INTRODUCTION

Early modern philosophers invested much thought into the mechanical philosophy: the view that all bodily phenomena are explicable by appeal to the shapes, sizes and motions of corpuscles. John Locke is no exception. For instance, Locke’s discussion of the distinction between primary and secondary qualities, a distinction central to the mechanistic philosophy, is probably the best known in the period. And Locke claimed that corpuscularianism, of all known alternatives, promises to go ‘farthest in an intelligible Explication of the Qualities of Bodies’ (IV.III.16).1

For quite some time now, commentators on Locke have been concerned to determine the nature and degree of Locke’s commitment to corpuscularianism. One angle of investigation has focused on Locke’s frequent appeals to God’s will in the explanation of various phenomena. To Stillingfleet he writes,

God creates an extended solid substance, without the superadding any thing else to it, and so we may consider it at rest: to some parts of it he superadds motion, but it still has the essence of matter: other parts of it he frames into plants, with all the excellencies of vegetation, life and beauty, which are to be found in a rose or a peach-tree, etc. above the essence of matter in general, but it is still matter: to other parts he adds sense and spontaneous motion, and those other properties that are to be found in an elephant.

(To Stillingfleet, p. 460)²,³

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1 All references to Locke’s Essay Concerning Human Understanding are by book, chapter and section number of Locke 1975. Italics are in the original. When needed, we have added our own emphasis by underlining.

2 The reference is to Mr Locke’s Reply to the Right Reverend the Lord Bishop of Worcester’s Answer to his Second Letter. All references to the correspondence with Stillingfleet are to Locke 1963, v. 3, and will be cited as ‘To Stillingfleet’.

3 Matthew Stuart has suggested to us that Locke may be describing, in this passage, not what God actually did but only what God could do. Phrases late in the passage such as: ‘Hitherto it is not doubted but the power of God may go’, may suggest such a reading. However, the
In addition to motion and the ‘excellencies’ of peach trees and elephants, Locke describes the power to produce motion through gravitation as ‘superadded’ to matter by God (To Stillingfleet, p. 467). He also says that God could (although probably did not) superadd thought qualities to matter (To Stillingfleet, pp. 460–1, and IV.III.6). Margaret Wilson argues that Locke’s appeals to divine intervention are in tension with his ‘official’ commitment to corpuscularianism. Wilson focuses on thoughts, secondary qualities and gravity, but the same problem would seem to arise for the ‘excellencies’ of entities like peach trees, roses and elephants, since Locke also describes them as superadded by God.4

Wilson’s questions arise from an interpretation of Locke that is central to much of the literature: for Locke, a commitment to corpuscularianism essentially involves a commitment to the idea that phenomena can be deduced from their causes, primary qualities in particular, analogously to the way properties can be deduced from a geometrical definition. Locke’s frequent appeal to God’s role gives rise to concern then for the following reason: if bodily phenomena are deducible from the qualities of corpuscles, once God creates the relevant corpuscularian structures, what would be left for him to do? Since Locke does take God to play some further part in bringing about the relevant phenomena, he must be denying that all bodily phenomena admit of corpuscularian explanation. While accepting the assumption that mechanistic explanations provide for deducibility, Michael Ayers and Edwin McCann both argue, contra Wilson, that Locke’s position can be made consistent.5 To this end, they offer interpretations of Locke’s

sentence before our quote seems to us to make quite clear that God will need to do something beyond creating matter to produce plants etc., and that what he does is to superadd the relevant ‘perfections’. Locke writes that ‘the idea of matter is an extended solid substance’ and that ‘whatever other qualities, not contained in that essence, it shall please God to superadd to it’.

4 Wilson 1979, p. 144.

mechanism’ was the view that the laws of physics can be explained, in principle if not by us, by being deduced from the attributes possessed essentially by all bodies qua bodies: i.e. from the nature or essence of the uniform substance, matter, of which all bodies are composed.

(Ayers 1981: 210)

In his 1991 book, Ayers offers an account that is not obviously the same. According to the ‘pure mechanist’, ‘Knowledge of the actual structure of the machine should enable us to understand why it must operate as it does’, and this understanding is of the same kind as that achieved in geometry. He argues that Locke held this view, albeit with some reservations (Ayers 1991: 135, 152–3). Unlike Ayers, neither Wilson nor McCann claim that the laws of nature are supposed to be derivable from the nature of body as Ayers’s first statement of mechanism asserts.

Lisa Downing also assumes that if mechanism is true, the powers and affections of substances are deductible from the primary qualities of the substances (Downing 1998). Downing, however, seems to hold that Locke’s attraction to mechanism does not derive from
conception of superaddition under which it is possible for a feature of a body to be both superadded by God and yet deducible (if not in fact, then in principle) from the primary qualities of corpuscles.6

The assumption that corpuscularianism involves deducibility for Locke is not limited to the discussion about superaddition and mechanism. Although he does not address the specific ‘tension’ to which Wilson points, Peter Alexander, too, ascribes the in-principle-deducibility view of corpuscularian explanation to Locke and takes Locke to have inherited it from Robert Boyle. Alexander suggests that Locke believed in necessary connections in nature, and that corpuscularianism is the best candidate for revealing these connections. He writes,

[Boyle uses the term] ‘deducible’ in the narrower sense of ‘deductively inferable’. I believe that Locke also used it in this way. How else could they be using it when they say that a complete knowledge of corpuscular structure would enable us to know, without observation of effects, what those effects would be?7

This paper argues that the assumption that deducibility and the revealing of necessary connections are essential to mechanistic explanation for Locke is false and proposes a rough sketch of an alternative view of Locke’s conception of mechanistic explanation. We argue that Locke takes corpuscularian explanations to take the form of connections between primary qualities that are intelligible in a sense that does not require necessary connections. This approach allows us to offer a new answer to the questions raised by Wilson, an answer that focuses on Locke’s conception of mechanistic explanation rather than on an interpretation of what he means by superaddition.

One of the main reasons why so many commentators on Locke take him to accept a deducibility model of explanation is this: in a number of places8

the promise of what Locke called demonstrations. Rather, he is attracted to other aspects of the corpuscularian model (for instance, the corpuscularian’s conception of body as corresponding to our nominal essence of body).

6 Matthew Stuart takes a different approach. He argues that Locke was ‘never seriously committed to mechanism in the first place’ (Stuart 1998: 352). Stuart takes this to be established if it can be shown that Locke did not take bodily phenomena to be deducible from the primary qualities of corpuscles, and so he, too, accepts the claim that a commitment to mechanism requires in principle commitment to deducibility.

7 Alexander 1985, p. 74. (See also pp. 73–4, 160, 280, 303.) Alexander focuses on the term ‘deduce’ here, and alludes to the fact that the term was used in different ways in the period, so that it does not always mean that necessary connections are at issue. It is worth noting that for our purposes not much hangs on Locke’s use of that term. He uses the term sometimes, but not always, in relevant contexts, and at least as important is his repeated use of the analogy with geometry. We will, however, use the term in a sense that is narrow enough to imply necessary connections. We are grateful to Donald Ainslie for pointing out the possible relevance of the usage of this term.
Locke suggests that if we knew the primary qualities of the corpuscles out of which bodies were made, it would be possible, in principle, to determine with demonstrative certainty what bodies would do in various circumstances. In the first section of the paper we address this concern. We do not deny that Locke may take bodily phenomena to be deducible, in principle, from the primary qualities of corpuscles, in particular those that constitute the essences of substances. However, we argue that in the passages in which he discusses this idea, he is not offering a characterization of corpuscularian explanation, but has a different aim. Consequently, these passages, which have been so crucial in supporting the deducibility interpretation of mechanistic explanation, do not provide evidence for such an interpretation. Furthermore, Locke recommends corpuscularianism while denying the possibility of what he calls ‘demonstrations’ in natural philosophy. So there is strong reason to deny that for Locke demonstrability is characteristic of the mechanistic model.

