**Gassendi and the 17th-Century Atomists on Primary and Secondary Qualities**

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**I**

Many different kinds of atomism were available in the 17th century. Gassendi and followers like Walter Charleton argued for a roughly mechanist version of atomism on which atoms had only the qualities size, shape, solidity and motion, and all other qualities of bodies supervened on the qualities of atoms.[[1]](#footnote-1) Others opted for Galileo’s mathematical point-atoms; atoms endowed with forms; atoms for each of the distinct elements, whether chemical or Aristotelian; and so on.[[2]](#footnote-2)

One can fairly easily reconstruct something like the primary quality – secondary quality distinction for each of these various forms of atomism. If you treat the determinable properties whose determinants atoms possess as the primary qualities, then everything else is a secondary quality that must derive from those primary qualities. Thus someone who thinks there are four types of atoms, one for each of the four Aristotelian elements, would identify the primary qualities as heat, cold, wetness and dryness, and treat all other qualities as secondary. Indeed, Gassendi uses the term ‘primary quality’ as a synonym for ‘elemental quality’ in precisely this way (1.494a).[[3]](#footnote-3)

Here, however, I shall limit my discussion to the primary quality-secondary quality distinction as it arises in mechanical atomism. Limitations of space preclude examining how all the different forms of 17th century atomism treat qualities. Moreover, we begin to lose our grip on the primary quality-secondary quality distinction quite quickly once we step away from roughly mechanist philosophies. As philosophers now commonly think of it, the primary quality-secondary quality distinction has a number of components. Both primary and secondary qualities are types of sensible qualities.[[4]](#footnote-4) However, they are ontologically – not merely epistemically – different in some important way. The primary qualities are size, shape, solidity and motion. The secondary qualities are color, taste, smell and the like. The primary qualities are used in scientific explanation; the secondary qualities are not.[[5]](#footnote-5) Abandoning too many of these components makes us lose our grip on the distinction.[[6]](#footnote-6) Mechanical atomism is the only form of atomism for which a primary quality-secondary quality distinction with these components is even a contender, so I shall limit my discussion to it.[[7]](#footnote-7)

However, discussing the primary quality-secondary quality distinction in mechanical atomism is a somewhat odd thing to do. Gassendi does not explicitly distinguish primary and secondary qualities, and I shall argue that none of the various ways he carves up qualities amounts to such a distinction. One of my goals is to clarify the ontology Gassendi assigns to the qualities that are paradigmatically thought of as secondary. This will show that they are more like primary qualities, as traditionally understood, than secondary qualities. The lack of a primary quality-secondary quality distinction in Gassendi may seem somewhat surprising to 21st century readers. For it strikes us as a very natural distinction for a mechanical atomist to draw. Thus, my second main goal is to explain why Gassendi draws the distinctions between qualities he does, and why he does *not* draw any clear distinction between the traditional primary and secondary qualities.

I shall proceed as follows. I begin, in (II), with the problem atomists face. Since atoms lack all qualities except size, shape, solidity and motion, we must explain the various macro-level qualities as categorical features deriving from the configuration or arrangement of atoms; as powers; or as appearances in the mind. When Gassendi speaks of the configuration or arrangement of atoms, he typically speaks of the *contextura* – the way in which atoms are woven together.[[8]](#footnote-8) I translate this term as ‘texture’. For although this is an archaic usage, Locke and Boyle used ‘texture’ to speak of the arrangement of corpuscular parts.[[9]](#footnote-9)

An important question is which of these three views Gassendi adopted and why. Contemporaries such as Descartes and Galileo held that primary qualities are categorical features of bodies while secondary qualities exist only in the mind. A generation later, Boyle and Locke agreed that primary qualities are categorical features but argued that secondary qualities are better thought of as powers. The texture view, the power view and the appearance view were all live options for Gassendi.

In (III), I outline the various distinctions Gassendi draws between types of qualities, and in (IV), I look at his overarching argument thatqualities are modes of bodies and consider why he rejects the Galilean appearance view. I consider his reasons for favoring the texture view over the power view in (V). In (VI), I consider a puzzling passage that seems to suggest the Lockean claim that there is nothing in bodies resembling the heat we feel. This is a problem for my interpretation because it is naturally read as contrasting ideas of color and heatwith ideas of shape and solidity, which *do* resemble something in bodies. In (VII), I draw on the distinction between appearance and reality and on Gassendi’s Epicurean claim that the appearances are always true to show that he draws no such contrast. In (VIII), I argue that because he holds that qualities like color and heat are textures, Gassendi in effect rejects the primary quality-secondary quality distinction. For an implication of his view is that while there is an important *epistemic* difference between qualities like size and shape on one hand and qualities like heat and color on the other, there is no real metaphysical difference. Finally, in (IX) I conclude by suggesting a reason why Gassendi may not have distinguished between primary and secondary qualities in the way many of his 17th century contemporaries did.

**II**

 17th century philosophers were familiar with the description of Democritean atomism provided by Diogenes Laertius:

The first principles of the universe are atoms and empty space … the atoms are unlimited in size and number … and thereby generate all composite things … The qualities of things exist merely by convention; in nature there is nothing but atoms and void space.[[10]](#footnote-10)

Not all scholars agree that ‘by convention’ is an accurate translation of Diogenes’ Greek. But in his *Physiologia Epicuro-Gassendo-Charletonia*, Walter translates the relevant part into Latin as follows: “Lege enim color, lege amaror, lege dulcor” – “For color exists by law, bitterness by law, sweetness by law.”[[11]](#footnote-11) He goes on to explain that

[Q]ualities … [ought] to be reputed not as absolute and entire Realities, but simple and occasional Appearances, whose specification consisteth in a certain modification of the First Matter, respective to that distinct Affection they introduce into this or that particular sense, when thereby actually deprehended. Not that *Democritus* meant, in a litteral sense, that their production was determinable *ex institutio hominum*, by the opinionative laws of mans Will … but in a *Metaphorical* [sense], that as the justice, injustice, decency, turpitude, culpability, laudability of Human actions, are determined by the Conformity or Difformity they bear to the Constitutions Civil, or Laws generally admitted, so likewise do the whiteness, blackness, sweetness, bitterness, heat or cold, of all Natural Concretions receive their distinct essence, or determination from certain positions and regular ordinations of Atoms.[[12]](#footnote-12)

