Primary and Secondary Qualities

The Historical and Ongoing Debate

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The Distinction between Primary and Secondary Qualities in Ancient Greek Philosophy

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1. Introduction

It is natural to ask whether the distinction between primary and secondary qualities that one finds among the mechanical philosophers of the seventeenth century has antecedents in ancient Greek philosophy.[1] But this question is difficult to answer for at least two reasons. First, the ancient Greeks did not possess terms corresponding to "primary quality" and "secondary quality", and hence did not have a terminology neatly marking the distinction as we do. They did have terms such as *aisthēta* ("those things that can be perceived"), *ta phainomena tais aisthēsesi* ("what appears to the senses"), and *aisthētai poiotētes* ("sensible qualities"), among others, which are often used to refer to the "secondary" qualities, but can also be used more broadly to refer to such things as dogs and horses, or the properties of being such. The primary–secondary quality distinction, however, is a distinction *within* the genus of sensible qualities, and hence these Greek terms fail to pick out the relevant distinction.

Second, though we moderns have terms marking a distinction, there is some confusion even for us about what exactly is intended by the distinction; depending upon how we understand the distinction, we will answer the question about the Greeks differently. It is generally agreed that the *locus classicus* for such a distinction is in the mechanical philosophy of Galileo, Descartes, and Boyle, as well as in Locke. Galileo seems to have drawn a distinction between "primary" and "secondary" qualities as part of an argument rejecting Scholastic-Aristotelian ways of understanding

[1] In this chapter, I use the following translations: for the Pre-Socratics with the exception of Democritus, Barnes 1987; for Democritus (and testimony about Democritus, including Theophrastus'), Taylor 1999a; for Plato, Cooper ed. 1997; for Aristotle's *De Generatione et Corruptione*, Williams 1982. References to the Pre-Socratics include the fragment or testimonium number in Diels-Kranz 1951–2; references to Democritus include the corresponding fragment number (e.g. "D16 Taylor") or testimonium number ("46a Taylor") in Taylor 1999a, which is much superior to Diels' collection, but does not include the Greek.

matter. On that view of matter, hot, cold, wet, and dry are the fundamental qualities of matter—to which Galileo responds by arguing that these are not primary qualities of matter at all, but *secondary* qualities, along with the other objects of sensation. The "primary and real properties" of body are shape, size, number, motion, spatio-temporal location, and contact. Primary qualities are those qualities which all bodies have necessarily: what makes qualities "primary" is that they are essential and necessary to body. "Secondary" qualities are all those (sensible) qualities that are not primary: being a brick and being a horse, as well as being red or sweet, would presumably count, on this criterion, as "secondary" qualities. Galileo and Descartes seem to have thought that matter has primary qualities, but not secondary qualities: secondary qualities are not "real" (since, for example, they are not causally efficacious). Locke by contrast, thought that bodies *do* have secondary qualities, and characterized those qualities as powers of bodies to produce certain effects in observers; hence, they are by definition relational, that is, are to be defined in relation to perceivers or minds. They are properties of bodies, but not fundamental properties—unlike the primary qualities, they are defined as "mere powers". In addition, he notoriously held that our ideas of the primary qualities "resemble" the primary qualities themselves which cause them, whereas our ideas of the secondary qualities do not resemble their causes—our ideas of color, for example, are caused by complex configurations of the primary qualities, which when characterized as powers to produce those ideas, are called secondary qualities. In any case, what makes secondary qualities "secondary" is that their existence and nature can be explained in terms of the primary qualities of bodies.

This distinction has become quite ordinary and familiar, and there is some agreement in popular usage about the extension of the terms "primary quality" and "secondary quality"; usually properties such as size, shape, solidity, etc. are referred to as "primary", and properties such as color, smells, tastes, objects of touch, and sounds (i.e. the objects of sensory experience, narrowly construed) are taken to be "secondary" (which is what I shall refer to as "secondary qualities" in the remainder of this chapter). However, there is little certainty about what the real basis of the distinction is supposed to be. First, one could have in mind a distinction based on a theory about what are the essential attributes of matter, and in particular, of pieces of matter, namely, bodies. One might argue that shape, weight, size, and solidity are essential to body, since no matter how many times one divides matter, it continues to retain these qualities, whereas, if one divides bodies past a certain point they lose their color, smell, etc. Secondary qualities are then simply all the other qualities of body, where this encompasses both non-relational properties (such as being human), and relational properties (such as being sweet). What unifies secondary qualities, on this understanding, is the fact that all of them can be explained in terms of the primary qualities of bodies. Hence, we expect some kind of account of the relation that secondary qualities bear to primary qualities—for example by assigning secondary qualities to groupings of certain kinds of bodies and their primary qualities, or by showing that changes in secondary qualities depend on changes in primary qualities

in such a way that the secondary qualities supervene on the primary ones. Following Pasnau in his chapter on the Scholastics, one might look for some of the following theses in order to establish the causal priority of the primary qualities over the secondary qualities: (i) the primary qualities are the fundamental explanation of natural change, (ii) the primary qualities are present in all bodies, (iii) the primary qualities, not the secondary qualities, are the primary causal agents (Ch. 2 pp. 45–6).

Alternatively, secondary qualities can be marked off from the primary ones by their subjectivity and causal relations to minds, in contrast with the primary qualities, which are objective and non-relational. For one can make mistakes about "secondary" qualities, and experience conflicting appearances with respect to them, without any change occurring in the objects themselves. For example, the wine appears both sweet to me and dry to you, while it remains the same in itself, undergoing no changes. Thus, its being sweet appears to be a matter of how it affects us, with our particular physical conditions and temperaments, not a matter of how the body constituting the wine is in itself. So understood, the primary–secondary quality distinction is a version of the distinction between appearance and reality.

Thus, the primary–secondary quality distinction can be understood in two ways: (1) it is a way of marking off a metaphysical distinction between essential and non-essential properties of matter and of bodies. As such, it promises to be a basic feature of any materialist ontology, and hence one would expect any theory of matter to have commitments on such a question. (2) In another sense, it is a way of marking off those sensible qualities which seem to be particularly subjective, that is, dependent on the responses that perceivers have to them. Qualities like colors and flavors give rise to conflicting appearances in different perceivers, and this in turn seems to have something to do with the epistemic facts about our sense-modalities and modes of perception.

Once we are clear about the fact that there are these two strands of thinking involved in the so-called primary–secondary quality distinction, we can both recognize the perils of anachronism in asking the question "did the ancient Greek philosophers draw the distinction?"—as though failure to combine these two strands of thought in a single distinction would be evidence of some kind of philosophical primitivism—but also answer it fairly straightforwardly by considering the ways in which they dealt with one or both strands of thinking.[2] In my view, the ancient Greek philosophers were concerned with both distinctions, though most of them did not combine them in the particular way that is distinctive of the seventeenth-century thinkers. Not surprisingly, it is the atomists of antiquity, Democritus, Plato, and Epicurus—the predecessors of the early modern corpuscularians—who seem to have come closest to drawing the

[2] These complications explain why there isn't much scholarly literature on the primary quality-secondary quality distinction in ancient Greek philosophy; discussions tend instead to focus on different ancient opinions about the nature of sensible qualities.

primary–secondary quality distinction in the way now familiar to us. But there are good reasons to view Aristotle himself—the target of the early modern mechanists—as having himself argued for a version of the primary–secondary quality distinction as well.

In the remainder of this introductory section, I shall give a brief overview of the entire period, with some comments about how the ancient Greek philosophers line up on these questions, and then I shall turn in subsequent sections to the views of the most interesting candidates: Democritus, Plato, Aristotle, and Epicurus.

