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9 The atomists

Atomism was the creation of two thinkers of the fifth century B.C., Leucippus and Democritus. The former, attested by Aristotle, our primary source, as the founder of the theory, was a shadowy figure even in antiquity, being eclipsed by his more celebrated successor Democritus to such an extent that the theory came to be generally regarded as the work of the latter. Epicurus, who developed and popularised atomism in the late fourth and early third centuries B.C. (following in the tradition of various figures such as Nausiphanes and Anaxarchus, now little more than names), went so far as to deny that Leucippus ever existed. Only a little more is known about Democritus (see p. xix). The precise relation between Leucippus and Democritus is unclear. Plato never mentions either by name. Aristotle and his followers treat Leucippus as the founder of the theory, but also assign its basic principles to both Leucippus and Democritus; later sources tend to treat the theory as the work of Democritus alone. While it is clear that the theory originated with Leucippus, it is possible that the two collaborated to some extent and almost certain that Democritus developed the theory in a number of areas, for example, extending it to include a materialistic psychology, a sophisticated epistemology, and an account of the development of human society that laid particular stress on the human capacity to learn from chance experience.[1]

PHYSICAL PRINCIPLES

According to Aristotle (*GC* I.7-8 324a35-325a31), the atomists attempted to reconcile the observable data of plurality, motion, and change with the Eleatic denial of the possibility of coming to be or

ceasing to be. Like Anaxagoras and Empedocles, they postulated unchangeable primary things, and explained apparent generation and corruption by the coming together and separation of those things. But their conceptions of the primary things and processes differed radically from those of Anaxagoras and Empedocles. For Anaxagoras the primary things were observable stuffs and properties, and for Empedocles they were the elements, earth, air, fire, and water: for both, the primary processes were mixing and separation of those primary things. By contrast, for the atomists the primary things were not properties or stuffs but physical individuals, and the primary processes were not mixing and separation but the formation and dissolution of aggregates of those individuals. Again, the basic individuals were unobservable, in contrast with the observable stuffs of Anaxagoras and the observable elements of Empedocles. Consequently, their properties could not be observed but had to be assigned to those individuals by theory.

Since the theory had to account for an assumed infinity of phenomena, it assumed an infinite number of basic individuals, while postulating as few explanatory properties as possible, specifically shape, size, spatial ordering, and orientation within a given ordering.[2] All observable bodies are aggregates of basic individuals, which must therefore be too small to be perceived.[3] These basic corpuscles are physically indivisible (*atomon*, literally uncuttable), not merely in fact but in principle; Aristotle reports (*GC* I.2 316a14-b7) an (unsound) atomistic argument, which has some affinities with one of Zeno's arguments against plurality (DK 29 B2), that if (as e.g., Anaxagoras maintained) it were theoretically possible to divide a material thing *ad infinitum*, the division must reduce the thing to nothing. This argument was supported by another for the same conclusion; atoms are theoretically indivisible because they contain no void. On this conception bodies can split only along their interstices; hence, where there are no interstices, as in an atom, no splitting is possible. (The same principle probably accounted for the immunity of the atoms to other kinds of change, such as reshaping, compression, and expansion. All were probably assumed to require displacement of matter within an atom, which is impossible without any gaps to receive the displaced matter.) It is tempting to connect the assumption that bodies can split only along their interstices with the Principle of Sufficient Reason, to which the atomists appealed as a

fundamental principle of explanation – arguing, for instance that the number of atomic shapes must be infinite, because there is no more reason for an atom to have one shape than another (Simplicius, *In phys.* 28.9-10).[4] Given the total homogeneity of an atom, they may have thought, there could be no reason why it should split at any point, or in any direction, rather than any other. Hence by the Principle of Sufficient Reason, it could not split at all.

The programme of reconciling the data of perception with the demands of Eleatic theory led the atomists to posit a void or empty space (a) as that which separates atoms from one another and (b) as that in which they move. Parmenides had argued (DK 28 B.22-25) that there could not be many things if there were no void to separate them, and Melissus had argued (DK 30 B7) that there could be no motion without a void into which the moving object moves; Aristotle attests that the atomists accepted both theses (*Phys.* IV.5 213a32-34, *GC* I.8 325a27-28). To the question what it is that separates atoms from one another, and into which they move, their answer was simply "nothing." "what is not" or "the empty," which they appear to have treated as interchangeable terms. They did not, then, shrink from the conclusion that what is no more is than what is not (Aristotle, *Metaph.*I.4 985b8; Plutarch, *Adv. Col.* 1108f).[5] But the assertion that what separates distinct objects is nothing leads straight to incoherence; either there is nothing which separates those objects, in which case they are not separate from one another, or there is something which separates them, in which case "nothing" is the name of something.

We have no idea whether this challenge was actually put to the atomists, or if it were, how they might have met it. The most we can offer is the following suggestion of an appropriate defence. There is indeed something which separates any two nonadjacent atoms, namely an interval. But an interval is not any kind of *thing*: it is merely a gap, an absence of anything. So there are indeed gaps between atoms, but gaps are nothings, and when an atom moves, it moves into a gap. But that can hardly be the whole story. For the notion of an interval or gap between objects presupposes a continuous dimension in which the objects and the interval between them are alike situated. That is to say, the atomists' conception of the void cannot have been merely that of the nonbeing of a physical object; it was at least that of a gap in space, where space is conceived,

however inchoately, as a continuous dimension. The atomists also claimed that the void is infinite in extent and used the term "the infinite" as another designation of it; this is most naturally interpreted as the claim that empty space is infinite in extent. They believed, then, that the universe consists of an infinitely large collection of indivisible physical objects (atoms) moving in infinite space, where space is a three-dimensional continuum of which any part may be either occupied or unoccupied.[6]

