Matthew L. Jones, in his book *The good life in the scientific revolution*, presents considerable evidence in favour of this suggestion, forcefully arguing that Descartes, Pascal and Leibniz conceived of the practice of mathematics as a method of cultivating the mind in the service of better moral judgements. This is to say that, as I suggest for natural history and anatomy, these philosophers thought that the disciplining effects of mathematics on the mind had consequences for morality, even though this was not the explicit matter at hand. Jones cites a striking example of this from Descartes’s correspondence with Elisabeth von der Pfalz, a member of the family that ruled the Rhine Palatinate. In 1643, Descartes had set Elisabeth a mathematical problem to solve, and he wrote to her again in November with its solution. The details of the problem and its solution are not too important in this place. Interesting here is Descartes’s attitude to the solution itself. As Jones relates, he left the solution slightly incomplete, because it remained necessary ‘to extract the [square] roots’ to arrive at the answer. Descartes advised Elisabeth that this stage was not crucial at all, and he advised her not to perform it: ‘For the rest serves not at all for cultivating or diverting the mind, but only for exercising the patience of some laboring calculator.’

The purpose of mathematics was not the production of mathematical solutions, but the production of better minds, fitter for the ‘good life’ referred to in the title of Jones’s book.

The case of the natural history and anatomy of the seventeenth-century Royal Society was a little different, or at least a different division of labour was involved. Having already performed the hard work of making judgements about the forms of natural things and the ways in which they functioned, Ray and his contemporaries used powerful comparisons to thrust their judgements upon the minds of their readers, hoping to quite literally impress them into their minds. In this essay I hope to have shown that it is useful to inquire into the stylistic qualities of their works because the style, and more importantly the full range of effects attributed to it, helps to reveal aspects of them that might otherwise remain undisclosed. Some of these, especially the way in which the use of comparisons overlaps with the importance of analogical reasoning in their thought, I have discussed only briefly here. I have chosen instead to focus on the medically and physiologically inflected claims about the effects of rhetoric on the brain. This is because they suggest that at least some of those reading works such as Ray’s *Historia Piscium* did so with the understanding that it would improve their minds in a range of ways not normally attributed to scientific descriptions.

Such a suggestion, if developed to the full extent of its potential, could be disruptive to some arguments about the progress of the natural sciences. Perhaps the most discomfiting implication of this suggestion is that, for Ray and his contemporaries, the production of knowledge of nature was somehow made by attempting to respond to, and condition, the needs of an audience. This is not a new observation—Simon Schaffer and Steven Shapin have demonstrated as much in their book *Leviathan and the airpump* (1985). In that work they showed that one of the sorts of natural knowledge often characterized in terms of objectivity, the experimental fact, was shaped by philosophers such as Robert Boyle in response to the demands of contemporary political culture. This conclusion makes it very difficult indeed to sustain clear-cut distinctions between objective and subjective statements, because it demonstrates that objectivity is the consequence of social judgements and compromises that seem to have a subjective character. Ray and his
contemporaries made equally subjective judgements about the effects that they attributed to vividness, and these may equally be framed in social terms. In his *Wisdom of God*, Ray made it clear that those people who took no pleasure from representations of nature were likely to be immoral and subject to all kinds of errors. For Ray, failures to perceive the world rightly were attributable to bodily distempers and moral ills that were symptomatic of each other, meaning that only certain people were equipped to gain knowledge from works of natural history and anatomy—although the others might be able to change themselves by attending to such books. This suggests, in my view, that those aspects of seventeenth-century scientific writing, including its rhetoric and capacity for provoking bodily pleasure, that have been seen conventionally as particularly external making knowledge of nature, should instead be seen as constitutive of knowledge.

**ACKNOWLEDGMENTS**

I am very happy to acknowledge, for their assistance in developing the ideas presented here, Simon Schaffer and Lawrence Klein. I have presented versions of this work at the ‘Restoration to Reform’ seminar in Cambridge (October 2011) and the conference that occasioned this special issue. I am very grateful to Lawrence Klein and Anna Marie Roos, respectively, for inviting me to speak on these occasions. Finally, I wish to thank the anonymous reviewers for their very useful comments on this essay—it is much better as a result.