Because many ancient Greek philosophers were concerned, from the very beginning, to explain what the nature of things really is, and which "beings" are most fundamental, we find evidence of the first strand of thinking about "primary qualities" throughout the period. Many of the so-called Pre-Socratic philosophers, including Thales up through Democritus, seem to offer competing theories of matter—thus, for example, one might say that when Thales said "the all is water", he was arguing that water is to be identified as the basic matter underlying all things (and similarly with Anaximander's *apeiron*, Anaximenes' *aer*, Empedocles' elements (earth, air, water, and fire), and Anaxagoras' so-called "roots").[3] Thus, many of them do offer explanations of change and alteration in observable things in terms of more basic substances and their qualities. And though they do not put it this way, some of them can be described (admittedly anachronistically) as distinguishing between primary, that is, essential, qualities of matter, and secondary, that is, derivative, qualities of material things. Thus, Empedocles, for example, argues that things like animals and plants are made up out of the four basic elements; famously, he says that

> Another thing I will tell you: there is no birth for any mortal thing, nor any cursed end in death. But there is only mixing and interchange of what is mixed—but men name these things birth.
>
> (Plutarch, *Against Colotes* 1111F = DK 31B8, trans. Barnes in Barnes 1987)

That is, what people call "coming into being"—for example, the birth of a baby—is not really anything other than a "mixing and interchange" of what already exists and does not in itself change.

However, with the exception of Democritus, none of the Pre-Socratics seem to have singled out the secondary qualities more narrowly construed (i.e. colors, sounds, smells, tastes, etc.) for special treatment, or attempted to show specifically how to derive them from the primary ones. Thus, for example, Anaxagoras' theory of elements includes stuffs-cum-qualities such as the sweet, the bitter, blood, bone, the hot, the red, etc.; he has what we would call "secondary" qualities mingling happily with "primary" qualities.

The second strand of thinking we identified above—the one which marks sensible qualities off as subjective and perceiver-dependent—makes its first appearance in

[3] This reading of the Pre-Socratics goes back to Aristotle (*Metaphysics* I 3). For texts translations and commentary, see Kirk Raven and Schofield 1983. Guthrie 1962 and Guthrie 1965 are still classic treatments of the earlier and later Pre-Socratics respectively. See also Kahn 1960, and more recently, Graham 2006.

some of the Pre-Socratics who made use of conflicting appearance arguments, in the service of the thesis that things are not as they seem, and that our means of discovering the truth are highly fallible.[4] Thus, for example, Xenophanes famously points out that if cows could draw pictures of the gods, they would give them cow-attributes; this seems to suggest that our conception of the gods is fallible (Clement *Strom.* V, 109, 3 = DK 21B15). And Heraclitus offers arguments of the form "things are F and not-F", either in order to emphasize how fallible human modes of understanding are, or in order to emphasize that things may have the appearance of confusion and diversity, though there does, in fact, exist an underlying order. Such arguments culminate in Protagoras' conflicting appearance arguments: he is said by Plato and other sources to have argued that things appear F and not-F, and thus are F for some and not-F for others (Plato, *Tht.* 152a2–4 = DK 80 B1; see also Sextus *M* VII 60, DL IX 51, and *Tht.* 161c3). While Protagoras' aim seems to have been to argue for some kind of thoroughgoing relativism or infallibilism (the position that no one ever has false beliefs), Plato regards the argument as being particularly plausible in, and relevant to, cases of sensible qualities (such as sweetness, bitterness, etc.) and value properties (such as goodness, beauty etc. *Tht.* 171d–172b). That is, such properties seem particularly prone to giving rise to conflicting appearances and disagreement, even when the objects involved do not change in themselves. Plato should therefore be credited, in the *Theaetetus*, with being the first to point out, in antiquity, that perceptible properties along with value properties seem to be the most likely to be observer-dependent and subjective. Plato goes on to develop—in the "secret doctrine" of the *Theaetetus*, where Plato develops Protagoras' ideas on his behalf—a radically perceiver-dependent theory of sensible qualities, where things are *F* (e.g. colored) if and only if they appear so to someone (*Tht.* 153–160).[5] (Of course, he himself goes on to reject as untenable both the metaphysical and epistemological doctrines he develops on Protagoras' behalf.)

The conflicting appearance arguments which Plato and Aristotle associate with Protagoras went on to have a long history in the Hellenistic period when they were collected by the Pyrrhonist skeptic Aenesidemus in the so-called Ten Modes of Aenesidemus.[6] Whereas the conclusion of these arguments for Protagoras was that "things are as they seem to each", the Pyrrhonists seem to have concluded, variously, that "all things are relative" (to how they seem), or that, given the equal strength of arguments on both sides, it is impossible to tell how things really are (or how they are in themselves), from which suspension of judgment follows. Sextus Empiricus, the second to third century AD Pyrrhonist doctor, and an important source for Pyrrhonist

[4] For a very helpful introduction to epistemology in the Pre-Socratics, see Hussey 1990, and also Hussey 1972; on the Greek tradition of *ou mallon* ('no more this than that') arguments, see DeLacy 1958.

[5] See Burnyeat 1979, Burnyeat 1982 for two seminal papers on this part of the *Theaetetus*, as well as McDowell 1973 and Burnyeat 1990; some recent responses to Burnyeat include Fine 1996 and Lee 2005.

[6] See Striker 1983, Annas and Barnes 1985.

skepticism, is arguably aware that it is sensible qualities and value properties in particular that are vulnerable to these kinds of skeptical arguments.

Thus, there is throughout the history of ancient Greek philosophy a rich tradition of thinking about sensible qualities and their distinctively subjective, relative, or observer-dependent status. However, it is really only the philosophers of the late fifth and fourth centuries BC, Democritus, Plato, and Aristotle, who for the first time attempt to develop theories about the nature of sensible qualities, and ask whether these number among the fundamental qualities of all bodies—thus linking the first strand of thinking about the primary–secondary quality distinction with the second. That these thinkers were the first to consider sensible qualities in any detail is confirmed by Theophrastus (*c.*372 to 286 BC), who was a student of Aristotle's and successor to him as head of the Peripatetic school. In his treatise *De Sensibus* or "On the Senses", he sets out an account of pre-Aristotelian views about the senses and the sensible qualities.[7] By way of introduction to the second half of the treatise where he deals with sensible qualities, he says that Plato and Democritus were the only ones (among Aristotle's predecessors) to go into the sensible qualities in any detail. He goes on to discuss Plato and Democritus critically, implicitly pointing forward to what he no doubt regards as Aristotle's more consistent and tenable position on sensible qualities in the *De Anima* and the *De Sensu*. In the remainder of this chapter, I shall follow Theophrastus by focusing on Democritus and Plato, before turning to Aristotle and Epicurus.

The topic of sensible qualities in antiquity is a huge one; my treatment will necessarily have to be selective and abbreviated for the purposes of this volume. One major school which I will mention only in order to set aside is that of the Stoics, who are notable for avoiding the distinction. The Stoics are foundationalists in their epistemology, and argue that all *kataleptic* or "cognitive" impressions are true;[8] these perceptual impressions are not confined to awareness of colors, sounds, and smells, say, but include such perceptions as perceiving *that there is an egg in front of me*, or perceiving *that this is not Socrates but his double*. They do not seem to have picked out colors, sounds, and smells as special in any way, but included them among the qualities of sensible objects.[9] Their lack of interest in the specific mechanics of perception and in the ontological status of so-called secondary qualities is notable; this is perhaps because Chrysippus and the other Stoics were ultimately more interested in locating qualities like virtue and vice in nature, than in investigating questions of metaphysics

[7] For the text see Diels 1879; for a translation and commentary, see Stratton 1917, which is badly outdated. But at least for Theophrastus' treatment of Democritus, we have the excellent translation and commentary in Taylor 1999a; Long 1996 is very helpful on the question of Theophrastus' reliability as a source for Plato's views.