In this empty space the atoms are in a state of eternal motion. This motion is not the product of design, but is determined by an infinite series of prior atomic interactions[7] (whence two of Aristotle's principle criticisms of Democritus, that he eliminated final causation (*GA* V.8 789b2-3) and made all atomic motion "unnatural" (*De caelo* III.2 300b8-16)[8]). The theoretical role of the void in accounting for the separation of atoms from one another has an interesting implication that is recorded by Philoponus (*In phys.* 494.19-25, *In GC* 158.26-159.7). Since atoms are separated from one another by the void, they can never strictly speaking come into contact with one another. For if they did, even momentarily, there would be nothing separating them from one another. But then they would be as inseparable from one another as the inseparable parts of a single atom, whose indivisibility is attributed to the lack of void in it (see above); indeed, the two former atoms would now be parts of a single larger atom. But, the atomists held, it is impossible that two things should become one. Holding atomic fusion to be theoretically impossible, and taking it that any case of contact between atoms would be a case of fusion (since only the intervening void prevents fusion), they perhaps drew the conclusion that contact itself is theoretically impossible.[9] Hence what appears to be impact is in fact action at an extremely short distance. Rather than actually banging into one another, atoms have to be conceived as repelling one another by some sort of force transmitted through the void. Again, though no source directly attests this, the interlocking of atoms, which is the fundamental principle of the formation of aggregates, is not strictly speaking interlocking, since the principle of no contact between atoms forbids interlocking as much as impact. Just as impact has to be reconstrued as something similar to magnetic repulsion, so interlocking has to be reconstrued as quasi-magnetic attraction. If this suggestion is correct (and it is fair to point out that no ancient source other than Philoponus supports

it) it is a striking fact that, whereas the post-Renaissance corpuscular philosophy that developed from Greek atomism tended to take the impossibility of action at a distance as an axiom, the original form of the theory contained the a priori thesis that all action is action at a distance. Consequently that impact, so far from giving us our most fundamental conception of physical interaction, is itself a mere appearance that disappears from the world when the description of reality is pursued with full rigour.[10]

CHANCE AND NECESSITY

While the broad outlines of the views of the atomists on these topics can be fairly readily reconstructed, there is much obscurity about the details. The atomists' universe is purposeless, mechanistic, and deterministic; every event has a cause, and causes necessitate their effects.[11] Broadly speaking the process is mechanical; ultimately, everything in the world happens as a result of atomic interaction. The process of atomic interaction has neither beginning nor end, and any particular stage of that process is causally necessitated by a preceding stage. But exactly how the atomists saw the process as operating is obscure. This obscurity is largely attributable to the fragmentary nature of the evidence that we possess, but perhaps the statement of the theory itself was not altogether free from obscurity.

The fundamental text is the single fragment of Leucippus (DK 67 B1) "Nothing happens at random, but everything from reason and by necessity." The denial that anything happens "at random" (*matên*) might well be taken in isolation to amount to an assertion that all natural events are purposive, since the adverb and its cognates frequently have the sense "in vain" (i.e., not in accordance with one's purpose) or "pointlessly." If that were the sense of not *matên* then "from reason" (*ek logou*) would most naturally be understood as "for a purpose." These renderings are, however, very unlikely. The majority of the sources follow Aristotle (*GA* V.8 789b2-3) in asserting that Democritus denied purposiveness in the natural world, explaining everything by mechanistic "necessity." A reading of Leucippus which has him assert, not merely (*contra* Democritus) that some, but that all natural events are purposive, posits a dislocation between the fundamental world-views of the two of such magnitude that we should expect it to have left some trace in the tradition.

Moreover, the attribution of all events to necessity, a central feature of the mechanistic Democritean world-view, is itself attested in the fragment of Leucippus. We ought, then, to look for an interpretation of the fragment that allows it to be consistent with Democritus' denial of final causation.

Such an interpretation is available without forcing the texts. Sometimes (e.g., Herodotus VII.103.2; Plato *Tht.* 189d) *matên* is to be rendered not as "without purpose" but as "without reason" ("in vain" and "empty" have similar ranges of application). Given that construal of *matên* "from reason" is to be construed as "for a reason," where the conception of reason is linked to that of rational explanation. The first part of the fragment ("Nothing happens at random, but everything from reason") thus asserts, not universal purposiveness in nature, but a principle that we have already seen to be pervasive in atomism, the Principle of Sufficient Reason. Instead of a radical discontinuity between Leucippus and Democritus, the fragment, thus construed, attests commitment to a principle basic to atomism. The second half ("and by necessity") makes a stronger claim, which links the notion of rational explanation to the notions of necessity and of cause. The stronger claim is that whatever happens *has to* happen, cannot but happen. This amounts to a specification of the reason whose existence is asserted in the first half of the sentence; nothing happens without a reason, and, in the case of everything that happens, the reason for which it happens is that it has to happen.[12]

There are, therefore, no chance events, that is, no events which simply happen. On the other hand, we have evidence that the atomists assigned some role to chance in the causation of events, though precisely what role is not easy to determine. Aristotle (*Phys.* II.4 196a24-28), Simplicius (*In phys.* 327.24-26, 330.14-20), and Themistius (*In phys.* 49.13-16) all say that Democritus attributed the formation of every primal cosmic swirl[13] to chance (indeed Aristotle finds a special absurdity in the theory that while events in a cosmos occur in regular causal sequences, the cosmos itself comes into being purely by chance). That might be thought to be confirmed by the statement in Diogenes Laertius' summary of Democritus' cosmology that he identified the cosmic swirl itself with necessity (IX.45). On this interpretation, the statement that everything happens by necessity is confined to events within a cosmos and states that all such events are determined by the atomic motions constituting the

swirl. The swirl itself, however, is not determined by anything; it just happens. On this view necessity governs, but is local to, a world order, which itself arises by chance from a precosmic state where there is no necessity.