**NOTES**

2 Carlo Ginzburg, ‘Ekphrasis and quotation’, *Tijdschr. Filos.* 50, 3–19 (1988). See also Mark Robson, *The sense of early modern writing: rhetoric, poetics, aesthetics* (Manchester University Press, 2006), p. 25; Quintilian, *Institutio Oratoria* (tr. H. E. Butler) (Harvard University Press, Cambridge, MA, 1921), vol. 3, bk VIII.III.61, p. 245. I have argued elsewhere that John Ray and several other contemporary naturalists, including Robert Hooke, took the vivid images that could be produced by words to be comparable in their effects on the mind to those produced by graphical means. This was because, as I repeat below, they argued that verbal descriptions caused the mind to order images that had, like those caused by pictures, been once taken in by the eyes. See Alexander Wragge-Morley, ‘The work of verbal picturing for John Ray and some of his contemporaries’, *Intellect. Hist. Rev.* 20, 165–179 (2010).
4 I am referring to this edited volume, which contains pieces by all of these historians: *Historia: empiricism and erudition in early modern Europe* (ed. Gianna Pomata and Nancy G. Siraisi) (MIT Press, Cambridge, MA, 2005).
5 Brian W. Ogilvie, ‘Natural history, ethics, and physico-theology’, in Pomata and Siraisi, *op. cit.* (note 4), pp. 75–105, at p. 82.
6 See Thomas Sprat, *The History of the Royal-Society of London, For the Improving of Natural Knowledge* (London, 1667) and John Wilkins, *An Essay Towards a Real Character and a
Philosophical Language (London, 1668). The best and most recent major survey of the Society’s interest in universal language schemes such as that initiated by Wilkins is Rhodri Lewis, Language, mind and nature: artificial languages from Bacon to Locke (Cambridge University Press, 2007).

This argument was made, for example, by Richard Foster Jones in his essay ‘Science and English prose style in the third quarter of the seventeenth century’, to be found in Richard Foster Jones, The seventeenth century: studies in the history of English thought and literature from Bacon to Pope, pp. 75–110 (Stanford University Press, 1951). Jones’s analysis, which dwells largely on the works of Joseph Glanvill as well as Sprat’s History and Wilkins’s Essay, relies on the anachronistic assertion that a ‘scientific’ cast of mind came into being in the later seventeenth century, ‘exert[ing] a distinct influence on ideas regarding the nature of language’ (p. 109). Brian Vickers has criticized Jones’s argument, showing that the Society’s Fellows developed their style in response to contemporary social conditions. See Brian Vickers, ‘The Royal Society and English prose style: a reassessment’, in Brian Vickers and Nancy S. Struver, Rhetoric and the pursuit of truth: language change in the seventeenth and eighteenth centuries, pp. 1–76 (Clark Memorial Library, University of California, Los Angeles, CA, 1985).

Sprat, op. cit. (note 6), pp. 111–112.


Peter Walmsley, Locke’s Essay and the rhetoric of science (Bucknell University Press, Lewisburg, PA, 2003), p. 111.


The work was first published as Bernard Lamy, De l’Art de Parler (Paris, 1675). The first English edition was Bernard Lamy, The Art of Speaking (London, 1676). All references here are from the version presented in The rhetorics of Thomas Hobbes and Bernard Lamy (ed and intr. John T. Harwood), pp. 129–408 (Southern Illinois University Press, Carbondale and Edwardsville, IL, 1986). Harwood notes that this work was very influential in England, like its sister work, Antoine Arnauld’s Port-Royal Logic. This was first published in English as Logic; or, the Art of Thinking (London, 1685). The Port-Royal Abbey in Paris was a centre of French Jansenism, a theological outlook that had much in common with English latitudinarianism; Robert Boyle, Some Considerations Touching the Style of the Holy Scriptures (London, 1663; first published in 1661). References are to the edition of 1663.


Lamy, op. cit. (note 15), pp. 221–222.
"Vividness" in natural history and anatomy


Willis, *Anatomy of the Brain*: ‘a net admirably variegated or flourished’ (p. 48), ‘Chambers or Vaults’ (p. 49), ‘two stems’ (p. 50), ‘two out-stretched wings’ (p. 54), ‘a Flood-gate’ (p. 60), ‘a bubble’ (p. 64), ‘transverse strings or cords’ (p. 66), ‘the serpentine chanel of an Alembick’ (p. 72), ‘Balneo Mariæ’ (p. 73), ‘as it were with furrows’ (p. 75), ‘the bill of a Pelican’ (p. 77), ‘a Cylinder rolled about into an Orb’ (p. 83), ‘four Mole-hills’ (p. 88), ‘the Kings High-way’ (p. 90), ‘Machine or Clock’, ‘distinct Store-houses’ (both p. 97), ‘little Tad-stoiles or Puffe’ (p. 100), ‘so many little holes in a Honey-comb’ (p. 104), ‘the Chest…of a musical Organ’ (p. 106).


Ibid., p. 351.

Ibid., p. 79.

Willis, *Anatomy of the Brain*, p. 79.

The translation of Willis’s *De Anima Brutorum* (London, 1672) by Samuel Pordage was, like that of the *Cerebri Anatome*, part of the collection of Willis’s works, *Dr. Willis’s Practice of Physick, op. cit.* (note 26). Therefore this English quotation is from Willis, *Of the Soul of Brutes*, p. 41.


Ibid., p. 308. John T. Harwood notes that this example is taken from the so-called Port-Royal Logic, another work produced by the Jansenist circle of the Port-Royal Abbey, and that the ‘excellent Person’ is Antoine Arnauld.


Ibid.


Ibid., p. 151.
46 Ibid., p. 134.
47 Ibid., p. 135.
49 Hooke, Micrographia, or Some Physiological Descriptions of Minute Bodies (London, 1665), preface, unpaginated.
50 Hooke, op. cit. (note 37).