In the second section we develop the view that Locke recommends mechanistic explanations on the ground that they afford a type of intelligibility that is independent from deducibility. We do this by taking some steps towards an alternative account of what, in Locke’s view, are the virtues of a satisfactory corpuscularian explanation. In the final section of the paper, we turn to the grounds for Locke’s pessimism with respect to the possibility of mechanistically explaining all phenomena, and argue that this pessimism has different grounds in different cases depending on the phenomena at issue. We argue that some features of the world are, for Locke, both superadded and mechanistically explicable, others are super-added and are not mechanistically explicable. We agree, then, with Ayers’s and McCann’s view that superaddition and mechanistic explicable are compatible, although our reasons for holding this view are importantly different from either of theirs. But we also find ourselves in agreement with a point Wilson makes in the course of her argument: Locke recognizes various limitations to the powers of mechanistic explanation.

1 DEUCIBILITY AND REAL ESSENCE

In a variety of places in the Essay Locke draws a parallel between the knowledge that we have of the properties of various geometrical figures – usually triangles – and some sort of deducibility of the qualities of substances from their real essences, which Locke supposes to consist of primary qualities of corpuscles. How should we understand these texts? In these texts Locke is criticizing a broadly Aristotelian model of natural philosophy, an important component of which is the claim that what natural

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8 See Wilson 1979, p. 143. III.XI.23, IV.VI.11, IV.III.25 and II.XXXI.6 are all mentioned by Wilson. For discussion of these passages, see also McCann 1985, pp. 222–3.
philosophers ought to be doing is striving towards demonstrations of observable qualities through appeal to essences. While Locke allows that bodily phenomena may in principle be deducible from corpuscularian structures, this possibility is irrelevant to his aims. We are not in a position to carry out the relevant demonstrations, and so the natural philosopher has no business either aiming to produce such demonstrations or claiming the explanations he does produce to be valuable because they point to a necessary connection between corpuscularian structures and observable phenomena. Part of what we have to say about these passages coincides with what other commentators have argued. But we part company with them in our view that these passages do not support the view that for Locke mechanistic explanation essentially involves demonstrability. Let us explain.

On the view Locke discusses, a substance has an essence, and a quality of a substance counts as a property of the substance only if it follows from the substance’s essence (it is a quality ‘proper to’ that substance). On a view of ideal scientific methodology based on this model, scientia in natural philosophy is obtained by deducing properties from real essences. It is important to note, while an Aristotelian would hold that the essence is the substantial form, one could adopt the notion of real essence and this model of ideal scientific methodology while holding that the real essence consists in a configuration of primary qualities instead. This latter view is also vulnerable to Locke’s criticisms. What Locke undertakes – and it is one of the primary goals of books III and IV of the Essay – is to argue that acceptance of this Essence–Property conception (whatever the nature of the essence is supposed to be) does not bring us one step closer to scientia concerning the natural world.

Crucial to Locke’s discussion is his well-known distinction between the nominal essence, which is a set of qualities that serve as a classificatory concept, and the real essence, which consists in the qualities from which the properties of the substance are supposed to flow (cf. II.XXIII.3, III.III.15). Locke argues repeatedly that we only know these nominal essences, and not the real essences from which the properties of substances are in principle

Interpreters have disagreed on Locke’s attitude about real essences. Our argument does not depend on a position on this issue. Our point is that Locke thinks such essences cannot help achieve scientific knowledge, a point that is neutral with respect to the question of whether or not he thinks substances have such essences, or whether members of a kind of substance share a real essence. For discussion of this issue, see Atherton 1998, Owen 1991, Alexander 1985, ch. 13.

For discussion of this view, see Ayers 1981, pp. 226–9. For some discussion of this model of substance and explanation in late Aristotelian scholasticism, see Nadler 1998, pp. 516–18. This view goes back to Aristotle’s Posterior Analytics. What is most relevant to Locke is the practices existing in his day rather than Aristotle’s own views. We have not explored in depth the conceptions of natural philosophy contemporary Aristotelians or others held in Locke’s time. Whether or not the conception of natural philosophy as deduction of properties from a real essence is Aristotelian is actually not essential to our argument. Our argument is that Locke criticizes the conception in question, whatever label is appropriate.
The primary aim of the passages that are easily taken as statements of a deducibility conception of mechanistic explanation is this: even if there is a meaningful sense in which the powers and affections characteristic of a substance are in principle derivable from the real essence of that type of substance, we are unable to perform the derivations given our ignorance of real essences. For, according to Locke, to have genuine knowledge of substances, we would have to be able to demonstrate that those substances have the powers and affections they have. Consequently, we are unable to reach anything resembling scientia, genuine scientific knowledge of substances, through appeal to real essences. Thus, Locke criticizes the view that natural philosophy should proceed by demonstration of properties from real essences.

This much others have recognized before. But the point we wish to make, and which has not been appreciated, is that in these passages Locke is not committing himself to the idea that mechanistic explanation involves demonstrability. Locke’s critical project is nowhere clearer than in II.XXXI.6:

The complex Ideas we have of Substances, are...certain Collections of simple Ideas, that have been observed or supposed constantly to exist together. But such a complex Idea cannot be the real Essence of any Substance; for then the Properties we discover in that Body, would depend on that complex Idea, and be deducible from it, and their necessary connexion with it be known; as all Properties of a Triangle depend on, and as far as they are discoverable, are deducible from the complex Idea of three Lines, including a Space. But it is plain, that in our complex Ideas of Substances, are not contained such Ideas, on which all the other Qualities, that are to be found in them, do depend. The common Idea Men have of Iron, is a Body of a certain Colour, Weight, and Hardness; and a Property that they look on as belonging to it, is malleableness. But yet this Property has no necessary connexion with that complex Idea, or any part of it: and there is no more reason to think, that malleableness depends on that Colour, Weight, and Hardness, than that that Colour, or that Weight depends on its malleableness.

So far the passage makes the point that our ideas of substances are ideas of nominal essences and not of real essences, since if they were ideas of the

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11 For Locke’s notion of demonstration, see IV.II.2. Demonstration is the perception of the agreement of ideas by way of intervening ideas. For discussion of this notion in Locke, see Owen 1998, ch. 3.

Our ignorance of real essences is not the only obstacle to the possibility of demonstrations. Locke expresses pessimism on other grounds at IV.III.28 and IV.VI.11, but those points are not of central concern to us here. For discussion of these further obstacles to demonstration, see Stuart 1996.

latter, we could deduce their properties from these ideas, something which we cannot do.\textsuperscript{13}

It is crucial to note that Locke’s point is about real essences, not about mechanism. And note that Locke has not yet said anything about what the real essence is. He considers this question next, and says we do not know:

the farthest I can go, is only to presume, that it being nothing but Body, its real Essence, or internal Constitution, on which these Qualities depend, can be nothing but the Figure, Size, and Connexion of its solid Parts; of neither of which, having any distinct perception at all, I can have no Idea of its Essence, which is the cause that it has that particular shining yellowness; a greater weight than any thing I know of the same bulk; and a fitness to have its Colour changed by the touch of Quicksilver.