The recognition of pure chance is, however, inconsistent with the Principle of Sufficient Reason, which we know the atomists accepted. A reconciliation is suggested by a passage of Aetius (I.29.7) "Democritus and the Stoics say that it [i.e., chance] is a cause which is unclear to human reason," which may be read as asserting that the ascription of events to chance is a confession of ignorance of their causes, not a denial that they have causes. Some other pieces of evidence support this suggestion. Diogenes' summary of the cosmology of Leucippus (IX.30-33) concludes with the sentence "Just like the coming into being of worlds, so do their growth, decay, and destruction occur according to a certain necessity, the nature of which he does not explain." In line with his famous dictum, then, Leucippus held that all events, including the formation of worlds, happen according to necessity but was unable to say what it is that necessitates cosmic events. It is then plausible that either he himself or Democritus said that such events may *be said* to occur by chance, in the sense that we are (whether merely in fact or in principle is indeterminate) ignorant of their causes. Explanations of specific kinds of events and of particular events were governed by the principle that there are no chance events, but no attempt was made to offer explanations of the fundamental cosmic processes themselves. That need not imply that they are literally uncaused, but that they might as well be treated as such, since their actual causes are of a degree of complexity outstripping the powers of the human mind to discover.

For the atomists, then, everything happens of necessity; the identification of necessity with the mechanical forces of impact and motion may have been due to Democritus. What exactly was his view on this? Aetius reports him as identifying necessity with "impact and motion and a blow of matter" (I.26.2). Are impact and motion given equal status in this identification, or is it taken for granted that motion is always caused by prior impact? On the former construal some motion may be either uncaused or attributable to a cause other than impact. In favour of the first alternative is Aristotle's evidence (*Phys.* VIII.1 252a32-b2) that Democritus held that one should not ask for a cause of what is always the case. He might then have said

that the atoms are simply always in motion. But while that principle allows him to exclude the question "What causes the atoms to be in motion?" the Principle of Sufficient Reason requires that the question "Why is any particular atom moving with any particular motion?" should have an answer, and it might appear inevitable that that answer should refer to a prior atomic collision, as is attested by various sources (e.g., Simplicius, *In phys.* 42.10-11; Alexander, *In metaph.* 36.21-25).

We have, however, to recall the evidence from Philoponus that atoms never actually collide or come into contact, with its implication that the basic physical forces are attraction and repulsion. On that view, most atomic motion is explained by the analogue of impact, namely repulsion, while the immobility of atoms relative to one another is explained by attraction, since the relative stability of atoms in an aggregate has to be explained, not by their literal interlocking but by their being held together *as if* interlocked by an attractive force operating over the tiny gaps between the atoms in the aggregate. But in addition, some form of attraction may also have explained some atomic motions; Sextus cites Democritus (*M.* VII.116-18) as holding that things of the same kind tend to congregate together, and as illustrating that by examples of the behaviour of animate (birds flocking together) and inanimate things (grains of different sorts being separated out by the action of a sieve, pebbles of different shapes being sorted together by the action of waves on a beach).

That this principle was applied to the atoms appears from Diogenes' account of the cosmogony of Leucippus where atoms of all shapes form a swirling mass from which they are then separated out "like to like." The separation out of atoms of different *sizes* could adequately be accounted for by the stronger centripetal tendency of the larger, itself a function of their greater mass. But the context in Diogenes, where the atoms have just been described as being of all shapes, with no mention so far of size, suggests that "like to like" is here to be understood as "like to like in shape." Aetius' report of Democritus' account of sound (IV.19.3) asserts that atoms of like shape congregate together, and it contains the same illustrative examples as the Sextus passage. It is plausible, though not explicitly asserted, that this same principle accounts for the formation of aggregates of spherical atoms, for example, flames.

We have, then, some evidence that Democritus' dynamics postulated three fundamental forces, a repulsive force that plays the role of impact in a conventional corpuscular theory and two kinds of attractive force, one that draws together atoms of the same shape and another that holds together atoms of different shapes in an atomic aggregate. It is plausible that he applied the term "necessity" to all three, regarding them alike as irresistible. It must, however, be acknowledged first that the evidence for this theory is extremely fragmentary and secondly that even if it is accepted we have no idea whether or how Democritus attempted to unify these forces into a unified theory. Stated thus baldly, the theory has obvious difficulties, for example, if two atoms of the same shape collide, do they rebound or stick together? If all atoms have both an attractive and a repulsive force, there must be some yet more basic principles determining what force or combination of forces determines their motion. Our sources give no hint of whether Democritus had so much as considered such questions.

EPISTEMOLOGY

While we have no evidence to suggest that Leucippus was concerned with epistemological questions, there is abundant evidence of their importance for Democritus. It is quite likely that the latter's epistemological interests were stimulated at least in part by his fellow-citizen and elder contemporary Protagoras (see pp. 302–4). Our evidence is highly problematic, in that it provides support for the attribution to Democritus of two diametrically opposed positions on the reliability of the senses. On the one hand, we have a number of passages, including some direct quotations, in which he appears to reject the senses as totally unreliable; on the other, a number of passages ascribe to him the doctrine that all appearances are true, which aligns him with Protagorean subjectivism, a position that he is reported as having explicitly rejected (Plutarch, *Adv. Col.* 1108f). The former interpretation is supported mainly by evidence from Sextus, and the latter mainly by evidence from Aristotle and his commentators, but we cannot resolve the question by simply setting aside one body of evidence in favour of the other, since (a) in the course of a few lines (*Metaph.* IV.5 1009b7-17) Aristotle reports both that Democritus says that either nothing is true, or it is unclear to us, and that

he asserts that what appears in perception is necessarily true, and (b) Sextus (*M.* VII.136) ascribes some of Democritus' condemnation of the senses to a work in which "he had undertaken to give the senses control over belief." *Prima facie*, then, the evidence suggests that both interpretations reflect aspects of Democritus' thought. Was that thought, then, totally inconsistent? Or can the appearance of systematic contradiction be eliminated or at least mitigated?

