

## Air-Imprints or Eidola: Democritus' Aetiology of Vision

WALTER BURKERT

Democritus' explanation of vision,<sup>1</sup> known to us mainly, if not solely, through the critical account of Theophrastus, *De sensu* 50–55, has been subject to severe criticism ever since. Theophrastus wrote: "Democritus wants to make some points in an original manner, but he raises still more problems," a judgment which becomes much more negative in the translations of Stratton and Guthrie: "In trying to say something original he has left the problem even farther from solution,"<sup>2</sup> as if raising problems were a setback. There have been recently penetrating and illuminating studies of this complex of Democritean problems by Kurt von Fritz and Peter Bicknell. Still the interpretation and even the reading of the basic text may need further discussion in some places, and there are some general, disquieting perspectives involved as to the consistency of Democritus' system and the reliability of the doxographical tradition as a whole.

<sup>1</sup> This paper was presented to the International Colloquium on Ancient Philosophy at Toledo in August 1974. My thanks are due to all participants, esp. to Peter Bicknell, Charles H. Kahn, and Heinrich von Staden, who read the manuscript; errors that may remain are mine. References are to H. Diels–W. Kranz, *Die Fragmente der Vorsokratiker* II, 1952<sup>6</sup> = 1972<sup>16</sup>, and S. Luria, *Democritea*, Leningrad, 1970. See K. v. Fritz, "Democritus' theory of vision," in: *Science, Medicine and History. Studies in honor of C. H. Singer*, Oxford, 1953, 83–99 ~ *Grundprobleme der antiken Wissenschaft*, 1971, 594–622; P. Bicknell, "The seat of the mind in Democritus," *Eranos* 66, 1968, 10–23; "Democritus' theory of precognition," *REG* 82, 1969, 318–326; "Democritus' parapsychology again," *REG* 83, 1970, 301–304. See further E. Zeller, *Die Philosophie der Griechen* I, 2, 1920<sup>6</sup>, 1126–1128; C. Bailey, *The Greek Atomists and Epicurus*, 1928, 165–170; G. M. Stratton, *Theophrastus and the Greek physiological psychology before Aristotle*, 1917; J. I. Beare, *Greek theories of elementary cognition from Alcmaeon to Aristotle*, 1906, 23–37; W. K. C. Guthrie, *A History of Greek Philosophy* II, 1965, 441–446; H. Steckel, *RE Suppl.* XII, 1970, 218.

<sup>2</sup> Guthrie 443; "even farther from solution" also Stratton 115.

Democritus, according to Theophrastus, starts from a simple observation, the "appearance in the eye," *ἐμφασις*:<sup>3</sup> "in" the pupil of the eye of man or animal a small picture of the world, and of the observer himself, "appears." This, of course, was generally known, as Theophrastus in another place condescendingly remarks: "As to the appearance in the eye, this is rather a general opinion; for nearly everyone thinks that seeing comes about in this way, by the appearance produced in the eyes"; in particular he mentions Anaxagoras for this assumption.<sup>4</sup> This image in the eye seems to be the important link in the process of transmission from the world outside to the seeing individual. For Democritus, this evidently implies two questions: (1) How is this "appearance" produced, and (2) What happens to it after it has entered the eye? In trying to answer these questions, he has to rely on his atomistic premises, that there is nothing but atoms, different in form and size, moving through the void, hitting each other or getting fixed together in varying arrangements.

Democritus' main effort is devoted to answering the first of these questions. He distinguishes three factors in bringing about the "appearance": there must be (a) a medium between object and eye, (b) some modification of the medium by the object, and (c) some means of transport from the object to the eye.

As a medium, "air" is introduced. Air, for Democritus, is a swarm of atoms, not of any specific shape—as in Plato's *Timaeus*—but with a certain limit of size; bigger atoms constitute water, still bigger ones earth.<sup>5</sup> Thus air is the finest of all possible media, it is suited best for receiving imprints, as fine sand in contrast to gravel; Theophrastus' polemical suggestion, that on Democritus' principles we ought to see better in water than in air (51, p. 514, 2 Dox.), misses this point.

Indeed Democritus, as Theophrastus expressly attests, used the picture of seal-imprints on wax to account for the modification of the medium by the object, thus creating a comparison which has loomed large in ancient and in modern epistemology.<sup>6</sup> Still it is difficult to see how imprints on air could be produced. Democritus has to presuppose an interplay of three activities: an "efflux" (*ἀπορροή*) of the object, some action of the eye, and an impulse coming from the sun or any other light. This third

<sup>3</sup> One should not translate "reflexion" (Guthrie 442), cf. v. Fritz 612; 614.

<sup>4</sup> 36, p. 509, 17 Dox.; 27, p. 507, 7 Dox. = Anaxagoras A 92. Theophrastus raises the objection that the image in the eye is distorted, 36, p. 509, 19 Dox., and that mirrors do not see (below, n. 49).