(II.XXXI.6)

So here he proposes a mechanical candidate. But he goes on to argue that we would be even more in the dark about the nature of real essences construed in an Aristotelian fashion:

If anyone will say, that the real essence, and internal Constitution, on which these Properties depend is not the Figure, Size, and Arrangement or Connexion of its solid Parts, but something else, call’d its particular form; I am farther from having any Idea of its real essence, than I was before. For I have an Idea of Figure, Size, and Situation of solid Parts in general, though I have none of the particular Figure, Size, or putting together of Parts, whereby the Qualities above-mentioned are produced . . . . But when I am told, that something besides the Figure, Size, and Posture of the solid parts of that Body, is its essence, something called substantial form, of that, I confess, I have no Idea at all, but only of the sound Form, which is far enough from an Idea of its real Essence, or Constitution.

Commentators have not been sufficiently puzzled by the fact that Locke aims at both an Aristotelian opponent in this passage and an opponent who adheres to the corpuscularian view of the real essences of bodies. What view do both these opponents hold and that Locke is attacking in this passage? We propose that the view under attack is this: it is worthwhile or valuable to try to explain the observable features of bodies by deducing those features from the essences of those bodies. Locke’s focus is on real essences, and the assumption that the properties of substances are deducible from them, in whatever the real essence may consist. He is pointing to the irrelevance of real essences – whether they consist in primary qualities or substantial forms – and the possibility of deduction of properties from them, to our efforts to explain the observable qualities of substances. Locke is not making a point about the nature of mechanistic explanation. Instead the passage argues as

\textsuperscript{13} Commentators have been well aware of this point, which is made in a variety of other places as well. Cf. IV.III.16, IV.VI.11, and IV.III.25, which is discussed below.
follows: whether we have a mechanistic or an Aristotelian conception of the real essences of substances, the notion of such essences points the way to a useless conception of how to do natural philosophy.

There is one particular passage that has convinced many, mistakenly in our view, that Locke thinks that mechanistic explanations will produce or strive to produce demonstrations, or that their intelligibility consists in providing demonstrations. Locke writes,

I doubt not but if we could discover the Figure, Size, Texture, and Motion of the minute Constituent parts of any two Bodies, we should know without Trial several of their Operations one upon another, as we do now the Properties of a Square, or a Triangle. Did we know the Mechanical affections of the Particles of Rhubarb, Hemlock, Opium, and a Man, as a Watchmaker does those of a Watch, whereby it performs its Operations, and of a File which by rubbing on them will alter the Figure of any of the Wheels, we should be able to tell before Hand, that Rhubarb will purge, Hemlock kill, and Opium make a Man sleep; as well as a Watch-maker can, that a little piece of Paper laid on the Balance, will keep the Watch from going, till it be removed; or that some small part of it, being rubb'd by a File, the Machin would quite lose its Motion, and the Watch go no more. The dissolving of Silver in aqua fortis, and Gold in aqua Regia, and not vice versa, would be then, perhaps, no more difficult to know, than it is to a Smith to understand, why the turning of one Key will open a Lock, and not the turning of another.

(IV.III.25)

The reason that this passage gives such a strong impression that Locke thinks of mechanistic explanations as demonstrations is because Locke here equates three different forms of reasoning: (a) mathematical, or geometrical, reasoning about the ‘properties’ of squares and triangles, (b) reasoning about the behavior of watches and locks by watchmakers and smiths, and (c) reasoning about the features of natural substances like rhubarb and hemlock by someone who knows the real essence of those substances. We do not wish to blunt the primary point that Locke is concerned to make: all three kinds of reasoning have something very important in common. But does this show that Locke takes the attraction of mechanistic explanation to be its promise of providing demonstrations of the sort provided by the mathematician? We think not.

There is a fundamental difference between natural philosophers who make an effort to produce mechanistic explanations, in the way Locke envisions, and the three kinds of reasoners Locke is discussing here: those who produce mechanistic explanations have no satisfactory idea of the nature of the real essences of the substances whose features they are trying to explain. By contrast, mathematicians know the real essences of triangles and squares because the ideas of those figures are what Locke calls ‘complex Ideas of Modes’: they are voluntarily produced by the mind, and do not aim at representing any ‘real Archetypes’. This, Locke writes, is the crucial
difference between ideas of modes and ideas of substances (see II.XXXI.3, 14). Similarly, watchmakers and smiths know the real essences of watches and locks because those objects are artifacts: they are created in order to conform to a conception formed by the watchmaker or the smith; the watchmaker produces the watch in such a way that it conforms to his idea of a watch. Its real essence, that is, is no different from its nominal essence, since it is produced in order to conform to a nominal essence. As Locke puts the point:

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\text{[1]In the Species of artificial Things, there is generally less confusion and uncertainty, than in natural. Because an artificial Thing being a production of Man, which the Artificer design'd, and therefore well knows the Idea of, the name of it is supposed to stand for no other Idea, nor to import any other Essence, than what is certainly to be known, and easy enough to be apprehended. For the Idea, or Essence, of the several sorts of artificial Things, consisting, for the most part, in nothing but the determinate Figure of sensible Parts; and sometimes Motion depending thereon, which the Artificer fashions in Matter, such as he finds for his Turn, it is not beyond the reach of our Faculties to attain a certain Idea thereof; and so settle the signification of the Names, whereby the Species of artificial Things are distinguished, with less Doubt, Obscurity, and Equivocation, than we can in Things natural, whose differences and Operations depend upon Contrivances, beyond the reach of our Discoveries. (III.VI.40)}
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Notice the emphasis that Locke places here on the difference between knowledge of the real essences of artificial things and knowledge of the real essences of natural things. We have the former, but cannot hope to have the latter. In IV.III.25, then, Locke is yet again explaining what we cannot do because we do not know the real essences of natural substances. We cannot hope to do for nature what the watchmaker and smith do for watches and locks, for unlike them, we do not know the real essences of natural objects since they ‘depend upon Contrivances, beyond the reach of our Discoveries’. 14

14 Similarly, Locke argues that in morality too, as in the case of geometry and artifacts, real essences are ‘not of Nature’s, but Man’s making’. He concludes that ‘Morality is capable of Demonstration, as well as Mathematicks: since the precise real Essence of the Things moral Words stand for, may be perfectly known’ (III.XI.16).

One might still argue that Locke is committing himself to the idea that if we did know the real essences of substances, we could deduce, in the strict sense, their properties by way of mechanical reasoning. And that this means that Locke is, after all, committed to a conception of mechanistic explanation as demonstration.

But there are various reasons why one cannot draw this conclusion. First, as we shall see, Locke simply does not recommend mechanistic explanation on the ground of a promise of demonstration. Locke does not present demonstration or the promise of demonstration as an
To sum up, we have discussed a type of passage in Locke that has been taken to support the view that Locke thought that it was characteristic of mechanistic explanations to provide explanations that deduce phenomena from real essences. In our view in these passages Locke is not stating such a view at all, but instead connects deducibility with real essences whether such essences are mechanical in nature or not. He refers to essences of natural substances in terms of primary qualities because he thinks that is the most plausible hypothesis about their nature, but he is simply not making general claims about the nature of mechanistic explanation. Now what we have argued leaves open the possibility that Locke presents deducibility as characteristic and distinctive of mechanistic explanation elsewhere. But we know of no place where he does so.