Set aside how odd it is to find an early modern philosopher suggesting that moral qualities are qualities human actions bear in relation to the civil law. Another oddity is more significant: in this brief passage, Charleton appears to suggest three different ontologies of the qualities of macroscopic bodies:

1. *The appearance view*. Qualities are appearances: very roughly, mind-dependent entities rather than “absolute and entire Realities”.[[13]](#footnote-13) On this view, bodies do not really possess qualities at all; qualities belong only to minds.
2. *The power view*. For a body to have a given quality is for it to have a certain causal power – the ability to ‘introduce’ an ‘Affection’ into the senses and thereby to affect the mind of the perceiver in a particular way.[[14]](#footnote-14) Bodies possess their powers to affect us in virtue of having certain textures, that is, by being composed of certain atoms arranged in a certain way.
3. *The texture view*. For a body to have a given quality is just for it to have a certain texture or arrangement of atoms. We pick out the relevant texture by identifying the one that causes a certain effect on us.[[15]](#footnote-15)

Despite these complications, the basic picture Charleton lays out is clear enough. Bodies have a certain texture. In virtue of possessing this texture, they have the power to affect human sense organs in certain regular ways. (They do this either by direct contact, in the case of touch and taste; through corpuscular emissions; or through modifications of light.) When the sense organs are affected, the perceiver senses or becomes aware of some aspect of the thing sensed. The three different possibilities are simply different ways of identifying what, within this picture, is the quality.

Why is this philosophically significant? Why was it important for early modern philosophers to decide between these three views? One way to get a handle on this is by looking at the disagreements that took place over the ontology of qualities in the early modern period. Boyle, Descartes, Galileo and Locke all agreed that the primary qualities are categorical properties that are intrinsic to bodies and depend on their micro-level constituents. This is as close as you can get to holding that primary qualities are textures without actually being an atomist. However, they disagreed about the ontology of secondary qualities. On the standard reading, Galileo and Descartes locate colors and the other secondary qualities in the mind while Locke and Boyle hold something more like the power view.[[16]](#footnote-16) I discuss their differing philosophical motivations in sections IV, V, and VI below.

Which solution did 17th century mechanical atomists adopt, and why? It turns out that answering this question is less than straightforward. One reason is that Gassendi does not draw any clear distinction between the primary and secondary qualities of macroscopic bodies. While he distinguishes the various sorts of qualities in a number of different ways, none of these distinctions is straightforwardly the distinction between primary and secondary qualities. To see this, let us begin by looking at his account of qualities as presented in the *Syntagma Philosophicum*.

**III**

 Gassendi’s *Physics* begins by laying out the fundamental entities of atomism: atoms – which possess only the properties of size, shape, solidity, and motion – moving in absolute space and time. Once this material is in place, he moves on to discuss the nature of qualities. The basic question is simple. If everything in the world is composed of mechanical atoms, how do qualities arise?

 Gassendi answers this question in several stages. He begins the chapter “What Qualities Are” by noting that

Since Atoms are the whole matter or corporeal substance that bodies consist in, if we conceive or notice something else in bodies, it is not a substance but a mode of a substance, that is, a certain texture [*contexturam*] of the material principle (1.372b).

Bodies consist just in atoms. Thus, whatever we perceive in bodies must either be the atoms themselves or a way of being of those atoms – in other words, a way in which those atoms are arranged. From this it follows trivially, he seems to think, that qualities must be ways in which atoms are arranged. Where are the other two options suggested by Charleton, qualities as appearances and qualities as powers? What has led Gassendi to think that the texture view simply follows from atomism? Answering this question will have to wait until we know a little more about what Gassendi’s texture view involves.

 After asserting that all qualities are modes or textures, Gassendi goes on to discuss the various qualities. His aim in this discussion is twofold: first, to begin investigating what texture constitutes what quality; and second, to show how it is even *possible* for a quality to be constituted by a texture. Given the generally speculative nature of Gassendi’s atomist explanations – a feature consonant with the general early modern articulation of atomism as a research programme rather than a complete science – the second is rather more important to him. Certainly the second will concern us more.

 The discussion begins with chapters on rarity, density, perspicuity and opacity; magnitude, figure, subtlety, coarseness, smoothness and roughness; motion or the motive power; and heaviness (*gravitas*) and lightness. Then – remarking that he will now move from qualities that depend on the properties of individual atoms to “those qualities that depend on the properties of many atoms joined together” (1.394b) – he goes on to discuss heat and cold; fluidity, firmness, wetness and dryness; and softness, hardness, flexibility, tractability and ductility. A subdivision of these are “the qualities by which the various senses are affected” (1.409b): taste and odor; sound; light; color; and *simulacra* or intentional species. Finally, he turns to those qualities called occult: magnetism, electricity and the like.

 A few observations about this method of proceeding are worth making. First, by starting with rarity and density – qualities that can be possessed by composite bodies but not by individual atoms – Gassendi provides a clue that his discussion is aimed just at the qualities of composite bodies. He distinguishes between size and shape as they apply to atoms, and size and shape as they apply to composite bodies, much more clearly than most early modern writers.[[17]](#footnote-17) Second, both the location of the book on qualities within the overarching structure of the *Syntagma* and the fact that it mixes together sensible qualities with Lockean ‘secondary qualities mediately perceived’ like flexibility and ductility suggest that Gassendi’s discussion will focus on what exists in bodies rather than what the mind perceives. This is a very different approach from the Lockean one, which discusses qualities by way of clarifying discussion of ideas, and which in any case Locke explicitly advertises as a digression. I shall argue that this difference in approach is significant for understanding the very different ontologies that Gassendi and Locke end up with.