<sup>5</sup> Arist. *cael.* 303 a 14 = 67 A 15 and *Simpl. cael.* 610, 24; 625, 1 = 275 Luria.

<sup>6</sup> Plat. *Th.* 191cd, 194c, *Phil.* 39ab; Arist. *an.* 424 a 17 ff., 425 b 23, 434 a 29; the Stoics, SVF II nr. 53, 55, 56, etc.; E. Hoffmann, *Sokrates* 47, 1921, 56–58; P. Friedlaender, *Platon* III<sup>2</sup>, 1960, 456 n. 60.

factor is easiest to explain: fire-atoms, being smallest and swiftest, are constantly emitted by every source of light; hitting the air, they produce a "condensation"<sup>7</sup> as children playing in sand "condense" it by tapping or pressing it; if the wax is too soft, it will not keep any imprint.

The thesis that "there is always some efflux from every thing" (50, p. 513, 20 Dox.) is taken over from Empedocles, nearly as a verbatim quotation.<sup>8</sup> Empedocles had used the "effluxes" to explain magnetism, odours, sounds, and even seeing, and at the same time he had considered them a sign of constant decay under the realm of Neikos. Democritus seems to have come close to this pessimistic view, judging by a fragment published recently from Arabic tradition:<sup>9</sup> everything is constantly disintegrating.

The third factor, some activity of "that which sees," has seemed to be suspiciously close to Plato's theory of the active eye; some tried to eliminate it by altering the text.<sup>10</sup> But the alternative of receptiveness or activity of the eye is not treated by the Presocratics as strictly exclusive; Aristotle already blamed Empedocles for using "effluxes" of the objects and still comparing the eye to a lantern;<sup>11</sup> and in his account of the mirror Empedocles spoke of "fire being separated off from the mirror," "condensing" and "pushing back" the effluxes.<sup>12</sup> There are still more important testimonies as to Democritus' opinion: a certain Heracleides who wrote an "Introduction to Music" answers the problem, why lightning is perceived prior to thunder, with the thesis that our vision is sent out to meet the light, whereas hearing waits to receive the sound, and he cites Democritus at least for the second part of this explanation.<sup>13</sup> And Democritus explained the fact that owls see at night by the "fire" in their eyes, which, being "sharp and cutting," "takes apart" (the eye or the dark air?) and "brings vision into contact" (with the object?).<sup>14</sup>

The result of this cooperation is a specific process expressed by the

<sup>7</sup> Theophrastus' argument that the sun would rather "separate" than "condense," p. 514, 27 Dox., uses Aristotle's concepts, *gen. corr.* 336 a 3, cf. Theophr. *De igne* 46.

<sup>8</sup> Empedocles B 89 = 554 Bollack γνοῦς ὅτι πάντων εἰσὶν ἀπορροαί, ὅσα ἐγένοντο, vgl. A 57; 86; 88; 89; 90; 92; B 109 a; on 553 Bollack, see *Gnomon* 44, 1972, 436.

<sup>9</sup> G. Strohmeier, *Philologus* 112, 1968, 1-19.  
<sup>10</sup> (στελλόμενον) κατὰ τοῦ ὄραντος "in direction to the seeing (eye)" Diels, Beare, Bicknell, instead of καὶ (sc. ὑπὸ) τοῦ ὄραντος.

<sup>11</sup> Arist. *sens.* 437 b 23 on Empedocles B 84, cf. A 90.

<sup>12</sup> Empedocles A 88 = 334 Bollack.

<sup>13</sup> Democritus A 126 a = 489 Luria; on Heracleides, W. Burkert, *Lore and Science in Ancient Pythagoreanism*, 1972, 380 f.

<sup>14</sup> A 157 = 550 Luria διαιρεῖ καὶ ἀναμίγνυσι τὴν ὄρασιω. Luria's translation of ἀναμίγνυσι as "bringing chaos," "confusing" cannot be right.

verb *συστελλόμενον*. This was translated "being compressed" by Stratton, followed by Guthrie, whereas Luria takes it to mean "being produced";<sup>15</sup> Diels tried to alter the text altogether (n. 10). Still if we look at the vocabulary of Theophrastus and Aristotle, we find *συστέλλεσθαι* in opposition to *αὐξάνεσθαι*, meaning "to shrink," "to get smaller." There have been repeated discussions in modern literature of the problem, how the atomistic theories of vision could account for big "imprints" or "images" passing through the pupil;<sup>16</sup> Democritus has answered it by the concept of *συστέλλεσθαι*. We know that Democritus dealt with problems of perspective,<sup>17</sup> and gave some explanations of how we can "see" magnitudes and distances correctly, though Theophrastus did not deign to describe it (54, p. 514 f. Dox.). He must have assumed that the size of the imprint is proportionally reduced according to the distance from the eye. In this process of "shrinking," "that which sees" plays some role. Democritus apparently supposed that, as in the case of the owl's eye, though with less force, fire-atoms constantly emanate from the eye, like the "cone of visual rays" of later optics.<sup>18</sup> Later on, the Stoics speak of a state of "tension," *συνέντασις*, of the air produced by the cone of visual rays.<sup>19</sup> The fire-atoms of the eye somehow cut a path through the air along which, then, the "imprint" is transported, shrinking all the time in the cone.