The former interpretation is based on the atomists' account of the secondary qualities, whose observer-dependence Democritus seems to have been the first philosopher to recognise. Our senses present the world to us as consisting of things characterised by colour, sound, taste, smell, and so forth, but in reality the world consists of atoms moving in the void, and neither atoms nor the void are characterised by any secondary quality. We thus have a dichotomy between how things seem to us and how they are in reality, expressed in the celebrated slogan (DK 68 B9): "By convention sweet and by convention bitter, by convention hot, by convention cold, by convention colour, but in reality atoms and the void." Further, the distinction between the reality of things and the appearances which that reality presents has to be supplemented by an account of the causal processes via which we receive those appearances. Atomic aggregates affect us by emitting from their surfaces continuous streams of films of atoms which impinge on our sense organs, and the resulting perceptual states are a function of the interaction between those films and the atomic structure of the organs. For instance, for an object to be red is for it constantly to emit films of atoms of such a nature that, when those films collide with an appropriately situated perceiver, the object will look red to that perceiver.

Hence we are doubly distanced from reality; not only phenomenologically, in that things appear differently from how they are, but also causally, in that we perceive atomic aggregates via the physical intervention of other aggregates (viz. the atomic films) and the action of those latter on our sense organs. A number of fragments stress the cognitive gulf that separates us from reality: (B6) "By this principle man must know that he is removed from reality"; (B8) "Yet it will be clear that to know how each thing is in reality is impossible"; (B10) "That in reality we do not know how each thing is or is not has been shown many times"; and (B117) "In reality we know nothing, for truth is in the depths."

This evidence immediately presents a major problem of interpretation. On the one hand, B9 and associated reports stress the gulf between appearance and reality, claiming that the senses are unreliable in that they misrepresent reality. That dogmatic claim presupposes that we have some form of access to reality, which enables us to find the sensory picture unfaithful to how things are in fact. On the other hand, B6, 8, 10, and 117 make the much more radical claim that reality is totally inaccessible, thereby undercutting the thesis that there is a gulf between appearance and reality. B7, "This argument too shows that in reality we know nothing about anything, but each person's opinion is something which flows in,"[14] and the second half of B9, "In fact we know nothing firm, but what changes according to the condition of our body and of the things that enter it and come up against it," attempt uneasily to straddle the two positions, since they draw the radically sceptical conclusion from a premise about the mechanism of perception that presupposes access to the truth about that mechanism. We might conclude that Democritus simply failed to distinguish the dogmatic claim that the senses misrepresent reality from the sceptical claim that we can know nothing whatever about reality. An alternative strategy is to look for a way of interpreting the evidence that will tend to bring the two claims nearer to consonance with one another.

We can bring the two claims closer to one another if the "sceptical" fragments are interpreted as referring, not to cognitive states generally but specifically to states of sensory cognition. These fragments will then simply reiterate the thesis that we know nothing about the nature of reality *through the senses*, a thesis that is consistent with the slogan stated in the first half of B9 and that dissolves the apparent tension internal to B7 and the second half of B9. Support for that suggestion comes from consideration of the context in which Sextus quotes B6-10, namely that of Democritus' critique of the senses, of which Sextus observes: "In these passages he more or less abolishes every kind of apprehension, even if the senses are the only ones which he attacks specifically." It thus appears that Sextus understands Democritus as referring in these fragments to the senses only, though in his (i.e., Sextus') view the critique there directed against the senses in fact applies to all forms of apprehension. This is confirmed by the distinction that Sextus immediately attributes to Democritus between the "bastard" knowledge provided

by the senses and the "genuine" knowledge provided by the intellect (B11). The latter is specifically said to be concerned with things that fall below the limits of sensory discrimination, and we must therefore suppose that the atomic theory itself is to be ascribed to this form of knowledge. This is supported by those passages (*M.* VIII.6-7, 56) in which Sextus associates the position of Democritus with that of Plato; both reject the senses as sources of knowledge and maintain that only intelligible things are real. For Plato, of course, the intelligible things are the Forms, whereas for Democritus they are the atoms, which are inaccessible to perception and, consequently, such that their properties are determinable only by theory.

On this interpretation the position expressed in the fragments cited by Sextus is not general scepticism, but what we might term theoretical realism. The character of the physical world is neither revealed by perception nor inaccessible to us; it is revealed by a theory which, starting from perceptual data, explains those data as appearances generated by the interaction between a world of imperceptible physical atoms and sensory mechanisms also composed of atoms. But now, as Sextus points out (*M.* VIII.56) and Democritus himself recognised (in the famous "Complaint of the Senses" (B125)), scepticism threatens once again because the theory has to take perceptual data as its starting-point. As a result, if the senses are altogether unreliable, there are no reliable data on which to base the theory, so, as the senses say to the mind in B125, "Our overthrow is a fall for you."

Commentators who read B125 as expressing commitment to scepticism on the part of Democritus[15] naturally reject the foregoing unitary interpretation. On this view B117 and B6-10 are not restricted to sensory cognition but express a full-blooded rejection of any form of knowledge, which must be seen as superseding the distinction between appearance and reality drawn in B9 (first part) and B11 and the claim to "genuine knowledge" in the latter. Yet Sextus presents B6-11 in a single context (*M.* VII.135-40) without any suggestion of a conflict within the collection. Moreover, in *PH* I.213-14 he points out that, though the sceptics resemble Democritus in appealing to phenomena of conflicting appearances, such as the honey that tastes sweet to the healthy and bitter to the sick, Democritus in fact uses those phenomena to support, not the sceptical position that it is impossible to tell how the honey is in fact, but the dogmatic position

that the honey is itself neither sweet nor bitter. (I interpret the latter as the assertion that sweetness and bitterness are not intrinsic attributes of the structure of atoms which is the honey (see p. 190). Sextus, in short, sees Democritus not as a sceptic, but as a dogmatist. Indeed, Sextus does not cite B125, and it is possible that he did not know the text from which it comes; *M.* VIII.56 shows that he was aware of the problem that is dramatised in the fragment, but he clearly saw it as a difficulty for Democritus, rather than as signalling Democritus' rejection of the basis of his own theory.