[8] For Stoic epistemology, see Long and Sedley 1987 chapters 39–41, Frede 1987, and Hankinson 2003.

[9] See Long and Sedley 1987 chapters 27–29 (on Stoic metaphysics). The fourth genus "relatively disposed" in the Stoic theory of "categories" seems to have included qualities such as sweetness, but the category is certainly not limited to the so-called secondary qualities; see also Sedley 2005.

and natural science for their own sake. At any rate, they do not seem to have made a significant contribution to our topic.

2. Democritus

We begin with the atomist Democritus (*c.*460 to 356 BC), who despite his traditional classification as a "pre-Socratic" was a younger contemporary of Socrates'. Democritus espoused the doctrines of his predecessor Leucippus, according to whom there are two fundamentally basic and distinct kinds of realities in the natural world, atoms and void. The atoms move around in the void, colliding or entangling with each other. But they are in themselves unchanging and indestructible. The macroscopic objects that we see are simply the products of the interactions of the atoms in the void. They are various compounds consisting of arrangements of different kinds of atoms; the changes in arrangements give rise to what we see as qualitative alteration and substantial generation and corruption.[10]

Democritus regards the atoms as having certain properties, but there are many controversies surrounding the details of his theory. Atoms possess intrinsic properties, such as shape, size, impenetrability, motion, ordering, arrangement, and maybe weight. All other properties besides these are apparently properties of aggregates of atoms, and can be characterized in terms of the intrinsic properties of the atoms making up an aggregate.[11] Thus, Aristotle reports Democritus' memorable analogy between atoms and the letters of the alphabet, which can produce a multitude of different words from a few letters in combination: the differences between words can be explained by differences in shape (*schēma*) of atoms (e.g. as A differs from N); differences in arrangement (*taxis*), as AN differs from NA; and differences in positional orientation (*thesis*), as N differs from Z (Aristotle, *Metaphysics* 985b4–22 = DK 67A6 = 46a Taylor). The bulk of the remaining fragments and reports about Democritus have to do with his "aitiologies", where he shows how to explain, in terms of his atomist theory, various kinds of macroscopic properties and phenomena.[12]

Aristotle criticizes Democritus at length for making heat an intrinsic property of spherical atoms—Aristotle regards this as an arbitrary exception (*GC* I 8. 324b35–326b6 = DK 67A7 = 48a Taylor). As Taylor notes, however, this is probably unfair to Democritus, since Democritus may very well have intended to say that heat is a

[10] For translations and commentary on Democritus, including excellent treatments of Democritus' atomism, theory of perception, and sensible qualities, see Taylor 1999a; for a briefer introduction to Democritus, see Taylor 1999b. Sedley 1992 contains an invaluable discussion of Sextus Empiricus' report on Democritus' epistemology. The treatment of Democritus and Theophrastus here depends heavily on Lee 2005.

[11] Difficulties include the question of whether the atoms are necessarily microscopic or whether as one fragment has it there could be atoms as big as a cosmos (DK 68A47); whether atoms are conceptually or only physically minimal (Furley 1967); and whether atoms have weight and move because of this, or whether their movement is entirely due to collision (cf. O'Brien 1981, Furley 1989, McDiarmid 1956, Balme 1941).

[12] Morel 1996 is an extended study of these aitiologies.

property of *aggregates* of spherical atoms, not of these atoms individually.[13] If so, then heat is not an exception to the thesis that shape, size, motion, and arrangement are the only intrinsic properties of atoms; all others are attributes of aggregates of atoms.

What about the other so-called secondary qualities? Does Democritus pick these out for special treatment? One famous fragment makes it appear that he does:

> By convention (*nomōi*) sweet and by convention bitter, by convention hot, by convention cold, by convention colour; but in reality (*eteēi*) atoms and void.
>
> (Sextus Empiricus *Against the Mathematicians* [*M*] VII 135 = DK 68 B9 = D16 Taylor; also Diogenes Laertius IX.72; Galen *On Medical Experience* 15.7 = DK 68B125; Galen *On the Elements according to Hippocrates* I.2; and in slightly different form Plutarch, *Against Colotes* 1110E-F = 206 Taylor)

Democritus seems to be marking a distinction between two types of qualities: (i) sweet, bitter, hot, cold, color, etc., which seems to correspond to what we would call secondary qualities, and (ii) the basic qualities of atoms and void, which he does not name here, but would presumably include shape, size, and motion. But at the same time there are a number of questions about what Democritus has in mind. First, there is some question of how to fill in the "etc."; he lists flavors, temperatures, and colors. But if the list is meant to go on, then what else is supposed to be on the list? Maybe smells? But Theophrastus says that Democritus didn't have much to say about them. Sounds? But Sextus seems to think Democritus did not include them, though he should have: sensible qualities are by *nomos*; sounds are a sensible quality; hence sounds must be by *nomos* (Sextus *M* VI 53 = 123b Taylor).

The uncertainty surrounding the list suggests that Democritus did not then go on to spell out exactly what this putative class of "secondary qualities" would include. This then leads to the second question: what is the point of this distinction for Democritus—indeed is he drawing a distinction at all? Is Democritus saying of the atoms themselves that they have their own intrinsic properties, but are not sweet, bitter, hot, cold, or colored—they only have these properties "by convention" (*nomōi*)? But what does it mean to say that these exist "by convention"? Perhaps what's meant is that things are red "by convention" in the way that we say that this arrangement is to be called "dog" and this arrangement of atoms is to be called "cat": there is something arbitrary and conventional about calling this arrangement of atoms "red" and this arrangement of atoms "sweet". But if that were the rationale, then it would appear that he's not distinguishing between primary and secondary qualities, but rather distinguishing between intrinsic properties of the atoms, and properties that belong to them in combination. The point, then, would be that atoms individually and by themselves are no more colored than they are dogs: being a dog is a property that belongs to a certain combination of atoms, and so too, being red is a property that belongs to a certain combination of atoms. If this is the thought, however, then it appears that Democritus is simply alluding

[13] Taylor 1999a: 75n63.

again to a distinction between microscopic and macroscopic properties, and saying that *all* macroscopic qualities are conventional.[14]

At least some readers in antiquity read Democritus this way. Plutarch, for one, paraphrases him as follows:

> But even more in his second charge he [i.e., Colotes the Epicurean who has attacked Democritus] fails to see that he is expelling Epicurus from life along with Democritus. For he says that Democritus' statements *that colour and sweetness and the compound and the rest are by convention, but the void and the atoms in reality contradict the senses, and that someone who abides by this theory and applies it would not consider that he is a man or that he is alive.*
>
> (Plutarch, *Against Colotes* 8, 1110e–1111c = 206 Taylor)

Thus Plutarch thinks that Democritus is saying that not only the secondary qualities (i.e. sweet, bitter, hot, cold, etc.) exist *nomōi* or "by convention", but also that atomic compounds and aggregates do. The thought is that aggregates are no more real than sweet and bitter are: they are nothing other than groupings of what is real. The point of saying that these things exist "by convention" is, then, to indicate that it is only a convention, an observer-dependent construction, to think that this grouping exists as opposed to that one. None of these groupings exists in reality: it is a mere "convention" on our part to talk as though such aggregates really exist—over and above the atoms that constitute such groupings. On this reading of fragment B9, Democritus is endorsing a sweeping form of anti-realism about all properties of aggregates and the aggregates themselves, in contrast with atoms and their essential properties. This claim could be given additional support with evidence that he thought that nothing is causally efficacious except for atoms and their essential properties. So understood, Democritus is not so much making a distinction between primary and secondary qualities, but rather denying that anything exists besides atoms and void.