Locke recommends mechanistic explanation, but does not recommend a search for scientia, demonstrative knowledge in natural philosophy. ‘But as to a perfect Science of natural bodies’, Locke writes, ‘we are, I think, so far from being capable of any such thing, that it is lost labour to seek after it’ (IV.III.29). His attitude towards the ideal of scientia in natural philosophy can be illustrated with an analogy. One could formulate principles of justice by imagining what an ideal society would be like in which people function in ideal ways; in such a society, people would always abide by principles of justice. But alternatively, one might decide that such a society is utterly unattainable, and that human beings always behave imperfectly. And one might argue that, consequently, different principles of justice are required, principles that take into account the fact that people do not always behave perfectly, or that rather than doing the good for its own sake, they often need incentives. Given inevitable societal imperfection, then, we might think that an ideal legislator ought not to aim at producing a utopia and ought not to present his proposed laws as valuable because they promise, in principle, to produce a utopian society. Locke’s view of the ideal natural philosopher is something like this conception of the ideal legislator. Since we, as opposed to angels or God (cf. II.XXIII.13), cannot hope to produce

essential feature of mechanistic explanation or a reason for adopting the mechanistic approach. And even if knowledge of real essences allows for demonstrations, it does not follow that mechanistic explanation in general is demonstrative, or aims at demonstration.

Furthermore, there is also a question about what exactly Locke thinks we could know if we did have knowledge of the real essence of natural substances. In the watchmaker passages he writes that, if we knew the mechanical real essences of bodies, ‘we should know without Trial several of their operations one upon another’ (IV.III.25, emphasis added). He does sometimes claim that we would have access to necessary connections (II.XXXI.6), and the analogy with triangles suggests demonstrations. But not the analogy with the knowledge of a watchmaker or locksmith: a locksmith does not have the knowledge that allows him to predict whether a key will fit into a lock by demonstration, but by experience. For helpful discussion of this issue, see also McCann 1985, pp. 222–3, Atherton 1984, p. 422 and n. 11 on the watchmaker passage, and Rogers 1979, p. 153. McCann concludes his analysis by writing ‘there is nothing in this of demonstration, or conceptual connections’. See also n. 21 below.
demonstrations of bodily phenomena, we are better off pursuing an entirely different approach to natural philosophy. Since Locke does think that natural philosophy is possible and useful (cf. IV.XII.12), there is good reason to think that he recommends mechanistic explanations not on the ground that they offer the prospect of attaining scientia, but because they have some different virtue.

2. LOCKEAN MECHANISM AND INTELLIGIBILITY

For the reader who thinks that deducibility is surely essential to mechanistic explanation, it may be helpful to keep in mind that interpreters of the mechanical philosophy have had different views of the reasons early modern thinkers found it attractive. In the case of Descartes, for instance, interpreters have seen his commitment to mechanism as a commitment to the idea that bodies must be understood mathematically: the quantifiability of primary qualities is crucial; this is what makes our perceptions of them clear and distinct. 15 Others have questioned the centrality of quantifiability, and stressed an interest in the qualitative nature of the physical world. 16

So what, for Locke, is worthwhile about mechanistic explanation? If we cannot produce demonstrations, and thereby gain scientia, by providing mechanistic explanations, what is the attraction of such explanations? The attraction of corpuscularianism to Locke, as for others, has something to do with the way in which mechanistic explanations render the phenomena they explain intelligible: he recommends the corpuscularian hypothesis as the most intelligible one available (IV.III.16). We now need to explore this notion of intelligibility. Fundamental to the mechanical philosophy was the distinction between primary and secondary qualities, and the rejection of all sorts of occult entities like substantial forms. And so the first thing to note is that mechanistic explanations only appeal to certain kinds of cause, namely, primary qualities. 17 But while interpreters sometimes take the definitive feature of mechanism to be this limitation on the allowable kinds of cause, for Locke that is clearly not the entire story. It is important not just that the

15 Burtt 1954, pp. 107, 118.
16 Anneliese Maier proposes this view for early modern mechanistic philosophers. She writes:

> What [the mechanistic theories] want is not measurement of qualities – at least not at once, and it is also not always the case that this ideal stands in the background – what they want is an interpretation, a determination of essences [Wesensbestimmung], an answer to the question quale – of what kind? – and not to the question quantum – how much?'

(Maier 1968: 25).

17 While we have focused on Ayers’s and McCann’s discussion of deducibility, their conceptions of mechanism include a view about the nature of the causal agents. See, for instance, McCann 1985, p. 209, McCann 1994, p. 75, Ayers 1981, p. 210.
cause consists only of primary qualities, but also that the effect consists only of primary qualities.

On one occasion, Locke describes the appeal of explanations in terms of primary qualities as follows:

That the size, figure, and motion of one Body should cause a change in the size, figure and motion of another Body, is not beyond our conception; the separation of the parts of one Body, upon the intrusion of another; and the change from rest to motion, upon impulse; these and the like, seem to us to have some connexion one with another.

(IV.III.13, emphasis added)

Next he denies that we see any such connections where secondary qualities are involved. Locke's point here clearly is that we see some connection between cause and effect if both consist in primary qualities, and that things are much worse whenever secondary qualities are involved. This aspect of the mechanistic model is central to the frequent analogy with machines: machines, as the early moderns saw it, simply worked by bits of matter pushing each other around. So the point is that mechanistic explanations are successful because the effect, too, consists only of primary qualities.18 This idea is clearly implicit in Locke's discussion in II.VIII of the distinction between primary and secondary qualities:

For if we imagine Warmth as it is in our Hands, to be nothing but a certain sort and degree of Motion in the minute Particles of our Nerves, or animal Spirits, we may understand, how it is possible, that the same Water may at the same time produce the Sensation of Heat in one Hand, and Cold in the other ... But if the Sensation of Heat and Cold, be nothing but the increase or diminution of the motion of the minute Parts of our Bodies, caused by the Corpuscles of any other Body, it is easie to be understood, That if that motion be greater in one Hand, than in the other; if a Body be applied to the two Hands, which has in its minute Particles a greater motion, than in those of one of the Hands, and a less, than in those of the other, it will increase the motion of the one Hand, and lessen it in the other, and so cause the different Sensations of Heat and Cold, that depend thereon.

(II.VIII.21, emphasis added)

The corpuscularian explanation for the difference in sensation in the two hands begins with an equation between the heat in our hands and the motion of the corpuscles out of which the hands are made. That is, Locke focuses on the idea that what makes it possible to provide an adequate and intelligible

18 We do not mean to imply that the mechanistic philosophy was exactly the same for all its early modern adherents. In so far as we know, the present point (that mechanistic explanations always involved explaining primary qualities through appeal to primary qualities) was central to all. But whether this is so is immaterial to our argument.
explanation of the phenomena – an explanation that ‘we may understand’ and that is ‘easie to be understood’\textsuperscript{19} – is that the effect is construed as consisting solely of primary qualities. And the same is true for Locke’s example of the pounding of an almond (II.VIII.20): we can understand why the pounding results in a change in color and taste if we understand these changes in corpuscular fashion as changes in texture. So here again, it is crucial to think of the effect in terms of (configurations of) primary qualities.

Why, then, are primary quality interactions intelligible? It is not easy to say in what this intelligibility consists, and Locke himself does not explain. As we saw, Locke writes that causes and effects that consist in primary qualities ‘seem to us to have some connexion one with another’ (IV.III.13), unlike cases where secondary qualities are involved. This claim falls far short of a claim of demonstrability. But it also falls short of a clear positive account of the source of the intelligibility of mechanistic explanations. This is not atypical: as Wilson has written, the early moderns expected that one could ‘simply see and agree’ that a mechanistic explanation, such as that offered in the case of the difference in heat in the two hands, is the only intelligible one.\textsuperscript{20} There is, it seems, simply some kind of affinity between primary quality causes and certain primary quality effects, and it is from this affinity that the intelligibility of mechanistic explanations derives. Although it is, perhaps, philosophically unsatisfying, our proposal is this: for Locke, the cause–effect relation in a successful mechanistic explanation is one of ‘intuitive fitness’. The reason this is philosophically unsatisfying is that there is no answer to be found in Locke to the inevitable next question: under what conditions are cause and effect fitted to one another?