At this point we should consider in what sense the theory of atomism takes the data of the senses as its starting point, and whether that role is in fact threatened by the appearance-reality gap insisted on in B9. According to Aristotle (*GC* I.2 315b6-15, I.6 325a24-26), the theory started from sensory data in the sense that its role was to save the appearances, that is, to explain all sensory data as appearances of an objective world. Both Aristotle and Philoponus (*In GC* 23.1-16) mention conflicting appearances as among the data to be saved; the theory has to explain both the honey's tasting sweet to the healthy and its tasting bitter to the sick, and neither appearance has any pretensions to represent more faithfully than the other how things are in reality. All appearances make an equal contribution to the theory. That is a position which atomism shares with Protagoras, but the latter assures the equal status of appearances by abandoning objectivity; in the Protagorean world there is nothing more to reality than the totality of equipollent appearances. For Democritus, by contrast, the reconciliation of the equipollence of appearances with the objectivity of the physical world requires the gap between appearance and reality. Without the gap, a world of equipollent appearances is inconsistent, and hence not objective. But there is no ground for denying equipollence; qua appearance, every appearance is as good as every other. Hence the task of theory is to arrive at the best description of an objective world that will satisfy the requirement of showing how all the conflicting appearances come about.[16]

So far from threatening the foundations of the theory, then, the appearance-reality gap is essential to it. In that case, what is the point of the complaint of the senses in B125? Does not that text provide conclusive evidence that Democritus believed that the gap threatened the theory, and hence (assuming that he understood his own theory) conclusive evidence against the interpretation that I am

advancing? I do not think so, for the simple reason that we lack the context from which the quotation comes. The point of the complaint need not (and given the nature of Democritus' theory certainly should not) be the admission that the theory is self-refuting. It is at least as likely to be a warning against misunderstanding the account of the appearance-reality gap as requiring the abandonment of sensory evidence. We may imagine an antiempiricist opponent (Plato, say) appealing to the gap to support the claim that the senses are altogether unreliable, and should therefore be abandoned. In reply Democritus points out that the attack on the senses itself relies on sensory evidence. Sextus does indeed align Democritus with Plato in this regard (*M.* VIII.56). It is my contention, however, that when we put the Aristotelian evidence of the atomists' acceptance of the appearances as the starting-point of their theory together with all the other evidence, including the fragments, we have to conclude that the picture of Democritus as a failed Platonist is a misunderstanding. The atomists' distinction between appearance and reality does not involve "doing away with sensible things"; on the contrary, appearances are fundamental to the theory, first as providing the data that the theory has to explain and secondly as providing the primary application for the observationally based terminology that is used to describe the nature and behaviour of the entities posited by the theory.[17]

A final objection, however, comes from Aristotle himself, who describes Democritus as concluding from conflicting appearances "that either nothing is true, or it is unclear to us" (*Metaph.* IV.5 1009b11-12). This is a very puzzling passage, for a number of reasons. Aristotle is explaining why some people go along with Protagoras in believing that whatever seems to be the case is so, and in the immediate context (1009a38 ff.) he cites the phenomena of conflicting appearances and the lack of a decisive criterion for choosing between them as conducing to that belief. But at B9 he shifts from the thought that conflicting appearances lead to the view that all appearances are true to the sceptical account of those phenomena, namely that it is unclear which of the appearances is true or false, "for this is no more true than that, but they are alike." This, Aristotle says (i.e., the belief that none of the appearances is truer than any other) is why Democritus said that either nothing is true, or it is unclear to us. So Democritus is represented as posing a choice of adopting

either the dogmatic stance that none of the appearances is true, or the sceptical stance that it is unclear (which is true). Yet, in the next sentence Aristotle says that because Democritus and others assimilate thought to perception, they hold that what appears in perception is necessarily true (cf. *GC* I 315b9 they (i.e., Leucippus and Democritus) thought that the truth was in appearance). So unless Aristotle is radically confused, the disjunction "either none of the appearances is true, or it is unclear to us" must be consistent with the thesis that all perceptions are true. If "it is unclear to us" is read as "it is unclear to us which is true," then the claims are inconsistent.

I suggest, however, that what Democritus said was to the effect that either nothing is true, or it (i.e., the truth) is unclear. The first alternative he plainly rejected, so he maintained the second. And that is precisely what he maintains in B117: the truth (about the atoms and the void) is in the depths, that is, it is not apparent in perception – it is unclear (*adêlon*) in the sense that it is not plain to see. That he used the term *adêlon* to apply to atoms and the void is attested by Sextus (*M.* VII.140), who cites Diotimus as evidence for Democritus' holding that the appearances are the criterion for the things that are unclear and approving Anaxagoras' slogan "the appearances are the sight of the things that are unclear." The truth, then, that is, the real nature of things, is unclear (i.e., nonevident), but all perceptions are true in that all are equipollent and indispensable to theory.

If that is what Democritus held, then it may reasonably be said that "true" is the wrong word to characterise the role of appearances in his theory. "All appearances are equipollent" is equally compatible with "All appearances are false," and in view of his insistence on the nonevident character of the truth, it would surely have been less misleading for him to say the latter. Though there are some difficult issues here, I shall not argue the point, since I am not concerned with defending Democritus' thesis that all appearances are true. I do, however, accept that he actually maintained that thesis and have sought to explain why he did and how he held it together with (a) his rejection of Protagorean subjectivism and (b) the views expressed in the fragments cited by Sextus.