On the other hand, there is another way of interpreting fragment B9, and Democritus quite generally, which understands his point, not to be about intrinsic properties of atoms in contrast with "conventional" properties at the macroscopic level, but more specifically about a subset of the latter, understood as the objects of the senses. On this reading, which I favor, Democritus is worried about the ability of the senses to discover the nature of reality: the senses seem to report only about what we would call secondary qualities, whereas reason (*logos*) is able to divine the truth about reality, namely, that it is composed out of atoms and void. Democritus' worry is epistemological in nature: perception of a certain class of sensible qualities is ultimately uninformative about the true nature of the things they belong to. For when one is perceiving color, the perception simply registers how one's eyes have been affected by some

[14] Pasnau 2007 argues along these lines, concluding that Democritus did not intend to draw a distinction between primary and secondary qualities; others who read Democritus as an eliminativist (who is then led however reluctantly to skepticism) include Sedley 1988: 298–9, Wardy 1988, Purinton 1991.

external object, and so one has not ultimately found out anything about what that external object is like in itself.[15]

This is how Theophrastus, Sextus, and Galen read Democritus; they present him as raising in fragment B9 a problem specifically about the senses.[16] They tend to paraphrase the Greek terms *nomos* and *eteē*, translated above as "by convention" and "in reality", which indicates that by the late fourth-century BC and later, these terms—certainly "*eteē*", which is rare, but perhaps also "*nomos*"—were felt to be somewhat archaic, or at least in need of explanation; they paraphrase him as meaning that according to the senses, things *appear* to be sweet, bitter, hot, cold, etc., but in reality there are atoms and void. Democritus is not here talking about which properties do or do not belong to atoms; rather, he is engaged in an attack on the senses. The problem is that they do not tell us about what things are in reality, namely atoms and void, but instead tell us about things like the hot, the cold, the sweet, etc.

What exactly is so objectionable about reports like "this is sweet, bitter, hot, cold, etc."? Democritus thinks these are only reports about how things appear to us, that is, how they affect us and how they are "for us", not reports about how things are in themselves. As far as the senses go:

> In fact we know nothing firm, but what changes according to the condition of the body and of the things that enter it and come up against it.
>
> (Sextus, *Against the Mathematicians* VII 136 = DK 68B9 = D17 Taylor)

And again:

> This argument too shows that in reality we know nothing about anything, but each person's opinion is something which flows in.
>
> (Sextus Empiricus, *Against the Mathematicians* VII 137 = DK 68B7 = D20 Taylor)

When the senses tell us "this is hot" or "this is red", they are reporting how they have been affected by the atoms and void (in aggregate), not reporting how anything is in itself. And because hotness, sweetness, and redness turn out to be nothing other than

[15] There are reasons for dismissing Plutarch's testimony, and with it the eliminativist reading. First, Plutarch is the only source among many ancient philosophers who quote B9/125 who includes the phrase "and by convention compound" (*nomōi sungkrisin*); the other sources (Theophrastus, Galen, and Sextus) are more careful and limit the clause to secondary qualities (see also Taylor, p. 152 n. 141). And Plutarch is almost certainly not looking at a text of Democritus, but rather discussing and relying on the Epicurean philosopher Colotes, whom we have independent reasons for distrusting as a source for Democritus' views. Second, some scholars have argued that it would be implausible to attribute to Democritus the anti-realist position described above on the basis of Plutarch's testimony alone, since there is a large body of evidence that Democritus did think that atomic aggregates, and macroscopic bodies, have causal efficacy (Furley 1993, Morel 1996, Taylor 1999: 152 n. 141). Thus, while he was certainly a reductionist of one kind or another, he was not an *eliminativist* who thought that the only things that exist and have causal powers are atoms, void, and their essential properties. Rather, he was happy to assign causal responsibility for a wide range of phenomena to atomistic aggregates.

[16] See Lee 2005 (chs. 8–9) on Democritus for supporting evidence and arguments; for other interpretations which also read Democritus as focusing on secondary qualities narrowly construed, see Furley 1993, O'Keefe 1997, Ganson 1999, Taylor 1999.

affections of the senses, we can conclude that things are intrinsically no more hot than not hot, no more sweet than not sweet, etc. (*Outlines of Pyrrhonism* I 213). Our senses thus systematically mislead us by representing things as having properties that they do not really have in themselves.

Theophrastus is an especially important source for Democritus because he fills out our picture about the reasons why Democritus was concerned about sensible qualities. He says that Democritus' considered view about sensible qualities is that at least some of them do not "have their own nature"; sensible qualities are relational properties of objects having to do with the power that aggregates of atoms have to affect objects with sense organs. Among the sensible qualities, heavy, light, hard, and soft can all be identified with aggregates of certain types of atoms; hence, presumably, these are *not* sensible qualities that are "by *nomos*". But, as Theophrastus says, "None of the other sensible qualities has any nature of its own, but all are states of the sense when it is altered so as to give rise to an appearance. For there is no nature belonging to hot or cold, but change in shape [sc. of the thing perceived] brings about alteration in us: a concentrated effect dominates each individual, whereas an effect which is spread out over time is not noticed" (*De Sensibus* 63 = 113 Taylor). Thus, flavors (including the sour, sweet, astringent, bitter, saline, pungent), colors, sounds, smells, and temperatures are properties that aggregates have in virtue of their ability to affect things with certain kinds of sense-organs in certain ways. Consider, for example, sharp flavor: "sharp flavour consists of small, fine-grained atoms of an angular zigzag shape. Because these are pungent they penetrate everywhere, and because they are rough and angular they compress and contract, thus creating empty spaces in the body and heating it; for the more void a thing contains, the hotter it becomes" (*DS* 65). Democritus thinks that sharp flavour is to be identified with a preponderance of a certain type of small, fine-grained zigzag shaped atom, precisely because such atoms have the power to produce a certain effect on tongues. For it turns out that tongues themselves are constituted in such a way that only certain shapes and sizes can enter in and produce certain effects, whereas others cannot enter and thus have no effect, or at least not the relevant kind of effect, on it.

If this is correct, then we can conclude that Democritus, like Plato as we shall see, is worried about the status of a certain subset of sensible qualities, precisely because they cannot be defined except in relation to perceiving subjects. This subset seems to correspond roughly to what we would call secondary qualities, although its membership does not seem to be very well defined. Democritus' concern here is not, evidently, to distinguish crisply between primary and secondary qualities, but rather to argue that the senses tell us about sensory experiences and affections, rather than how things are in themselves. Galen (*c.*129–200 AD) thus presents Democritus as concerned with the nature of evidence: the senses basically give us reports about how we are affected by the atoms that impinge upon our bodies—but this does not tell us anything about what the atoms in objects themselves are like (*On Medical Experience* 15.7, p. 114 Walzer = DK 68 B125/T179c Taylor). For that, we need to turn to the evidence of reason—in

particular, the kind of reasoning that leads us to the hypothesis of the existence of atoms and void, and to the explanatory work that such a hypothesis can do. This strongly suggests that the shape, size, and motion that belong to atoms are not, for Democritus, *sensible* in nature at all—these are qualities that are discerned by the intellect alone, along with the very existence of atoms and void. If Democritus thinks that the shape, size, and motion that we attribute to macroscopic objects are grasped by the senses, this leaves it unclear what relation there is between the size, shape, and motion belonging to atoms, and the corresponding sensible qualities of shape, size and motion belonging to macroscopic objects.[17]

Consider the following line of thought: (1) atoms are imperceptible because of their smallness, (2) secondary qualities are perceptible qualities; hence (3) atoms don't have secondary qualities (Taylor 1999: 175). This is supported by the fragment preserved in Sextus: "Of knowing there are two forms, the one genuine, the other dark. And of the dark kind this is the complete list: sight, hearing, smell, taste and touch. The one which is genuine, but separated from this one . . . [*then Sextus remarks "Then, by way of judging the genuine one superior to the dark one, he adds these words:"*] . . . is when the dark one is no longer able either to see in the direction of greater smallness, nor to hear nor to smell nor to taste nor to sense by touch other things in the direction of greater fineness" (Sextus *M* VII 139 = DK 68B11 = Taylor D22, trans. after Sedley 1992: 35–6). The idea is that atoms are imperceptible because they are so small, and hence *cannot* have qualities such as color, taste, or smell. But this suggests that the atoms themselves have no sensible qualities at all; the size, shape, and weight that they have must also be imperceptible, by the same argument. If so, then Democritus is distinguishing between two modes of cognition, the intellectual (by which we can grasp what features matter has) and the perceptual (which is a mode of affection by groupings of atoms and void)—but correspondingly to a distinction between the intrinsic qualities of atoms (whose nature is discerned by means of inference to the best explanation) and the non-intrinsic qualities of compounds (which are grasped by the senses). This then looks very much like a distinction between primary qualities of atoms and secondary qualities of macroscopic bodies.