 A number of distinctions are made in the course of Gassendi’s discussion. One is straightforward: the distinction between the qualities of atoms and the qualities of composite bodies. Atomic qualities are fundamental; composite qualities somehow flow from them. A second distinction – that between essential (*coniuncta*) and accidental (*eventa*) properties – is also relatively straightforward. The size, shape and motive power of atoms are essential properties: atoms cannot persist without their size, shape and motive power persisting. Position, on the other hand, is an accidental property of atoms. It is obviously a substantive metaphysical question what properties of composite bodies are essential, but we can put that aside for current purposes. For the distinction between primary and secondary qualities is pretty clearly not the distinction between essential and non-essential properties: size and motion are no more intuitively essential to composite bodies than color and heat.[[18]](#footnote-18)

 The third distinction between types of qualities is the most important for current purposes:

1. “[Q]ualities depending on or adjunct to the properties of individual [atoms], of which sort are magnitude or quantity and consequently subtlety and coarseness: and similarly figure, and what follows from it, like smoothness and roughness” (1.375a).

Rarity and density are also qualities of this type.

1. Qualities that are “adjunct to things as composite, or taken all at once: of this sort are, foremost, those that pertain to the various senses, as in respect of touch the qualities heat, cold, fluidity, firmness, humidity, dryness; and then, arising from them hardness, softness, flexibility, ductility, malleability and similar others … In respect of taste, flavor; in respect of smell, smell; in respect of hearing, sound; in respect of sight, light, color and … Intentional species” (1.375a).

This sort of quality can be subdivided into two types: sensible qualities and qualities that are made manifest only indirectly, by sensing their effect on other bodies. But some qualities – such as heat, which causes both felt heat and changes in other bodies – are both sensible and otherwise manifest.

 The distinction between type 1 and type two qualities, then, is the distinction between qualities that are “adjunct to the properties of individual [atoms]” and qualities that are “adjunct to things as composite, or taken all at once”. The fact that rarity and density are type 1 rather than type 2 is a useful clue for understanding what this means.

Density, unlike size, shape and spatial location, is not a property individual atoms can possess. But someone who knew the size, shape and spatial location of all the atomic components of a thing could immediately calculate its density. In contrast, knowing the color of a thing also requires knowing something about how the component atoms interact with each other.

1. “[Q]ualities that pertain to interior faculties and less sensible operations, such as sympathy, antipathy, magnetism, electricity, and in a word all those said to be occult” (1.375a).

Two questions immediately arise when confronted with this taxonomy. First – since the Lockean account of primary and secondary qualities is the paradigm on which our understanding of the distinction relies– how does this taxonomy relate to the Lockean taxonomy of primary qualities, immediately perceived secondary qualities and mediately perceived secondary qualities? Second, what is the precise ontological status of these various types of qualities? Are they appearances, powers or textures – or should we assign different ontological statuses to the different types of qualities?

To the extent the text makes any clear suggestion, it suggests understanding all three types of qualities as textures.[[19]](#footnote-19) No powers are mentioned, and although sensations are mentioned there is no suggestion that the quality *is* the sensation.[[20]](#footnote-20) Consider passages like the following:

Sound is nothing distinct from corpuscles configured in a certain way and continuously translated very quickly from the resounding thing, moving the organ [of hearing] and causing the sensation called Hearing (1.414b).

Or, in case the point is clearer in the case of a quality known via a contact sense rather than via corpuscular emissions:

It seems that taste, in those things that are called tasty, is nothing other than corpuscles configured in such a way that they enter into the tongue and palate … affecting them in such a way that the sensation which is called ‘taste’ occurs (1.409b).

Qualities are corpuscles, configured in a certain way: that is, qualities are *textures*.[[21]](#footnote-21)

 I will argue that given Gassendi’s various philosophical assumptions and the constraints he is operating under, the texture answer makes the most philosophical sense for him. However, I shall also argue that the texture answer turns the primary-secondary quality distinction into a purely epistemic distinction. And since it is a crucial component of the primary quality-secondary quality distinction as commonly understood that it is a *metaphysical* distinction, the texture answer in effect erases the primary quality-secondary quality distinction. Because of this, and because it is so natural for mechanical atomists to embrace the primary quality-secondary quality distinction in either its Galilean or Lockean forms, it will be worth our while to work our way through the other two alternatives and see *why* Gassendi embraces the texture view.

Explaining the ontology of qualities and how Gassendi’s taxonomy relates to Locke’s will occupy the rest of the paper. First, however, it is worth saying a little about type 3 qualities: electricity, magnetism and the rest of the Aristotelian ‘occult qualities’. On an Aristotelian picture, sensible qualities are not occult because the quality itself is grasped in sensation. What’s exhibited to the mind is like what’s really in the body. In contrast, qualities like magnetism are ‘hidden’ in the sense that experience does not tell us about the quality itself, only its effects. Gassendi distinguishes type 2 and type 3 qualities mainly for the benefit of readers with an Aristotelian education.[[22]](#footnote-22) He does not draw the Aristotelian distinction because he does not think that sensible qualities like color resemble our ideas of them any more than the occult quality of magnetism resembles the attraction of metal. Both derive from causes that are typically unknown but that are, in principle, knowable.[[23]](#footnote-23)

In some passages, Gassendi contrasts occult qualities with sensible qualities. In others he has a trivision: occult qualities, sensible qualities, and “manifest” qualities, namely insensible qualities whose causes are known (1.449b). From the perspective of the Aristotelian tradition, it seems easy and natural to equate sensible qualities with manifest qualities. But it does not make sense to do so on Gassendi’s view. For by arguing that heat, color and the like are textures, Gassendi in effect argues that the nature of these qualities extends far beyond what we perceive when we perceive hot or colored bodies. Gassendi typically talks about ‘those qualities commonly called occult’, and Charleton has a chapter entitled ‘Occult Qualities Made Manifest’. But it would be more accurate to say that Gassendi and Charleton turn almost *all* qualities into occult qualities: almost all of them have a nature that is not immediately apparent in sense perception.[[24]](#footnote-24) I shall argue that this also applies to the shape, size, solidity and motive power of macroscopic bodies. For even in that case there is a sharp distinction between the real nature of the quality in bodies and the appearance produced in our mind.