The atomists' account of appearances depends on the whole theory of perception of which it is part, and that in turn on their theory of human nature, and ultimately of the natural world as a whole. The theory is entirely speculative, since it posits as explanatory entities

microscopic structures of whose existence and nature there could be no experimental confirmation. Developments in sciences such as neurophysiology have revised our conceptions of the structures underlying perceptual phenomena to such an extent that modern accounts would have been unrecognisable to Leucippus or Democritus; but the basic intuitions of ancient atomism, that appearances are to be explained at the level of the internal structure of the perceiver and of the perceived object, and that the ideal of science is to incorporate the description of those structures within the scope of a unified theory of the nature of matter, have stood the test of time.

PSYCHOLOGY

Democritus' uncompromising materialism extended to his psychology. Though there is some conflict in the sources, the best evidence is that he drew no distinction between the rational soul or mind and the nonrational soul or life principle, giving a single account of both as a physical structure of spherical atoms permeating the entire body. This theory of the identity of soul and mind extended beyond identity of physical structure to identity of function, in that Democritus explained thought, the activity of the rational soul, by the same process as that by which he explained perception, one of the activities of the sensitive or nonrational soul. Both are produced by the impact on the soul of extremely fine, fast-moving films of atoms (*eidôla*) constantly emitted in continuous streams by the surfaces of everything around us. This theory combines a causal account of both perception and thought with a crude pictorial view of thought. The paradigm case of perception is vision; seeing something and thinking of something both consist in picturing the thing seen or thought of, and picturing consists in having a series of actual physical pictures of the thing impinge on one's soul. While this assimilation of thought to experience has some affinites with classical empiricism, it differs in the crucial respect that whereas the basic doctrine of empiricism is that thought derives from experience, for Democritus thought is a form of experience, or, more precisely, the categories of thought and experience are insufficiently differentiated to allow one to be characterised as more fundamental than the other. Among other difficulties, this theory faces the problem of accounting for the distinction, central to Democritus' epistemology, between perception

of the observable properties of atomic aggregates and thought of the unobservable structure of those aggregates. We have no knowledge of how, if at all, Democritus attempted to deal with this problem.[18]

ETHICS AND POLITICS

The evidence for Democritus' ethical views differs radically from that for the areas just discussed, since while the ethical doxography is meagre, our sources preserve a large body of purported quotations on ethical topics: the great majority from two collections, that of Stobaeus (fifth century A.D.) and a collection entitled *The sayings of Democrates*. While the bulk of this material is probably Democritean in origin, the existing quotations represent a long process of excerpting and paraphrase, making it difficult to determine how close any particular saying is to Democritus' own words. Various features of style and content suggest that Stobaeus' collection of maxims contains a greater proportion of authentically Democritean material than does the collection which passes under the name of "Democrates."[19]

Subject to the limitations imposed by the nature of this material, we can draw some tentative conclusions about Democritus' ethical views. He was engaged with the wide-ranging contemporary debates on individual and social ethics of which we have evidence from Plato and other sources. On what Socrates presents as the fundamental question in ethics, "How should one live?" (Plato, *Gorg.* 500c, *Rep.* I 352d), Democritus is the earliest thinker reported as having explicitly posited a supreme good or goal, which he called "cheerfulness" or "well-being" and which he appears to have identified with the untroubled enjoyment of life. It is reasonable to suppose that he shared the presumption of the primacy of self-interest which is common both to the Platonic Socrates and to his immoralist opponents, Callicles and Thrasymachus. Having identified the ultimate human interest with cheerfulness, the evidence of the testimonia and the fragments is that he thought that it was to be achieved by moderation, including moderation in the pursuit of pleasures, by discrimination of useful from harmful pleasures, and by conformity to conventional morality. The upshot is a recommendation to a life of moderate, enlightened hedonism, which has some affinities with the life recommended by Socrates (whether in his own person or

as representing ordinary enlightened views is disputed) in Plato's *Protagoras*, and, more obviously, with the Epicurean ideal of which it was the forerunner.[20]

An interesting feature of the fragments is the frequent stress on individual conscience, or sense of shame.[21] Some fragments stress the pleasures of a good conscience and the torments of a bad one (B174, B215) while others recommend that one should be motivated by one's internal sense of shame rather than by concern for the opinion of others (B244, B264, B84). This theme may well reflect the interest, discernible in contemporary debates, in what later came to be known as the question of the sanctions of morality. A recurrent theme in criticisms of conventional morality was that, since the enforcement of morality rests on conventions, someone who can escape conventional sanctions, for example, by doing wrong in secret, has no reason to comply with moral demands.[22] A defender of conventional morality who, like Democritus and Plato, accepts the primacy of self-interest therefore faces the challenge of showing, in one way or another, that self-interest is best promoted by the observance of conventional moral precepts. Democritus seems to have attempted this both by appeal to divine sanctions (not *post mortem*, since for the atomists the soul-atoms were scattered on the death of the body, but in the form of misfortunes occurring during life, B175), and by appeal to the "internal sanction" of conscience. Democritus seems to have been the earliest thinker to make the latter central to his attempt to derive morality from self-interest, thus opening up a path followed by others including Butler and J.S. Mill.