Even so, Theophrastus accuses Democritus of inconsistency because he says that the attack on the senses—in particular the claim that the sensible qualities which the senses tell us about are nothing other than affections of the senses—is elsewhere contradicted by Democritus' account of sensible qualities. He writes, "In general, the greatest contradiction, which pervades the whole theory, is his both making them states of perception and at the same time distinguishing them by their shapes, and saying that the same thing appears bitter to some, sweet to others, and different to yet others. For it is

[17] Presumably size, shape, and solidity cannot be explained just in terms of the size, shape, and solidity of atoms alone, since a large mug, for example, could be made up of many small-size atoms or fewer larger-size atoms. Only in the case of location and weight of macroscopic objects is there a direct correlation with the location and weight of the atoms constituting them.

impossible for the shape to be a state, or for the same thing to be spherical to some and differently shaped to others (yet perhaps that is how it has to be, if it is sweet to some and bitter to others), or for the shapes to change according to our dispositions. It is simply the case that shape is intrinsic, but sweet and sensible qualities in general are relative and dependent on other things, as he says" (*DS* 69). According to Theophrastus, Democritus wants to explain sensible qualities that objects have in terms of their atomic constitution (hence, as he says, things have sharp flavors when they are constituted out of small, fine-grained zigzag atoms which easily penetrate the surfaces of the tongue), but that seems to be inconsistent with the view that sensible quality is really to be identified with the effect that is produced on the tongue—where some people might taste one mixture as being sharp flavored, and others might taste it as being mild.

Theophrastus' charge of inconsistency is probably an artifact of an overly literal reading of Democritus:[18] he thinks it is inconsistent to (A) identify particular sensible qualities with intrinsic qualities of the atoms, but at the same time to (B) define sensible qualities quite generally as affections of the senses (as part of his attack on the senses). Theophrastus is probably mistaken to read the passages where Democritus says, for example, that sweetness is round, good-sized atoms as stating strict identities. Rather, Democritus means that there are consistent correlations between something's being sweet and its having round, good-sized atoms in it; he may even think that it is impossible for round, good-sized atoms to produce the sensation of bitterness (say), even in someone ill. Thus, the presence of round, good-sized atoms is a necessary condition for something's appearing sweet to perceivers. However it is not a sufficient condition: as Theophrastus reports, Democritus is very attentive to the importance of environmental and physiological factors in determining the kind of perceptual experience someone will have. And since objects are composite aggregates of different kinds of atoms, it is easy to explain why something can appear both sweet and bitter—to different perceivers, or in different environments—even when they remain the same. In sum, Democritus probably endorses (B), the thesis that sensible qualities are affections of the senses, not (A), the thesis that particular sensible qualities are identical with certain kinds of intrinsic qualities of atoms.

In any case, whether Theophrastus is correct to charge Democritus with inconsistency, his criticisms do strongly suggest that Democritus was not very clear about whether sensible qualities, because they are not intrinsic properties of atoms, but rather relational properties belonging to aggregates, (i) do not really belong by nature to anything at all (as Theophrastus suggests), or (ii) are real but non-intrinsic properties of aggregates. The latter option is open to Democritus, that is, to maintain that sensible qualities are relational, causally efficacious properties of macroscopic bodies. Thus, just because sharpness is the disposition that small zigzag atoms have of producing a certain effect in tongues, it doesn't follow that things aren't "really" sharp in flavor, or that

[18] This is a very condensed version of my argument at Lee 2005: Ch. 8.3.2.

there can't be an objective answer as to whether or not a thing is sharp in flavor. And part of the reason why things *are* really sharp in flavor is precisely because there is a systematic relationship between atomic composition and effects on other objects. This is the kind of view that Theophrastus favors—and which we see Aristotle and Epicurus develop.

3. Plato

In the so-called middle period dialogues like the *Phaedo* and the *Republic*, Plato notoriously holds that perception is systematically misleading about a systematically misleading part of reality. And so one might think that he would be an unlikely figure to turn to for the primary–secondary quality distinction, or at least for any close analysis of the nature of sensible qualities. But people forget about the importance of the *Timaeus* both in antiquity and later (when it was the only book of Plato's that was translated into Latin until the Renaissance). And the *Timaeus* contains what appears to be Plato's own attempt to offer a *Peri Physeōs* or "Physics" of his own. In it, he draws a kind of distinction between primary and secondary qualities.[19]

In the *Timaeus*, we find a triple account of the cosmos from three different points of view: once viewing it purely as the product of Reason (29e–47e), once viewing it purely as the product of Necessity (48b–68d), and once viewing it as the joint production of Necessity and Reason together (69–92). In the account of the world viewed as the product of "Necessity" alone, that is, viewed purely in terms of the material which the Demiurge was given to work with, we are told that at the most fundamental level, there is something which is exceedingly hard to grasp, but can be understood by employing metaphors and analogies—something which doesn't have a name, which Plato initially calls "the receptacle (*hypodochē*) of all becoming" (*Ti* 49a5-6) and subsequently calls "space" (*chōra*, 52a8, d3). This is a kind of matter which does not have any qualities of its own, but is the "receptacle" in which all other qualities are reflected. There is considerable scholarly debate about whether Plato's "receptacle" is a material substratum (in particular, a kind of ultimate prime matter underlying the primary bodies or elements), a kind of spatial field (see e.g. *Ti* 52b "We say that whatever is must necessarily be in some place"), or perhaps both. Aristotle, at any rate, regards his own theory of matter as an improvement upon Plato's (*De Generatione et Corruptione* II 1).

Having hypothesized the existence of this "receptacle" or as we might think of it, basic matter, Plato then offers an account of the elements. On his view, the elements are the parts of the receptacle that form regular solids. Beginning with a variety of shapes of regular solids, Plato explains the four primary bodies in terms of those basic shapes: particles of fire are tetrahedra, that is, pyramids, which are the most mobile regular solids; particles of air are octahedra; particles of water icosahedra; and particles

[19] Not much has been written on the secondary qualities in Plato's *Timaeus*, but for a very helpful treatment of Plato's theory of colors, see Ierodiakonou 2005.

of earth cubes (*Ti* 55d6–57d6). He goes on to explain how transformation of these primary, elemental bodies is possible; he also tries to explain how the varieties of physical bodies—for example, different kinds of liquids, metals, and other kind of compounds—come to be from the four primary bodies.