It might be suggested that the intelligibility of primary quality interactions derives from the intelligibility of genuine in-principle-possible demonstrations from, say, a relatively small quantity of motion in the water to a decrease of motion in the hand on contact with the water. Now the first thing to note is that Locke’s argumentation simply does not rely on references to demonstrations in II.VIII. One way to make the point is this: the mechanistic intuition we find in Locke is that only certain types of effect are intelligible as results of physical contact between the hand and the water; namely effects that consist in alterations of primary qualities. But that is not to say that it is possible, even in principle, to deduce the specific actual effect from the cause.\textsuperscript{21}

\textsuperscript{19} McCann, by contrast, claims that Locke does not rely on any strong claim of explanatory intelligibility but holds instead that the primary-secondary quality distinction fits well with our common sense conceptions. McCann 1994, pp. 60–7.

\textsuperscript{20} Wilson 1992, p. 472.

\textsuperscript{21} Alexander has offered an explanation why a mechanistic outlook would result in deducibility by explaining how knowledge of the mechanical real essence of a substance would allow deducibility of its characteristic behavior. He suggests that the idea is that the solubility of gold in \textit{aqua regia} can be accounted for in the following sort of way.
The objection implies that it would be a serious problem for Locke’s argument in II.VIII if it were shown that no such genuine demonstration is possible, even in principle. It seems quite plausible to say that the fact that the motion in the hand slows down is not deducible from the fact that it is placed in water the parts of which are not moving as quickly as those in the hand, even given various subsidiary hypotheses; the particles of the hand might just as well have increased the motion of the particles of the water, or all the particles might have continued to move as before, for instance. Do we then undermine the argument voiced in II.VIII.21 for the claim that the sensations of heat and cold do not resemble their primary quality causes? Certainly not. It makes sense that the hand’s motion would decrease, while it does not make sense for contact between hand and water to directly cause changes in a quality in the hand that, as Locke would put it, resembles our idea of heat. And this is so even if reduction in motion cannot be deduced from contact with water (which, as a matter of fact, it cannot).

An important question in this matter is the role of laws of nature. One might argue that deducibility is going to be a characteristic of mechanistic explanations given knowledge of natural laws connecting causes and effects. So given certain laws, we could deduce that the motion in the hand would decrease.

Suppose that part of this description [of gold] is that the corpuscles have certain specified shapes, are \( x \) units in diameter, at rest and \( y \) units apart. Then its solubility might be explained by the complete and regular intermingling of this patterns with the patterns of various liquids having, for example, spaces between corpuscles greater than \( x \) units and equal to \( y \) units. . . . If solubility is just a matter of such fitting, then we can know, in advance of experience, the conditions for solubility.


On this view, the primary qualities constitutive of the real essence of gold simply allow us to deduce its solubility in aqua regia when we also know the real essence of aqua regia. (See also McCann 1985, p. 222 for this idea).

Note that Alexander’s explanation is not based on any explicit claims by Locke that mechanistic explanation offers the prospect of deducibility: rather it is based on a philosophical analysis of how such deducibility would work. And while his example holds appeal, it can hardly be used to characterize such explanations in general. One systematic problem is that Alexander’s explanation ignores the role of motion. Shape is prominent in the predictability of the fit of a key in a lock or of the mutual fit of patterns of particles. But if a causal interaction crucially relies on the speed of the particles or larger bodies, the rate at which the speed changes, and the laws of impact, it is not clear at all that by knowing the patterns of the corpuscles and their primary qualities we can predict the effect with demonstrative certainty. At least one would also have to know the laws of motion and impact. We address the role of laws in this context in a moment.

There are problems even for the type of case Alexander describes. Alexander sets up his example so that when gold dissolves in aqua regia, the corpuscles of gold are spaced just right for the corpuscles of the aqua regia to pass freely between them. But what if gold dissolves in aqua regia by the particles of aqua regia pushing gold particles apart? On that scenario, the dissolution of gold in aqua regia rests on the possibility of deducing the conditions under which the coherence of the parts of matter will be broken. And Locke is very clear that the prospects for understanding, much less demonstrating, how coherence works are very dim (see II.XXIII.23 – 7).
decrease on contact with the water. This objection is in line with McCann’s conception of superaddition, according to which

> God superadds a power or quality to body by ordaining that a law holds connecting a certain type or types of material constitution (i.e. a certain arrangement of mechanical affections or primary qualities of the constituent parts of bodies) with the power or quality.\(^{22}\)

And McCann argues that on this conception, superaddition is compatible with deducibility, and so, in his view, with mechanistic explanation.

Now it is not our purpose to argue that Locke would deny that deducibility could be achieved in this way, in principle. But our claim is that an appeal to this type of deducibility misses the point that it is the intelligibility of mechanistic explanation that appeals to Locke. We see no evidence that Locke recommends mechanistic explanation on the ground that it could allow for this type of deducibility: the type of intelligibility he points to is entirely different from deducibility by way of laws. Consider the following: in this way deducibility can also be achieved given a law that links contact with water with a change in the hand’s felt temperature – construed non-mechanistically as a quality of the hand actually resembling our idea of its temperature. In other words, this line of thought ignores the importance of the primary–secondary quality distinction to Locke’s praise for the (relative) intelligibility of the mechanistic world view. The truth of such a law does not make the connection between the two things linked any more intelligible than they were in the absence of the law: in principle a law could obtain between any two types of event, however disparate in nature, and allow for deducibility.

Indeed, on McCann’s view of superaddition, if there were a law that simply said that all brain states of a certain sort were followed immediately by certain ideas, then there would be an adequate mechanistic explanation (from Locke’s point of view) of the occurrence of the ideas. Such an explanation would point to the relevant brain state and the relevant law and deduce the relevant idea. This view deviates from Locke’s conception of mechanism because, as we argued before, on Locke’s conception not only causes but also effects in mechanistic causal interactions consist in primary qualities. Indeed, McCann seems to be committed to thinking that mechanistic explanations might yield no intelligibility of the phenomena whatsoever since the brute conjunction of brain state with idea occurrence is just that, brute, a conjunction arbitrarily established by God.\(^{23}\) While an appeal to laws might provide for deducibility of effect from cause, it would not provide for the kind of intelligibility that distinguishes a mechanistic understanding of what happens when we place a warm hand in cold water

\(^{22}\) McCann 1985, p. 216.  
\(^{23}\) McCann 1994, p. 72.
from a non-mechanistic understanding. Therefore, Locke cannot have such a view in the background in II.VIII.

So salvaging deducibility in the face of superaddition is not necessary to saving Locke’s commitment to mechanism. This is not to say, however, that what McCann or Ayers undertakes to accomplish has nothing to offer towards a better understanding of Locke’s thought. In section 1 we argued that in the texts where Locke speaks of deducibility of the properties of substances, his point is to disconnect natural philosophy, which he believes should proceed by pursuing mechanistic explanations of phenomena, from the effort to deduce phenomena from real essences. This is compatible with his holding that real essences, if known, allow for the deduction of the qualities of a substance and thus for scientia. But then superaddition poses a problem, not for mechanism, which does not require demonstrations, but for the in-principle-possibility of demonstration from real essences and scientia, if not for us, for beings equipped with better faculties.\(^{24}\) And this is where Wilson’s concerns about tensions in Locke between superaddition and deducibility, and McCann’s and Ayers’s attempts to respond to these concerns retain their value. Or to put the point differently, one result of our discussion should be to refocus the discussion in which these three scholars are engaged away from questions about Locke’s conception of, or commitment to, mechanism. So, to take McCann as an example, his view could offer a solution to this new problem: if God superadds features to substances by establishing laws that allow for the demonstration of the features from what underlies them, scientia is saved for the angels, God and whatever other beings can gain access to the relevant information. And this is an interesting undertaking. But still, that leaves unaffected our claim that Locke recommends mechanistic explanations as intelligible not because they offer the prospect of demonstrability but because of a type of intelligibility that is distinct from deducibility.