**IV**

 The view that qualities are appearances in the mind would have been familiar to Gassendi. Galileo – one of his biggest philosophical influences – asserted that “tastes, odors, colors and so on … reside only in the consciousness”.[[25]](#footnote-25) One argument for this claim is the following:

[P]eople … believe that heat is a real phenomenon, or property, or quality, which actually resides in the material by which we feel ourselves warmed. Now I say that whenever I conceive any material or corporeal substance, I immediately feel the need to think of it as bounded, and as having this or that shape; as being large or small [etc] … But that it must be white or red, bitter or sweet, noisy or silent, and of sweet or foul odor, my mind does not feel compelled to bring in as necessary accompaniments. Without the senses as our guides, reason or imagination unaided would probably never arrive at qualities like these. Hence I think that tastes, odors, colors, and so on are no more than mere names so far as the object in which we place them is concerned …[[26]](#footnote-26)

I find the argument puzzling. Let us grant Galileo that bodies cannot be conceived without size and shape, but can be conceived without color or heat. How does it follow that color and heat are not actually in the body but in the perceiver? How, that is, does it follow that secondary qualities are purely mental? Matter can be conceived without magnetism, but no one is tempted to say that magnetism is really in the mind, not the world. We continue to think there is a distinction between magnetism and the idea of magnetism even after we realize that nothing resembling our idea of magnetism exists in bodies. This question is particularly salient since Locke agrees that the primary qualities are the ones that are “wholly inseparable from body” (2.8.10), but unlike Galileo locates the secondary qualities in bodies.

 However, we can safely put this aside. Our main concern is why Gassendi rejects the Galilean position. As we have seen, his initial discussion of qualities suggests that atomism implies that qualities are modes of bodies. While this is neutral between the power view and the texture view, it is incompatible with the appearance view. But why is Gassendi so willing to assume that qualities are modes? Why does he discard Galileo’s appearance view out of hand?

The basic form of Gassendi’s argument is this:

1. No individual atoms have the qualities of color and heat.
2. Some macroscopic bodies *do* have the qualities of color and heat.
3. Macroscopic bodies are just collections of atoms arranged in a certain texture.
4. Therefore qualities are (or emerge from) textures.

Gassendi’s (2) is just the denial of Galileo’s claim that color and heat are in the mind. Hence, it is implausible that Gassendi siimply thought (2) is so uncontroversial as to need no defense. Why then does he believe (2)? We can find an answer, I think, by looking at what Gassendi is willing to count as evidence that a body has a certain quality. Although he never articulates a general view here, one can be elicited from his account of cold.

 After discussing heat, Gassendi asks, “whether cold is a genuine and positive quality or a mere privation” (1.401b) and answers that cold should be considered a positive quality for the same reason that heat is considered a positive quality. We gain evidence that heat is a positive quality from observations like the following: “if you set a glass bottle next to a [burning] coal the water contained in that bottle is changed so that it becomes hotter and bubbles”. But we have exactly parallel evidence concerning cold: “if you surround a glass bottle with snow or ice, the water is changed so that in a moderate amount of time it becomes colder and freezes.” Thus cold should be considered a genuine and positive quality, too, on the principle that a privation is incapable of action (1.401b). In other words, cold must be a genuine, positive quality *because it has genuine effects.* And so we should reserve the term ‘cold’ for something in bodies – not for a feeling in perceivers – else we have no term for the cause of that feeling (and of various other effects).

 Thus, a quality is whatever causes a certain effect. For a body to have a certain quality is for it to have certain effects. So far, this is compatible with either the texture view or the power view. Let us go on to consider these two views and determine why Gassendi opted for the texture view.

**V**

 One implication of Gassendi’s quick rejection of the appearance view is that it makes it easy for him to group qualities like color and heat together with qualities like flexibility, as metaphysical equals. His type 2 qualities include both what Locke would later call the immediately perceivable secondary qualities and the mediately perceivable ones. But are these qualities textures or powers? We need to answer this question to figure out whether there is a significant ontological distinction between type 1 and type 2 qualities for Gassendi – to see, that is, whether color and size are ontologically different in the way they are within the Cartesian or Lockean framework.[[27]](#footnote-27)

I said above that the text favors the texture reading. But what could be Gassendi’s motivation for identifying qualities with textures? Since he does not explicitly consider the power view, we shall need to speculate a bit.

Gassendi’s fundamental way of conceiving of a body as qualified is conceiving of it as having certain effects. So whatever it is in virtue of which the body has effects must be the quality. But what it is in virtue of which bodies have effects? Like many other 17th century philosophers, Gassendi is hostile to the notion of ungrounded powers. We must identify a categorical cause, not just a bare disposition, to avoid slipping back into unsatisfactory Aristotelian metaphysics. What causes the magnet to attract iron is that it emits hooked corpuscles that attach onto pieces of iron – not that it has a magnetic power. Similarly, what causes the body to look red is its texture, not the power it has in virtue of having that texture. (And in any case, it is uncontroversial that the powers bodies have to cause certain sensations are grounded in their texture. Even Locke thinks that.) To put the point in somewhat anachronistic terms, Gassendi is committed to the texture view rather than the power view by identifying qualities with what realizes a certain functional role. And his reason for doing so is that in any actual causal situation, it’s what realizes the functional role that does the causing.