But how, finally, are the imprints transported? This too is expressly stated in the text of Theophrastus, although ever since the editio princeps this indication has been eliminated by conjecture: "perhaps it is the sun that produces the appearance and the light, bringing it, as it were, right up to the eyes (literally 'to vision')." <sup>20</sup> This makes perfect sense; there is a slight irregularity of syntax, a masculine participle *ἐπιφέρων* being

<sup>15</sup> Stratton 111, Guthrie 443; Luria 478, p. 326; Beare 26 (accepting Diels' conjecture, see n. 10): "being dispatched in a compact form." Correctly F. Wimmer, *Theophrasti Eresii Opera*, 1866: "contractum." *αὐξανόμενων—συστελλόμενων* Arist. *mot. an.* 701 b 15; cf. Theophr. *ign.* 13; 17; 67; *caus. plant.* 1, 8, 3; 1, 15, 1; Heracleides Ponticus fr. 55 Wehrli; *Epicurea* 323 Usener.

<sup>16</sup> Bailey 412; Guthrie 442; Bicknell, *Eranos* 1968, 11.

<sup>17</sup> 139 Luria = Anaxagoras A 39; the title Ἀκτινογραφίη in the catalogue Diog. Laert. 9, 48, B 15 b (Tetralogy IX 4).

<sup>18</sup> It may be a coincidence that Democritus dealt with the geometrical problems of the cone, B 155 = 126 Luria.

<sup>19</sup> SVF II 863-71; R. B. Todd, *Synentasis and the Stoic Theory of Perception*, Grazer Beiträge 2, 1974, 251-261.

<sup>20</sup> 54, p. 514, 24 Dox. ἀλλ' ἴσως τὴν ἔμφασιν ὁ ἥλιος ποιεῖ καὶ τὸ φῶς, ὡσπερ ἐπιφέρων ἐπὶ ὄψιν. καὶ was deleted in Camots Aldina edition 1552 and in the Codex Vossianus, as in Stratton and Luria; Diels indicated a corruptela in Doxographi and suggested ὡσπερ ἀκτίνα > ἐπιφέρων in "Fragmente der Vorsokratiker" II 115, 26.

attached to ὁ ἥλιος . . . καὶ τὸ φῶς, but this is not unprecedented and does not call for emendation. The phrase “and the light” is an afterthought; sun is not the only source of light, but its action dominates the sentence. Light consists of an emission of fire-atoms, which hit all objects, jump back, and thus produce a movement leading away from the objects which are exposed to light. So light has a double function in Democritus’ theory: it condenses the air so that it can receive the imprint, and it transports the imprint along the narrowing cone produced by the seeing eye. That the imprint appears to be colored is not difficult to explain in principle, since the impression of color is produced by a special arrangement of atoms.<sup>21</sup>

Understandably, Democritus has much less to say on the second main question, what happens to the “appearance” when it has come to be in the eye. Evidently it does not stay there, but is transmitted to the “rest of the body.”<sup>22</sup> Soul, for Democritus, is not concentrated in any “leading” organ. Democritus goes into detail about the physiology of the eye: the outward membrane must be thin and transparent,<sup>23</sup> the water in the eye spongy, without flesh or fat liquid, and the “veins” leading from the eye to the brain must somehow be accommodated to the imprints.<sup>24</sup> Of course Democritus had no idea of what we call processing of information, and we need not blame him for that.

On the whole, Democritus’ explanation of vision is rather consistent and detailed. Among the special objections raised by Theophrastus, the argument that an imprint must be inverted right-left (52, p. 514, 7 Dox.) is acute, but irrelevant—the retinal picture is even upside down; the other argument, that the imprints cannot help clashing in the air, if two persons are looking at one another,<sup>25</sup> is rather fatal to any theory of vision

<sup>21</sup> ἀλλόχρων 50, p. 513, 21 Dox. recalling Anaxagoras (A 92) *ibid.* 27, p. 507, 11 Dox.; τροπή γὰρ χρωματίζεσθαι Arist. *gen. corr.* 316 a 2 = 337 Luria.

<sup>22</sup> 54, p. 514, 30 Dox.; cf. Bicknell (above, n. 1).

<sup>23</sup> 50, p. 513, 23 Dox. εἰ ὁ μὲν ἕξω χιτῶν ὡς λεπτότατος καὶ πυκνότατος εἶη can hardly be right; cf. Anaxagoras *ibid.* 37, p. 509, 31 τοὺς ὑμένας τῶν ὀμμάτων λεπτοὺς εἶναι καὶ λαμπροὺς; Democritus (A 135) *ibid.* 73, p. 521, 2 καὶ εὐθύτροπα καὶ διαυγῆ τὰ λαμπρὰ εἶναι; Alcmeon (A5) *ibid.* 26, p. 507, 1 Dox. ὄραν δὲ τῶι στίλβοντι καὶ τῶι διαφανεῖ; 77, p. 522, 12 τὸ λαμπρὸν καὶ διαυγές. I would suggest *στιλπνότατος* for *πυκνότατος*.