What has been argued in this section is that for Locke corpuscularian explanations yield a kind of intelligibility of phenomena by virtue of the fact that they do no more nor less than indicate connections between primary qualities and other primary qualities. Abandoning the idea that Locke thought demonstration was the goal of natural philosophy is a crucial part

\(^{24}\) The issue we see here is akin to a problem Mary Astell raised for Locke. Like Leibniz, she criticized Locke for allowing the possibility of the superaddition of thought to matter. But neither Leibniz nor Astell focus on questions about mechanism. Astell focuses her criticisms on questions about essence. One complaint she has is that according to the Essay

it is impossible for a Solid Substance to have Qualities, Perfections, and Powers, which have no Natural or Visible Connexion with Solidity and Extension; and since there is no Visible Connexion between Matter and Thought, it is impossible for Matter or any Parcels of Matter to Think.

(Astell 1705: 259)

We are grateful to Eileen O’Neill for pointing us to Astell’s discussion.
of a proper grasp of Locke’s broader vision of how natural philosophy
should be done, a vision that was far more empiricist than the deducibility
model of explanation suggests. After claiming that the impossibility of
scientia with regard to the natural world should not lead us to give up
entirely the making hypotheses about the nature of the world, he remarks:

[W]e should not take up any [Hypothesis] too hastily...till we have very well
examined Particulars, and made several Experiments, in that thing which we
would explain by our Hypothesis, and see whether it will agree to them all;
whether our Principles will carry us quite through, and not be as inconsistent
with one Phaenomenon of Nature, as they seem to accommodate, and explain
another.

(IV.XII.13)

Ultimately, the test for determining the adequacy of a particular
corpuscularian explanation is not whether or not we can offer a
demonstration, but, instead, whether or not the explanation fits our
empirical observations of the behavior of substances. It is experience that
determines if we have gotten Nature right, not a-priori investigation of
necessary connections. While Locke allows that there may be a fundamen-
tally rationalistic structure to the world – each and every feature of the
world very well may flow necessarily from the real essences of substances –
the existence of such a structure has no implications for how we ought to
inquire into the nature of the world.

3 SUPERADDITION AND THE LIMITS OF INTELLIGIBILITY

We now return to questions about Locke’s frequent appeals to God’s power
and the limits of mechanism. Wilson argues that Locke’s appeals to God’s
power in various contexts indicate Locke’s grasp of ‘the limitations of the
explanatory capacities of Boylean mechanism.’ We agree that some of the
cases with respect to which Locke makes such appeals indicate such a grasp,
but we wish to take issue with the tendency in Wilson and others to group the

25 The view for which we have been arguing is closely allied to the view advocated by Margaret
Atherton. (See Atherton 1984 and 1991.) Atherton argues that Locke did not see
corpuscularian mechanism as any kind of step towards an a-priori demonstrative science
of nature. She claims, instead, that he thinks of such a science as being what would be
provided by a genuine theory of the nature of substance, a theory that our faculties preclude
us from producing. We hope to be adding to Atherton’s excellent work on this topic in two
ways: first, by allying the possibility of a demonstrative science less with a theory of substance
than with a theory of real essence, the knowledge of which we are precluded by our nature
from gaining; and second, by suggesting a way of understanding what Locke takes to be
valuable about the effort to give mechanistic explanations even given that that effort brings us
no closer to a demonstrative science of nature.

26 Wilson 1979, p. 144.
various examples of such appeals together. In our view, appeals to God’s power, as such, are not indicative of a limitation on mechanism, and are generally not in conflict with Locke’s commitment to mechanism. One reason is that once deducibility is no longer seen as an essential feature of mechanism, there is little reason to believe that a feature of the world could not be both superadded by God and mechanistically explicable. But, in addition, we contend, different cases ought to be treated in different ways. Sometimes when Locke appeals to God’s power, he is not evincing a belief in the limitations of mechanism, and sometimes he is. In this section, we distinguish between (a) the case of peach trees (and similar examples), (b) the case of thought, and (c) the case of gravity. In addition, we separate a final set of particularly interesting cases – namely, (d) the communication of motion by impulse and the cohesion of the parts of matter – that indicate that Locke saw some important limitations on the intrinsic explanatory capacities of Boylean mechanism.

(a) Let us begin with the case of peach trees. Once deducibility is dropped as a requirement for a mechanistic explanation, Locke’s claim that God superadds the ‘perfections’ of peach trees does not raise any questions about whether corpuscularian explanations apply for peach trees. As long as the emergence of a peach from a bud – and whatever else counts as perfections of the tree – can be explained in terms of interaction between primary qualities, mechanistic explanations are possible in this domain. This is true even if God in some way determined exactly how this happens, that is, even if he determined what primary qualities produce just what other ones, and even if his role rules out the possibility of demonstrating such perfections from the primary qualities constitutive of the real essence of the peach tree. So, as for Ayers and McCann, under our interpretation, it is perfectly possible that some qualities are both superadded and mechanistically explicable.27

(b) Now, consider the case of thought. Wilson mentions but rejects the suggestion that Locke’s requiring God’s intervention for thinking matter is no more than ‘an unsurprising qualification’ to his commitment to mechanism rather than a view that compromises that commitment.28 But we think this suggestion is exactly right. The reason that Locke takes thought qualities to be mechanistically inexplicable is that he thinks it impossible that such qualities be identical with mechanical qualities, and so they cannot be explained merely by appeal to primary qualities. The reason he believes thoughts could not be mechanical qualities – even if they adhere in a material substance – are roughly the reasons that drive philosophers to dualism, be it property dualism or substance dualism: material qualities

27 Locke also suggests that God superadds the laws of motion (IV.III.29). This is another example of superaddition that poses no conflict with mechanism as we understand it. Although, as we note below, there is something unintelligible about motion, the unintelligibility does not derive from the fact that God superadds the laws.

28 Wilson 1979, p. 144.
seem to be of an entirely different sort from thought qualities. It is this point that Locke is registering in IV.X.10 when offering his proof that God exists and is a thinking being: if there were ever a time in which there were only material qualities, no amount of mixing, bumping and shaking would ever result in the occurrence of thought. Of course, Locke lived in a time unlike ours, a time when materialism about the mental was not particularly popular or well received. While Locke thought that one cannot show substance dualism to be true, he thought it was probably true, and his writings contain many dualistic passages. Once it is recognized that mechanistic explanations for Locke involve an appeal to interaction between primary qualities as causes and effects, and not just as causes, and once his dualistic tendencies are acknowledged, one should not expect him to think that bodies can mechanistically produce thoughts. For the

29 For a different interpretation of this text, see Ayers 1981, pp. 244–6. Stuart argues that Ayers's 'deflationary' readings of Locke's remarks on superaddition are unconvincing (see Stuart 1998: 367).

30 Locke states on a number of occasions that from his principles, substance dualism cannot be demonstrated, but that it is highly probable (To Stillingfleet, pp. 33, 37, Essay II.XXVII.25, IV.III.6).