What is of great interest to us is what Plato does next. Before he turns to his account of what we would call the sensible qualities, which will be the last topic in his account of the properties of basic matter, he says:

> We have now pretty much completed our presentation of the kinds of bodies that are distinguished by their multifarious shapes, their combinations and their intertransformations. Now we must try to shed some light on what has caused them to come to have the properties they do. First, we need at every step in our discourse to appeal to the existence of sense perception, but we have so far discussed neither the coming to be of flesh, or of what pertains to flesh, nor the part of the soul that is mortal. It so happens, however, that we cannot give an adequate account of these matters without referring to perceptual properties, but neither can we give an account of the latter without referring to the former, and to treat them simultaneously is all but impossible. So we must start by assuming the one or the other, and later revisit what we have assumed. Let's begin by taking for granted for now the existence of body and soul. This will allow our account of these properties to succeed the account we've just given of the elemental kinds.
>
> (*Timaeus* 61c–d, trans. Zeyl in Cooper 1997)

The reason for Plato's worry is that the qualities he's about to describe cannot be described purely in terms of the primary bodies and their basic properties which he's already described, but also require one to assume the existence of perceivers and the nature of their sense organs. But the account of perception, sense organs, and perceivers is not given until the third part of the *Timaeus*, where he describes the world as a joint product of Reason and Necessity. One cannot really give an account of perceptual properties apart from perception, but at the same time, one cannot give an account of perception without referring to perceptual properties. That is, perceptual properties cannot strictly speaking be dealt with purely in terms of the fundamental properties of matter: any account dealing with them has to also refer to the fact that perceptual properties are those properties which have a certain effect on perceivers constituted in a certain way. Plato is clearly worried about the fact that some properties of body cannot properly be characterized without referring to the fact that they have the power to produce certain effects on perceiving subjects. We might put the point by saying that they are relational properties, unlike the intrinsic properties of matter and of the elements which he has been discussing so far.

With this prelude, Plato then goes on to talk first about tactile qualities which affect the whole body (61c–64a), as well as pleasure and pain (64a–65b), and then about the perceptual properties that affect particular parts of the bodies, that is, the sense organs (65b–68d): tastes, smells, sounds, and colors. Throughout, the account is meant to show how the fundamental properties of the primary bodies (i.e. fire, earth, water, air) can explain what we would call the secondary qualities of those bodies. Fire is *hot*, for example, because the particles making it up act on our perceiving bodies by dividing

and cutting it (61d–62a). Something is *hard* because it is what our flesh gives way to (62bc); things that are composed of quadrangles are "the least liable to being displaced because [their] bases are very secure" (62bc). Likewise, color is "a flame which flows forth from bodies of all sorts, with its parts proportional to our sight so as to produce perception" (67c–68d).

Plato is explaining why objects are hot, hard, or colored by appealing both to the primary elements out of which they are composed *and* to their effects on perceivers and sense organs. This then explains why Plato thinks there is something problematic about these properties—not that they are derivative of the primary ones, since in his view many macroscopic objects, such as wine, or saps, or types of frost, are derivative in this sense, but that some properties make an essential reference to the existence and nature of perceivers. Note that this worry is rather different from the familiar old complaint from the middle dialogues that things in the sensible world are variable and unstable: it has specifically to do with the perceiver-dependent nature of some sensible qualities.

There is strong support for this reading of Plato from Theophrastus. After praising Plato and Democritus for going into the topic of the sensible qualities more fully than any others (*DS* 59), he then makes the claim that will be the theme of his discussion of the two:

> Democritus and Plato discussed them [i.e. *ta aisthēta*, 'the objects of sense'] the most fully, for they distinguish them in detail; except that Plato does not deprive the objects of sense (*ta aisthēta*) of their own nature, whereas Democritus reduces them all to states of sense. We shall not discuss which of these views is true, but let us try to set out how far each pursued the topic and what distinctions he made, having first given an outline of each view in its entirety. Democritus does not give a uniform account of them all, but differentiates some by size, some by shape, and some by order and arrangement. Plato ascribes almost all to states and [i.e., states of] the sense. So each seems to contradict his assumption (*hypothesis*), as Democritus makes them out to be states of the sense but distinguishes them with respect to their own nature, while Plato makes them out to be things in their own right but ascribes them to states of the sense
>
> (*De Sensibus* 60–61 = 113 Taylor)

Plato "contradicts" himself when, by including sensible qualities in his account of the fundamental properties of matter, he implicitly "assumes", as Theophrastus puts it, that sensible qualities are "things in their own right" (since he includes them in his treatment of material necessity and basic matter), but in the details of his explanation of each sensible quality he ends up making them nothing other than affections of the sense. (In my view, "depriving them of their nature" is Theophrastus' way of saying that an account has rendered a property in relational terms, in particular, the relation a perceiver has to an object, instead of describing it in intrinsic terms, purely in terms of the body and its non-relational properties.) The idea is presumably that Plato is not an anti-realist about sensible qualities, since after all he analyzes such qualities as powers enjoyed by elements and the complexes they can form, and he includes them in his basic theory of matter and material necessity. But at the same time, he ends up undermining their status by defining the sensible qualities in terms of their effects on

the senses. Thus, for example, color is nothing other than the effect that certain (fire) particles have on the sense organs. Theophrastus thinks that there is an implicit tension in both Democritus' and Plato's accounts of sensible qualities—between regarding sensible qualities as being a part of an account of the basic and derivative natural features of matter, and regarding them as not really belonging to matter by nature. Whether Theophrastus is correct about there being an inconsistency in each view is not something we can go into here. His criticism, however, raises exactly the right questions about both philosophers: both Democritus and Plato seem to regard sensible qualities as depending in some sense upon the fundamental, primary qualities of matter (atoms and void, or the elements, respectively). Thus, for example, Democritus correlates flavors with atoms of a certain shape and size; Plato includes his account of sensible qualities under the rubric of the basic and derived properties of matter. But at the same time, both of them, in different contexts, recognize that sensible qualities are distinct from properties like texture or being heavy because an account of them requires one to make essential reference to the effect that such qualities have on perceivers. Thus, Democritus rejects perception as misleading because it only reports about how things are "for us". And Plato defines the sensible qualities as properties things have to affect the sensory organs in specific ways; for example, "things that rinse the vessels and wash the entire area around the tongue are all called bitter *when they do so to excess and so assault the tongue as to dissolve some of it*, as soda actually can do" (*Ti.* 65d). For both philosophers, this raises the question of whether such qualities belong to the nature of things—or whether things are in themselves no more bitter than not. They do not squarely answer this, however, because their concerns lie elsewhere. It remains for later thinkers—such as Aristotle, Epicurus, and their followers—to try to formulate their answers more precisely.

4. Aristotle

Aristotle draws much more precisely than his predecessors two different sets of distinctions between sensible qualities, both of which are relevant to the distinction between primary and secondary qualities.

The first place where Aristotle draws something that looks like a primary–secondary quality distinction is in the *De Anima* (II 6, III 1), where he distinguishes broadly between intrinsically sensible qualities (*aisthēta kath' hauta*), and coincidentally sensible qualities (*aisthēta kata sumbebēkos*). Roughly speaking, this is a distinction between those qualities which we perceive because they affect the sense organs, and those qualities which are coincidental to, that is, happen to belong to (or follow upon), the sorts of qualities which *are* capable of affecting the sense organs. Hence, color is the sort of thing that directly affects the eye; it is therefore intrinsically sensible. By contrast, when I see Socrates, it is not insofar as he is Socrates that he is visible to my eye, but rather because he is colored. Hence, his being Socrates is coincidentally sensible. Aristotle goes on to make a second distinction, within the class of intrinsically sensible qualities,

between (i) the "proper sensibles" (*idia aisthēta*) and (ii) the "common sensibles" (*koina aisthēta*). The proper sensibles include colors, sights, sounds, smells etc., whereas the common sensibles include shape, size, motion, etc. His distinction here actually provides us with a very sensible basis for making a distinction between primary and secondary qualities, understood as a distinction between those sensible properties such as size and shape that can be detected through various sense modalities, and those to which we have access only through a distinctive sort of sensation produced by a specialized sense modality.[20] Aristotle's purpose here is not, of course, to distinguish between the more and less fundamental properties of matter, but simply to explain what sorts of properties are capable of "moving" (*kinein*) the senses. (He defines color, for example, as what is able to move (*kinētikon*) the transparent (*DA* II 7. 418a26–b2); the property of being able to be seen belongs to color not as part of its essence, but as a necessary (*kath' hauto*) accident of color.[21]) Thus, historically, when seventeenth-century philosophers put forward the primary–secondary quality distinction as a way of criticizing Aristotle's view of the fundamental properties of matter, this is not the doctrine that they had in mind.