The attempt, however pursued, to ground morality in self-interest involves the rejection of the antithesis between law or convention (*nomos*) and nature (*physis*) that underlies much criticism of morality in the fifth and fourth centuries. For Antiphon, Callicles, Thrasymachus, and Glaucon, nature prompts one to seek one's own interest while law and convention seek, more or less successfully, to inhibit one from doing so. But if one's long-term interest is the attainment of a pleasant life, and if the natural consequences of wrong-doing, including ill health, insecurity, and the pangs of conscience, give one an unpleasant life, while the natural consequences of right-doing give one a contrastingly pleasant life, then nature and convention point in the same direction, not in opposite directions as the critics of morality had alleged. (We have no evidence whether

Democritus had considered the objections that conscience is a product of convention, and that exhorting people to develop their conscience assumes that it must be.) Though the texts contain no express mention of the *nomos-physis* contrast itself, several of them refer to law in such a way as to suggest rejection of the antithesis. B248 asserts that the aim of law is to benefit people, thus contradicting Glaucon's claim (Plato, *Rep.* II 359c) that law constrains people contrary to their natural bent. B248 is supplemented and explained by B245; laws interfere with people's living as they please only to stop them from harming one another, to which they are prompted by envy. So law frees people from the aggression of others, thus benefiting them by giving them the opportunity to follow the promptings of nature towards their own advantage. The strongest expression of the integration of *nomos* and *physis* is found in B252: the city's being well run is the greatest good, and if it is preserved everything is preserved, while if it is destroyed everything is destroyed. That is to say, a stable community is necessary for the attainment of that well-being which is nature's goal for us. This quotation encapsulates the central point in the defence of *nomos* (emphasised in Protagoras' myth (Plato, *Prot.* 322a-323a)) that law and civilization are not contrary to nature but required for human nature to flourish; that point is also central to the Epicurean account of the development of civilization (see especially Lucretius V).[23]

CONCLUSION

Atomism can thus be seen as a multifaceted phenomenon, linked in a variety of ways to various doctrines, both preceding, contemporary, and subsequent. Atomistic physics is one of a number of attempts to accommodate the Ionian tradition of comprehensive natural philosophy to the demands of Eleatic logic. Atomistic epistemology takes up the challenge of Protagorean subjectivism, breaks new ground in its treatment of the relation of appearance to reality and constitutes a pioneering attempt to grapple with the challenge of scepticism. Atomistic ethics moves us into the world of the sophists and of early Plato in its treatment of the themes of the goal of life, and of the relations between self-interest and morality and between *nomos* and *physis*. The atomism of Leucippus and Democritus exercised a continuing influence throughout subsequent centuries, whether as

a challenge to be faced, most notably by Aristotle, or as a forerunner to Epicureanism in all its aspects, and thereby to the revival of atomistic physics in the Corpuscular Philosophy of the sixteenth and seventeenth centuries.

APPENDIX

I conclude with a brief discussion of the vexed question of the connections (or lack of them) between Democritus' ethics and his physical theory. In an earlier discussion (Taylor [423], endorsed without further argument in Gosling and Taylor [414]) I argued against Vlastos' claim (Vlastos [424]) to find significant connections between the content of the two areas of Democritus' thought. Vlastos' position has found some recent defenders (and my views some critics), notably Sassi [421] and Farrar [96]; these discussions seem to me to call for some reexamination of the question.

It is, I take it, common ground that in composing his ethical writings Democritus had not abandoned his physical theory, and therefore that, at the very least, he would have sought to include nothing in the former that was inconsistent with the latter. I shall make the stronger assumption that he took for granted in the ethical writings the atomistic view of the soul as a physical substance pervading the body. However, I remain unconvinced of any closer connection between physics and ethics. In particular, I see no indication that any ethical conclusions (e.g., that the good is "cheerfulness") were supposed to be derived from the physical theory, or that the physical theory provided any characterisations of the nature of any ethically significant psychological state. In other words, I see no evidence that Democritus believed in type-type identities between ethical states such as cheerfulness and physical states such as having one's soul-atoms in "dynamic equilibrium" (Vlastos [424] 584, Farrar [96] 229). My earlier criticisms of this kind of view still stand.

There is, however, one particular point on which I now think that I took scepticism too far. This was in my rejection of Vlastos' interpretation of B33, that teaching creates a new nature by altering the configuration of the soul-atoms. My reason was that *rythmos* was an atomistic technical term for the shape of an individual atom, not for the configuration of an atomic aggregate, for which their term was *diathigê*. Hence *metarythmizei* (or *metarysmoi*) in the fragment

could not mean "reshape" in the sense of "produce a new configuration." But, as Vlastos had already pointed out, the catalogue of Democritean titles includes *Peri ameipsirysmiôn, On changes of shape* (D.L. IX.47), which cannot refer to changes in the shapes of individual atoms (since they are unchangeable in respect of shape), and must therefore refer to changes in the shape of atomic aggregates. Further, Hesychius glosses *ameipsirysmein* as "change the constitution (*synkrisin*) or be transformed," and though he does not attribute the word to any author it is at least likely to have been used in that sense by Democritus, since neither the verb nor its cognates are attested to anyone else. It therefore now seems to me that Vlastos' reading of the fragment is probably correct. For Democritus, teaching, like thought and perception is a physical process involving the impact of *eidôla* on the soul, with consequent rearrangement of the soul-aggregate. (Cf. B197: "The unwise are shaped (*rysmountai*) by the gifts of fortune ...," and n.14) Acceptance of that causal picture does not, of course, commit one to endorsing type-type psychological identities.

Psycho-physical identity having been set aside, some looser connections between Democritus' ethics and other areas of his thought may perhaps be discerned. In Taylor [423] I argued for a structural parallel between ethics and epistemology, a suggestion that still seems plausible to me. Another vague connection is with cosmology. It is not unreasonable to suppose that Democritus saw at least an analogy between the formation of worlds (*kosmoi*) from the primitive atomic chaos by the aggregation of atoms under the force of necessity and the formation of communities (also termed *kosmoi*, B258, 259) by individuals driven by necessity to combine in order to survive. It may also be (as suggested by, for example, Müller [496]) that the aggregation of like individuals to like, which is attested as operating in the formation of worlds (DK 67 A1.31), had some counterpart in the social sphere.

NOTES

A version of this chapter has already appeared as part of the chapter "Anaxagoras and the Atomists" in C. C. W. Taylor, ed. *Routledge History of Philosophy*, Vol. I, *From the Beginning to Plato* (London, 1997), and material from it also appears in *The Atomists*, text and translation by

C. C. W. Taylor (Toronto, 1999). Permission from these publishers to reprint Mr Taylor's work is gratefully acknowledged.