31 Stuart 1998 contains an extensive discussion of the question whether Locke's views on superaddition conflict with mechanism. He agrees that they do not as long as Locke speaks of mind – body interaction or the connection between primary and secondary qualities within substance dualism, since mechanism is meant to cover only bodies. But he thinks that the superaddition of thought to matter does violate mechanism (pp. 364–7), because it means ascribing non-mechanical causal powers to bodies. We disagree. Locke seems to envisage a property-dualistic version of thinking matter – unlike what Ayers seems to ascribe to him – and Stuart seems to agree. But we think that the scope of mechanism should be described differently. We think that mechanism should be understood to aim to explain interactions between corporeal states. Stuart formulates it as 'a view about bodies and their interactions' (p. 362, emphasis added), thus making any ascription of non-mechanical, incorporeal states to bodies incompatible with mechanism. This means that a property dualism that understands the mental non-corporeally and non-mechanistically is incompatible with mechanism, unlike substance-dualism. We do not see why there should be this asymmetry. One feature that might distinguish the mental and the physical – whether or not they pertain to different substances – is precisely the types of explanation that apply within each realm. Donald Davidson is no substance dualist but separates the realms of explanation for the mental and the physical. Surely one can be a consistent mechanist and adopt the kind of picture Davidson offers.

32 Hannah Ginsborg has suggested to us that attributing such dualistic tendencies to Locke seems in tension with his suggestion to Stillingfleet that the superaddition of thought no more undermines the materiality of the substance to which thought is superadded than the superaddition of the excellencies of peach trees undermines the materiality of those things. This text seems to treat thought and other, presumably material, qualities in much the same way. This is true, although we do not think that this point counts against attributing some sort of dualism to Locke. We take it that his point to Stillingfleet is the following: there is no reason to think that adding thought to matter, although thought is not a material quality, robs matter of its material nature. This was a controversial point in the period. For instance, Leibniz did not accept it. In response to Locke's claim, he argued that if God adds thinking to matter, this must ultimately amount to God adding a thinking substance (Letter to Masham, 30 June 1704, in Leibniz 1996, 3: 356, translated in Leibniz 1997: 214). The same
same reasons, it is also unsurprising that Locke appeals to divine intervention when discussing mind–body interaction: in that context, either causes or effects fail to be mechanistic primary qualities.  

Locke’s belief that thought properties cannot be mechanistically explicable extends to his pessimism about the possibility of mechanistically explaining secondary qualities, a case that receives much attention from Wilson. Locke insists repeatedly on the lack of intelligible connections between primary qualities on the one hand, and secondary qualities on the other. There is controversy regarding the question of how Locke’s term ‘secondary quality’ is to be interpreted. However, whether secondary qualities are understood as relational qualities of substances, as powers, as sensations, or as primary quality constitutions, somewhere in an account of secondary qualities an appeal must be made to the causal influence of body on mind. So, the intelligibility gap concerning secondary qualities reduces to our inability to explain how it is that a particular corpuscularian structure can possibly have any effect on our minds, much less the particular effect, a sensation as of red, say, that it does have. Since, as noted above, Locke should not be expected to think that mechanistic explanation covers mind–body interaction, it is really no surprise that he thinks that mechanistic explanations fail when secondary qualities are invoked.  

point was also made by Mary Astell (Astell 1705: 261). Leibniz did not seem to take Locke’s claim to contain the idea that thinking could itself be a material quality like a configuration of physical primary qualities. Rather, he engaged the question whether God could add a non-material quality to a material substance. So Leibniz interpreted Locke’s point the way we do. But this issue is quite complicated, and a full discussion falls beyond the scope of this paper.  

33 See for instance, IV.III.28, 29. One might question the claim that the influence of body on mind is considered, by Locke, to be so unintelligible in light of the following passage: ‘The next thing to be consider’d, is how Bodies produce Ideas in us, and that is manifestly by impulse, the only way which we can conceive Bodies operate in.’ (II.VIII.11) But Locke merely means to address the physiological part of sensation here. The claim that ‘Bodies produce ideas in us...by impulse’ is intended to rule out the Scholastic notion that the object produces sensation by sending something like a sensible species. Elsewhere Locke makes very clear what is and isn’t intelligible about the production of sensations, and the transition from bodily processes to ideas in the mind is not:  

‘Impressions made on the retina by rays of light, I think I understand: and motions from thence continued to the brain may be conceived, and that these produce ideas in our minds, I am persuaded, but in a manner to me incomprehensible. This I can resolve only into the good pleasure of God, whose ways are past finding out’

(Works IX., p. 217)


35 A criticism of Alexander by Wilson suggests that she thinks this sort of move will not save Locke from inconsistency. She argues that while noting the ‘arbitrary relation of sensation to the operations of matter’, Locke also commits himself to the claim that ‘a body’s sensible appearances flow from its real essence’ (Wilson 1979: 147). Wilson’s arguments, however, rely
(c) Matters are different, however, in the case of matter’s tendency to gravitate: here the phenomena to be explained are only changes in motion, a typical example of a primary quality. Nonetheless, Locke is clear that reflection on Newton’s work made him think that gravitational phenomena are a deep mystery. To Stillingfleet he writes that he had said, in the Essay,

That bodies operate by impulse, and nothing else’. And so I thought when I writ it, and can yet conceive no other way of their operation. But I am since convinced by the judicious Mr Newton’s incomparable book, that it is too bold a presumption to limit God’s power, in this point, by my narrow conceptions. The gravitation of matter towards matter, by ways inconceivable to me, is not only a demonstration that God can, if he pleases, put into bodies powers and ways of operation, above what can be derived from our idea of body, or can be explained by what we know of matter, but also an unquestionable and every where visible instance, that he has done so.

(To Stillingfleet: 467)\textsuperscript{36}

The failure to gain intelligibility in this arena comes from a very natural and appealing thought: if something moved, and nothing bumped it or pulled it, then plainly we just do not understand why it moved. In the case of gravity, the primary qualities allowably appealed to in a mechanistic explanation do not seem able to do the needed explanatory work.

The example of gravity is distinctive in this regard in Locke’s thought. With regard to no other example where Locke both appeals to God’s intervention, and expects mechanistic explanations to apply, does he indicate that he himself sees a limitation on the degree of intelligibility that can be supplied through mechanistic explanations. Locke’s qualms about gravity are typical of the period: it is well-known that Newton’s work raised questions about the adequacy of the mechanistic world-view as presented by Descartes. The Cartesians, for their part, objected that a Newtonian treatment of gravity involves appeal to ‘occult’ qualities. Unlike on the idea that Locke uses the relevant terms consistently (‘secondary quality’, and the names of secondary qualities, such as ‘colour’, ‘gold’). We cannot address this issue here, but in our view Locke does not always use the terms consistently in the way Wilson assumes (although we do not see this as giving rise to any serious philosophical problems). In fact, Wilson herself is more cautious in a later article where she writes that ‘Locke very often uses terms like “color”, “red”, “taste”, “sweet”, etc. to refer to ideas, and not to secondary qualities.’ (Wilson 1992: 490 n. 82, emphasis in the original). What is crucial here is her use of the expression ‘very often’.

\textsuperscript{36} In this passage Locke’s claim might be taken to be merely epistemological: Locke says that gravity goes beyond our idea of matter. But in Some Thoughts Concerning Education, he says,

[I]t is evident that by mere matter and motion none of the great phenomena of nature can be resolved, to instance but in that common one of gravity, which I think impossible to be explained by any natural operation of matter or any other law of motion but the positive will of a Superior Being so ordering it.