<sup>24</sup> The text in 50, p. 513, 26 is quite uncertain; the codices have καὶ μὴ εὐσχημονεῖν, corrected to ὡς ὁμοιοσχημονεῖν by Diels Dox.; ὁμοιοσχημονεῖν in “Fragmente der Vorsokratiker” II 115, 2 seems to be a mere slip, which got into the first edition, was taken over by Stratton, and has made its way into LSJ.

<sup>25</sup> 53, p. 514, 20 πολλὰ ἐναλλάττειν should be emended to ἐπαλλάττειν: the imprints do not get “one in the place of the other,” but “one on the other,” cf. ἐπαλλάττειν 80, p. 523, 13/15; A 146 = 546 Luria; ἐπαλλαγῆς Simpl. *cael.* 295, 15, A 37 = 293 Luria; on ἐπάλλαξις J. B. McDiarmid, *Hermes* 86, 1958, 294 f.

starting from the simple mechanics of blow and impact; again, we can hardly blame Democritus for not having invented wave theory.

It is true that he has to accept some strange *ad hoc* hypotheses as to the mechanics of air-atoms being compressed, imprinted, and transported; but he has done as much as could be done on his own principles. To this extent the theory is to be judged quite satisfactory.<sup>26</sup>

---

Much greater problems are raised by the contradictions which exist between the account of Theophrastus and some other testimonies. Aristotle, setting out his own theory of vision in *De anima*, pleads for the assumption that air is necessarily the medium (*μεταξύ*) and criticizes Democritus for holding an opposite view: "For Democritus is wrong in saying that, if the space between were void, one could even see clearly an ant on the vault of the sky" (*an.* 419 a 15 = 68 A 122 = 468 Luria). So Democritus is credited with the view that "air" is an obstacle to sight, whereas in Theophrastus' account air is the necessary medium exactly as in Aristotle. How to reconcile both reports has been a vexed question for a long time. Zeller<sup>27</sup> took the "ant" to be a contrafactual example, which was to support the theory described by Theophrastus: we do not see such an ant, therefore the process of vision must be totally different. Guthrie tried to belittle the discrepancy by taking "void" not in an absolute sense, but "void of anything nontransparent to obstruct the view"<sup>28</sup>—but atoms hardly are transparent. Kurt von Fritz stated that the disquieting "ant" presupposes a different theory of vision,<sup>29</sup> and one cannot but agree: if Democritus said what Aristotle reports, he did not, at that moment, think of the explanation of vision which is in the text of Theophrastus.

But there is more: Theophrastus himself, in some later chapters of *De sensu*, gives an account of Democritus' explanation of colors (73–82). Following Empedocles again,<sup>30</sup> Democritus states that there are four basic colors, white, black, red, and green, and he tries to assign special arrangements of atoms to each of them. We cannot go into all the details of this rather involved passage. It is in the explanation of "black" that "effluxes" turn up, emanating from the "black" object; they are "slow" and "confused," getting such qualification "on account of the air contained in

<sup>26</sup> "Least satisfactory" G. Kirk–J. E. Raven, *The Presocratic Philosophers*, 1957, 423.

<sup>27</sup> 1127, 1, followed by Beare 27.

<sup>28</sup> 444; followed by Bicknell, *Eranos* 1968, 12, 15.

<sup>29</sup> *Grundprobleme* 614, 50.

<sup>30</sup> W. Kranz, "Die ältesten Farbenlehren der Griechen," *Hermes* 47, 1912, 126–140 = *Studien zur antiken Literatur und ihrem Fortwirken. Kleine Schriften*, 1967, 247–257.

them" (*De sens.* 74, p. 521, 13 Dox.); "black" is produced by "the thickness of the air and of the efflux coming in and the confusion of the eye" (81, p. 524, 5 Dox.). Democritus is very difficult to understand on this point, Theophrastus says; but his repeated statement leaves no doubt that Democritus spoke of "air" as a determining factor in the special case of "black", and of "effluxes" "entering" the eye directly, without all that mechanism of condensation, imprints, and moving light. The connection of "air" and darkness is old and popular; indeed it is the basic meaning of *ἀήρ*. This meaning is present here and in Aristotle's remark; it is incompatible with Theophrastus' earlier report.