This shows that we need to be a little bit careful in how we characterize the texture view. When we say that for a body to be red is for it to have the texture that causes red-sensations, we could mean one of two things:

1. *x* is red just in case *x* has some texture that causes red-sensations (whatever that texture may actually be); *or*
2. *x* is red just in case *x* has texture *t* and texture *t* is the texture that actually causes red-sensations.[[28]](#footnote-28)

On (a), the texture view and the power view are much the same in spirit, if not in letter. For (a) makes bearing a certain relation to perceivers essential to being red. What I have in mind is (b). And in contrast, the reference to a perceiver in (b) is not essential. To figure out what texture *t* is, we must figure out what texture actually causes red-sensations. But a body can have texture *t* and hence be red without being such as to cause red–sensations. If the human perceptual apparatus were different, so that some other texture caused red-sensations, possessing texture *t* would still constitute redness.

 The point can be put another way. On (a), being red is a relational property – a property something bears in virtue of standing in a certain relation to another thing, in this case the human perceptual apparatus. On (b), redness is not a relational property. It is an intrinsic property.

 I am not aware of any text that favors (b) over (a). But thinking of the quality as what endows the body with certain causal powers fits better with (b). To say that a body is red because it has some texture that causes red-sensations – whatever that texture may actually be – is not to offer much of an explanation. Unless we actually specify what texture causes red-sensations, we are merely pointing at some unexplained power. We are not explaining what grounds that power, and hence have not advanced much past dormitive-virtue type explanations. So from now on, (b) is what I mean by the texture view.

If secondary qualities are powers or relational properties, there is a sharp metaphysical distinction between primary and secondary qualities. For primary qualities, on the typical view, are intrinsic and categorical. However, if secondary qualities are textures, in sense (b), then there is no real metaphysical difference between primary and secondary qualities. The difference lies simply in our different modes of epistemic access to them. We can characterize a quality like size or shape without making any reference to ourselves or our sensory apparatus. The same is not the case, Gassendi suggests, for qualities like heat and color. Given the present state of scientific knowledge, we can only refer to these qualities by identifying them as whatever textures cause certain sensations – or certain effects on other bodies. Our descriptions of secondary qualities must involve a relation, although they are not relational properties.

 It is relatively easy to confuse the epistemic claim that we must characterize secondary qualities in relational terms with the metaphysical claim that secondary qualities are not relational properties. But we should be careful not to do this. Let us return to the example of heat to help clarify the picture.

Gassendi begins his discussion of heat by saying that “heat is often conceived from the relation it has to sensation” (1.394b), but that this common conception is misleading. For in fact, heat “cannot be explained except by the size, shape, and mobility of atoms” (1.394b). More specifically, we feel the sensation of heat when heat enters into the pores of the body and penetrates and loosens its various parts. Gassendi clarifies the point by admonishing the reader as follows. When he says that heat

enters in, penetrates, loosens, etc, do not understand a certain nude and solitary quality but rather certain atoms insofar as they are furnished with such a size, such a shape, such a motion. (1.394b).

The other effects of heat occur when such corpuscles penetrate insensate bodies. Corpuscles possessed of such a size, shape, and motion are hence referred to as heat corpuscles. In other words, something is a heat corpuscle just in case it has a certain texture – that texture which in factcauses a certain sensation in perceivers (as well as certain other effects in other bodies).

**VI**

 If we read on, however, we will see that Gassendi’s discussion of heat almost immediately complicates things. For he adds:

Indeed these atoms do not have heat *ex se* or, what is the same thing, they are not hot, but can nevertheless be judged and called atoms of heat, or calorific atoms, insofar as they create heat, that is, have this effect (1.394b).

This is puzzling, on two counts. First, it seems that Gassendi should not be talking about *atoms* of heat at all, but rather about corpuscles or molecules – little atomic composites. Second, it is hard to know what to make of Gassendi’s claim that heat atoms “are not hot”. Let us consider these two puzzles in turn.

 Olivier Bloch argues that heat and cold function as exceptional cases in Gassendi’s account of qualities.[[29]](#footnote-29) For, on his view, they are the two cases in which Gassendi uses the Democritean technique of reducing qualities to individual atoms rather than his more usual, and more complex, technique of reducing them to small atomic composites or molecules.[[30]](#footnote-30) There is substantial textual evidence for this, since Gassendi very frequently uses the term ‘heat atom’ as well as the more neutral term ‘heat corpuscle’.[[31]](#footnote-31) And clearly the Democritean view retained substantial influence on Gassendi. However, on balance I think we are best off understanding him as meaning heat *corpuscles*. While calling a compound an atom sounds terrible to modern ears, some of the chemical writers Gassendi could have been familiar with do so.[[32]](#footnote-32) And there are some significant cases where Gassendi calls things ‘atoms’ that he *clearly* thinks of as composite.[[33]](#footnote-33)

This makes it possible to read Gassendi as thinking of heat in terms of molecules rather than atoms. Once this possibility is on the table, positive reason to go for it is not hard to find. As we saw, in his initial classification of qualities Gassendi classifies heat among the qualities that depend on the properties of many atoms joined together (1.394b). He reiterates the point in the chapter “On heat, and cold” which begins, “Next follows those Qualities which depend on the properties of many Atoms joined together simultaneously” (1.394b). Elsewhere, he remarks that “heat, cold and other qualities are not congenital to Atoms but are proper to concretions and arise from … the qualities of atoms” (1.366a). And so on. A lone indivisible atom, then, cannot have the quality of heat: only corpuscles or molecules can have that quality.

 Now for the second difficulty. Why does Gassendi say that heat corpuscles are not hot, that is, do not have heat *ex se*? This is puzzling: if being hot is just having the texture that causes certain effects, then heat corpuscles *are* hot. The passage is easily read as suggesting that heat is a sensation in the mind, and that heat corpuscles should not be called hot because there is nothing in those corpuscles resembling the sensation. However, this is not the point Gassendi intends to make. He goes on to explain that such corpuscles can be called heat corpuscles because “they can excite heat by the emission of this sort of atoms [i.e. heat corpuscles]” (1.394b). The heat that he is talking about being excited here is not the *sensation* of heat, but rather the heat that is excited in a log or a piece of wax or fat when they burst into flame. Gassendi assumes that the same texture causes a person who puts their hand in front of the fire to feel warmth and causes the log to blacken and smoke, so he might add that heat corpuscles excite heat in the skin of the perceiver. Then what is hot, properly speaking, would be the skin – not whatever corpuscular emission affected it. In this passage, Gassendi is concerned about the possible lack of resemblance between the qualities taken on by the corporeal effect and the qualities of its cause, not the possible lack of resemblance between states of sense organs and sensations in the mind.