(Locke 1969, section 192.)
the case of thought, questions about gravity do lead Locke to reconsider his previous commitment to the idea that all physical phenomena could be explained mechanistically, by impulse. However, Locke does not say which of two responses to cases of gravitation is called for: should we expand our understanding of corpuscularianism to broaden the range of admissible causes? or, should we abandon that model of explanation entirely and look for some alternative to the corpuscularian hypothesis?37

(d) It is now time to turn to a very different and more challenging set of issues. That of gravity raised the question about the scope of mechanism: need gravitational powers be included among the qualities allowably appealed to in mechanistic explanations? But sometimes Locke indicates, rather strikingly, that there are severe limits on the intelligibility of explanations appealing only to undeniably mechanistic qualities. Thus, on the one hand, he claims repeatedly that the communication of motion by impulse is ‘the only way which we can conceive Bodies operate in’ (II.VIII.11, also To Stillingfleet: 467). But on the other hand, he writes:

Another Idea we have of Body, is the power of communication of Motion by impulse; and of our Souls, the power of exciting of Motion by Thought. These Ideas, the one of Body, the other of our Minds, every day experience clearly furnishes us with: But if here again we enquire how this is done, we are equally in the dark. For in the communication of Motion by impulse, wherein as much Motion is lost to one Body, as is got to the other, which is the ordinariest case, we can have no other conception, but of the passing of Motion out of one Body into another; which, I think, is as obscure and unconceivable, as how our Minds move or stop our Bodies by Thought; which we every moment find they do.

(II.XXIII.28)

Here Locke sounds extremely pessimistic about our capacity to understand the communication of motion by impulse. Now it is important to note that Locke’s main aim here is to argue that body is no better understood than mind (against materialism), and his point is that we understand how motion is communicated by impulse just as poorly as we understand how motion is originated by volition. And later in this section he puts the point more optimistically: both are understood equally well. Be that as it may, Locke explains the difficulty quite clearly: it is hard to understand how motion is communicated by impulse just as poorly as we understand how motion is originated by volition. And later in this section he puts the point more optimistically: both are understood equally well. Be that as it may, Locke explains the difficulty quite clearly: it is hard to understand how motion is communicated, since it is natural to imagine that the affection is literally transmitted from one body to another, and such a view simply is not coherent. And it is not just the communication of motion by impulse which Locke finds obscure: he also argues at length that the extension of bodies, the coherence of their parts, is unintelligible (II.XXIII.23–7). These are very different kinds of problem from those raised by gravity: it is not a question about the scope of mechanism, but

37 For this point, see also Atherton 1984, p. 426.
about the intelligibility of mechanistic explanations themselves. So what should we make of Locke’s recommendation of mechanism on the basis of its intelligibility?

Now it is important to note that Locke never claims that corpuscularianism is completely intelligible, utterly perspicuous. He seems to grant it a relatively high level of intelligibility: he writes that the ‘corpuscularian Hypothesis’ goes ‘farthest in an intelligible Explication of the Qualities of Bodies’ (IV.III.16, our emphasis). And, as we saw, he claims that we see ‘some connexion’ (IV.III.13, our emphasis) between causes and effects that consist in primary qualities. Thus Locke thinks mechanism is the best approach available, but his praise for mechanism is guarded. This is a more cautious attitude than displayed by other mechanists, and we agree with Wilson that Locke offers some real insight here. But, unlike Wilson, we wish to propose that there is no deep inconsistency in Locke’s thought: the solution is to see Locke’s attitude as guarded, not as swaying between unqualified praise and skepticism. It is true that Locke seems to claim a high level of unintelligibility for corpuscularianism on some occasions. But perhaps those claims should be understood in light of the fact that they occur in the context of comparisons with the mind in an argument against materialism: materialists might think matter is utterly intelligible, but, Locke’s point is, this is not so. His very strong claims of its unintelligibility in that context should perhaps be seen as cases of hyperbole in view of his anti-materialist argument.

One way to look at the issue is this: surely, if there is any type of causal interaction that is intelligible, it is interaction between primary qualities – bits of matter pushing each other around. But this is not to say that even that type of interaction is entirely perspicuous. It makes sense that the impact of one ball on another causes the second to move. But exactly how this works, what the underlying process is, is not so easy to grasp. In this domain, we do not fall short only of scientia, we also fall short of complete intelligibility of a different type. We cannot deduce that upon impact between two balls, the second ball moves in a particular way. But even if we could do that, say in virtue of our knowledge of a natural law, there is the question how that happens: if the motion does not hop from one ball to the next, then what exactly does happen?

This does leave us with a question: while it seems right to say that Locke praises corpuscularianism for its relatively high level of intelligibility rather than for a perfect level of perspicuity, one may well wish to understand exactly the nature of this type of intelligibility. As we noted before, Locke does not offer a clear explanation, and this was typical of the early modern mechanists who thought the high level of intelligibility found in paradigm cases of mechanistic explanation was obvious. But given Locke’s reservations, one wishes more strongly that he would explain the nature of this type

38 For some discussion, see Downing 1998.
of intelligibility. Part of the idea is that mechanists do not rely on obscure notions like the notion of substantial form. And, unlike substantial forms, the mechanical qualities they appeal to are familiar to us from sensory experience. But that explanation goes only so far. After all, we are equally familiar from experience with secondary qualities, and with apparent causal interactions between them and primary qualities. Perhaps the idea is that primary qualities are of a kind, in some sense, and that is why their interaction is particularly intelligible. But again once Locke questions the intelligibility of the communication of motion by impulse, one wonders about the precise nature of the intelligibility of such interaction, even though, as we noted before, it seems like a good candidate for being the most intelligible type of causal interaction (pace the occasionalists).

Be that as it may, our point is that while Locke does think that there are limitations on mechanism, these limitations do not result in inconsistencies in his position. Moreover, they vary greatly in kind: thought properties cannot be explained mechanistically since they cannot be identical with (collections of) primary qualities, but Locke did not expect them to fall within the scope of mechanism. Gravity, on the other hand, raises the question whether mechanism can explain all physical phenomena; and finally he sees intrinsic limitations that derive from the limits of the intelligibility of features central to mechanism itself. But none of these issues has anything to do, in and of itself, with the failures of in-principle demonstrability. They all have to do with the limits of understanding phenomena in terms of primary qualities in a different sense. And we wish to emphasize that Locke’s appeals to superaddition by God do not necessarily indicate limitations on mechanism: as the case of peach trees illustrates, God may superadd without affecting the powers of mechanistic explanation at all, even if we cannot retrace his steps with demonstrative certainty.

CONCLUSION

In this paper we have argued against a crucial assumption underlying discussions of Locke’s commitment to corpuscularianism. We have argued that Locke did not recommend mechanistic explanation on the ground that it promises the possibility of explanations that are deductions, or, in his own terms, demonstrations. Thus we propose a radical reassessment of Locke’s understanding of mechanism. The type of intelligibility he ascribed to the explanations it can offer, while perhaps not easy to define, has nothing to do with deducibility. In the texts that have inspired interpreters to see such a connection, Locke instead connects deducibility with the investigation of real essences and rejects the production of demonstrations as the proper aim of natural philosophy. While recommending corpuscularianism, Locke denies that we should seek scientia by deducing properties from real essences, because he thinks it is ‘lost labour’ to do so. Instead, we have
argued, the approach that he does advocate generates a picture of a more thorough-going empiricist than previous interpretations, with their emphasis on deduction on the model of geometry, have suggested.

BIBLIOGRAPHY


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