Finally, there is the famous theory of "eidola," which has its place in every handbook as *the* theory of vision of atomism, ever since Lucretius.<sup>31</sup> "External objects are constantly giving off films of atoms which retain the approximate form of their surfaces and so constitute 'images' of them. These actually enter the eye . . ." <sup>32</sup> Doxography ascribes this theory to "Leucippus and Democritus"<sup>33</sup>; we have the title of a book of Democritus, *Περὶ εἰδώλων ἢ περὶ προνοίης* (68 B 10a = 578 Luria), and of a polemical work of Heracleides Ponticus, *Περὶ εἰδώλων πρὸς Δημόκριτον*.<sup>34</sup> In fact Theophrastus, in the main text discussed above, refers to this theory: "On the whole, if one assumes an efflux from the form, as in the book *Περὶ τῶν εἰδῶν*, why should one bring in the imprinting process? For the images, by themselves, appear in the eye." It is generally agreed that Theophrastus, in the parenthesis, is referring to some special book of Democritus, and that there was no book *Περὶ τῶν εἰδῶν* of Democritus. There are two possible solutions to this dilemma: J. G. Schneider, who edited Theophrastus in 1821, suggested *Περὶ τῶν εἰδώλων*; whereas Diels thought that the reference was to *Περὶ ἰδεῶν* and that Theophrastus had written *Περὶ εἰδῶν* instead according to his own usage. The latter explanation, which avoids any alteration of the transmitted text, has won almost general acceptance.<sup>35</sup>

Still Diels' arguments are clearly wrong. It is true that Democritus called the atoms "ἰδέαι," and if the title *Περὶ ἰδεῶν* is absent from the catalogue of Thrasyllus, it may have been an alternative title for one of

<sup>31</sup> Lucr. 4, 26–352; Epicur. Ep. 1, 49 f. and *περὶ φύσεως* 23, 36 ff. Arrighetti; Bailey 406–413.

<sup>32</sup> Guthrie 442.

<sup>33</sup> Act. 4, 13, 1 = 67 A 29 = 469 Luria; Act. 4, 14, 2 = 67 A 31 = 479 Luria; cf. Act. 4, 8, 10 = 67 A 30 = 469 Luria.

<sup>34</sup> Fr. 36/37 and Fr. 123 Wehrli; Wehrli thinks these are two different titles. There was also a book of Theophrastus *Περὶ τῶν εἰδώλων*, Diog. Laert. 5, 43.

<sup>35</sup> Luria p. 521 on nr. 478, 8; Steckel, RE Suppl. XII, 1970, 218; *περὶ εἰδώλων* was preferred by V. E. Alfieri, *Gli Atomisti*, 1936, 144.

the books listed there.<sup>36</sup> But since Theophrastus, like Aristotle, uses both *εἶδος* and *ἰδέα* in his own works indiscriminately, even within the same sentence,<sup>37</sup> he had neither conscious nor unconscious reasons to change a title *Περὶ ἰδεῶν* to *Περὶ εἰδῶν*, as if this were “translation into Attic dialect,” as Luria believes. On the contrary, there is not a single instance in either Aristotle or Theophrastus where atoms are called *εἶδη*. The one passage adduced by Diels (DK II 115, 7), Arist. *phys.* 184 b 21, is corrupt in the wording, but the sense is clear:<sup>38</sup> if there are infinitely many principles, these can be one in essence, though different in shape, like the atoms of Democritus; or they can be different in character, or even opposites. Here *ἢ εἶδει διαφερούσας* belongs to the alternative to Democritus’ view and is not a description of the atoms.

So Schneider’s emendation *Περὶ τῶν εἰδώλων* comes up again, as *εἶδωλα* are mentioned in the context; the title appears in the catalogue of Thrasyllus. The change of the manuscript tradition involved is minimal; in fact the same kind of corruption occurred or was about to occur in the transmission of the catalogue in Diogenes Laertius: the Laurentianus F writes *εἶδω<sup>λ</sup>* with a small λ above the line; a copyist would easily tend to write *εἰδῶν*; the other manuscripts, BP, have *εἰδώλου*, probably the transcription of a similar abbreviation.<sup>39</sup>

Thus Theophrastus turns to a special book Democritus wrote on *εἶδωλα* in order to combat Democritus’ explanation of vision: these are two conflicting theories which should not be conflated into one. Confirmation comes from Epicurus, who still keeps both apart: he rejects the concept of “imprints” and generalizes the theory of “images”: “for the external objects could not ‘imprint’ their own nature as to color and shape through the air between them and us.”<sup>40</sup>

This passage of Epicurus makes it probable that he knew the theory reported by Theophrastus, to which Aristotle too alludes.<sup>41</sup> So there is

<sup>36</sup> As suggested by Brandis and Diels, B 5i. It is quoted by Sextus *Adv. math.* 7, 137, B 6 = 48 Luria.

<sup>37</sup> *plant.* 1, 12, 1; 7, 15, 3; cf. 6, 2, 7; 7, 7, 2; 8, 5, 1; *De od.* 1; *ign.* 5.

<sup>38</sup> See the edition of W. D. Ross, Oxford, 1950, and the commentaries of H. Bonitz, *Aristotelische Studien* (1866), repr. 1969, 273–281; A. Torstrik, “Der Anfang der Physik des Aristoteles,” *Jahrb. f. Cl. Philol.* 95, 1867, 236–239; W. D. Ross, *Aristotle’s Physics*. A revised text with introduction and commentary, 1936, 459–460. H. Wagner, *Aristoteles, Physikvorlesung*, Darmstadt, 1967, 396.