 Locke’s claim that there is nothing in bodies that resembles our ideas of secondary qualities lies near the surface in any discussion of primary and secondary qualities, and it is easy to read it into Gassendi’s discussion. However, this is a mistake. There is no talk of resemblance between sensations or ideas and qualities in the text; in fact, there is almost no talk of ideas in this section of the *Syntagma* at all. Perhaps more importantly, given Gassendi’s other philosophical commitments, he cannot hold that ideas of shape and solidity resemble some real feature of bodies in a way that ideas of heat and color do not. There is a gap between appearance and reality for *all* sensible qualities, not just qualities like heat and color. Let us see how that gap arises.

**VII**

The distinction between reality and appearance is central to Gassendi’s way of thinking. It is a mainstay of his early *Exercitationes*, which uses conflicts among the appearances to argue that we have no knowledge of reality, and continues to recur in later philosophical works. But although Gassendi was at first tempted by skepticism, in his mature work he is committed to avoiding the Pyrrhonian problematic. His version of the Epicurean doctrine that the appearances are always true was developed to make Pyrrhonian worries impossible.

Consider two Pyrrhonian examples: the tower that looks round from a distance and square from close up, and the wine that tastes sweet to a healthy man and bitter to a sick man.[[34]](#footnote-34) How can both ways the tower looks and both ways the honey tastes be ‘true’? Only – to put the point as briefly as possible – if the information conveyed by the appearances is understood as information about what is received in sensation rather than information about what the wine is really like. The appearance of the tower as round does not, properly speaking, inform us that the tower *is* round; it informs us that the tower *looks* round under conditions such as the current ones, “for causes having to be investigated by physics” (3.388b).

 There may well be some tension between the way Gassendi handles the truth of the appearances and the way he handles qualities. He often seems to identify the quality with the appearance in the mind when he is outlining his theory of perception, although this is flatly inconsistent with his ‘official’ account of qualities. However, this is not a sign of any deep philosophical confusion. The picture of what happens in perception is clear: the only thing unclear is whether we use the term ‘red’ for what is in the body or what is in the mind.[[35]](#footnote-35)

 In any case, a tension here would not count against my interpretation. For Pyrrhonism is full of examples of perceptual error and relativity that pertain to the Lockean primary qualities as well as ones that pertain to qualities like heat and color. Thus if we took the doctrine of the truth of the appearances to motivate a view of qualities as appearances, we would have to think it motivates thinking of *all* qualities as appearances. But whether or not we understand tastes, colors etc. as modes of body, we must understand macro-level size, shape, solidity and motion as modes of body. These qualities cannot be simply appearances in the mind. Someone who reads Gassendi as thinking that heat and color are powers or even mental entities must still square his view of the Lockean primary qualities with the truth of the appearances.

 So far, we have been discussing how perceptual error and relativity open up an appearance-reality gap for perception of qualities like shape and solidity. But in fact, on Gassendi’s view, macroscopic shape and solidity differ in appearance and reality even in *ideal* cases. The appearance of roundness or solidity that a body produces in the mind does not resemble that body’s texture any more than its appearance of redness does.

Consider what bodies are like, on Gassendi’s view. The material world is composed of atoms moving through the void. Thus, even apparently solid bodies are in fact composed mainly of void space. And even bodies with apparently smooth surfaces and regular shapes are in fact highly irregular and porous. Moreover, on Gassendi’s view atoms are constantly in motion, even when the macroscopic bodies they compose are at rest.

Thus just as Gassendi denies that anything like color as it appears to us in the world is really in bodies, he also denies that bodies have anything like the qualities of shape, solidity and motion that we experience them as having. An orange appears to us as orange – but also as round, solid, and (let us suppose) stationary. But in reality, it is porous and irregularly shaped; it is composed mainly of void space; and its parts are in continuous motions. The appearances produced by the Lockean primary qualities do not inform us about what bodies in themselves are really like any more than our experiences of secondary-quality appearances do.[[36]](#footnote-36)

**VIII**

 We have seen two main reasons to deny that Gassendi’s distinction between type 1 and type 2 qualities is the distinction between primary and secondary qualities – and, more generally, to deny that he draws any significant distinction between primary and secondary qualities. First, both type 1 and type 2 qualities are categorical features of bodies that depend on their micro-level constituents. While it is true that we pick out type 2 qualities by means of the relation they bear to the human perceptual apparatus, this is merely an epistemic difference. Second, there is an appearance-reality distinction for both type 1 and type 2 qualities. Neither sort of qualities resemble the appearances they produce.

 By not drawing any clear distinction between primary and secondary qualities, Gassendi may appear to side with the Aristotelians against new philosophers like Galileo and Descartes. But in a deeper sense, his view is the exact opposite of the standard Aristotelian view. Aristotelianism sees properties like color and taste as really in bodies, just as we perceive them, in exactly the same way size and shape are. For Gassendi, on the other hand, *no* sensible qualities are in bodies exactly as we perceive them. Thus while the standard Aristotelian view is that all sensible qualities resemble our ideas of them, Gassendi’s view is that none of them do. Atomism emphasizes the gap between our manifest image of the world and the way the world really is. In doing so, it need not – and in fact should not – draw any strong distinction between primary and secondary qualities. The fact that we can specify the texture responsible for shape perception more easily than the texture responsible for color perception is no reason to think the two sorts of qualities are *metaphysically* different. And since the distinction between primary and secondary qualities is traditionally thought of as a metaphysical distinction, we are best off reading Gassendi as drawing no real distinction between primary and secondary qualities at all.