1 For Democritus' poetics, which falls outside the scope of this chapter, see Most in this volume p. 339.

2 To adapt Aristotle's example (*Metaph.* I.4 985b18-19), AN differs from NA in ordering, and AN from AZ in orientation within a given ordering.

3 While most of the ancient sources agree that atoms are too small to be perceptible, some late sources indicate that some atoms are very large (even on one account "as big as a world"). It seems to me most likely that the atomists held that, while there are atoms of all possible sizes (for the same reason that there are atoms of all possible shapes), all the atoms in our world are too small to be perceived. See Barnes [14] ch. 17 (b).

4 For a full discussion of the atomists' use of this principle, see S. Makin, *Indifference Arguments* (Oxford and Cambridge, MA, 1993).

5 Plutarch states this maxim in what is presumably the atomists' own terminology: "The thing no more is than the no-thing," where "thing" represents the word *den*, an artificial formation specifically coined to contrast with *mêden*, "nothing," itself etymologically equivalent to *mêd' hen* "not one [sc. thing]."

6 For a fuller discussion, see Sedley [409].

7 On the nature of these, see p. 187.

8 In Aristotle's system natural motion is motion that is intrinsic to the nature of a thing of a certain kind, for example, it is natural for a stone to move downwards, that is, to fall to the earth when unsupported. Things may also be caused, by the exercise of external force, to move in ways contrary to their natural motion, for example, a stone may be thrown upwards. The atomists' thesis that all atomic motion is the product of precedent atomic interaction, is thus in Aristotle's terms equivalent to the thesis that all atomic motion is unnatural, a claim that he held to be incoherent (since the concept of unnatural motion presupposes that of natural motion).

9 See Kline and Matheson [403] and Godfrey [404]. I. M. Bodnár, "Atomic Independence and Indivisibility," *Oxford Studies in Ancient Philosophy* 16 (1998), 35–61, argues (at 49–53) that, rather than providing evidence for the actual views of the atomists, the texts of Philoponus are mere guesses prompted by his interpretation of the Aristotelian texts on which he is commenting.

10 Restrictions of space preclude discussion of various questions about the nature of atoms that have been the subject of much scholarly dispute. The vexed question of whether atoms have weight is discussed by numerous writers, most fully by O'Brien [407], with cogent criticism by

Furley [408]. On the questions of whether, and in what sense, atoms may be said to have parts, see for example, Barnes [14] ch. 17 (c) and Furley [400] ch. 6 and [99], ch. 9.3-4. I discuss these matters in my forthcoming commentary on the atomists, to be published by Toronto U.P. in the *Phoenix* Presocratics Series.

11 On the absence of explicit evidence for the early Greek philosophers' reflection on causal explanation, see Vegetti in this volume, Chapter 13.

12 The best discussion of the fragment is Barnes [399], who, while finally opting for an agnostic stance, is more sympathetic to the view that Leucippus may have accepted universal teleology. The nonteleological interpretation that I propose is also maintained by McKirahan [10] 321–22.

13 On the atomists' theory a world order begins to form when some of the infinite mass of randomly jostling atoms form a circular eddy or swirl.

14 The Greek of the last clause is *epirysmiê hekastoisin hê doxis*. I translate *epirysmiê* as an adjective, qualifying *doxis* (opinion), having the sense of "flowing in," from the verb *epirreô*. That is the sense of the word (which is found only in this passage (quoted by Sextus *M.* VII.137)) attested in the fifth century A.D. lexicon of Hesychius. On the other hand, *rysmos* (an Ionic form of *rythmos*) was an atomistic technical term for "shape" (Aristotle, *Metaph.* I.4 985b15-16), and one of the titles preserved in Diogenes Laertius' list of the works of Democritus (IX.47) is *Peri ameipsirysmiôn On Changes of Shape*, where *ameipsirysmiê* is a noun. Further, though the noun *epirysmiê* is not itself found, the verb *epirrythmizein* does occur (very rarely) in the sense of "alter." Some scholars (including Guthrie [16] and Barnes [14]) therefore interpret the word here as a noun, a variant for *ameipsirysmiê*, giving the sense "opinion is a reshaping." (H. de Ley, "Δόξις ἐπιρυσμίη: A critical note on Democritus fr. 7," *Hermes* 97 (1969) 497–98 actually proposes emending Sextus' text to read *ameipsirysmiê*.) The point of the fragment is the same on either interpretation, namely, that our opinions about the world are determined by the impact of the flow of atoms from objects around us on our receptive mechanisms. That impact, produced by the constant influx of atoms, produces constant alteration (reshaping) of those mechanisms. The alternative interpretations pick out different stages in the causal process; since the whole process is required for an account of opinion and its relation to the reality of things, nothing substantial hinges on the choice of interpretation.

15 For instance, Barnes [14], ch. 24.

16 For a similar view see McKim [417].

17 See Taylor [423].

18 For further discussion of Democritus' psychology, see Laks in this volume, Chapter 12.

19 For details see my forthcoming commentary.
20 For a fuller discussion, see Kahn [416]. This valuable study identifies a number of areas, such as the conflict between reason and desire, in which Democritus' thought shows significant similarities to, and contrasts with, the early views of Plato.
21 While the relation between the concepts of conscience and of shame raises some intricate philosophical issues, I am not concerned to differentiate them, since the basic concept of self-reproach, which we find in the fragments, is common to the two.
22 See Antiphon DK 87 B44; Critias DK 88 B25; Glaucon's tale of Gyges' ring in Plato's *Republic*, 359b-360d; and Decleva Caizzi in this volume, Chapter 15. The text of Critias is translated in this volume p. 222.
23 For a fuller discussion, see Procopé [420], and for Democritean theology, see Broadie in this volume, p. 220.