<sup>39</sup> Diog. Laert. 9, 47, B 10 a; as all the testimonies of Aristotle, Plutarch, Sextus (n. 57) have *εἶδωλα* in the plural, Diels’ emendation *Περὶ εἰδώλων* is convincing.

<sup>40</sup> Epist. 1, 49: οὐ γὰρ ἂν ἐναποσφραγίσαιτο τὰ ἔξω τῆν ἑαυτῶν φύσιν τοῦ τε χρώματος καὶ τῆς μορφῆς διὰ τοῦ ἀέρος τοῦ μεταξύ ἡμῶν τε καὶ κείνων; reference to Democritus in G. Arrighetti, *Epicuro, Opere*, 1960 *ad loc.*; H. von Staden notes that it could also be aimed at Zeno (*ἐναποσφραγίζεσθαι*, SVF I n. 59, etc.).

<sup>41</sup> *ἔμφασις sens.* 438 a 6, see n. 47.

no question about the authenticity of Theophrastus' account, which Bailey was prone to discount as otherwise "unsupported."<sup>42</sup> We can indeed trace the influence of Democritus' explanation of vision for three more generations: After Aristotle, whose own theory of light and vision owes much to Democritus in contrast to the Academy,<sup>43</sup> Theophrastus himself seems to have accepted, at least provisionally, a process of "imprinting in the air";<sup>44</sup> Strato, diverging from Aristotle, came still closer to atomism; he said that colors "move away from the bodies, coloring the air between." Instead of Aristotle's qualitative change (*ἀλλοίωσις*) he reintroduced motion through the medium of air; and if the comparison with the electric blows dealt by the torpedo fish goes back to him, he came surprisingly close to modern physics. A pupil of Strato was Aristarchus of Samos, the famous astronomer; he taught that vision occurs through certain "shapes forming the air by themselves," and that color is "the light falling on the objects," which must be modified somehow in the process.<sup>45</sup>

This seems to be the latest echo of Democritus' air-imprints. In the later period even the doxographers—represented by Aetius and Diogenes Laertius—seem to have forgotten about them. Aetius mentions exclusively the *εἶδωλα*; as the atomistic theory of vision he ascribes it to "Leucippus and Democritus" and adds Epicurus in the same lemma; this combination clearly comes from a late Hellenistic source. Diogenes Laertius gives the same theory to Democritus, Calcidius to atomists in general.<sup>46</sup> Very interesting is the case of Alexander of Aphrodisias.<sup>47</sup> Commenting on a passing remark of Aristotle about the "appearance in the eye" according to Democritus—which we can easily understand thanks to Theophrastus—he gives a close paraphrase and a correct explanation of the word *ἔμφασις*, then goes on to report on the *εἶδωλα*-theory of "Leucippus, Democritus, and Epicurus," though this adds nothing to the point.

<sup>42</sup> Bailey 167.

<sup>43</sup> Light is *ἐνέργεια τοῦ διαφανοῦς*, color is *κινητικόν* of this, *an.* 418 b 9, 419 a 11, *sens.* 438 b 5, 440 a 15–18, 446 b 27; this has in common with Democritus the hypothesis of a medium and of modification of the medium by light. Cf. n. 51.

<sup>44</sup> Theophrastus, as quoted by Priscianus Lydus 1, 33 p. 15 Bywater: *φαμέν γὰρ δὴ καὶ τῆς μορφῆς ὡςπερ ἀποτύπωσιν <ἐν> τῷ ἀέρι γίνεσθαι.*

<sup>45</sup> Strato Fr. 113 Wehrli = Act. 4, 13, 7; the torpedo-example in Hero, *Pneumatica*, p. 26, 23, was attributed to Strato by Diels, *Sitzungsber. Berlin* 1893, 113 = *Kleine Schriften zur antiken Philosophie*, 1969, 251; contra, Wehrli on Fr. 66; and, against Wehrli, H. B. Gottschalk, "Strato of Lampsacus: Some Texts," in: *Proceed. of the Leeds Philos. and Lit. Soc.*, Lit. and Hist. Sect. 11, 1965, 95–182, esp. 156, but cf. M. Gatzemeier, *Die Naturphilosophie des Straton von Lampsakos*, 1970, 22–24. Aristarchus: Act. 4, 13, 8 (the manuscripts have "Aristagoras," see Diels *Dox.* 853) and 1, 15, 5.

<sup>46</sup> Aetius, see n. 33; Diog. Laert. 9, 44; Calc. 236.

<sup>47</sup> *In de sens.*, CAG III 1 p. 24, 14 (cf. 56, 12) = 477 Luria, on Arist. *sens.* 438 a 5.