**IX**

 I have argued that Gassendi understands both primary and secondary qualities non-relationally, as textures of atoms.[[37]](#footnote-37) In the case of qualities like color and taste, we must specify the relevant texture in terms of some relation to the human perceptual apparatus. For instance, given the current state of scientific knowledge, we can only refer to the texture that constitutes redness by describing it as the textures that causes red-sensations. In contrast, we can characterize the primary qualities without appealing to any relation. However, this is merely an epistemic difference between primary and secondary qualities. It does not imply that secondary qualities are relational properties. And this, I think, implies that there is no real distinction between primary and secondary qualities in Gassendi’s version of mechanical atomism.

 This conclusion may well strike readers as surprising. Shouldn’t any atomist – or indeed any mechanical philosopher – draw some sort of distinction between primary and secondary qualities? Why *didn’t* the distinction between primary and secondary qualities strike Gassendi as important?

 One clue as to why not is provided by the fact that Gassendi, unlike most other mechanical philosophers, was not involved in the project of quantifying nature. The main goal of Gassendi’s physics is to show how it is possible for a world such as our own to be composed of nothing but atoms moving through void. His explanations are almost entirely qualitative. He explains the behavior of the magnet, for instance, by positing that it emits hook-shaped corpuscles – and explains the effects of gravity on falling bodies in roughly the same terms. Gassendi has very little interest in quantitative explanations of any kind.[[38]](#footnote-38) Instead, he is interested in explaining how macro-level qualities, powers and the like emerge from the interaction of atoms.

An implication of this approach to natural philosophy is that it leaves Gassendi no real reason to quantify the properties of macroscopic bodies. Thus the fact that some properties of macroscopic bodies are far more easily quantified than others is not particularly salient in Gassendi’s physics. And this is significant because the easily quantified properties of macroscopic bodies are the traditional primary qualities: size, shape and motion. For Gassendi, the traditional primary qualities of macroscopic bodies are not used for explanatory purposes in physics. They are mere *explananda*, just like color and taste. And this leaves him with little reason to insist on a metaphysical difference between the two sorts of qualities.[[39]](#footnote-39)