Rather, what they had in mind is the distinction made in the *De Generatione et Corruptione* Book II 1–6, where Aristotle turns to describing the very lowest-level of matter, i.e. the "elements", the primary qualities of matter, which are the Hot, the Cold, the Wet, and the Dry. These two pairs of contraries can be combined to form the so-called simple bodies:

Earth is Cold and Dry.
Air is Hot and Wet.
Fire is Hot and Dry.
Water is Cold and Wet.

Hot–Cold are active forces, Hot being "that which aggregates things that are of the same kind" and Cold being "that which gathers and aggregates indiscriminately things that are related and things that are not of the same type" (*GC* II 2. 329b24–31). Wet–Dry are passive qualities having to do with the capacity to be affected: "wet is that which is not bounded by any boundary of its own but is easily bounded; dry is that which is easily bounded by a boundary of its own, but is hard <for other things> to bound" (*GC* II 2. 329b31–33, trans. Williams). All other qualities are in some emergent way from, or supervenient on, the mixtures which can be formed from

[20] On this as the basis for making a distinction between primary and secondary qualities, see Pasnau 2006: esp. 579ff.

[21] Aristotle does not define color as a subjective-dispositional property—that is, he does not define color simply as the disposition to produce a certain experience of color; see Silverman 1989. There is a huge literature on Aristotle's theory of perception, in particular, on Aristotle's perceptual realism, and on the question of what exactly he thinks happens in the eye, for example, when someone sees color (cf. Sorabji 1979, Burnyeat 1992, Nussbaum and Putnam 1992, Broadie 1992, Burnyeat 1995, Menn 2002, Caston 2004).

the simple bodies and their basic qualities.[22] Though he does not systematically try to show how all the other qualities can be explained in terms of the primary ones, he is arguably committed to the claim that (i) primary qualities are the fundamental explanation of natural change; changes in secondary qualities occur because of changes in primary qualities in the constituents making up an aggregate or mixture. Furthermore, he is arguably committed to (ii) the thesis of universality, according to which the primary qualities are in all bodies; that is, they continue to exist, and are not supplanted via mixture. (Claim (ii) is not entailed by claim (i) since there could be primary qualities that only belong to certain kinds of beings, e.g. living beings.)

Did Aristotle also endorse the claim—often made by proponents of a primary–secondary quality distinction—that (iii) the primary qualities, not the secondary qualities, are the only causally efficacious agents in nature? That is, did he think that the only causal agents are the primary qualities: Hot, Cold, Wet, Dry? No, he did not. On the contrary, he seems to have held that sensible qualities, such as sounds and colors, are to be identified as the causal bases of powers things have to produce perceptions. Colors, for example, are causally responsible for our perceptual experiences of them (*DA* II 7). But at the same time colors, and the things that have them, possess these causal powers because of lower-level facts about the presence of the Hot, the Cold, the Wet and the Dry in them. This at any rate appears to be the project of the *De Sensu*: to show what kind of physical facts ground the ability of colors (ch. 3), flavors (ch. 4), and odors (ch. 5) to have causal effects on, and set in motion the senses. Thus, in the *De Sensu*, Aristotle offers an account of what colors, flavors, and odors are, in order to show how they are able to have causal effects on perceivers, as discussed in the *De Anima*.[23]

If Aristotle did indeed argue that sensible qualities are causally efficacious—that is, productive of causal effects on perceivers that are revealed in their perceptual experiences—then this sets the stage for the attacks that would follow in the sixteenth century and later on Scholastic Aristotelianism and on the idea that qualitative "forms" have any place in a science. Why Aristotle felt compelled to argue for this claim is probably partly to be explained by his response to his predecessors, Plato and Democritus. Recall that Theophrastus reviewed their theories of sensible qualities, accusing both of them of an inconsistency: "each seems to contradict his assumption (*hypothesis*), as Democritus makes them out to be states of the sense but distinguishes them with respect to their own nature, while Plato makes them out to be things in their own right but ascribes them to states of the sense" (*DS* 61). He reveals his own stance when he elaborates his criticism of Plato as follows:

[22] See Williams 1982 *ad loc.*, especially pp. 158–161; for difficulties in Aristotle's account of mixture, see Cooper 2004.

[23] See Ganson 1997 for this interpretation of Aristotle, which he frames as a kind of reply to Galileo's understanding of Aristotle.

With respect to the nature of the flavors, he <Plato> does not say what each is . . . ; rather, he makes clear the effects (*ta pathê*) which come about from them. For <he claims> that the harsh or astringent flavor contracts the pores, and that the saline flavor cleanses them, which just is an affection (*pathos*) of us; similarly with the other flavors. But we seek their essence (*tên ousian*) more and why they do these things, since we observe the effects (*DS* 89).

Thus, Theophrastus thinks that by studying Plato and Democritus' theories one can learn from their mistakes—in particular, one can see that it is a mistake to simply characterize the sensible qualities in terms of their effects on perceivers. They are not simply *relational* properties of bodies in the sense that they have the ability to produce "an effect of this kind in a body of this kind", for that ability should be grounded in bodies' intrinsic properties as well. Hence, for Plato and Democritus, that means describing sensible qualities in terms of the particular shape, size, and grouping of particles or atoms that enable an object to affect a perceiving eye and produce the impression of redness. Aristotle's own view is set out in the *De Sensu*: there, he offers an empirical, scientific account of the physical basis of the colors, smells, flavors, etc., relating these to the primary qualities of hot, cold, wet, and dry. But showing this is simply a part of saying why they have causal efficacy: it is not Aristotle's intention to try to eliminate the so-called secondary qualities altogether from a scientific account of the properties of bodies and matter.

5. Epicurus

In the Hellenistic period, Epicurus (341–271 BC) develops—in reaction to Democritus—a defense of the reality of sensible qualities. Though he endorses many of the same atomist doctrines as Democritus, he goes to great lengths to distance himself from him, often stressing the internal tensions and problems in Democritus' theories that his own can overcome. Epicurus and his followers tend to read Democritus as a skeptic, one who thinks that nothing exists besides atoms and void. Whether or not Epicurus is correct in reading Democritus as a skeptic,[24] he develops his own views expressly in order to counter what he correctly regards as the self-stultifying consequences of such a skepticism—as he puts it, life becomes impossible if one believes that nothing exists besides atoms and void. Rather, Epicurus thinks that, even if atoms and void are ontologically primary, other things too are real, including secondary qualities.[25] In his view, sensible qualities are relational properties, but no less real for that.

Epicurus contributes to the debate by gaining clarity about how to think about this relational aspect of sensible qualities. He distinguishes per se substances—bodies and space—from the entities that depend on them: permanent attributes, accidental properties, and time. But he is at pains to emphasize that, despite the parasitic nature of the latter on the former, they are nonetheless real. Permanent attributes of body include

[24] Barnes 1982 reads Democritus as a skeptic, but for arguments against, see McKim 1984 and Curd 2001.