Evidently he did not use the book of Theophrastus, but some handbook of the Aetius-type, and there he could find nothing about Democritus' authentic views. This is rather a disquieting fact about the surviving doxography. Though it ultimately goes back to Theophrastus, as far as the Presocratics are concerned, in its present form it has undergone heavy remodelling in late Hellenistic times, and in more than one case the authentic tradition has been ousted by Hellenistic views and perspectives. Just as in the doxography for Pythagoras Academic reconstructions prevail against Aristotle's indications,<sup>48</sup> in the atomistic theory of vision Epicurus has got the better of Democritus.

In his decision to generalize the eidola-theory and to give up the complicated air-imprints, Epicurus has chosen a doctrine which is simple and easy to remember, and this ensured his success in all the handbooks. Still there was some scientific reason, too, why Democritus' explanation should seem to be outdated: it relied on the observed fact of the "appearance in the eye." On this point Aristotle had remarked disdainfully: "This comes to pass because the eye is smooth, and the picture is not in the eye but in the observer; what happens, is reflexion. But generally, as it seems, nothing was yet known about mirror-images and reflexion."<sup>49</sup> Geometrical optics appears to have started with Philip of Opus.<sup>50</sup> The explanation of mirror-images by the law of reflexion was a great achievement of mathematical physics, but at the same time this new branch of mathematics seemed to entail the theory of visual rays.<sup>51</sup> Hence Democritus' earlier attempts were reduced to shambles. There happened here, on a smaller scale, the same phenomenon as in astronomy and cosmology as a whole: the speculations of the Presocratics about the physics of the universe were superseded by precise mathematical science, which seemed however to preclude any simple materialistic physics. Homocentric spheres or epicycles as well as visual rays combined with *quinta essentia* and soul-substance put a halt to physical theory for nearly two millenia.

<sup>48</sup> Burkert (see n. 13) 53-83; see also W. Rösler, "Lukrez und die Vorsokratiker," *Hermes* 101, 1973, 48-64.

<sup>49</sup> *sens.* 438 a 7 = A 121 = 477 Luria, cf. *meteor.* 370 a 16 f., Theophrastus *sens.* 36.

<sup>50</sup> The earliest surviving treatise is the "*Optika*" in the Corpus of Euclid, cf. A. Lejeune, *Euclide et Ptolémée, Deux stades de l'optique géométrique grecque*, 1948. Plato seems to know nothing about geometrical optics, but in the works of Philip of Opus there are *ὀπτικά* and *ἐνοπτ<ρ>ικά* (Suda s.v. *φιλόσοφος*), parallel to the later distinction of *ὀπτικά* and *κατοπτρικά*.

<sup>51</sup> Euclid, *Optica* pp. 148-150 Heiberg. The ancient commentators acutely observed that Aristotle, in flat contradiction to his theory of light (n. 43), speaks of an active *ὄψις*, when dealing with geometrical optics: *ἡ ὄψις ἀνακλάται meteor.* 372 a 29, cf. Alexander *In meteor.* 141, 3; *De an. mant.* 128, 27 ff.; Olympiodorus *In meteor.* 4, 27; P. Moraux in: *Mélanges Mansel*, 1974, 279.

We are left with two disconnected theories in Democritus, the explanation of vision by the air-imprints and the assumption of emanating eidola. Theophrastus clearly indicates how to deal with the contradiction: The conflicting doctrines come from two different books. As *Περὶ εἰδώλων* is brought in for the sake of polemics, the main report must refer to another book of Democritus, the title of which is easy to guess. In his chapter on Democritus, Theophrastus treats vision and hearing, makes a passing remark on "the other senses" (57, p. 515, 22 Dox.) and continues *περὶ τοῦ φρονεῖν* (58). In the catalogue of Thrasyllus, there are two consecutive titles, "On Nous" and "On senses,"<sup>52</sup> with the note "some editors combine these two under the title *On the soul*." Later on in Theophrastus' book there is an account of "taste" (64–72) and of "colors" in Democritus (73–82), and there are separate titles "*On tastes*" and "*On colors*" in the catalogue.<sup>53</sup> Thus the contradiction between the role of "air" in the explanation of "black" and of vision in general, too, is reduced to conflicting statements in different books. There is still a passage in Theophrastus on "light and heavy" (62–64) which is not directly attributable to a Thrasyllus title; the sentence τὸ σχῆμα μεταπίπτον ἐργάζεσθαι καὶ τὴν ἡμετέραν ἀλλοίωσι (p. 517, 11) could suggest *Περὶ ἀμειψιρυσμιῶν*,<sup>54</sup> but Theophrastus also made use of "other" books (61 f., p. 516, 28 f. Dox.).

Of course the fact that different books of Democritus contained different views is not very satisfying to historians of philosophy. Some tried to assume an evolution of doctrines: Democritus first took over the "simple" theory of eidola from Leucippus and later tried to give a more detailed explanation along the lines described by Theophrastus.<sup>55</sup> But the latter view is so directly dependent on Anaxagoras and Empedocles (as can be shown in many details: see nn. 4; 8; 21; 30), that it is difficult to fit another atomistic theory in between. We are drawn to the more radical thesis that there was no eidola-theory of Leucippus nor, as regards the general explanation of vision, of Democritus himself.