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1. Two caveats. First, Gassendi distinguishes motion from motive power, and ascribes both motion and motive power to atoms. But while this is important for other reasons, it plays no role here: hence I shall simply speak about motion. (For more on motive power, see LoLordo 2008a.) Second, Gassendi – like many other atomists – allows the possibility of superadded powers, for example the power involved in animal generation. But he insists that if there are such powers, they must be superadded *by God*: it takes divine intervention for there to be anything in body that does not supervene on the qualities of atoms. For more on this, see LoLordo 2007, chapter 7. [↑](#footnote-ref-1)
2. [↑](#footnote-ref-2)
3. [↑](#footnote-ref-3)
4. More precisely, both primary and secondary qualities are determinants of a determinable at least some of whose determinants are sensible. There are obviously some bodies whose size, shape and perhaps color are too small for us to see. [↑](#footnote-ref-4)
5. I do *not* claim that part of the primary quality-secondary quality distinction is that use in scientific explanation is a criterion for distinguishing primary qualities from secondary qualities. That would be too strong. For scholars argue about whether Locke derives his primary quality-secondary quality distinction from corpuscularianism, or whether he takes himself to have independent arguments for it – arguments that depend merely on ordinary experience. And if use in scientific explanation must be a criterion for distinguishing primary qualities from secondary qualities, the second way of interpreting Locke would be *prima facie* absurd. [↑](#footnote-ref-5)
6. However, our grasp on the distinction can survive *some* change in its components. Certain contemporary philosophers argue that color is a primary quality. See e.g. Jackson 1996. However, Jackson is careful to note that his view that colors are physical properties “is sometimes known as the primary quality view of color, although the idea is not that colors are identical with complexes of primary qualities in a sense tied to Locke’s famous list, but rather that they are identical with complexes of properties the physical sciences appeal to in their causal explanations” (199). [↑](#footnote-ref-6)
7. For instance, a form of atomism on which there are atoms for each of the three chemical elements makes the primary qualities – and perhaps some of the secondary qualities as well – insensible, and alters the list of primary and secondary qualities drastically. [↑](#footnote-ref-7)
8. From the verb *contexo* – to weave, entwine, join or bind; secondarily, to compose, construct, or put together. [↑](#footnote-ref-8)
9. See e.g. *Essay* 2.8.10: “by their ­*primary qualities*, *i.e.* by the bulk, figure, texture, and motion of their insensible parts” and Boyle, “Origin of Forms and Qualities” 4 (Boyle 1979, 30): “a certain disposition or contrivance of parts in the whole, which we may call the ­*texture* of it”. [↑](#footnote-ref-9)
10. DL IX 44-45. Diogenes Laertius, *Lives of Eminent Philosophers*, trans. R. D. Hicks. Loeb Classical Library (Harvard University Press): Cambridge MA, 2000. [↑](#footnote-ref-10)
11. Charleton’s *Physiologia* is a free partial translation of Gassendi, with some of Charleton’s own remarks tossed in. The discussion of qualities is fairly close to Gassendi’s, although some of the examples are different. Charleton’s *Physiologia* is important as one of the main vehicles by which knowledge of Gassendi was transferred to later English philosophers. [↑](#footnote-ref-11)
12. Charleton 1654, 129. [↑](#footnote-ref-12)
13. Charleton neither defines the term ‘appearance’ precisely nor uses it particularly frequently. However, that appearances are in the mind is suggested by the following passage: “An Apparence we term it, because the *Quale* or Suchness of every sensible thing, receives its peculiar determination from the relation it holds to that sense, that peculiarly discerns it: at least from the judgment made in the mind according to the evidence of sensation”. In any case, it does not matter much for current purposes whether Charleton intends to suggest the possibility that qualities are mental: it is a live option for early modern philosophers in any case. [↑](#footnote-ref-13)
14. More precisely, a power to cause a certain effect on the sense organs of a certain kind of perceiver under certain specified conditions. From now on I will simply say ‘the power to affect us in a certain way’, as shorthand. The reader should insert an implicit clause about normal perceivers and normal circumstances. [↑](#footnote-ref-14)
15. I make this view more precise in section V below. [↑](#footnote-ref-15)
16. See Lisa Downing’s “Sensible Qualities and Material Bodies in Descartes and Boyle”, in this volume. [↑](#footnote-ref-16)
17. I suggest below that this flows from his interest in the perceptual relativity of the qualities of macroscopic bodies. [↑](#footnote-ref-17)
18. One way of drawing the primary quality-secondary quality distinction is, however, related. It is sometimes suggested that the primary qualities are those determinable qualities that any body whatsoever must have. Thus although having a particular shape is not essential to any body, having some shape is; in contrast, a body can exist without having any color at all. I do not see any trace of this way of drawing the distinction in Gassendi, perhaps because he does not hold the Lockean resemblance thesis often associated with it. For more on this, see section VII. [↑](#footnote-ref-18)
19. Of course, they are not all textures of the same things. In the case of ‘occult’ qualities like electricity, gravity and magnetism, what’s relevant is the texture of the interior of the body and the texture of the corpuscles emitted. The various smells are also a matter of corpuscular emissions, although in this case it’s the texture of the *surface* of the body that’s relevant. In the case of qualities known via touch and taste, what’s relevant is the texture of the body’s surface. And in the case of qualities known by vision – which occurs through modifications of light rather than through corpuscular emissions – the relevant textures are the texture of the body’s surface and the texture of the light corpuscles modified by it. [↑](#footnote-ref-19)
20. However, Gassendi does sometimes (e.g. 1.410b) suggest that the quality, properly speaking, is primarily in the sense *organ* and only secondarily in the body sensed. [↑](#footnote-ref-20)
21. I read Gassendi here as meaning that the quality is the configuration and not the corpuscle, in keeping with his insistence that qualities are modes. [↑](#footnote-ref-21)
22. I say ‘mainly’ because from the point of view of physics there is one important difference: type 3 qualities are a matter of the interior texture of the body while type 2 qualities have to do with surface textures. [↑](#footnote-ref-22)
23. At 1.452a-1.457b, Gassendi explains occult qualities including magnetism, electricity and the healing power of the weapon salve in terms of corpuscular emissions. These are only partial explanations – he does not claim to know precisely what the relevant texture is in each case – but they are sufficient to show that he thinks such occult qualities are in principle knowable. [↑](#footnote-ref-23)
24. I suspect that Charleton has in mind the view that occult qualities are unintelligible: by making them manifest, he is making them intelligible. [↑](#footnote-ref-24)
25. Galilei 1957, 274 (selection from “The Assayer”). [↑](#footnote-ref-25)
26. Ibid. [↑](#footnote-ref-26)
27. However, it can be argued that Locke reduces powers to primary qualities and hence holds that powers *are* textures in the sense I use the term. For instance, Locke says that “*Powers* are Relations, not Agents” (II.xxi.19: 243) and that “the different Bulk, Figure, Number, Texture, and Motion of [a body’s] insensible Parts” (II.xxi.73: 287) is the *only* cause we can imagine for the ideas bodies produce in us and for the changes they bring about among one another. Thanks to Walter Ott for this point. [↑](#footnote-ref-27)
28. Both (a) and (b) should be understood to include ‘in normal perceivers, under normal circumstances’, etc. [↑](#footnote-ref-28)
29. Bloch 1971, 253. [↑](#footnote-ref-29)
30. When atoms first combine, they form themselves into “certain very subtle composite corpuscles or very fine molecules … that are, as it were, the seeds of things” (1.472a; cf. 1.282b, 1.337a). Molecules do a great deal of explanatory work for Gassendi: for instance, by reinterpreting the chemical elements as molecules, he can capture what he sees as the successes of chemistry without its metaphysics. [↑](#footnote-ref-30)
31. He refers to heat corpuscles at e.g. 1.396a and 1.397b. The term ‘corpuscle’ is more neutral because a corpuscle – literally, a small body – can be either an atom (e.g. 1.256a) or a molecule (e.g. 1.357a). [↑](#footnote-ref-31)
32. See e.g. Sennert 1636, 95 and 107, who speaks of “the second genus of atoms” – salt, sulphur and mercury, which are made up of the fundamental atoms earth, air, fire and water – and then a third genus of atoms such as gold. [↑](#footnote-ref-32)
33. One example comes from Gassendi’s explanation of the solubility of silver in ­*aqua fortis* and gold in *aqua regia*, which is that gold atoms fit the pores of aqua regia and silver atoms fit the pores of *aqua fortis* (2.33a ff). Gassendi clearly does not think that there are indivisible atoms of silver and gold. Gold is a molecule or corpuscle, not an atom, as is shown by the discussion of the transmutation of lead into gold by implanting gold seeds which will re-texture the lead into gold (3.259a). [↑](#footnote-ref-33)
34. For such examples, see Sextus Empiricus 2000. [↑](#footnote-ref-34)
35. There is a parallel – and equally unserious – confusion in Locke (see *Essay* 2.8.8). [↑](#footnote-ref-35)
36. Size is an exception here. [↑](#footnote-ref-36)
37. Although I have not argued for this in any detail here, the same applies to Locke’s mediately perceivable secondary qualities. For in Gassendi’s taxonomy, these are type 2 qualities just like the secondary qualities. [↑](#footnote-ref-37)
38. The one exception is his *De motu*, which makes use of the quantitative, Galilean science of motion. However, even in this work his main interest is in explaining how micro-level atomic phenomena can account for the motion of macroscopic bodies and not providing quantitative descriptions of that motion. [↑](#footnote-ref-38)
39. I would like to thank Paul Lodge, Larry Nolan, Walter Ott and an anonymous referee from this Press for helpful comments on previous versions of this essay. [↑](#footnote-ref-39)