[25] For more on Epicurus' physics, see Bailey 1928, Furley 1976, Long and Sedley 1987, chapters 4–15, especially ch. 12 'Microscopic and macroscopic properties', Sedley 2005.

tangibility, shape, size, and weight. They are permanent because they are inseparable from anything considered as body; they are the only essential qualities that atoms have at the microscopic level. At the macroscopic level, however, some secondary qualities, such as temperature and color, may be essential to body, as for example heat is essential to fire, and yellow color is essential to gold, and may be regarded as its permanent attributes. Accidents, that is, non-essential attributes, exist not at the atomic level, but at the macroscopic level (Epicurus *Letter to Herodotus* 54–5 = LS 12D; Lucretius *De Rerum Natura* 2.730–833 = LS 12E); they can include relational and dispositional properties. Thus, Lucretius gives as examples of accidental properties servitude and poverty, both of which belong to things not per se but in virtue of complex relations that hold between people (*DRN* I 455–6).

Polystratus, who was the third head of Epicurus' school, the Garden, in the third century BC, defends the reality of relation and dispositional properties in the course of defending value properties like "fair" and "foul". He puts the point exactly: just because a predicate is relative, and just because a thing is F only in relation to something else, does not mean that F-ness is not real (Polystratus *On Irrational Contempt* 23.26–26.23 = LS 7D).[26] Relational properties are not intrinsic properties of objects, and so one might mistakenly conclude that these properties do not really belong to objects. But this would be a mistake. Consider, for example, being bigger. A thing is not per se bigger: "bigger" is a relational predicate, and hence a thing can only be bigger than something else. But it does not follow from this that things are not really bigger or smaller at all. And the fact that something is both bigger than X and smaller than Y does not show that it is not really bigger or smaller at all.

The same point can be applied, Polystratus argues, to powers, which are also relational properties. Consider for example, the properties of being nourishing or deadly. Peanuts (to use O'Keefe's example) can be nourishing or deadly to different people—nourishing to some, but deadly to those with a peanut allergy. Its deadliness is relational, but it does not follow that deadliness is not a real property of peanuts at all—that it is somehow conventional or subjective for that reason. The Epicureans thought we should regard sensible qualities like colors and flavors as relational in the same way. Colors are not intrinsic but relational properties of bodies—for they are powers of certain bodies to produce certain sensory affections in the bodies of perceivers, which in turn produce certain effects in their minds. Whether bodies have those colors depends on the atomic constitution of those bodies; whether they produce those effects on a given perceiver depends very much on the atomic constitution of their bodies, in particular, their sense organs. Thus, the same object may give rise to different impressions in different perceivers who are differently constituted. It does not follow, however, that colors are not real properties of objects for Epicurus. Like the property of being deadly, the property of being sweet or red is a dispositional property that objects

[26] See Striker 1983: 110ff. and O'Keefe 2009: 36–38.

have in relation to other objects under certain conditions. Proper understanding of the nature of relations can thus help Epicureans to make the point that, even if atoms do not possess in themselves any other attributes besides size, shape, weight, and motion, and even if sensible qualities only belong to macroscopic objects in virtue of complex relations they have with other objects, sensible qualities should still be regarded as real, existent properties of things, powers that they have to cause effects in other objects. Thus, like Aristotle, Epicurus appears to have endorsed a view of sensible qualities that makes them dependent upon the primary qualities of matter, but at the same time no less real, causally efficacious attributes of the bodies to which they belong. In this way, their theories look forward to developments in the Scholastic and seventeenth-century debates concerning the nature of primary and secondary qualities.

6. Conclusion

None of the ancient Greek philosophers used terminology exactly corresponding to our terms "primary" and "secondary" qualities, but as we have seen, that fact by itself is not very interesting. For we see that many of them did concern themselves with (i) the question of what properties are essential to matter, and to bodies, (ii) the question of whether any non-intrinsic properties of body are causally efficacious, and (iii) in particular, the special causal connection that the so-called secondary qualities have with our sense-modalities and sensory experiences. We started with Democritus and Plato who each posit a mechanistic theory to explain natural change and movement; both philosophers start with a theory of elements—atoms and void, and triangular solids, respectively—which have a limited set of intrinsic properties. This then raises for both the question of how to explain the properties of macroscopic objects, including the qualities that are the objects of the senses. Both recognize, though in different ways, the relational nature of the objects of sense. Democritus thinks that qualities like colors, smells, and flavors belong to objects insofar as they affect perceivers in certain ways; he seizes on this to attack the senses as uninformative about the true nature of things. His treatment makes it clear that sensible qualities do not belong to the atoms themselves; it is uncertain however, whether he thinks that sensible qualities are relational powers of aggregates to cause certain effects in certain objects under certain conditions, or whether he thinks sensible qualities are little more than appearances produced in the minds of perceivers. Plato clearly regards sensible qualities like colors and smells as real properties of objects, and yet he seems to think that they are different from qualities like texture and weight because they make an essential reference to perceivers.

The very existence of Aristotle's *De Anima* and *De Sensu*, and Theophrastus' treatise *De Sensibus* indicates that by the late fourth century BC, Aristotle and his students were focusing on the topic of sensible qualities. Aristotle distinguishes between those qualities like color, sound, and smell, that are the objects of a single sense-modality—which he calls the "proper sensibles"—and those qualities like size and shape that are the objects of more than one modality—which he calls "common sensibles". The

extension of these terms—"proper" vs "common" sensibles—corresponds roughly to what we usually think of as primary and secondary qualities. However, Aristotle's objective here is not so much to draw a metaphysical distinction between more and less fundamental properties, but rather to analyze the sense in which these properties are sensible; only some of these are "sensible" in the strict sense, that is, those to which we have access only through a specialized kind of sensation produced in a special sense.

Like Democritus and Plato, Aristotle has a view about the basic principles of nature, that is, the "elements", set out in the *De Generatione et Corruptione*, where he argues that the four primary bodies, earth, air, water, and fire, are characterized by four basic properties, the Hot, the Wet, the Cold, and the Dry. These are not actually sensible qualities, but rather are active and passive powers that in combination through mixture produce higher-level qualities. Aristotle seems to think that sensible qualities—color, flavors, and smells—can be explained in terms of the elemental constitution of objects. And yet at the same time, they cannot simply be identified with combinations or mixtures of elements, since they are clearly causal powers themselves—powers to move and set in motion the senses.

Finally, Epicurus, like Democritus, thinks that atoms and void have a limited number of primary qualities: size, shape, motion, and weight. All other qualities are either accidental or essential qualities of bodies. Among the accidental qualities of bodies are the sensible qualities like color, smell, flavor, and sound. Epicurus regards these qualities as relational properties of bodies; they consist of the power that these bodies have to produce certain effects in perceivers under certain conditions. Epicurus stresses—in what is presumably meant to be a rebuke to Democritus—that the fact that they are relational should not be taken to mean that they are merely appearances. That is, relational properties—like being bigger than, or being deadly (to human beings)—do not belong intrinsically to objects, but they are at the same time real properties with real causal effects. Thus, both Epicurus and Aristotle seem to have (i) developed a theory of the basic qualities of matter or of the elements, (ii) distinguished from other derived properties of bodies a special category of sensible quality, that is, those qualities whose definition requires some reference to perceivers, and (iii) regarded these qualities as non-primary qualities of bodies, but at the same time very real properties with causal powers.

Claims of influence by these thinkers on later philosophers clearly depend upon what among their writings later philosophers read, and how they read them. Be that as it may, the ancient Greek philosophers as a group bequeathed a number of fruitful and interesting ideas concerning primary and secondary qualities to the Aristotelian Scholastics of the medieval period and to the seventeenth-century mechanists inspired by Epicurus and the ancient atomists.[27]

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