In fact Democritus did speak of εἴδωλα or δέικελα (B 123 = 467 Luria).

<sup>52</sup> Diog. Laert. 9, 46, Tetralogy IV 3/4.

<sup>53</sup> Tetralogy V 1/2. It is important to note that Theophrastus confirms the authority of Thrasyllus' catalogue; the possibility of which a sceptic might think, that titles could be forged or "reconstructed" on the sole basis of Theophrastus, is minimal, considering that this treatise of Theophrastus was not widely known, not even to Alexander.

<sup>54</sup> Tetralogy V 4.

<sup>55</sup> Bailey 166; Guthrie 442 f. One testimony of Clement seems to say that the eidola-theory was an innovation of Democritus as against Leucippus, *Protr.* 66, 2, (not in DK and Luria), but Diels, *Dox.* 130 showed this to be a result of compilation by Clement himself.

But the only reference to them in the *Corpus Aristotelicum*<sup>56</sup> as well as in the well informed reports of Plutarch<sup>57</sup> and Sextus (B 166 = 472 a Luria) clearly show that these "images" are not supposed to account for normal vision, but for "parapsychology":<sup>58</sup> apparitions of demons, dreams predicting the future, sudden ideas which involuntarily strike us; the "images" do not even enter through the eye, but through "pores" in the body; dreams come when the eyes are closed. The word *εἰδωλον* itself is suggestive of deceptive apparitions and ghosts of the dead. In Thrasyllus' catalogue, the book *Περὶ εἰδώλων* has a second title, *Περὶ προνοίας*; this suggests a discussion of soothsaying spirits and a polemic against Anaxagoras' doctrine of a *Nous* who "knows everything that was, is or shall be" (B 12). This has little to do with vision in the clear light of day. But Theophrastus could play off one doctrine against the other, and Epicurus could generalize the *eidola* theory at the cost of Democritus' original doctrine.

Plutarch, one of the rare people who still read original works of Democritus in imperial times, remarks that, like Aristotle or Chrysippus, Democritus "gave up some of his earlier doctrines without ado or irritation, even gladly" (A 35 a). Some historians will hardly be satisfied with this. Consistency of thought is the only virtue left when the factual problems and solutions of the early "physiologists" are hopelessly outdated. Democritus could not share this perspective. For him, there is a set of ontological premises guaranteed by reasoning, and there is a wide range of observable facts which, though subject to due criticism, are indicative of reality: *ὄψις ἀδήλων τὰ φαινόμενα* (A 111 = 81 Luria). But there is an enormous gap of uncertainty, *ἀδηλα*, between the foundations and the "appearance," and even if Democritus is convinced that "nothing occurs at random, but everything for a reason and by necessity,"<sup>59</sup> the truth

<sup>56</sup> *De divinatione per somnium* 464 a 5 = 472 Luria, not in DK.

<sup>57</sup> Besides A 77 = 476 Luria, there is an important passage in *Aem. Paul.* 1, 4 (parallel to, but more detailed than B 166); this was quoted by Zeller 1160, 1, but disregarded by subsequent scholars including Luria. See also Diogenes of Oinoanda, New fragment 1 in *AJA* 74, 1970, 57.

<sup>58</sup> See Bicknell, n. 1.

<sup>59</sup> This verbatim quotation—on the importance of which see J. Kłowski, "Der historische Ursprung des Kausalprinzips," *AGP* 48, 1966, 225–266—in Stob. 1, 4, 7 = Act. 1, 25, 4 appears as Leucippus B 2 (= 22 Luria). But the parallel passage in Theodoretus, *graec. aff. cur.* 6, 13 = 22 Luria—omitted in *Doxographi*—gives the name of Democritus in this context. The Aetius lemmata on Pythagoras, Parmenides, and atomists seem to be variously conflated by Ps.-Plutarch, Stobaeus, and Theodoretus in this passage (1, 25). The original must have had "Leucippus and Democritus" for the atomists; and since *περὶ νοῦ* occurs in Thrasyllus' catalogue (Tetralogy IV 3) and is nowhere else brought into connection with Leucippus, the quotation must be from Democritus.

about such a reason may "lie in the depths" (B 117 = 51 Luria). Democritus again and again tries to find such reasons; hence his many books on "causes," *αἰτίαι*;<sup>60</sup> he said "he would rather find one causal explanation than become king of Persia" (B 118 = 29 Luria). He was sure there was progress in knowledge by more and more "findings," but he left it to his critics to see whether all the explanations suggested were mutually compatible; it was an easy triumph to show that they were not.

*University of Zurich*

<sup>60</sup> No less than 8 books, listed under the rubric Ἀσύντακτα, in the catalogue (Diog. Laert. 9, 47). Aelian in A 150a-155 evidently gives excerpts from *Αἰτίαι περὶ ζώων*.